

Regional Variation in Diet and Crop Choices: A Comparison of Roman Italy and the Near East

Doctor of Philosophy

Department of Classics

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I confirm that this is my own work and the use of all material from other sources
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Abstract

This thesis examines plant production and consumption in Roman period Italy and the Near East by means of archaeobotanical meta-analysis. The aim of this study is to shed light on the effects that the Roman Empire had on foodways in these two regions, which have received less attention in terms of large-scale archaeobotanical studies. Such an endeavour necessarily entails the reconstruction of dietary patterns, cultivation practices, and aspects of the agricultural economy more broadly. In comparing two very distinct regions, the disparate ways that socio-cultural, environmental, and political-economic setting impacted crop choices and dietary patterns may be better understood.

In order to achieve this, published archaeobotanical data have been collated along with primary evidence examined by the author, from the sites of Jerash in modern-day Jordan, and Hippos-Sussita in Israel. The dataset is comprised of both presence/absence and fully quantified data, resulting in a two-tiered approach to data analysis, which utilises both frequencies and abundance. The distribution of remains are analysed by site type, chronological period, as well as region, and the results are integrated with ancient literary sources.

The results include evidence of agricultural expansion and intensification in the Roman period in both regions, though the diversity characterising agricultural regimes, which would have incorporated an array of intensive and extensive techniques, is emphasised. The distribution of cash crops such as olive and grape suggests that while viticulture was universally important throughout the study period, olive oil production shows regional fluctuations and may have been affected by comparative advantage. Other findings include a rise in dietary diversity in the Roman Imperial period in both regions, particularly with regards to fruit remains, speaking to the increased prevalence of horticulture throughout the Roman world. Plant consumption, in general, appears to have been at once regionally distinctive as well as subject to interregional trends. It is also possible to detect regional variations in fuel economies, with alternative fuel sources being comparatively more important in the East than in Italy. The evidence also suggests shifts in fuel use over the course of the study period, with agricultural by-products rising in prominence in the Near East. The results from the Late Roman period show considerable variation between the two regions, and have implications concerning the impact of socio-economic and climatic instability on the resilience of agricultural systems.

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Introduction

The importance of foodways in ancient (and modern) societies is, by now, widely recognised; food and agriculture are enmeshed in the political and economic spheres, and imbued with socio-cultural significance (Palmer and van der Veen 2002; Twiss 2007; Hastorf 2017; Heinrich 2017). With regard to the Roman Empire, food and especially plant foods were not only the backbone of the Roman economy, but also reflected more subtle relationships between Empire and regional identities. Though subject to preservation biases and the effects of taphonomy, archaeobotany provides for a way to examine plant foods via the material remains themselves.

Whilst there is a wealth of studies using archaeobotanical macroremains to shed light on topics including early agriculture, plant domestication, and the dissemination of particular plant types in prehistory (Bogaard 2004; Willcox et al. 2008; Asouti et al. 2013; Fuller 2007; Riehl et al. 2013; Fuller et al. 2014, McClatchie et al. 2014), archaeobotanical approaches are less often integrated within the fields of Classics and Classical Archaeology. This is particularly true with respect to large-scale data synthesis, which, though increasing in prevalence in recent years, has continued to focus on particular parts of the Roman world (Bakels and Jacomet 2003; van der Veen et al. 2008; Peña-Chocarro et al. 2017; Lepetz and Zech-Matterne 2018; note focus on the western provinces).

However, plant remains offer valuable insight into the socio-political and economic functioning of particular provinces, as well as the Roman Empire as a whole. In conducting large-scale archaeobotanical meta-analysis, trends affecting plants are able to be understood within their greater context, both regionally and imperially. In the western provinces, archaeobotanical remains have been utilised to examine the expression of social identity and to track increased access to rare plant foods due to cross-cultural contact, infrastructural development, and expanded economic connectivity (Wiethold 2003; Van der Veen 2008; Livarda and van der Veen 2008).

In the Near East, large-scale archaeobotanical studies are less common for Classical antiquity, and the broader patterns affecting plant consumption are less well understood. As in the West, integration of the eastern provinces into the larger economic systems of the Roman empire would have expanded access to networks of exchange, further connecting the region to other provinces, but also shifting interregional supply chains. However, complex infrastructure and high levels of urbanisation had long been present in the East, and thus the impact of these shifts on consumption patterns and agricultural regimes would have been made manifest in different ways (Ball 2016: 173 for reminder of long legacy of urbanisation prior to Roman occupation). Furthermore, the local peoples were diverse and distinct from other populations which have been the subject of previous studies, and would have reacted differently to increased contact and connectivity with the rest of

the Roman world. Additionally, as many plant foods travelled east to west, the Near East will serve as an interesting comparison for the rest of the Empire, and may further highlight the dynamic nature of cross-cultural and interregional exchange.

Until recently, Italy also had been largely overlooked in the context of large-scale archaeobotanical synthesis; though studies have focused on how the expansion of the Roman Empire affected consumption patterns in the western European provinces, less attention has been directed to the Italian peninsula (though for recent regional syntheses, see Bosi et al. 2020 for northern Italy; Bosi et al. 2017 on the colony of *Mutina*; Bowes et al. 2017 on southern Tuscany). However, it would be negligent to assume that imperial expansion did not also affect the core of the empire, both in terms of consumption patterns and the agricultural economy, for the imperial period would have seen the region placed at the centre of a much wider system than previously. Thus, instead of only exploring the affect that Roman occupation had on the provinces, this thesis will also allow for consideration of the affect that provincial occupation had on Roman customs in Italy.

A large-scale examination of archaeobotanical evidence from Italy will also allow for comparison between the textual evidence provided by ancient literary sources and the material remains. This may help to verify and shed light on popular research themes such as agricultural intensification, fluctuations in the Italian wine industry, olive oil production, and the rise in horticultural activity, among other topics (White 1970; Kron 2000, 2012, 2017; Tchernia 2006; Wilson 2009 Marzano 2013).

This thesis will therefore look to examine foodways as a whole, focusing not only on dietary patterns, but also on agricultural production, the impact of environment, as well as the role of agricultural by-products in complex regional fuel supply systems. As much archaeobotanical data as possible will be collated from both Italy and the East; the regions will be considered in their own right as well as compared (see Fig 1-1 below for study area). The chronological scope will be broad, with archaeobotanical data spanning from as far back as the 11th century BC for the East, or the 5th century BC for Italy, until the 5th century AD. It is the hope of the author that this will allow for the changes that occurred under the Roman Empire to be better understood.



Figure 1-1 Map of ancient Roman Empire at its greatest extent (c. AD 117) with study area indicated in orange. Dark grey indicates areas outside of the Roman Empire.

1.1 Aims and objectives

This research aims to achieve a better understanding of the disparate ways- and the degree to which- integration into the Roman Empire affected crop choices and consumption patterns in two very different parts the Roman world.

In the East, this will entail determining the impact of Roman imperial occupation on foodways and assessing if this varied from that observed in other regions that are better understood in terms of plant consumption. With respect to Italy, the project aims to refine the understanding of what can be characterised as 'Roman' dietary patterns by conducting the first large-scale archaeobotanical examination for the entirety of the Italian peninsula. This will also aid in highlighting not only the ways that Roman expansion effected change in the provinces, but also how it impacted the core of the Empire itself.

Furthermore, this thesis seeks to shed light on the role played by, and the importance of, political and economic structures, socio-cultural context, and environmental factors in determining plant production and consumption practices in ancient societies.

In order to achieve these aims, individual objectives include:

- Collating the largest and most comprehensive body of (secondary) archaeobotanical evidence for Roman period Italy and the Near East.

- Examining the distribution of food plants according to chronological period, region, and site type in order to detect any patterns affecting the remains.
- Analysing said patterns in order to observe regional, social, and chronological variations, which may be viewed and interpreted in light of the general historical context.
- Critically assessing the ability of the datasets to shed light on agricultural regimes, as well as regional and interregional agricultural economies.
- Contributing to the current body of knowledge via original archaeobotanical research on material from the sites of Jerash and Hippos-Sussita.

1.2 Structure of thesis

This thesis is comprised of twelve chapters, as well as a limited number of appendices, though the majority of the tables and figures are included in the text. The following chapter (2) provides insight into, first, the theoretical paradigms that have been utilised in studies of food and foodways, and, secondly, the methodological approaches that have been employed in large-scale, synthetic studies of archaeobotanical remains. These sections are intended to inform and provide context for this research within the disciplines of Classics and Classical Archaeology, and the field of archaeobotany.

Chapter 3 provides a brief introduction to archaeobotany for non-specialist audiences, and covers the different modes of preservation, as well as the formation processes and biases that may affect the plant remains. Chapter 4 is intended to introduce the reader to the two regions of focus: Italy and the Near East. This section describes environmental settings, provides a brief historical overview, and touches on important research topics within each region, with special reference to those related to diet and agriculture, and those that the study of archaeobotanical macroremains may contribute to.

Chapter 5 details the methodological approach utilised in this study, including aspects of data collection and entry, as well as data analysis. The protocol for the collection and processing of primary archaeobotanical evidence is also indicated in this chapter. Chapter 6 focuses on the primary evidence from both Jerash and Hippos-Sussita, describing the sites, sampled contexts, sample composition, as well as the results and a brief discussion of the remains.

Chapter 1 Introduction

Chapters 7 and 8 include the results of the analysis of the Near Eastern and Italian datasets respectively. These chapters are organised by plant type and chronological period, and are each divided into two parts, with the results of the presence/absence analysis preceding that of the fully quantified analysis. Chapters 9 and 10 feature discussions of the evidence from the East (Chapter 9) and Italy (Chapter 10), interpreting the results in light of their contribution to subjects including, but not limited to, agricultural practices, dietary patterns, regional fuel economies, and climatic variations.

In Chapter 11, the results from both regions are compared in order to shed light on interregional as well as regionally specific patterns, and to highlight the disparate ways in which socio-cultural and political-economic factors motivated the trends affecting plant consumption over the course of the study period. Finally, chapter 12 consists of a brief conclusion, with a summary of key findings as well as an acknowledgment of data and research limitations, and recommendations for future work.

Chapter 2. Overview of Approaches to Foodways

2.1 Introduction

Despite the many various approaches to the study of food and consumption patterns, it is widely accepted that food throughout history has been far more than a biological necessity or means of achieving sufficient nutritional standards. It is embodied with greater significance pertaining to the economic, social, and political realms, and is often connected to the maintenance and demarcation of socio-cultural identity and distinctions (Twiss 2012: 357; Lévi-Strauss 1963; Goody 1982; Dietler and Hayden 2001; Twiss 2007; Luley 2014).

The study of food and drink in ancient history has been approached in a number of different ways, particularly in the last half-century. Anthropological approaches have been prevalent, often looking to works focusing on more modern societies or ethnographic comparisons, as well as social history, with scholars considering foodways from a primarily literary perspective (see Goody 1982; Gowers 1993; Mintz and Du Bois 2002 for anthropological perspectives; see Dalby 1996; Wilkins 2000 for approaches influenced by social history). More general overviews employ a variety of methods, while archaeological approaches are flourishing, with new techniques being continuously developed and improved (Wilkins and Nadeau 2015; see Pitts 2015 for archaeological approaches).

Like the study of ancient history in general, early scholars tended to view ancient foodways through the lens of ancient literary sources, relying primarily on textual evidence. Much of their knowledge would have been owed to the encyclopaedists of the ancient world, including authors such as Pliny and Athenaeus, who touched on foodways in their seminal works, often by producing great lists that described foods and their origins (see Athenaeus' *Deipnosophistae* and Pliny the Elder's *Natural History*). Ancient cookery books such as that of Apicius were also heavily utilised, providing valuable insight into not only what was being eaten, but also how it would have been prepared (see Apicius' *De re coquinaria*). Even genres such as satire offer insight into ancient food culture, as is highlighted by Petronius' *Satyricon*.

Today, many modern works still look to ancient literature as a primary source of information, though these often tend to include other types of evidence as well, with texts forming just one avenue through which ancient foodways may be explored. Wilkins' *The Boastful Chef*, for example, has a primarily textual basis, whereas some of the broader overviews, such as Wilkins and Hill's *Food in the Ancient World*, or Cool's *Eating and Drinking in Roman Britain*, feature literary sources as one of many evidence types (Wilkins 2000; Wilkins and Hill 2006; Cool 2006).

The archaeology of food consumption in particular is seen as useful in studies concerning identity, society, and culture, for, while studies of the production and transport of foodstuffs may shed light on economic structures, consumption activities are affected by choices that serve to delineate social and cultural affiliations or differentiations (Pitts 2015: 95). As such, archaeological studies of food consumption have been described as offering 'significant potential for fresh understandings of ancient society, particularly in terms of characterising of social and cultural change' (Pitts 2015: 95; Hastorf 2017; Twiss 2019).

2.2 Trends and theoretical approaches

Scholars have utilised varied approaches to studies of foodways, and theoretical frameworks have risen and fallen in popularity. Many of the early studies of food from the 1970s through 1980s focused on its nutritional value, an approach which came to be criticized by the more post-processually inclined scholars as failing to take into account the factors and significance unique to different cultures (Twiss 2012: 359).¹ With the increased interest in culturally specific components and the decline in the social-anthropologically influenced processual and 'New Archaeology' methodologies, sociocultural anthropological approaches to archaeological evidence rose in popularity (see, for example, Goody 1982, Mintz and Du Bois 2002). Anthropology, in general, has had significant influence in archaeological theory, and the effects of this influence are highly detectable in studies of food and diet. Lévi-Strauss' structuralist approach has proved extremely influential in archaeological theory and remains so to this day (Lévi-Strauss 1963). In such a paradigm, food is viewed in terms of semantics, with diet and consumption acting as a symbolic language that is 'culturally shaped and socially controlled' (Caplan 1997: 1). In opposition to such a model, processually-minded materialist approaches, such as that of the famed Jack Goody, reject the linguistic approach of structuralism, and instead view consumption practices as largely affected by economic and ecological factors (Hitch 2015: 121).

Scholars have long been interested in 'feasting' activities, a prominent trend in studies of food and culture, and anthropologic and ethnographic schools of thought commonly influence approaches to such phenomena (Dietler 2007; Dietler and Hayden 2001; Bray 2003). In Roman archaeology, this interest has been borne out in the numerous studies of the Roman influence on feasting in the

¹ Though such observations are undeniably relevant to archaeological studies of foodways and culture, Roman archaeology, in particular, has been criticised for its lack of theoretical engagement. While this issue has been recognised in recent scholarship, the sub-discipline is still commonly described in terms such as 'under-theorised' (Gardner 2013: 3).

provinces, shedding light on the effects of culture contact in provincial societies, as well as in the long standing interest in elite dining practices, an interest which some scholars view as neglectful of the rest, and the majority, of Roman society (see Luley 2014a for recent, and beneficial, work on Roman influence on provincial feasting; see Laurence 2009 for interest in elite cultures, particularly chapters 7 and 8 for food and dining).

However, the determination of feasting activities in the archaeological record is often fraught with difficulties and is inherently problematic, causing a decline in the popularity of such methodologies (Twiss 2012: 363). As such, scholars have encouraged a more well-rounded and inclusive approach that, rather than focusing on the exceptional, considers all evidence related to consumption activities, including that which may previously have been associated with the mundane (Pitts 2015: 103).

Anthropologically influenced evolutionary approaches also have their limits and have been widely viewed as ill-suited in considerations of food and cultures (Wilkins and Hill 2006: 27). Wilkins and Hill, for example, touch on issues of assessing any supposed 'developments' in foodways during the classical period, asking if it is really possible to say that change in consumption activities throughout the classical period represented any notion of progress, or if this can be viewed as reflecting overall cultural development (Wilkins and Hill 2006: 27). This concept of development, and of 'becoming more advanced' should be avoided, for even though foodways are commonly subject to, and reflective of, cultural processes and influences, the idea of cultural advancement is flawed. In general, it is now thought to be important not to view food, or culture for that matter, in terms of an evolutionary construct unless strictly in reference to technological advances (and technical elements) such as in tools and cooking utensils, as the relationship between food and society is an omni-important phenomenon, and never can any one society be qualified as greater in complexity or more advanced than any other (see Johnson 2011 chapter 9 for discussion of evolutionary approaches to culture).

Environmental archaeology, and archaeobotany in particular, is often perceived as less theoretically engaged, though links with processual/'New Archaeology' and the interest in scientific approaches, processes, and modelling is undeniable (Thomas 1990; see Binford 1972.) Indeed, it can be said that plants are too often viewed as passive subjects of human processes and actions such as domestication, cultivation, crop processing and consumption, and are rarely ascribed any sense of agency in their own right (though see work such as van der Veen 2014 for exception).

Archaeobotany, in practice, is influenced by uniformitarianism, with seed identification and the use of modern reference collections highlighting the projection of contemporary understanding of

modern natural processes onto the past (Lodwick 2019). Work such as that of Martin Jones (1985) highlights the considerable influence that behavioural archaeology has had in archaeobotanical approaches, with plant remains interpreted as markers of human action/activity (here, crop-processing activities). More recently, materiality has come to the forefront and plants have been ascribed more active roles, such as in the demarcation of social roles and relationships (see van der Veen 2008 on 'embodied material culture'; van der Veen 2014 on materiality). The rise in social approaches can be observed in archaeobotanical studies as in the field of archaeology as a whole and will be discussed below in more detail (2.2.4).

2.2.1 Approaches to cultural contact and change

2.2.1.1 *Romanisation*

Although food is an undeniably fruitful avenue through which scholars may view issues such as cultural contact and the resultant shifts and developments, there has been much discourse regarding the particular interpretive frameworks with which such processes may be considered. One of the most controversial models affecting studies of Roman foodways has been that of Romanisation, a term which scholars have struggled to aptly define. Haverfield was one of the earliest and most prominent voices on this concept (Haverfield 1906). His approach, and conception of Romanisation in general has since been dubbed as intrinsically flawed for its subjective treatment of Roman conquest, which was seen as a positive force that benefitted the more primitive native civilisations, who willingly adopted the superior and more civilised Roman way of life.

Martin Millett also contributed much to scholarly discourse on Romanisation, and his work marks an important step toward current ideas surrounding the term. In his 1990 volume, which was particularly influential, Millett redefined 'Romanisation' as a two-way process and negotiation in which local populations were active agents, rather than just passive recipients of the colonising Roman culture (Millett 1990). He recognised the importance of acculturation, which he claims, 'removes us from the one-sided view of Romanisation' (Millett 1990: 1). However, Millett's approach views culture change as occurring by means of 'progressive emulation,' an idea that implies that the lower social strata looked to the example of the elites, who were adopting aspects of Roman culture, and thus strove to adopt more aspects of 'Roman' culture themselves (see Millett 1990 for discussion). This concept of wilful emulation and the aspiration to be more 'Roman' is flawed and likely too simplistic; societies may have adopted aspects of Roman culture due to the availability of Roman commodities, and they may have conceived of, and employed, seemingly Roman commodities in entirely different ways (see James 2001: 203-204; Mattingly 1997: 9). As such,

assuming that local, or native, societies venerated 'Romanness' due to the presence of Roman goods reveals that subjectivity continued to affect the concept of Romanisation even decades later. This also highlights the issue of whether emulation can actually be detected in the archaeological record when the specifics of how a commodity was being used cannot be determined with certainty (James 2001: 204 discusses this phenomenon with regards to finds of Roman vessels and *terra sigillata* in provincial contexts).

Since Millett, scholars such as Simon James have recognised that, though recent approaches to Romanisation have significantly improved by incorporating native populations and their potential for diversity and agency into the discussion, there remains a great need to stop 'over-privileging the role of the elites,' which was just part of a complex process that saw not only the convergence, but also the continued diversity, of life and culture across the Roman empire (James 2001: 205). James points to the potential of a bottom-up perspective, with the common populace playing a much more important role in studies of culture change in the Roman world, an approach which he feels would drastically alter current conceptions (James 2001: 205). He also emphasises the importance of the great diversity and variation that would have characterized such as a process, pointing to the shortcomings of former approaches that view 'Romanisation' in terms of 'binary cultural opposites' (James 2001: 204). To remedy this situation, James suggests the potential of an approach that, in efforts to increase inclusivity, considers Roman culture as, in a sense, the sum of multiple interacting 'aspects,' including 'state culture,' public culture,' 'elite culture,' and 'mass culture(s)' (James 2001: 205-206). In general James offers a sensible critique of the current state of scholarship, and, though the success of the suggested approaches remains largely to be determined, by calling such issues into question, James' discussion of the term Romanisation highlights not only some current shortcomings, but also the potential to improve future understandings.

Another major inadequacy of the Romanisation paradigm concerns the question of what, exactly, can be categorized as 'Roman?' As the Empire grew, it came to encompass many previously foreign lands and peoples, making 'Romanness' increasingly diverse and exceedingly difficult to identify. This supposed cultural homogeneity is unethical with respect to 'Romans' as well as to 'native' populations, who would also have exhibited diversity amongst themselves, further complicating the issue of any formerly accepted 'roman/native' dichotomy (see Mattingly 2006 for apt description and discussion of such problems with the Romanisation paradigm).

The work of David Mattingly, another important voice in the Romanisation dialogue, is extremely relevant to such issues and his proposed theoretical framework strives to eradicate such oversimplifications. Mattingly criticizes not only traditional views of Romanisation but post-colonial

critiques as well, claiming that in essentially switching one stereotype for another, both sides of the debate portray a 'static and unvaried structure,' and impress the sense that only one point of view can exist now, as well as in history. (Mattingly 1997: 7). In efforts at remedying the situation, Mattingly looks to the word of Edward Said, who posed the idea of 'discrepant experiences' in exploring colonial and imperial situations in history. Such an approach aims to analyse the historical experience in a manner that is void of exclusionary tendencies, by urging scholars to overcome their own cultural biases and consider multiple different perspectives and historical experiences, which would have overlapped and intersected (Said 1993; Mattingly 1997: 12). Such a phenomenon is described as producing 'parallel but distinct histories' (Mattingly 2006: 17).² Mattingly's influential 2006 volume on Roman imperialism actually uses the concept of 'discrepant experiences' in place of the oversimplifying paradigm of 'Romanisation.' The overall success of the study in conveying the great variety of historical experiences and disparate perspectives that can be associated with Roman cultural history illustrates the utility of such an approach.

In short, 'Romanisation' remains a controversial and problematic approach to acculturation, or more generally, culture change, and, despite extensive attempts to reconcile the concept with modern scholarly thought, no single definition of, or approach to, Romanisation has yet been agreed upon (for more recent work on 'Romanisation,' see also Versluys 2014; Woolf 2014; Van Oyen 2015).

2.2.1.2 Creolisation

Scholars such as Jane Webster and Gillian Hawkes support an alternative to the Romanisation paradigm that is known as 'creolisation theory' (see Hawkes 1999). This concept of creolisation goes back to studies of the emergent African American cultures of the 18th century, in works such as Ferguson's *Uncommon Ground* (Ferguson 1992). In such works, the popular linguistic approaches were again applied, with the material culture of past societies acting as a sort of language, through which creolisation could be examined (Hawkes 1999: 90).

² Like Mattingly, I too will quote the work of Edward Said, who explains the concept in such a succinct way that I hesitate to reword it. Said (and Mattingly) urge scholars to recognise the 'massively knotted and complex histories of special but nevertheless overlapping and interconnected experiences... and there is not particular intellectual reason for granting each and all of them an ideal and essentially separate status... That is, we must be able to think through and interpret together experiences that are discrepant, each with its own particular agenda and pace of development, its own internal formations, its internal coherence and system of external relationships, all of them co-existing and interacting with others' (Said 1993: 36; also quoted by Mattingly 1997: 12).

According to Hawkes, creolisation theory builds on the concept of acculturation, adding to it that of 'interculturalisation,' which is described as being a more reciprocal process in which, rather than one culture adopting that of, or being absorbed into, another, two cultures intermix (Hawkes 1999: 89-90). Similarly, Webster, who has been a major proponent of the creolisation paradigm, describes it as a bottom-up approach, which occurs in conditions with 'asymmetric power relations' (Webster 2001: 218). The process is said to often feature an aspect of '*resistant* adaption;' that is, rather than (completely) following along with the dominant, elite culture, traditions are maintained, the result of which is not 'a single, normative colonial culture, but mixed cultures' (Webster 2001: 218).

Hawkes praises the concept of creolisation for providing for some element of agency on the part of the subjected populations, allowing for the possibility that they could 'accept or reject in part the package of Roman material culture' as they wish (Hawkes 1999: 90). She also claims that studies which focus on the economic aspect of foodways (i.e. its production and supply) overlook the individual, and that scholars should also consider the meaning behind food and consumption patterns, and, for this, she recommends creolisation as a perfect paradigm (Hawkes 1999: 90). Regardless if this is the case or not, creolisation is superior to traditional understandings of Romanisation in that it allows for two-way input and creation of new cultural practices and identities, taking into account the various ways in which culture contact and change may have occurred, rather than generalising the many different instances and unique encounters.

Though there is considerable overlap in some respects, it should be noted that what differentiates the creolisation model from traditional views of Romanisation is that it does not represent the replacement of one culture by another, but rather the formation of a new, blended culture. In this way, such an approach moves away from definitions of Romanisation that measure culture change in the province in terms of 'Romanness;' however, increasingly, new definitions of Romanisation are moving away from such tendencies as well.

[2.2.1.3 Globalisation](#)

Richard Hingley is a dominant voice and advocate for the concept of globalisation and its utility as an approach to Roman imperial culture and culture change in the Roman world (Hingley 2005). While adopting a notably economic interpretation of the term globalisation, Hingley places great emphasis on the interaction between modernity and our conception of the Roman world, pointing to the profound impact our current world experience has on our understanding of the past (see Hingley 2005 chapters 1 and 2). In employing the modern idea of globalisation to the ancient past, Hingley stresses the importance of recognising the coexistence of 'a global perspective and a regional cultural diversity' that developed the Roman world (Hingley 2005: 2).

Martin Pitts has also been an important advocate for globalisation and has sought to demonstrate the potential of the paradigm (see Pitts 2008). In his 2008 article, Pitts examines the incorporation of new peoples into the Roman Empire with an approach that looks to globalisation and world-systems theories, considering how the 'effects of the expansion of global systems' affected eating and consumption practices (Pitts 2008: 498). Using quantitative analysis of ceramic assemblages to examine consumption patterns, Pitts suggests globalisation as an additional alternative to the controversial paradigm of Romanisation. He states that the ceramic assemblages, though of an increasingly homogenous supply, highlight that the process of negotiation that took place with Roman conquest resulted in the fusion of elements of both local as well as global cultures (Pitts 2008: 493).

Thus, globalisation is not unlike Hawke's creolisation in that it allows for the varied and bidirectional effects of culture contact, as well as the complex cultural negotiations that Romanisation lacks (Pitts 2008: 493-494). However, there are important elements that set Pitt's framework apart, including an emphasis on the role of greater processes of connectivity and economic integration, rather than on identity and external expressions of cultural adherence (Pitts 2008: 494). This concept of connectivity in the Roman world has been increasingly popular, particularly in studies of the Roman economy, and perhaps rightly so; without the structures that allow for the increased connectivity of the Roman empire, people and material culture, including foodstuffs, would not have been able to travel long distances, inhibiting significant culture contact and change (Pitts 2008: 494). In this way, the importance of the Roman economy to studies of foodways and culture has been reintroduced back into the dialogue (see also Pitts and Versluys 2014).

Andrew Gardner, however, raises some issues of uncertainty concerning the applicability of globalisation due to the inherent differences between the modern and ancient world, stating that though some definitions allow for much variability so as to make the term more inclusive, ascribing the term with too much variability renders it far less useful than it might otherwise have been (Gardner 2013: 7). Gardner claims that, while globalisation has proved useful in highlighting the importance of economic considerations which previously may have been somewhat overlooked by postcolonial approaches, it does not sufficiently fill the gap so as to serve as an interpretive tool that allows for a better understanding of imperialism in the Roman period (Gardner 2013: 9). That is not to say that the theory is otherwise without its merits; the phenomenon known as 'glocalisation,' for example, which refers to the process of change and fusion that results in new local identities, is of particular utility in considerations of Roman imperialism and culture change (Gardner 2013: 7). As such, Gardner explores an approach that draws upon globalisation, post-colonial theory, as well as institutional archaeology, which minds the roles and impact of institutions on daily life (Gardner

2013: 9). He urges scholars to utilise such a framework in order to engage with 'the ongoing debate over structure, agency and practice' (Gardner 2013: 19). In this way, globalisation has been drawn upon so as to form part of an approach, though not serving as the whole approach in itself.

2.2.4 Food and identity

The connection between food and social identity has also received due attention in recent decades. Wilkins and Nadeau, for example, discuss food as an expression of self and/or group identity. Thus, individuals demonstrate affiliation, or conversely, exclusion from groups by means of food, enabling it to act as a means of communication, a form of language, much as in Lévi-Strauss' structuralist paradigm (Wilkins and Nadeau 2015: 3). Though the factors and considerations that lead to certain choices may be products of particular historical contexts and unique social and cultural constructions, the symbolic nature of food choices are universal (Wilkins and Nadeau 2015: 3). These themes of food and social identity, and the demonstration of identity have been of immense popularity among scholars in recent years, which has been borne out in studies, and even entire books dedicated to this topic (see, Twiss 2007; see also Caplan 1997, Wilson 2005, and Cheung, Schroeder and Hedges 2012 for a variety of applications). As previously mentioned, this particular avenue of research is one in which archaeobotanical studies may be viewed as more theoretically engaged, with post structural approaches to food and consumption focusing on social access and identity (see, for example, Palmer and van der Veen 2002).

Luley, as well as Dietler, and many other scholars have also recognized the important role food and diet play in culture, or 'colonial', contact and the resultant exchanges and transformations (Luley 2014b; Dietler 2007; see also Counihan and Van Esterik 1997 and Dietler 2010). Like many other scholars, Luley recognizes the use of food for the demarcation of difference, both socially and politically, though he points out that this can be shown by quality of food as well as quantity of food, the latter of which may be more difficult to detect in the archaeological record (Luley 2014b: 33). His research shows that with Roman conquest came a shift in societies of Mediterranean France that was made manifest in foodways by the development of a 'high cuisine' (Luley 2014b: 33). The term 'high cuisine' references the development in foodways under the early Roman empire that manifested itself in the adoption of a different way of eating by upper classes, which featured an increase in attention to the quality, as well of the taste, of food with the use of more intricate recipes and newly available spices by those who were able to procure them (see Goody 1982 on the term; Luley 2014b: 34). Such a development is described as expressing the greater social and

political process of integration that occurred with imperial annexation, highlighting the utility of consumption as a proxy for greater historical and cultural concerns such as these.

2.2.5 Consumption Theory

Recent scholarship has also shown favour to consumption theory (see Henry 1991 for detailed theoretical model). In such a framework, rather than being viewed as an event or destination for foodstuffs, consumption is seen as a social practice and a process that is comprised of three basic stages: acquisition, which refers to production and distribution activities; transformation, which includes cooking and food preparation, as well as ingestion; and then finally, disposal (Pitts 2015: 95). In this way, such an approach aligns with that of anthropologist Jack Goody, who also views food related activities in terms of all the different stages that the whole process of consumption entails (Pitts 2015: 96; see Goody 1982).

Scholars of consumption and consumption theory such as American historical archaeologist Susan Henry believe that consumer choices and thus consumption patterns are shaped by factors including consumer identity, the type and necessity of a commodity, and the socio-cultural setting (Henry 1991: 3). As such, Henry believes that it is possible to develop a 'general model of consumer behaviour,' that should prove applicable to all segments of a given population and serve as an explanatory model, allowing scholars to better understand consumer choices in any scenario or situation (Henry 1991: 3). Though certainly an interesting lens to view consumption processes through, Henry's concept disregards notions of the individual, circumstance, as well as natural and environmental phenomena, which other scholars such as Horden and Purcell view as being of primary importance (Horden and Purcell 2000).

Another notable scholar of consumption in the Roman world, Kevin Greene utilises material culture to examine Roman consumption, and considers the question of whether consumption developed into consumerism in the Roman Empire (Greene 2008). Greene distinguishes between consumption and consumerism, with consumption referring to biological necessities such as food for sustenance, as well as clothing necessary for survival, while consumerism is more associated with, and driven by, desire (Greene 2008: 66). With regards to consumption, what and how such items are consumed are influenced by cultural factors, though not to the same degree as consumerism (Greene 2008: 66).

Employing an approach that is influenced by 'new institutional economics', Greene identifies particular 'elements' that can be seen as indications of consumerism, and describes how they may

be detected in the archaeological record (Greene 2008: 69).³ Examining these elements and the possible development of consumerism due to situational factors such as increased potential for the transfer of knowledge and goods, and the formation of identities via consumption, Greene determines that, despite the great increase of security and access to new commodities that occurred with the advent of the Roman Empire into provincial territories, continued subdivisions inhibited the development of true consumerism as well as globalisation (Greene 2008: 82).

2.2.6 Regionalism

Regionalism has been another fruitful approach to studies of food in the ancient world. Rather than focusing on the cultural aspects related to food such as popular topics of commensality and identity, Horden and Purcell look primarily to environmental considerations and concepts of regionalism and 'microclimates,' emphasising the importance of natural and environmental factors on diet and consumption patterns (Horden and Purcell 2000). Martin Pitts has offered a view that combines consumption theory and regionalism by pointing out that, in antiquity, the concept of 'consumer choice' would have, to some extent, been subject to the effects of regional limitations (Pitts 2015: 96). Regionalism is also highlighted as important, as such a consideration reveals the diversity inherent across the ancient world, or more specifically relevant, the Roman Empire. The differences between the centres and major cities as opposed to the hinterland are well recognized and apply to issues of diet as well. Additionally, consumption habits varied considerably between the East and West of the Empire (Wilkins and Hill 2006: 22).

There is no shortage of archaeological, as well as non-archaeological, evidence related to food and consumption. In fact, the wide array of evidence and approaches has ultimately posed problems as scholars tend to over-specialise, rather than synthesize information gleaned from the various different evidence types (Pitts 2015: 103). The value of integrating the various methods and employing a more holistic research design that encompasses varying types of evidence cannot be stressed enough, particularly with regard to consumption, as such an integrated approach allows

³ In his quest to determine whether consumption in the Roman world actually became consumerism, Greene deems the term 'Romanisation' as wholly unhelpful, using instead the proposed term 'crystallization,' a term associated with 'new institutional economics', that connects increased confidence in economic transaction with the 'steady accumulation of institutions and practices' (Greene 2008: 67).

scholars to consider what was being eaten and how, allowing for a more complete understanding to be formed (see Cool 2006, for example).

Some scholars have tried to incorporate a wide array of evidence and studies into their work and have yielded encouraging results that place individual studies and types of evidence within their greater relative contexts. Recent work by Robinson and Rowan serves as an example of scholarship that, though still specialised, offers farther reaching interpretations, considering the socio-cultural and economic implications of their finds in their greater historical context (Robinson and Rowan 2015; Rowan 2017; see also Lodwick 2014; van der Veen 2008, 2011). Scholars are increasingly taking such measures rather than simply reporting the results of their research without consideration for broader implications. Such efforts should be recognized and continued in future research.

2.3 Methodological approaches to synthetic studies in archaeobotany

In addition to the theoretical underpinnings, it is necessary to consider the various methodological approaches to studies of foodways, particularly in terms of archaeobotanical approaches, as archaeobotanical evidence is of primary importance in this thesis.

A number of themes underlie much of the recent, and not so recent, archaeobotanical research, and it is according to these that this overview will be organised. This review will broadly focus on studies relevant to food and diet, in several different forms. First, studies of foods and social access and identity will be considered, followed by studies that place greater focus on the productive side of plant foods, examining crop husbandry and agricultural practices. The methodologies considered here can all be characterised as featuring synthetic approaches, which typically combine evidence from chronologically and/or geographically diverse datasets. Such studies often collate archaeobotanical data in order to consider themes related to variation, such as within or between regions, as well as change over time.

2.3.1 Synthetic studies of food, social access, and identity

Food and identity has become a popular avenue of research in archaeobotanical studies. Such studies typically focus on the dispersal trajectories of new plant food introductions, which often accompany the movements of peoples and the implementation of new political and economic powers (see below). One such power that has received much attention with regard to matters of identity is of particular relevance here: the Roman Empire and the expansion of the Roman world. It

should be noted that the term 'luxury foods' is common in such studies and can generally be defined as referring to imported foods that are unable to be produced by means of local cultivation (though see van der Veen 2010 for somewhat different definition of what makes a food a 'luxury,' also see *World Archaeology*, Volume 34, Issue 3, which is entirely devoted to studies of luxury foods).

Although social approaches to food have enjoyed particular popularity recently (see Hastorf 2017, for example), interest in identity, as explored via new and imported foods, can be traced back to the 1970s in works such as Wilcox (1977). Wilcox (1977) analyses botanical remains from Roman London, considering the data in terms of the presence/absence of the various taxa at seven urban sites (Wilcox 1977: 271). The author presents his results by separating the plants into categories according to their economical use in Roman Britain, and discussing the exotics and imports present in each. These groupings include imported pine, spices, succulent fruits, vegetables, pulses, walnut, oil and fibre plants, cereals, and newly introduced weed seeds (Wilcox 1977: 273-280).

Wilcox points to the difficulties in discerning when plants represent new introductions or imports, but a challenge such as this could be aided by the inclusion of pre-Roman assemblages that act as a baseline and serve to highlight the new plant varieties identifiable in the Roman data. Still, the rich assemblages of exotic plants in London are interpreted as highlighting the increased variety of economic plants available in Britain during the Roman period, as well as the 'Romanizing influences' acting in the region (Wilcox 1977: 281). Though the use of the terms 'Romanizing' and 'Romanization,' have been the topic of considerable debate and have now fallen out of fashion among Romanists, later studies also provide overwhelming evidence of a significant influx of new plant foods into Roman Britain (see van der Veen et al. 2008 below for example).

Romanisation continued to be the main paradigm under which the Roman period archaeobotanical record was studied in a paper by Julian Wiethold. Wiethold (2003) concludes that agricultural practices (and general subsistence procurement) were affected by the 'rapid "Romanisation"' of central Gaul and seeks to explore this using macroremains from Iron Age and Roman Burgundy (Wiethold 2003: 296). With the article's problematic focus on 'Romanisation' aside, the author's goal is not unlike other synthetic archaeobotanical studies of the Roman period: Wiethold seeks to explore the effects of the new cultural and economic interactions by examining the plant record in order to highlight shifts in consumption patterns, the introduction of new crops and imports, as well as continuations and/or reorganizations in agricultural systems.

In order to achieve this, Wiethold looks to published and unpublished evidence from 10 sites dating between the late first to the late 4th century AD. The data include different modes of preservation

recorded using presence and absence, with cases of a species being particularly prevalent denoted (Wiethold 2003: 274). In general, the author describes the numerous assemblages and offers broader interpretation but discloses little in terms of detailed data analysis; lacking in maps or anything in the way of visual data representation, Wiethold chooses not to graphically illustrate the trends present in the data nor to discuss the specific methodologies in terms of quantification or analytical methods that allowed them to be detected.

In terms of results, Wiethold observes little change in cereal and pulses cultivated in the region during the Iron Age or under the Romans. Variations are spatial rather than temporal, and are thus reflective of ecological factors, such as different soil and climatic conditions, and the existence of regional crop patterns (Wiethold 2003: 278). The Roman period did, however, bring shifts in oil plants in the region, with *Camelina sativa* (gold-of-pleasure), formerly characteristic of the region, virtually disappearing (note: this trend was also reported in Matterne 2009 for greater Gaul in general) (Wiethold 2003: 278). Furthermore, as seen in other studies, the most significant developments during the Roman period are marked by imports and newly introduced luxury foods, as well as the rise of horticulture and viticulture in the region (Wiethold 2003: 278; see also Livarda et al. 2008 below). Thus, the archaeobotanical evidence shows the continuation of aspects of local agricultural practices under the Romans, but also diversification with new introductions in terms of both plants and cultivation techniques.

In this way, Wiethold emphasises the importance of recognising the reciprocity of the cultural shifts often labelled under the term 'Romanisation,' pointing to the Roman adoption of pre-existing Celtic agricultural structures such as is exemplified in the continuation of trends in cereal and pulse cultivation (Wiethold 2003: 277). He also concludes by linking shifts in diet to political and economic developments such as the implementation of Roman infrastructure systems, and associates new and imported taxa, or, in this case, 'typical indicators for "Romanisation,"' with centres of cultural and commercial exchange such as towns, military sites and *vici* as opposed to rural settlements and *oppida* (Wiethold 2003: 279).

Like Wiethold, Bakels and Jacomet detect a correlation between certain site types and newly introduced foods in their seminal 2003 paper. Bakels and Jacomet (2003) focus on a relatively large study area and, though not to the scale of this thesis, it does span a number of provinces. Incorporating sites from across central Europe, the data come from 180 sites in Belgium, the Netherlands, Luxemburg, northern France, Germany, Switzerland, Austria and Hungary. The authors separate the Roman period into four phases, which span from the 1st century AD (time of military conquest and occupation in the region) to the 4th century AD (Late Roman). The sites are then

divided according to their nature, into five categories, allowing the authors to consider their sites in terms of the different social groups that they represent.

In the analysis, Bakels and Jacomet considered both waterlogged and carbonised data in terms of frequency of occurrence (based on presence/absence) per period and site (Bakels and Jacomet 2003: 547-552). A number of newly introduced species are identified, including but not limited to *Oryza sativa* (rice), *Cicer arietinum* (chickpea), *Piper nigrum* (black pepper), *Pinus pinea* (stone pine), *Phoenix dactylifera* (date palm), *Olea europaea* (olive), *Pistacia vera* (pistachio), *Allium sativum* (garlic), *Persica vulgaris* (peach), *Prunus domestica* (plum), *Vitis vinifera* (grape), and *Juglans regia* (walnut) (Bakels and Jacomet 2003: 543).

The authors identify that in central Europe many foods were introduced during the Roman period, and these can be broken down into two groups: those that were initially luxuries but eventually became mundane as they were integrated as part of the local cuisine, and those that were unable to be produced by local cultivation and thus retained luxury status (Bakels and Jacomet 2003). The results show that most of the plant foods are present from the early Roman period only in military contexts. Civilians adopted these new introductions shortly after, initially in the towns in which military supply was handled or traded (Bakels and Jacomet 2003: 552). Local villas soon made efforts to produce some of the products, though they were not always wholly successful in these endeavours (Bakels and Jacomet 2003: 552). Eventually local rural populations consumed at least some of the foodstuffs of concern.

Bakels and Jacomet choose not to include species level data in the study, instead displaying frequency patterning for each of the described plant food groups. The authors do touch on certain select species in the discussion section, though a more detailed report of such data would be useful. Additionally, if the authors had analysed the data to the species level, they may have been able to shed light on some patterns of interregional variation masked by the use of the food groups. Further limitation can be seen in the lack of consideration for geographical factors, which limit the study by making it unable to contribute to major economic and environmental discussions.

Van der Veen et al. (2008) is a landmark study that represents a further development of methodological approaches to studies of food and social access and identity, though in this case focusing on Roman Britain. The authors include a large body of data, consisting of 639 records from 514 sites, with 271 records from 226 sites containing carbonised, waterlogged, and mineralised evidence of the new plant foods focused upon in the study, though waterlogged remains are by far the most prevalent (van der Veen et al. 2008: 14). As in Bakels and Jacomet (2003), the authors classify sites into five broad categories, including 'Rural,' 'Urban,' 'Military,' 'Ceremonial,' and 'Other'

in order to facilitate the study of social aspects such as differential access to particular foods stuffs. Chronologically, the records span from the 1st to the 4th centuries AD, and are subdivided into 'Early Roman,' 'Middle Roman,' and 'Late Roman,' as well as a few broader divisions for records that are less specifically dated, including 'Roman mid/late' and 'Roman' (van der Veen et al. 2008: 14). In analysing the remains, the authors use presence and absences per site, though note any circumstance of particular abundance.

The study features a four-fold analysis, which is broken down into geographical dispersal, social dispersal (distribution by site type), chronological dispersal and multivariate analysis (i.e. correspondence analysis). In order to analyse chronological dispersal, the authors assessed changes in abundance in various taxa over time by calculating the percentage of all waterlogged records for each phase (early, middle, and late Roman). The results highlighted three detectable patterns in the data: exotics that were introduced, but then decreased in prevalence in time, failing to become established components of the plant-based diet in the region; herbs that increased from introduction, but eventually declined in popularity by the Late Roman period; and finally, examples of successful introductions, in which plants, fruits, nuts, and vegetables increased during the Roman period and became established parts of the plant-based diet in the region (van der Veen et al. 2008: 32).

Correspondence analysis, which could only be performed with waterlogged remains, showed a few interesting links. Imported fruits and nuts were largely associated with urban records, from London in particular (and decreased with time), while herbs (which increased and then decreased) show a strong association with military sites, and vegetables and oil seeds (which increase over time) tend to characterise the rural assemblages (van der Veen et al. 2008: 23).

In addition to the three food groups previously mentioned, the authors identify four detectable consumer groups: major towns, military sites, rural sites in SE England (which includes small towns and industrial sites), and, finally, rural sites from the rest of the country (van der Veen et al. 2008: 31). The fact that rural sites in SE England appear to have had greater access to new plant foods than those of similar nature in the rest of the country highlights the importance geographical factors have in shaping consumption patterns, with implications that outreach divisions by consumer groups (van der Veen et al. 2008: 31). Furthermore, many of the rural sites that yielded evidence of new plant foods were subject to greater connectivity, whether it be by military presence, or proximity to major roads, ports, or rivers (van der Veen et al. 2008: 31).

The introduction of horticulture during the Roman period is an additional, and particularly important, hypothesis, which would indicate a reorganisation of the agricultural economy in general

(van der Veen et al. 2008: 33). This introduction has interesting implications, as it is associated with increasingly stratified societies and craft specialisation, a development that created a market for cultivated foods, as portions of the population did not engage in farming/agricultural activities (van der Veen et al. 2008: 33).

Still, the verity of such an observation should not be taken for granted without further research. Though interesting, this conclusion is based on the lack of Iron Age evidence of fruits, nuts, vegetables and herbs. This, however, is somewhat problematic, as the possibility that such remains are yet to be uncovered is an important consideration to bear in mind (see Lodwick 2014 for evidence of flavourings from Late Iron Age Silchester, for example). Furthermore, such remains are commonly preserved in waterlogged conditions, and waterlogged conditions are described as being exceptionally more common at urban sites (van der Veen et al. 2008: 16). As the advent of urbanism is associated with Roman conquest in Britain, it is also a possibility that evidence of early horticulture was simply not preserved.

Van der Veen et al. discuss a number of biases in their dataset at length. In addition to the preservation biases that skew virtually all archaeobotanical assemblages, the authors also recognise the presence of geographical biases. The data are strongly skewed so that the east and south of England is far better represented than other areas such as Wales, northwestern England, as well as much of Scotland. This is attributed to the lack of published archaeobotanical material from some areas, which have been less of a focus for archaeologists (van der Veen et al. 2008: 14).

Furthermore, there is notably less data from rural sites than from urban sites, where, as mentioned above, waterlogged preservation is distinctly more common (van der Veen et al. 2008: 16).

In addition to the biases recognised by the authors, the study features a number of other limitations. As in other studies, van der Veen et al. neglect to incorporate pre-Roman data with which to compare the Roman data. The inclusion of earlier evidence would serve as a control and render the authors better able to trace shifts induced by the advent of the Romans into the region (see Lodwick 2014, 2018, and 2020 for examples of archaeobotanical studies that incorporate pre-Roman (in this case, Iron Age) evidence as a baseline of comparison). Furthermore, the authors do not report the details of their data at a site level, but rather often organise it by 'site type,' which indicates the assumption that all 'urban' or 'rural' sites, for example, yield rather homogenous assemblages despite any variation in ecologies or environmental settings.

Recently, a team of Spanish scholars has synthesised the archaeobotanical data available for the Iberian Peninsula during the Roman, Late Antique and medieval periods, covering a time span of approximately 1500 years (Peña-Chocarro et al. 2017). Peña-Chocarro et al. (2017) place greater

emphasis on changes in agricultural practices during the Roman and medieval periods, as opposed to van der Veen et al. 2008's focus on social access, in addition to tracing the introduction and dispersal of new species (Peña-Chocarro et al. 2017: 2). Data on the remains of some 70 taxa were gathered and classified as cereals, legumes, cultivated fruits, fibre and oil plants, spices, or gathered fruits. The sites were categorised by settlement type, comparing urban and rural, and were divided geographically into 8 sectors and chronologically by Roman, Late Antique, and the medieval period (Peña-Chocarro et al. 2017: 2). For the Roman period, data were analysed regionally so as to consider distribution patterns geographically, while for the medieval period data, religious and cultural factors were taken into consideration by comparing Christian and Islamic sites (Peña-Chocarro et al. 2017: 2). The data were analysed in terms of presence and absence, assessing a given taxon according to its frequency, and its 'percentage distribution', which was calculated using the number of occurrences for each taxon and the total number of occurrences for all taxa represented (Peña-Chocarro et al. 2017: 3).

A number of inconsistencies in the data are noted. First of all, there is a discrepancy in sampling practices, with only some excavations employing systematic sampling strategies as well as processing by means of flotation. An additional inconsistency is in the mode of preservation, with waterlogged and mineralised remains accompanying the carbonised remains, which comprise the majority of the data (Peña-Chocarro et al. 2017: 2). It is also notable that, though there are a number of urban sites, rural sites dominate, in contrast to other regions, such as Britain, where rural sites are often more of a rarity (Peña-Chocarro et al. 2017: 3; see van der Veen et al. 2008 above).

In general, cereals prove to be the most abundant remains (Peña-Chocarro et al. 2017: 3). The dominance of naked wheat and hulled barley, except for in the northwest sector, applies to urban and rural sites, with no detectable variation according to site type. Environmental factors may, however, have more of an impact, as hulled barley can be associated with areas of lower soil quality. Observations regarding the impact of environmental factors such as regional soil quality on crop variation are made possible by the inclusion of geographically based analysis in this study, whereas in studies that lack such a consideration (such as Bakels and Jacomet 2003), environmentally influenced patterns may be overlooked.

Otherwise, notable fruit introductions during the Roman period suggest the development of arboriculture (Peña-Chocarro et al. 2017: 16). This is hardly the first time scholars have remarked on new agricultural techniques (e.g. horticulture) introduced by the Romans, as well as the subsequent increase and diversification of fruit consumption, though it may be a new observation with regard to the Iberian Peninsula specifically (see Bakels and Jacomet 2003, as well as van der Veen et al. 2008

for example). However, in the case of the Iberian Peninsula, the authors still suggest an overall lack of proof for major shifts in the Roman and medieval periods, instead postulating that continuity better characterises the situation (Peña-Chocarro et al. 2017: 16). In this way, Peña-Chocarro et al. 2017 provides for an interesting contrast with the results obtained from studies of other regions, such as in van der Veen et al. 2008 (see discussion above).

Still, a few additional limitations should also be pointed out. As has been noted for many other Roman studies, the authors neglect to include prehistoric data against which the Roman material may be compared. Such an exercise would allow for a more developed understanding of the shifts that did or did not occur under the Romans and would provide evidentiary support for the authors' conclusions. Furthermore, a large amount of unpublished data is included in these studies. It would be useful for future scholars if these data were reported at a site level, rather than only incorporated into the larger dataset for each respective geographical sector. However, as it is not, the data lacks a certain level of accessibility that would allow the reader to understand the crop distribution within each region and to better discern any inter-site discrepancies that may or may not be extant in the data. In this way, the authors make generalisations, creating a picture of regional homogeneity, and minimising any variability in the data.

Moving beyond the Roman period, Sabine Karg's study on medieval food traditions synthesises available archaeobotanical data in order to explore the relationship between dietary shifts, particularly in terms of nutrition, and imports transported by the Hanseatic League (Karg 2007: 11). The Hanseatic League was a union for traders that was both political and economic in its reaches, and facilitated commercial, as well as cultural, exchange from around 1160 to 1650 AD (Karg 2007: 9). The data are sourced from some of the key countries where the organisation was active, including the Nordic countries of Finland, Denmark, Sweden and Norway, as well as Germany, northern Poland, and Estonia (Karg 2007: 10). Most of the sites are located on the coast or close to bodies of water that facilitate trade and transport, making them ideal locations for centres of commercial activity and exchange (Karg 2007: 10).

Karg included plant taxa from more than 75 sites, and grouped the taxa into categories including: cereals, legumes, oil and fibre plants, vegetables, arable weeds, fruit and nuts, herbs and species, and other useful plants (Karg 2007: 12). The remains are approached country by country, in each case offering an overall synopsis of the results, rather than reporting the results of each site. Karg used presence/absence data in her analysis, with symbols denoting the general region (i.e. north, south, east, west) in which the taxa were found (for example, see Karg 2007: 21 for German data). Each country is the focus of a chapter, with a final chapter then attempting to synthesise the overall

results. One strength of the research is the inclusion of, and comparison with relevant textual evidence from the period, an aspect that is often disregarded in scientifically based archaeological studies.

The author portrays the Hanseatic town as a place associated with the rise of urbanism, market systems, and, as can be seen in consumption patterns, the introduction and acceptance of new cultural trends (Karg 2007: 181). Karg also highlights the role of new plant foods in projecting social identity, as well as the importance of food in economic structures (Karg 2007: 181). In terms of overall results, the author offers a synopsis of each category of plant remains and assesses overall plant diversity in order to identify two distinct regions: in Germany, North Poland, and Estonia, new plant foods quickly became normalised as typical dietary components for all social classes, while in the remaining Baltic countries, new plant foods are much less common, and appear to have retained their luxury status (see Karg 2007: 182-189 for discussions of each category; 190).

Changing foodways and access to new plant foods have also been examined with regard to mobility, and the ways in which the movements of peoples have affected dietary patterns and the crop packages that characterise various regions. Stevens, et al. (2016) examines early food movements that represent the beginnings of the globalisation of food from the end of the 3rd millennium BC to the early 1st millennium AD. During this time, numerous species spread across central Asia, increasing crop diversity across Eurasia (Stevens, et al. 2016: 1541). Using the AsCAD database of domesticated plants from across Asia, the authors track the expansion of plant foods including wheat and barley, pulses and flax, Chinese millets, peaches and apricots, and rice through human agency. These species exhibit varied dispersal patterns in terms of both the routes followed and chronology, supporting selective transport as opposed to a 'demic-diffusion of farmers with a defined crop package,' the latter of which is associated with earlier crop transport during the Neolithic period (Stevens, et al. 2016: 1541-1542). In exploring these dispersal events, the authors emphasise the role of small, mobile societies of Central Asia (as opposed to complex, hierarchical societies), who relied upon crops of diverse ecologies, and thus participated in regular exchange of resources from an early date (Stevens, et al. 2016: 1541).

Though Stevens et al. describe the chronological and geographical spread of crops, the methodology is left somewhat implicit; the authors presumably used frequency of occurrence for different chronological periods, but did not articulate this, or how they dealt with other challenges encountered when utilising synthetic approach. Additionally, Stevens et al. did not disclose the specific sites used, instead only referred to sites when relevant in text. Similarly, the chronologies

and locations of the sites were expressed on a map that is rather difficult to read, making the specific site information in general very difficult to access, to the detriment of future scholars.

In the same year, Crowther et al. (2016) explore the colonisation of Madagascar, as well as the Comoros and parts of East Africa by the peoples inhabiting the islands of South East Asia. They do so by using archaeobotanical macroremains of crops with Asian origins, which offer the first traceable source of archaeological evidence of this colonisation event. The authors collected samples from 18 sites scattered throughout Madagascar, the Comoros, as well as the eastern coast of mainland Africa. All assemblages are charred and date to from 650 to 1200 cal. AD (Crowther et al. 2016: 6636). Data are presented fully quantified, with numerical counts for select species that are indicated as being of either African or Asian origin and is also expressed in terms of the relative proportions of the different African and Asian sites for each site (Crowther et al. 2016: 6637). The inclusion of both quantification methods is noteworthy, and affords the data, and the study in general, a transparency that should be characteristic of more archaeobotanical studies.

In analysing the data, the authors were able to detect two major points of origin: Africa and Asia. Some records feature predominately African crops and some Asian. A clear pattern can be seen, in which mainland and near-mainland sites yield assemblages in which the majority of plants are of African origin, while assemblages from the Comoros and Madagascar are dominated by crops of Asian origin (Crowther et al. 2016: 6637). The Asian crops at mainland and near-mainland African sites appear initially in small quantities near major ports, and thus seem to be the result of commercial trade (of exotic goods across the Indian Ocean) (Crowther et al. 2016: 6637). At sites on Madagascar and the Comoros, however, Asian crops exhibit different patterns, and instead seem to be reflective of human migration and the process of colonisation (Crowther et al. 2016: 6638).

While the study certainly yields interesting results, the datasets for each site generally rely on fairly few remains, which may or may not be indicative of the greater trends that they are interpreted as representing. Furthermore, the authors include a fairly limited range of crop types, confining the study to cereals and field crops such as cotton and mung bean, and thus fail to consider other new types of food that could have been adopted. Despite these limitations, this research does serve to the utility of such an approach to studies of population migration and colonisation, as well as cultural interaction and assimilation (Crowther et al. 2016: 6639).

The studies discussed here exemplify the diverse methodologies that have been employed in archaeobotanical analysis of food and social identity. Though varying in terms of scope and time period, as well as geographical area of focus, each demonstrates the efficacy of the synthetic

approach, and in considering them in terms of both strengths and weaknesses, the methodology of this thesis may be better informed.

2.3.2 Synthetic studies of shifts in crop husbandry and agricultural techniques

Shifts in crop husbandry and agricultural practices remain particularly popular themes among scholars of archaeobotany. This interest has been explored with evidence from many different geographical regions and time periods.

Rösch (1998), for example, combines plant records from more than 100 sites in southwest Germany with the aim of exploring the development of weeds and changes in crop cultivation in order to better understand economic and environmental shifts occurring between the Neolithic and present day. Rösch looks to a diverse body of evidence, including carbonised, waterlogged, desiccated, and even impressions of plants for nine chronological phases (Early Neolithic, Late Neolithic, Bronze Age, Iron Age, Roman, Early Medieval, High Medieval, Late Medieval, Modern) (Rösch 1998 113). The remains are reported using presence values for each taxon per period, number of total taxa, as well as average presence counts for ecological groupings (Rösch 1998: 113).

Plants that are considered field crops, including cereals, oil/ fibre plants, and pulses exhibit relative stability over time, with only a slight increase in taxa from the Neolithic period all the way up to modern times (Rösch 1998 115). Other cultivated taxa, such as vegetables/spices and fruits/nuts, increase significantly in the Roman period, as is commonly seen, and then decrease briefly in the early medieval period, before quickly increasing again (Rösch 1998: 115). Such a trend is interesting in that it may be indicative of an initial importation of horticulture and gardening under the Romans, followed by a brief rejection of such techniques by Germanic tribes (Rösch 1998: 115).

Crop weeds are examined according to ecological groupings (i.e. woodland and shrub plants, ruderal weeds, grassland plants) and are classified according to whether they grow in neutral, acidic or basic soils (Rösch 1998: 117). Weeds are also considered in terms of their origins, allowing the author to determine from where they came as well as to distinguish between apophytes (native plants that grow in human impacted habitats) or anthropochores (plants subject to human introduction) (Rösch 1998: 117).

The author notes that plants of the same ecological grouping did not necessarily behave the same over time; that is, they exhibit different patterns in terms of their presence as well as significance, indicating there must be some reason for such shifts that is not entirely environmental or ecological

(Rösch 1998: 121). Furthermore, after examining indicated trends in soil quality and agricultural techniques, Rösch ultimately argues that the detected shifts in crop significance attest to agricultural adjustments in response to degrading soils due to over exploitation (Rösch 1998: 122). Such a study demonstrates the utility of tracking changes in ecologically similar weeds over time in order to shed light on environmental, as well as agricultural, change (Rösch 1998: 123).

In a study that features a rather developed approach in terms of statistical analysis, Riehl (1999) uses archaeobotanical remains to study the Bronze Age environment and economy in the Troad. Due to its location between the Black Sea, the Aegean, and Inland Anatolia, the Troad has long been an ideal centre for exchange (Riehl 1999: vii). The author collated 363 samples from two sites: 38 from Kumtepe and the rest from the much larger site of Troy. The earliest sample is associated with Chalolithic Kumtepe, and the latest with post-Bronze Age Troy. This chronological span allowed the author to examine the shifting agricultural systems and associated influence that humans had on the local environment.

The study features a detailed section on methodology, with lengthy discussion of sampling methods, identification, as well as the taphonomic process potentially affecting the remains (Riehl 1999: 16-19). The author uses percentage occurrences of particular plant groups in assessing the data, in order to convey an impression of how dominant or rare a given species appears to have been per period (Riehl 1999: 21). Statistical methods are also employed, using sufficiently saturated samples for multivariate analysis: if a sample did not contain over fifty records, it was omitted, as, due to its limited size, it may not offer a true representation of the context from which it came (Riehl 1999: 21). Pattern-searching techniques are given primacy, and include canonical discriminant analysis, which is used to distinguish groupings in the data, as well as correlation analysis, in which correlation coefficients are used to assess the strength or weakness of the relationship between two variables (Riehl 1999: 21). Furthermore, in order to detect patterns that may shed light on economic activity, Riehl also utilises correspondence analysis, or CA, which visually projects relationships and results that are typically complimentary to those obtained with correlation analysis (Riehl 1999: 22; see results from page 38). In this way, Riehl is able to explore species abundance and proportion, distribution as well as patterns, groupings and diversity during time periods (Riehl 1999: 38-45).

The author generally approaches the study through an ecological and environmental lens, and highlights an increased diversity in crops over time, as well as shifts in agricultural organisation and cultivation practices. Ultimately such analysis allows for a reconstruction of the environment as well as the subsistence economies that characterised the Troad region during the Bronze Age (Riehl 1999: 83-86). Also touching on social implications of the results, the author is able to detect the rise

in socio-economic complexity at Troy via the plant remains; during the Early Bronze Age a small yet stratified society appears to have been practising subsistence farming, but by the Late Bronze Age, large-scale surplus and specialised production emerges (Riehl 1999: 77). Interestingly, the similarities between the economic model produced for the Troad and contemporary situations in Anatolia, and the Aegean in particular, are significant, and point to a notable degree of connectivity between the regions, which is supported by archaeological correlations such as in settlement patterns and ceramic forms (Riehl 1999: 86).

Some years later, the same author produced a study that combines archaeobotanical macroremains with isotopic analysis and focuses on the distribution of plant foods in northern Mesopotamia and the Levant during the Early to Middle Bronze Age (see Riehl 2008). Rather than considering changes in the plant record as subject to socio-cultural and political mechanisms, the shifts detected by Riehl are ascribed to human responses to climate change and the increasingly arid conditions that characterised the region after 4200 BP (Riehl 2008: S43). Riehl utilises presence/absence data to discern a crops relative presence/ubiquity, as well as the proportions of a given assemblage that it comprises (Riehl 2008: S45). The author also incorporates information regarding the specific ecologies of different plants, as well as climate changes such as in rainfall, and in this way, is better able to observe patterns and deduce possible correlations with climatic shifts (Riehl 2008: S45). In general, the data are interpreted as confirming the hypothesis that changes in agricultural practice, particularly with regard to agricultural organisation, were made in response to climate change. However, the relationship between these changes in agricultural production, and the cultural and political environments cannot be understood without further study (Riehl 2008: S50).

Considering the strengths of the study, Riehl points to the advantage of using such a sizeable dataset in that it is able to shed light on patterns without being skewed by potential outliers, but also to the disadvantages, which include variability in terms of the quality of data reported, as well as the distribution of sites geographically and chronologically (Riehl 2008: S45). These limitations appear repeatedly and serve to highlight the main issues inherent in any large-scale synthetic study, regardless of the chronological and geographical focus or particular research interest. In this case, however, the correlation of the different evidence types is viewed as confirmation that, despite these potential limitations, the use of relative presence to explore crop distribution is, in fact, a fruitful exercise (Riehl 2008: S48).

Produced in the following year, Zech-Matterne et al. (2009) examines agricultural trends during the Iron Age, synthesising archaeobotanical reports from 161 studies conducted throughout France. In

the analysis, various crops are considered in terms of their geographical and chronological distribution and shifts in the prominence of particular species are considered (Zech-Matterne et al. 2009: 385). The authors have a strong interest in regionalism, emphasising the regional variation that characterised the protohistoric agricultural practices in Gaul. Regional diversity is explored in terms of cultivation practices, long distance trade, and the introduction and dispersal of new plant varieties.

The authors divide their study period, the sixth to 1st century BC, into four periods: Period 1 spans from 600 to 400 BC, Period 2 from 400 to 250 BC, Period 3 spans 250-120 BC, and Period 4 covers 120 BC to AD 30 (Zech Matterne et al. 2009: 386). The authors point to the importance of including multiple context types due to variations in the occurrence of particular types of remains between different contexts (Zech-Matterne 2009: 386). This attention to context type is a worthy consideration that other synthetic archaeobotanical studies commonly overlook. With this in mind, the relative frequencies as well as average number per period were calculated for select crops in both storage structures as well as domestic refuse deposits (Zech-Matterne et al. 2009: 387). These crops include species such as hulled and naked wheats, barley, millets, legumes, oil plants, as well as fruits and condiments (Zech-Matterne et al. 2009: 387). The taxa of economic importance were also quantified according to a scale of abundance based on the percentage of the total number of remains of domesticated species (the 'NTR'). Those that form over 75% of the total number of domesticated plant remains, for example, qualify as 'predominant species', while those of under 5% of the NTR are labelled 'anecdotal' (see Zech-Matterne et al. 2009: 389).

In general, the large-scale comparative approach allows scholars to see how various geographical and/or social entities reacted to the introduction of new plants and cultigens, new agricultural techniques, as well as to the reorganisations following important political changes such as the advent of the Roman Empire (Zech-Matterne et al. 2009: 389). However, it should be noted that such a study is only possible in regions that offer sufficient amounts of evidence due to long histories of archaeobotanical sampling. In regions where the implementation of strategic archaeobotanical sampling remains a relative novelty, such a large-scale approach is, unfortunately, far less feasible.

As in the earlier study by Rösch (1998), McClatchie et al. (2014) incorporate weed seed analysis in their examination of early agriculture in Ireland, which is based on archaeobotanical remains from the Neolithic period (4000-2500 BC). Due to the large quantity of unpublished reports in Ireland, previous analyses of Neolithic data have been characterised by an overreliance on a few sites in order to understand farming in general (McClatchie et al. 2014: 206). This has led to an underrepresentation of the abundance and diversity of Neolithic macroremains in the region

(McClatchie et al. 2014: 207). The authors strive to overcome such limitations, and to expand upon previous studies by utilising a comprehensive dataset, drawn from fifty-two Neolithic sites in Ireland. Particular consideration is given to cereal grains, as well as the analysis of arable weed seeds so as to form a better understanding of settlement patterns, especially with regard to cultivation plots, and the human-environment relationships. Despite the expanded dataset, the data have a strong bias toward the east of the country, with the west and centre of the island markedly underrepresented (see map on McClatchie et al. 2014: 207).

The sites are divided chronologically into Early Neolithic I, Early Neolithic II, Middle Neolithic I, Middle Neolithic II, and Late Neolithic with sites that spanned more than one category being assigned to 'indeterminate Neolithic' (McClatchie et al. 2014: 207). The Middle Neolithic II and Late Neolithic sites were subsequently combined due to the small numbers that each period yielded (McClatchie et al. 2014: 208). The authors quantify remains in terms of frequency of occurrence, which is expressed as the percentage of sites at which particular taxa were found (McClatchie et al. 2014: 207). In addition to ubiquity, when possible, cereal grains were also assessed in terms of abundance, so as to consider which was the most prevalent type during each period (McClatchie et al. 2014: 209). When data were not fully quantified, but rather reported in terms of scales of abundance, such analysis was not possible. In the case of hulled wheat, the authors also use the ratio of grain to chaff in a given assemblage so as to assess crop-processing practices (McClatchie et al. 2014 207-208).

Interesting results were gleaned from the arable weed taxa, though not based on an exceedingly robust dataset. The trends detected follow along the lines of trends characterising European and British data, with taxa that favour disturbed habitats dominating, while perennial woodland taxa are rather rare (McClatchie et al. 2014: 209). Annuals dominate the arable weed flora, which would seem to point toward the use of established plots as opposed to shifting cultivation practices, contra previous hypothetical views that downplayed the permanence characterising Neolithic settlement patterns in the region (McClatchie et al. 2014: 209-213; see Barrett 1994 144-149 for reference to later Bronze Age adoption of ongoing, intensive land use). Comparisons with European data shed light on patterns including a generally consistent decrease in crops with the spread of agriculture north-westward across Europe, as well as regional trends in cereal preference, the latter of which was deduced by comparing frequencies, from various regions including Ireland, Northern France, Britain, the Netherlands, Belgium, Northern Spain, Southern Sweden, and Denmark (McClatchie et al. 2014: 213). This wide, interregional comparison proves a useful technique, that, though often omitted even in large-scale synthetic studies, produced interesting results.

McKerracher (2016) also takes interest in shifting agricultural practices, exploring crop husbandry in the Mid Saxon period in England (AD 650-850). Using a new, expanded archaeobotanical dataset than earlier studies, McKerracher challenges an existing agricultural model (first suggested in the early synthetic work of Banham (1990)), in which *Triticum aestivum* (bread wheat) replaces *Hordeum vulgare* (hulled barley) as the dominant cereal during the period. As *Triticum aestivum* requires more labour-intensive agricultural techniques, such methods would have seen a rise as well (McKerracher 2016: 88).

McKerracher synthesised 736 archaeobotanical samples, which derive from 96 sites, from published and unpublished reports (McKerracher 2016: 91). The dataset is exclusively comprised of carbonised archaeobotanical remains of four free-threshing cereals, including *Triticum aestivum* (bread wheat), *Hordeum vulgare* (hulled barley), *Secale cereale* (rye), and *Avena sativa* (oat) (McKerracher 20016: 89). The cereal remains were sourced from rural sites from two study areas, and is roughly divided into century long chronological phases, including Early Saxon (5-6th c.), Intermediate (7-8th c.), and Mid Saxon (8th-9th). The samples are grouped according to any 'common functional origin' (i.e. from same stage of crop processing), as well as geographic and environmental factors, in order to shed light on regional patterns in the data (McKerracher 2016: 91, 95).

Though all possible samples were included in the presence/absence analysis, a subset of samples, which had fully quantified data as well as at least 30 of the cereal grains in question, were then subject to further analysis to discern the relative abundance of the different types of cereal grains in each sample (McKerracher 2016: 91). In this way the author was able to overcome the limitations posed by the varying quantification methods utilised in excavation reports, and was able to include semi, as well as fully, quantified data in his study.

While the evidence gathered offers no indication of the shift in which bread wheat displaces hulled barley in terms of popularity (i.e. the 'bread wheat thesis'), it does highlight some other trends, such as the increased importance of rye and oats, the presence of regional patterns that align with different environmental settings, and a greater ability to produce surpluses during the Mid Saxon period (McKerracher 2016: 88).

2.3.3 Conclusions

Upon reflection of the various methodologies employed in synthetic archaeobotanical studies, a number of commonalities may be detected.

The employed quantification method, for example, is one aspect that varies according to the focus of the study. The use of only presence and absence data and frequency counts can be associated with studies focusing on large-scale shifts, such as the spread of agriculture and cultivation techniques, as well as the distribution of particular crops, such as imports, luxuries, or new introductions. In such cases, consideration for only ubiquity is suitable in that it allows for the detection of dispersal trajectories, often over time.

Consideration for abundance, however, is necessary when the authors take an interest in the relative importance of particular crops, as is appropriate for studies that focus on dietary reconstruction. For such a topic, quantification by ubiquity alone would be insufficient, as it would not indicate the relative importance of different crops because all crops present are deemed of equal importance, which can lead to an overestimation of the dietary significance of some foods. McKerracher (2016), for example, includes fully quantified data when possible, so as to foster comparison between the relative importance of different cereals and determine the dominant grain for time and place of focus. Bakels and Jacomet (2003), as well as van der Veen et al. (2008), however, utilise presence analysis, as such a technique is sufficient for tracking the spread of luxury foods.

Other trends in methodologies are detectable among studies that focus on varying topics. Research that explores plants in terms of social access and identity, for example, tend to incorporate site type categories so as to allow the authors to distinguish between different social groups and their remains. However, studies focusing on agricultural techniques, on the other hand, commonly include weed seed assemblages as such remains can shed light on agricultural organisation as well as crop-processing practices (see above McClatchie et al. 2014; Rösch 1998).

A notable gap can be seen in the general lack of large-scale interregional studies of the Roman world (see discussion Bakels and Jacomet 2003 above for rare exception). Some scholars do consider large regions such as central Europe, Britain, and Iberia, but they do not compare data from regions of very different settlement patterns, levels of economic connectivity and infrastructure, social organisation, and cultural influences. In comparing regions that differ in such aspects, the impact that they have may be better illuminated (though issues of comparability will, inevitably, be greater).

Instead, studies focusing on variations in plant foods under the Romans are more often based in Central and Northwest Europe as well as Britain, where scholars have taken a greater interest in the effect of Roman contact and occupation on dietary patterns in the regions (see above van der Veen et al. 2008; Wiethold 2003; Zech-Matterne et al. 2009). There are a few exceptional articles dealing

with other parts of the Roman world (Peña-Chocarro 2017, for example), but they are distinctly less common.

In the East in particular, though conditions and resultant state of preservation are well suited for studies of foodways, the topic, especially as it relates to matters of culture contact, has not been subject to the same level of scrutiny as in the more westerly provinces, particularly in terms of broader overviews. That said, while large scale consideration may be somewhat lacking, individual studies have provided useful information and have highlighted the potential of the region.

Much of the archaeobotanical research that does focus on the East has broached questions related to the advent of agriculture and, in general, much earlier time periods (see, for example, Hopf 1969; Kislev et al. 1993; Chernoff and Paley 1998; Riehl 2004; Weiss et al. 2011; White et al. 2014; Farahani et al. 2016). This is also true for other regions: Greece for example has been approached with a much greater focus on prehistoric periods as opposed to the Roman world (see Livarda 2014 for overview).

The East, however, is an interesting case study, as research on food and culture is necessarily different from that of other regions, with culture contact occurring in a context undeniably unlike that of its western counterpart. The advent of the Roman world is not credited with introducing infrastructure and urbanism to the region, for they had long existed already. Furthermore, while it has been said that 'the north- western expansion of the Roman Empire triggered the introduction of a large number of new food plants there...' the same cannot necessarily be said for the East, where many of the food plants prevalent in the Roman diet, particularly those dubbed as 'luxuries' already existed (Livarda 2011: 143).⁴ This does not necessarily mean, however, that diet in the East was wholly unaffected by the conquering Romans, rather that Roman influences perhaps manifested themselves in a different manner. As such, it is questions such as this that will be explored in this thesis.

Additionally, one notable oversight in terms of the studies of 'Roman' food, is the failure on the part of the authors to consider, what exactly qualifies as 'Roman.' If the authors compared the data to assemblages from the centre of the Roman Empire itself, perhaps then they may be able to better define 'Roman food' as well as to track its influence in the regions focused on in the individual

⁴ Many studies of diet and culture change, particularly in northwest and central Europe, examine these 'luxury' foods, or plant foods that cannot or were not subject to local cultivation before the Roman period. Such studies hold a far less prevalent place in the East, largely because many of said 'luxury foods' were able to be cultivated in the region, rendering such an approach less applicable.

studies. Such an observation was taken into consideration in this thesis and has informed the methodology. Therefore, the Italian data will not only be utilised as a basis of comparison for the more distant East, but will also aid in refining current understanding of Roman foodways.

Chapter 3. Introduction to Archaeobotany and Archaeobotanical Preservation

The study of plant remains from archaeological sites began as early as the 19th century, when desiccated material from Egyptian tombs and waterlogged material from Swiss villages began to attract attention (see Kunth 1826; Heer 1866). The 1941 volume by Volney Jones *The Nature and Status of Ethnobotany* was an important development in the field, showing interest not only in the plants themselves, but in the study of human-plant interactions. Now referred to as archaeobotany, or paleoethnobotany in North America, Jones' 'ethnobotany' marks the beginnings of the interdisciplinary field, combining aspects of both anthropology and plant sciences, as it is known today (Jones 1941; see Pearsall 2000 for further discussion of this early stage).

The field expanded greatly during the 1970's, when methods, including systematic sampling and the recovery of remains by means of flotation, began to be employed more widely (Pearsall 2000: 7). Much of this early work focused on prehistoric periods, however, and systematic sampling was a much later development at most classical period excavations, a pattern which is particularly visible in viewing archaeobotanical research in the East (for early work in prehistoric Near East, see: Helbaek 1969, Renfrew 1973; Hopf 1983 on Jericho). Maria Follieri's work on the remains from the Colosseum should be mentioned and is an important marker of early work on Roman remains in Italy (Follieri 1975).

A notable increase in interest in crop-processing activities can be observed from the early 1980s, with studies such as that by Hillman (1981) offering interpretative models that shed light on how the various stages of crop processing affect, and are made manifest in, archaeobotanical assemblages. Such studies often look to ethnography to inform interpretations of assemblages reflective of crop processing, as is illustrated by Jones (1990), and more recently, Warnock's study of the olive oil industry in the East (Warnock 2007). There has been an increased interest in social theory in recent decades, with studies examining social access to plant foods throughout the ancient world (van der Veen et al. 2008; Livarda 2011; see 2.2.4).⁵

Today there are a wide variety of approaches and techniques within the field of archaeobotany, and archaeobotanical sampling is an increasingly common aspect of archaeological excavation. Still, systematic sampling strategies are at times variously employed, with some excavations continuing to implement little strategy beyond hand-picking remains visible to the naked eye, if they are sampling

⁵ Of course, there are many other research interests that rose to popularity in past decades (such as the domestication of early crops), however it is impossible to touch on all of these in the span of this thesis, and thus this section touches on only a few trends relative to this project.

at all. This has certainly impacted the data collected in this study for both the Italy and the East, and is important to bear in mind in considering the dataset, which may consequently favour larger macroremains (see sections 7.1 and 8.1 for overview of datasets for each respective region.).

However, before turning to the dataset itself, it is important to consider archaeobotanical modes of preservation as well as the various biases and formation processes that may affect the remains.

3.1 Carbonisation

Carbonised remains are by far the most common type in the dataset examined in this study. Such remains occur when botanical materials are charred in certain conditions, to the point that they are reduced to elemental carbon (Jacomet 2013: 499). In optimal conditions, organic material will combust; thus, the carbonised remains in the archaeobotanical record represent chance situations in which conditions were not optimal, allowing the organics to transform into the carbon that remains unaffected by any processes of decay (Märkle and Rösch 2008: S257).

It should be noted that, while such remains are indeed the most ubiquitous type of macroremain, they typically occur at lower densities, with fewer items per sample than is commonly found with other modes of preservation (Jacomet 2013:499).

3.1.1 Carbonisation: biases and formation processes

It is always important to recognize the limitations of archaeobotanical, as well as, more generally, archaeological, evidence. Archaeobotanical assemblages are inherently biased, providing an incomplete picture of the plant foods and crops present at any given site for a number of reasons. Carbonised remains are no exception, and notoriously represent only a small portion of the total plant species that would have existed (van der Veen 2007: 977). The assemblages can be markedly homogeneous, typically consisting of particular types of remains, which is significantly influenced by the formation processes associated with them.

Carbonisation typically reflects particular anthropogenic events and, as a result, certain groups of plants are more likely to be exposed to such a method of preservation. One of these groups is formed by species that were commonly burnt as fuel, which can at times include remains that were found in animal dung, as well as by-products from crop processing or the production of goods such as wine or olive oil (for botanical remains deriving from the use of animal dung as fuel, see Hillman 1981; Charles 1998; Miller and Smart 1984; see Rowan 2015 and Margaritis and Jones 2008b on

olive fuel; see also Margaritis and Jones 2006). The crop-processing by-products are often comprised of items related to the harvest of cultivated species, such as chaff and fragments of various parts of cereal plants, as well as grains and pulses (Wiethold 2003: 270). Seeds of wild plants and weeds are often found in such assemblages, and represent an 'indirect anthropogenic' element, as such species were commonly gathered by mistake during harvesting activities (see Gallagher 2014: 31). Edible plants, which were prepared in such a way so as to require heating by fire also comprise a significant portion of carbonised assemblages (Jacomet 2013: 499). Further examples of events that impact the formation processes of carbonised assemblages include waste disposal as well as accidental burning, the latter of which can be small scale, preserving individual macroremains, or on a large scale, as in cases of site destruction by fire (van der Veen 2007: 979, see Weiss and Kislev 2004 for plant remains preserved in the destruction of Iron Age Ashkelon).

Differential preservation, due to attributes of the plants themselves, is also an important consideration in assessing the composition of botanical assemblages. This is particularly true with regard to carbonised material, as carbonisation is known to be more likely to preserve heavier and more durable plant remains that can fall through the flames of fire, such as during food preparation activities (van der Veen 2007: 979). In this way, the prevalence of cultivated species such as cereals, pulses, and fruits with large stones in carbonised assemblages may also be due to their size and density (see Wiethold 2003 on the prevalence of such species, van der Veen 2007: 979). On the other hand, leafy items, seeds rich in oil, and particularly light plant remains such as fruit flesh and herbs are unlikely to survive by exposure to fire. Not only do such remains incinerate more rapidly, and at lower temperatures, but they are also less likely to be subject to charring due to the nature of their consumption (see Märkle and Rösch 2008: S26, who touch briefly on the varying destruction temperatures of certain remains). Because of this, fleshy/leafy plant remains may be underestimated in carbonised assemblages, and thus the dietary contribution of plants such as vegetables and condiments may be difficult to discern, particularly in areas where other modes of preservation are rare (see Livarda and van der Veen 2008 for example of a study able to focus on these plant types by utilising waterlogged remains from north-western Europe, though in other regions [e.g. the Middle East], such regional analysis would not be possible).

The impact of differential preservation on carbonised assemblages is highlighted by experimental studies such as that of Märkle and Rösch (2008). The authors conducted experiments on a number of species, in which they exposed seeds to fire at a range of different temperatures (180-750°C), for varying lengths of time (1-4 hours), and in conditions that were oxidizing as well as reducing (i.e. covered and uncovered) (Märkle and Rösch 2008). The results illustrate the highly variable

combinations of conditions at which different types of seeds as well as different species may preserve. It is also noted that larger cereal grains have a significantly better chance of surviving exposure to heat and fire than the millets and oil seeds examined in their study, a statement that certainly seems to be supported in the archaeobotanical record (Märkle and Rösch 2008: S264).

The earlier study by Boardman and Jones (1990) marks another important experimental study that highlighted the preservation biases inherent in carbonised assemblages. Boardman and Jones (1990) focus on cereal chaff and conclude that certain components such as straw and the rachis of free-threshing cereal varieties in particular, are the first items to incinerate when subject to carbonisation (Boardman and Jones 1990: 9). The results highlight that, though the ratio of grain to cereal chaff is often taken as an indicator of crop-processing activities, this ratio may in fact be skewed by preservation biases, particularly in the case of free-threshing cereals (see Hillman 1981). This is indeed an important consideration to take into account in discussions regarding site function and the location of crop-processing activities, which may not always be detectable.

3.2 Mineralisation

Archaeobotanical remains preserved by mineralisation can also be found variously in Roman period datasets. During the mineralisation process, organic substances in the macroremains (i.e. seeds) are replaced with inorganic material, such as, though not limited to, calcium phosphate (see Green 1979 for early work on mineralisation). Thus, the remains retain their appearance (or at least their shape) to varying degrees, but are formed by crystalline mineral structure (Green 1979:282).

Mineralised plant remains are often found in contexts associated with human faecal matter, including latrines and cesspits, as such a substance can provide for the phosphate commonly involved in mineral replacement (Green 1979: 281, McCobb et al. 2003, see Rowan 2017). As such, mineralised material is typically reflective of ingested foodstuffs, and is, in this way, made particularly well suited to studies of diet.

In addition to mineralisation via mineral replacement, biomineralisation is more frequently encountered in the dataset, though is restricted to specific species. Biomineralisation differs from mineralisation by replacement as the minerals are produced by the plants themselves rather than forming from the surrounding materials and conditions and then impregnating permeable remains (see Shillito and Almond 2010 for more detailed discussion). The most common biomineralised remains in this study are those of the Boraginaceae family, the fruits of which produce carbonates, which resist the process of decay and decomposition (Shillito and Almond 2010: 225).

3.2.1 Mineralisation: biases and formation processes

There are certain biases detectable in mineralised assemblages. As such material commonly represents material derived from human excrement, remains tend to represent edible foods that had passed through digestion. This limits the type of plant foods that may be present, as certain materials break down in the digestive process. Furthermore, some plant foods are processed in such a way that the seeds are discarded or broken down; these remains would not often be preserved whole either (cereal grains such as wheat, for example, are rarely ingested whole, but are commonly used in flour form). Thus, plants that are consumed whole are more likely to be represented in assemblages preserved by calcium-phosphate replacement mineralisation, except in instances where waste or other plant material has been discarded with faecal matter (see Smith 2013: 538-539 on nature of seed assemblages from cesspits).

An additional aspect to bear in mind when considering biases in mineralised assemblages is the effect of seed coat permeability: species with more permeable seed coats and endocarps are more likely to be preserved, whilst impermeable seed coats act as a barrier, inhibiting mineral replacement and thus preventing preservation (McCobb et al. 2001: 939).

In terms of formation processes, though initial deposition certainly depends on human action, whether it be in the form of human excrement or garbage disposal, thereafter, the remains are subject to little anthropogenic intervention. In this way, the formation of mineralised deposits is more affected by environmental process and conditions (see Carruthers 2000).

There are, however, some interpretive issues associated with mineralized remains, as discerning between plant remains originally deposited in faecal matter and thus consumed by humans, and those that were preserved because they came in contact with such a substance, either by being thrown in as refuse or merely by being in the vicinity, poses its own challenges.

3.3 Desiccation

Desiccation refers to the dry preservation of plant materials, in which the lack of moisture prevents decomposition by hindering the microorganisms behind such a process (Gallagher 2014: 21). This phenomenon occurs primarily in environments with extreme aridity, such as can be found in North Africa, Egypt in particular (see Cappers 1996; van der Veen 1996 on Mons Claudianus; Thanheiser 1999, Thanheiser and König 2008 on Kellis). As such, desiccated remains are encountered only

occasionally in the regions considered here (see Simchoni and Kislev 2009 on remains from the Caves of the Spear, for rare instance of desiccation).

Desiccated remains tend to represent a wider array of plant types than is common in assemblages subject to some other modes of preservation, with the exception of perhaps waterlogging. At Mons Claudianus, for example, van der Veen records the presence of a variety of different types of remains, including staples such as cereal grains and pulses, as well as fruits and vegetables, oil plants, and species used as condiments (see van der Veen 1996). It should also be noted that desiccation does not significantly alter the form of the preserved items, so that remains continue to appear similar to modern examples and references (van der Veen 2007: 969).

An additional notable characteristic of desiccated remains is the particularly high densities common in such assemblages. This allows for highly productive samples, especially in comparison to assemblages subject to other modes of preservation, such as carbonisation (van der Veen 2007:969).

3.3.1 Desiccation: biases and formation processes

The preservation of desiccated remains is highly dependent on the surrounding environment and climatic conditions rather than on depositional processes and anthropogenic events: that is, if conditions allow (i.e. sufficient aridity) the botanical material will be preserved, which is an attribute that, in a sense, is not entirely dissimilar to preservation by mineralisation. Preservation by desiccation is far less limited than mineralisation in terms of context type, however, as the process is not limited to, or more likely to occur in, specific contextual settings (see van der Veen 2007: 969). A wide variety of formation processes can lead to desiccated assemblages, and these are not always fully discernible.

Wild and cultivated plants can both be subject to desiccation (see van der Veen 2007). Assemblages of cultivated species can derive from middens and refuse deposits, but their presence can also be indicative of storage caches, building materials, or any other potential plant use (see van der Veen 1996 for example of refuse deposits, see Thanheiser and König (2008) on the use of chaff in mud-bricks). Wild plants may include those not purposefully gathered during the harvesting of cultivated crops, as well as those purposefully gathered and intended for use as fuel or fodder. Additionally, wild species may also represent accidental accumulations of the vegetation that was in and surrounding a given site, highlighting the challenges associated with the interpretation of desiccated assemblages (van der Veen 1997: 969-970).

3.4 Waterlogging

In contrast to desiccation, waterlogging occurs when botanical materials are situated in, and remain in, wet contexts such as standing water or generally wet environments. The anoxic nature of such contexts prevents normal processes of decay and decomposition of organic material (Jacomet 2013: 499).

As is the case for desiccated material, waterlogged assemblages commonly feature rather high densities of remains, and may yield extremely productive samples, even at relatively small volumes (Jacomet 2013: 501). This richness also tends to characterise the species present in waterlogged samples, with a diversity of plants including fruits, condiments and spices, cereal chaff, oil-rich seeds, and wild taxa all commonly represented (see Livarda 2008; Lodwick 2014; see Bosi et al. 2015 for preservation of rare, waterlogged plants in Italian dataset). Furthermore, preservation by waterlogging is not limited to certain plant parts, but rather may preserve even the more fragile portions of the plant, such as fruit flesh and inflorescence (Jacomet 2013: 500).

3.4.1 Waterlogging: biases and formation processes

Waterlogged preservation is more likely to be encountered at sites with certain favourable conditions, such as a high-water table and deep excavation areas, the latter of which is often associated with large sites with long occupational histories and extensive stratigraphic sequences (van der Veen et al. 2008:16). In general, a wide array of plant types and components may be subject to preservation by waterlogging, including more delicate plant portions, though robust items such as cereal grains and pulses may be less commonly preserved (see Jacomet 2013: 500-501; Lodwick 2017: 33 on scarcity of pulses in waterlogged assemblages).

Regional biases are detectable, as, in general, waterlogged remains are more commonly encountered in regions with temperate climates, such as Britain, as well as north western and central Europe (see Livarda 2011, van der Veen et al. 2008, Lodwick 2014). As such, these subfossils are relatively rare in the semiarid and arid climates in the East as well as in much of the Mediterranean in general and form a smaller portion of the dataset in this study. When waterlogging does occur, it is often at marine sites such as ancient ports, where the excavated contexts are now submerged, and occasionally at sites featuring aquatic structures such as wells, ornamental pools or other waterworks (see Sadori et al. 2015, see Ramsay 2010 on Caesarea for an example of rare waterlogged remains from the East).

Though the impact of environmental conditions on the formation processes of waterlogged assemblages is relatively clear, anthropogenic impact can vary. In some circumstances remains can be comprised of surrounding vegetation that was not purposefully deposited in water, and thus represents non-anthropogenic processes. Whereas, in other instances, the botanical remains may have been gathered and deposited, such as in the case of refuse deposal in a well, for example, and are thus anthropogenically formed assemblages, reflective of human exploitation (see Arobba et al. 2013 for material from the well at Vada Sabatia; see contexts in Lodwick 2014, 2017).

In this way, discerning if plants were subject to human use, and whether they were purposefully or accidentally deposited can be challenging, but it is highly important in terms of determining what can be learned from the assemblages: if the remains represent a non-anthropogenic accumulation of seeds from local vegetation, the assemblage is better able to inform about past environments than consumption practices. Sadori et al. (2015) put forth an important point on this matter, indicating that assemblages can be 'univocal,' representing natural and human action, and thus shedding light on past environments, as well as human-plant interactions

3.5 Conclusion

The consideration of the different modes of archaeobotanical preservation has a number of implications for the analysis in the chapters that follow. Firstly, it is important to note that, due to the various biases highlighted above, remains subject to one mode of preservation should be analysed at a time in order to facilitate the comparison of like datasets. In this way, monitoring the preservational categories affecting the data will be of high importance when undertaking data entry and subsequent analysis.

As charred remains are by far the most common, particularly in the regions focused upon in this thesis, it is unlikely that fragile plant types, such as vegetables and flavourings, will play as an important role in the analysis and subsequent discussion. On the other hand, heavier staples like cereal grains, as well as any items commonly burnt as fuel, may be explored further. Finally, as charred assemblages may be preserved by both direct and indirect anthropogenic influence, it will be particularly important to consider the formation processes that lead to preservation when interpreting the data.

Chapter 4. Introduction to the Roman East and Italy

4.1 Introduction to environmental setting

As environmental setting plays an important role in determining crop choices and shaping the agricultural economy, it is important to consider the climates and phytogeographical zones found throughout the study areas.

4.1.1 The East: Climate and phytogeographical setting



Figure 4-1 Phytogeographical zones of the East, after White and Leonard (1991).

The majority of the sites are located in the Mediterranean phytogeographical region, which encompasses most of the Levant, as well as southern and western Anatolia (Fig. 4-1; Zohary 1962: 51; Zohary 1973: 83-87). As this region encompasses all areas bordering the Mediterranean, with the exception of particularly arid areas in North Africa, it is floristically diverse. In general, crops such as (*Olea europaea*), grape (*Vitis vinifera*), wheat (*Triticum* sp.), fig (*Ficus carica*), and a variety of pulses (e.g. *Cicer arietinum*, *Lens culinaris*, *Pisum sativum*, *Vicia* sp.) can be grown in much of the region without irrigation throughout the year (Zohary 1973: 83). Most of the region has a warm-temperate, Mediterranean climate (Csa), which is characterised by generally warm temperatures, with hot, dry summers (Fig. 4-2). There is some variation in vegetation according to topography, however, as different species grow in elevated areas such as in the uppermost zones of the Lebanon Mountains (Zohary 1973: 86; see Zohary 1973: 130-164, 500-556 for more on Mediterranean region).

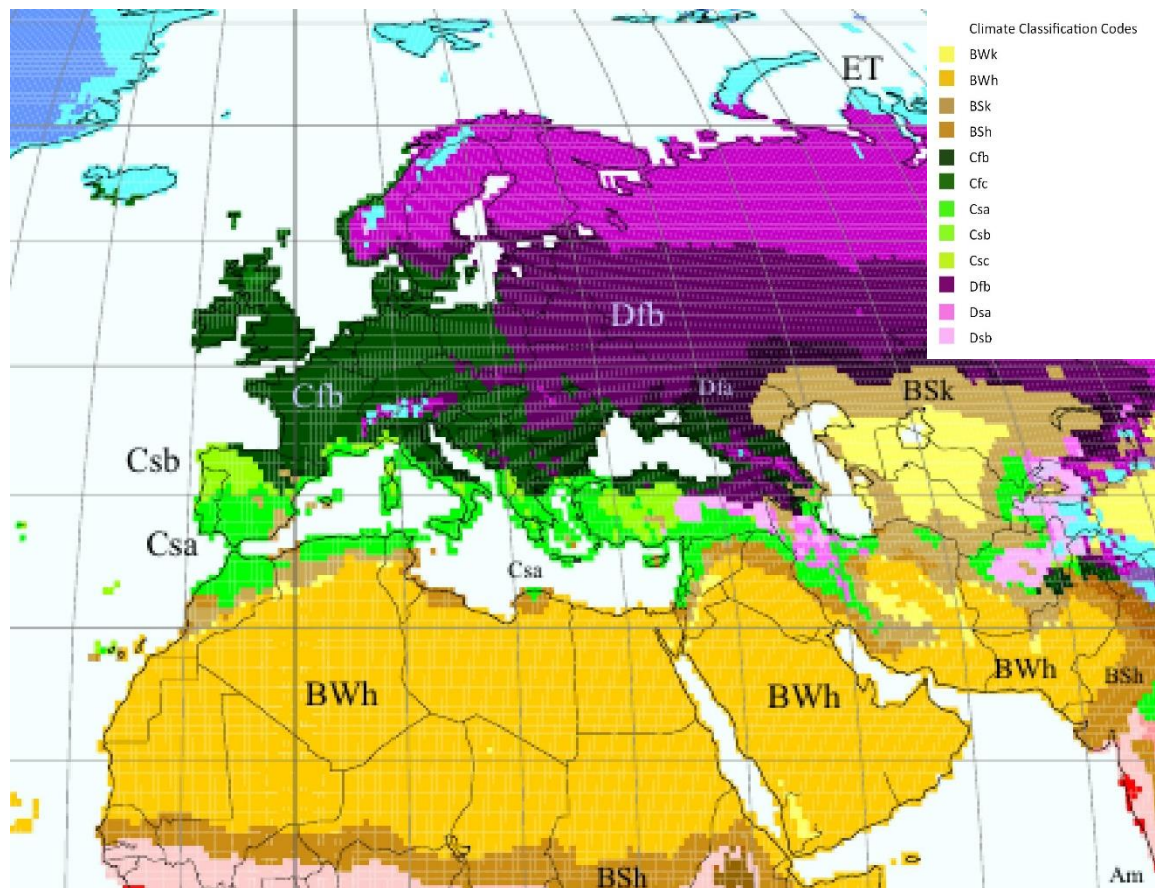


Figure 4-2 Köppen-Geiger climate classification map (Kottek et al. 2006).

Table 4-1 *Climates represented in Figure 2 (after Kottek et al. 2006). Note: additional Köppen-Geiger climate classifications not found in the study areas are excluded.*

Main climate	Precipitation	Temperature
B: arid	W: desert	h: hot arid
C: warm temperature	S: steppe	k: cold arid
D: snow	f: fully humid	a: hot summer
	s: summer dry	b: warm summer
		c: cool summer

The Irano-Turanian steppe dominates most of inland and eastern Anatolia and extends east and southward, encompassing the northern portions of modern-day Iraq and Syria, and much of Iran (Fig. 4-1). Considering the vast expanse of this region, it is unsurprising that it contains a wide diversity of flora, and includes areas dominated by deciduous trees and forests as well as steppe, such as in Central Anatolia (see Akhiani et al 2013, for study that demonstrates the heterogeneity, focusing on northern Iran alone; see Zohary 1973: 88-89 on various subdivisions suggested in

previous scholarship). This region also is the most climatically diverse, containing areas that can be described as: cold arid steppe (BSk), hot arid steppe (BSh), areas with snow and dry, warm summers at higher elevations (Dsb), as well as warm, temperate areas with dry, hot summers (Csa) (See Fig. 4-2). Zohary (1973) highlights the continentality of the region, which experiences extreme ranges of temperatures and low precipitation, and the consequential break in plant life during the harsh summers and cold winters (87-91). Crops able to be cultivated in the Irano-Turanian region include cereals such as barley and wheat, apricot (*Prunus armeniaca*), poppy (*Papaver somniferum*), and, in some areas, grape (Ekim and Güner 2000: 58).

Within the study region, the Euro-Siberian phytogeographical region is located on the northern coast of the Anatolian Peninsula. Deciduous forest is the most common vegetation, though conifers dominate at higher elevations, and crops requiring warmer conditions do not grow readily in this area (Çolak and Rotherham 2006: 447-348; Zohary 1973: 80-83). Climatically, this region is referred to as the Euxinian province; it is made distinct by its wet climate, with heavy rain occurring throughout the year (Çolak and Rotherham 2006: 347). According to the Köppen-Geiger classification, the climate can be described as warm temperate, fully humid, with warm summers (Cfb), though some more easterly areas see considerable amounts of snow (Dfb) (Fig. 4-2).

The Saharo-Arabian phytogeographical zone occupies the southern portion of the study area, including the south of Iraq and Syria, Jordan, and Saudi Arabia, as well as parts of south and southwest Israel-Palestine (Fig. 4-1). This area is characterised by an arid climate: the Köppen-Geiger classification system describes it is hot, arid desert (BWh) though small portions are considered cold, arid desert (BWk) (Fig. 4-2). Hydrophilic plants and crops needing regular watering do not grow naturally in this area, though the use of hydraulic systems can facilitate some cultivation. Zohary (1973: 93) emphasises the marginal ecological conditions of this region, which, though following a similar pattern to Mediterranean climates, has a much shorter winter and a longer, drier summer season.

4.1.2 Italy: Climate and phytogeographical setting



Figure 4-3 Phytogeographical regions of Italy (based on Pedrotti 2013: Figure 10.4).

Italy is divided into two main phytogeographical regions, both of which can also be found in the East. The Euro-Siberian region dominates the North, extends into central Italy, and occurs in the mountains further south (Fig. 4-3; Pedrotti 2013: 223, 230). Climatically, the Euro-Siberian region is largely comprised of areas that experience warm, temperate conditions, frequent precipitation (i.e. 'fully humid'), and warm summers (Cfb), though areas with high elevation in the alpine region are subject to cool temperatures and significant amounts of snow (Fig. 4-2). The western coastline, however, experiences similar conditions to the south of the peninsula, which is also characterised by a warm, temperate climate, but with dry, hot summers (Csa) (Fig. 4-2). The Euro-Siberian region is floristically more similar to central Europe, featuring deciduous and coniferous forests, particularly at higher elevations, in addition to scrubs and grasslands (Blasi et al 2014: 1262). Arable agricultural is practised predominately in the hills and plains, such as in the fertile Po Plain.

The Euro-Siberian region is set apart from the Mediterranean region by the presence of winter frost and the short duration, or complete lack, of arid conditions in the summer (Blasi et al. 2014: 1262; though see Pedrotti 2013: 222 on division between phytogeographical zones in Italy as based on the distribution of certain orders of evergreen sclerophylls, which favour the coast and grow inland only in certain areas in the South). The Mediterranean phytogeographical region generally corresponds with most of the areas that experience warmer and drier climatic conditions: southern Italy and the

western coast (Fig. 4-3). The region features forests of both deciduous and evergreen trees, and is well suited to crops including olive and grape (Blasi et al. 2014: 163; see Pedrotti 2013 for details).

4.2 The Roman East

Prior to examining the archaeobotanical remains and the trends characterising their distribution, it is important to situate the data in their greater context, both in terms of the history as well as the relevant research topics. As such, the section that follows will include an introduction to the history of Roman occupation in the region, followed by a brief introduction to key research themes, including select topics broadly pertaining to settlement patterns, the agricultural economy, agricultural regimes, as well as environmental events and climate change. It is the hope of the author that with an improved understanding of these matters, a better understanding of the data and interpretations to follow will be achieved.

4.2.1 Historical overview

The Roman army is thought to have been led to Asia, for the first time, to face Hannibal in the 2nd century BC. Hannibal, having fled to the court of Antiochus III, sought the help of the Seleucid Empire to defeat the Romans, though the Roman forces were triumphant at the Battle of Magnesia in 190 BC (Ball 2018: 2). Later, Rome sent the general Lucullus to quell threats and aggressions in the East, where he faced the armies of Pontus and Armenia, which had conquered much of the region as the Seleucid empire declined in the 1st century BC (Butcher 2003: 20). Having made impressive conquests in the region, Lucullus was called back to Rome, paving the way for Pompey's subsequent incursion (Ball 2000: 11). After achieving victory, Pompey turned his attention southward to Syria, where the already greatly weakened Seleucid empire was easily annexed by Rome in 64 BC and was henceforth known as the Roman province of Syria (see Butcher 2003: 19-20 for details of preceding events). The province of Syria, however, was at times contested, and even occupied by Parthian forces until peace ensued under Augustus. After revolts in AD 193, Septimius Severus divided Syria into two smaller provinces, with Coele Syria in the north and Syria Phoenice in the south. This act was likely carried out in order to deter future revolts and threats to the imperial position by preventing any single provincial official from having too large a territory, and thus too many people, under his command (Ball 2016: 18).

Soon after the annexation of Syria, Rome turned south to Judaea, solidifying control over much of the coastal areas in the East, which allowed Roman forces to quell pirate activity that had plagued

the seas in the Eastern Mediterranean. Pompey's incorporation of Judaea was almost invited, when a member of the Hasmonean dynasty who was competing for the throne sought the help of Pompey, providing him with the opportunity to siege and capture Jerusalem in 63 BC (Ball 2016: 49). Judaea then became a client-kingdom, with the Hasmonean dynasty continuing to rule, at least nominally. However, after the Parthian incursion into Judaea in 40 BC, Rome lost trust in the Hasmoneans, and supported Herod as 'King of the Jews,' even providing military backing to Herod to ensure his victory, which was actualized in the capture of Jerusalem in 37 BC (Ball 2016: 51-52). Apart from a brief period in AD 41-44, Judaea was brought under direct Roman rule from 6 BC (Safrai 2003: 1). Tension built between Jews and Romans, and the province saw a number of revolts, leading to the destruction of the temple and much of Jerusalem in AD 70. After the Bar-Kochba revolt of AD 135, the province was renamed Syria-Palestina (or Palestina), and the Jewish character of the region is thought to have gradually diminished (Ball 2016: 62). The province remained more or less intact until the 4th century AD, when it was divided into *Palestina Prima* and *Palestina Secunda* (Safrai 2003: 1).

The Roman province of Arabia corresponds with the Nabataean kingdom, which spanned modern Sinai, southern Jordan, and north western Saudi Arabia, and is thought to have become an ally -if not client- kingdom to Rome during the 1st century BC (see Butcher 2003: 96-98). The kingdom saw prosperity and expansion, and extended into the area of the Decapolis, a group of 10 cities which were considered as beacons of Hellenised/Roman culture in the region (see Ball 2016: 207-222 on the Decapolis). The Nabataean kingdom profited from trade that linked India with the Mediterranean via the Red Sea, and was officially annexed in 106 under Trajan, becoming the province of Arabia (Gawlikowski 1997: 42).

There were numerous other territories brought under Roman rule throughout its occupation of the East as a whole, and, though not all can be described in the space of this section, a few more will be touched upon. Palmyra, which was in the desert in modern central Syria, was significant in its location on trade routes, as well as between the Roman and Parthian Empires. Annexed by AD 75, Palmyra appears to have been a form of client state ruled by a council of elders (Ball 2016: 81). Though the revolt under Zenobia during the 3rd century AD was ultimately quelled, subsequent revolts in the following years led to the sacking of the city by the emperor Aurelian and forces, leaving behind the spectacular ruins well-known (and lamented) in modern times. Edessa, formerly part of Armenia, spanned from the Anatolian foothills to the Mesopotamian plains. Edessa was one of the last standing client kingdoms in the East, though any semblance of independence ended after the murder of the king Abagar IX as ordered by Caracalla in AD 213, and the subsequent annexation of Edessa in the following year (Ball 2016: 99).

As made evident above, large portions of the East were brought under Roman rule not by bloodshed and warfare, but rather, as aptly described by Ball, by a system of 'creeping conquest,' (Ball 2018: 28). Rome would initially recognize the independence of an entity, though within the bounds of a client-based relationship. With time, political and economic ties would bind the client-state closer to Rome, until it was eventually incorporated without conflict (Ball 2018: 28).

4.2.2 Settlement patterns

4.2.2.1 Urbanism

Urbanism in the East has received considerable scholarly attention in previous decades as well as in recent years, with studies looking to various forms of evidence, including archaeological remains of urban centres, archaeological survey and settlement patterns, as well as textual evidence, including inscriptions (see Woolf 1997 and Hanson 2011 below for studies focusing on settlement patterns; see Ball 2018 chapter 4, as well as Gates 2011 for studies of urban architectural remains; see Grainger 1995 for study utilising inscriptions from Roman Arabia, though Ball 2018: 173 points to issues with interpreted inscriptions as indicative of a city's cultural character).

Woolf (1997) examines the development of urban networks in the eastern provinces during the early imperial period, emphasising the profundity of the impact that the Roman empire had. Woolf looks to studies of urbanism from other period and regions, considering rank-size and primate distributions, in order to deduce broad patterns that are likely to be applicable to the Roman East (Woolf 1997: 4-8). From this exercise, the author postulates that the Roman empire would have increased hierarchy in urban networks of the East, with metropolises increasing in size, especially in systems with greater proximity to the connectivity offered by the Mediterranean (Woolf 1997: 8). It should be noted that though the East is described as far surpassing the western empire in terms of urbanism, credit is not given entirely to Roman imperial presence, but rather, the unique and long history of urbanism in the East is recognized (Woolf 1997: 13).

This interest in urban networks is later continued by Hanson (2011), who examines the urban system in Asia Minor during the Roman period (see also Hanson 2016 for later work on urbanism by the same author, though with a much-expanded geographical focus). Hanson highlights the dense distribution of urban sites, which are described according to central-place theory, with cities functioning to provide services and administrative control for the surrounding countryside in much of the region. After detailed analysis, the author confirms claims by the ancient author Aelius Aristides that the urban system of Asia Minor was subject to significant growth under the Roman empire, concluding that Roman presence in the region led to not only growth in cities, but also

increased nucleation in the region (Hanson 2011: 267; see Arist. *To Rome* 93-4). Ultimately, the study looks to the distribution of both urban and agricultural sites to highlight the high level of integration of urban centres, both in terms of connectivity with their surrounding countryside as well as in the wider economic network of the Roman empire.

Ball (2016), however, reminds readers that, though great cities and urbanism are at times viewed as Rome's great legacy in the East, none of these cities were new foundations, but rather re-founded under the empire (Ball 2016: 173). Furthermore, Rome's definition of city, and the significance of such a title, is called under scrutiny. That is not to say that there were not great cities in the east, however, nor that they did not grow and flourish under the Roman empire; only that their existence is not owed to the Roman empire, which they often predated (Ball 2016: 173). Though Ball minimalises the overall impact the Romans had on urbanism in the East, the author does recognise a peak in expansion in the 3rd century AD, as evidenced by an increase in building programmes and, especially, monumentalisation (Ball 2016: 240, though Ball's exclusion of Anatolia in the study, and thus, in such observations, should be kept in mind). Notably, unlike Hanson, Ball places less focus on economic connectivity, with much of the discussion of urban sites centring on architectural forms.

The strict dichotomy between urban and rural environments is a framework that has also merited critical consideration. Studies of the Roman East commonly refer to a mutual interdependence of cities and countryside. Not only did cities rely on villages for agricultural supply, but villages also relied on cities for access to markets, as well as for access to the social, cultic, and organizational services that cities provided (Butcher 2003: 140; Woolf 1997 and Hanson 2011 also refer to cities in terms of such functions). The 'symbiotic relationship' between urban and rural environments has been noted by a number of scholars and can be seen in their interrelated cycles of growth. With increased urban growth in the Late Roman period came also rural development, with a marked increase in villages and the spread of rural populations into marginalised areas (see discussion below). Infrastructural development benefitted both, as can be seen in Zena Kamash's consideration of aqueducts (Kamash 2012, discussed in depth below). Similarly, Butcher (2003: 140) observes that in some areas, as cities reduced in size, rural areas and villages also saw a decline, as did settlement in marginalised zones.

4.2.2.2 Late Roman settlement expansion

The expansion of rural settlement including into marginalised zones, in general, is a common topic among studies of the Roman East, particularly in the Late Roman/Late Antique period. Bar (2004) uses survey data to explore settlement expansion in Late Roman (here, the 1st-4th centuries AD) and Byzantine period Palestine. The author concludes that, though previously the Byzantine period was

seen as a sort of golden age, with the region flourishing after the adoption of Christianity, in reality, prosperity began earlier, and is highly apparent in the archaeological record of the Late Roman Period. Not only can large-scale settlement expansion be observed from archaeological survey of the 'stable settlement areas,' but the expansion into the marginalised zones – or 'unstable settlement areas' – was marked as well (Bar 2004: 311).

Bar credits increased population pressures, beginning as early as the Early Roman period, with encouraging small-scale farmers to settle in these less-hospitable, formerly marginalised zones, in order to meet new food (and space) demands (Bar 2004: 112; see also Tate 1997: 64 on increased urban demand as motivating rural expansion). This settlement growth and economic expansion is attributed to the political and economic benefits afforded by integration into the Roman Empire, including relative peace and stability, as well as connections to the vast networks of the Roman economy (Bar 2004: 112; see Hanson 2011 on connection between economic integration and growth in Asia Minor).

In addition to population growth (as evidenced by settlement growth) and pacification, both Gawlikowski (1997) and Tate (1997) highlight the increase in sedentism under the Romans in areas such as the Syrian desert, where the line between sedentary and nomadic peoples was pushed further east over time (see Gawlikowski 1997: 52; Tate 1997: 57-58; increased populations and sedentarism also highlighted in Butcher 2003: 140). Tate looks to dated inscriptions in effort to better understand the chronology of sedentary settlement expansion in the Syrian countryside, concluding that growth began during the 1st century and peaked during Antonine rule (Tate 1997: 58-59).

Additionally, some scholars credit legislation for leading to rural expansion, referring to 1st and 2nd century AD laws stipulating that if peasants were to settle on, and tend to, previously uncultivated land, then they were permitted to own it (see Butcher 2003: 140 for discussion). Others point to the reformation of the tax code by Diocletian as stimulating productivity in order to meet new demands of tax in kind (Tchalenko 1953).

In general, the specific impetus for expansion remains contested. However, whether expansion in the region was fuelled by pacification, sedentism, population growth, increased demand, imperial legislation, economic integration, or- more likely- a complex interplay of all of these factors, it seems to be the general consensus that, in one way or another, the Roman empire prompted settlement expansion and increased agricultural productivity in the region.

4.2.3 The agricultural economy

The studies discussed above have demonstrated that the East saw considerable urbanism as well as settlement expansion under Roman occupation. The region would have necessarily had a developed agricultural economy in order to sustain growing urban and rural populations, and it is important to consider the nature of its operation and organisation.

Contrary to primitive models, scholars now argue against cereal monoculture, and instead assert that agricultural regimes were integrated, with multiple crop types and animal husbandry playing an important role (Butcher 2003: 152; Decker 2009: 204-227; Waliszewski 2014: 315 among many others). Mixed farming would have allowed for risk reduction and could have involved either the simultaneous cultivation of crops that are complementary to each other, or crop rotation, such as with cereals and legumes. Furthermore, integrated farming, in combination with specialisation in certain cash crops (i.e. olive and vine), would have allowed for increased profit in addition to reduced risk (Decker 2009: 205; Butcher 2003: 166-170). In Decker's model for the Late Antique period, crops such as orchards and vines were intensively cultivated, with cereals being, in general, less dominant, and instead worked in where opportune (Decker 2009: 204).

According to scholars such as Geoffrey Kron (2000), ley farming, or convertible husbandry, was also known to have been practiced in the Roman period. In this system, land is rotated between crop cultivation and years of fallowing, which allows for nutrients such as phosphate and nitrogen to be replenished into the soil, rendering the soil suitable for arable farming once again (Zohary et al. 2012: 75; Marston 2017: 121-132 on Gordion). During years of fallow, the fields would have served as pasturelands, allowing for fertilization by animal dung to replenish the soil. Though Kron (2000) bases his analysis on literary evidence, it should be noted that such a system has yet to be securely detected by means of archaeobotanical evidence (although see Bowes et al. 2017 for recent effort).

Olive was an important cash crop in the region, and, as it can grow in a range of soil types and is a xerophyte, it is particularly suited to some of the more arid parts of the region where other cultivates may struggle (see Zohary et al. 2012: 116-121 on olive). Vine, too, was subject to widespread cultivation in the region, and was a major cash crop. The central role olive, as well as vine, played in the economy is clearly discernible from the abundant press remains throughout the region. These have been surveyed extensively, though many resulting publications focus on the technology rather than on the implications for the wine and oil sectors or the greater economy (see Frankel 1997; Frankel 1999; Ayalon et al. 2009 for overviews, though with particular focus on the southern Levant).

4.2.3.1 Scale of production

The degree to which agricultural products were produced for subsistence, local markets, or export in the Roman East is a topic which, though it has received a considerable amount of scholarly attention, remains largely unresolved. Looking to settlement patterns and the nature (i.e. degree of luxury and/or ornamentation) of the archaeological remains, Lewit (2007) asserts that the level of agricultural production achieved in the Late Roman period exceeded the level necessary for subsistence, and, often even at smaller rural settlements, reached an 'impressive commercial scale' (Lewit 2007: 121). Butcher (2003), too, considers the archaeological evidence, including the distribution of presses as well as the nature of the structural remains, to affirm that ample agricultural activity in the region would have been able to produce surplus at a level that would certainly have been sold for profit (Butcher 2003: 152).

The circulation of wine from the East is not only attested by amphora evidence, such as of the well-known Gaza wine jars, but also by historical references. The 4th-century writing *Expositio totius mundi* (§29), for example, attests to the exportation of wine from southern Palestine, from Gaza and Ascalon (Ashkelon) in particular: *Ascalon et Gaza, civitates eminentes et in negotio bullientes et abundantes omnibus, mittunt omni [negotio] Syriae et Aegypto*.

The extent of the exportation and circulation of olive oil, on the other hand, remains difficult to trace. This is largely due to unresolved questions regarding the use of amphoras from the Roman East and a lack of literary references. Contrary to subsistence-based arguments, early survey work of the Syrian Limestone Massif led Tchalenko to interpret the impressive number of press remains as indicating a scale of olive oil production that would be suitable for the supply of urban centres in the region, as well as for large-scale export (see Tchalenko 1953; see Ball 2016: 274 for more recent expression of the same view).

Decker (2009) combines conservative, subsistence-based interpretations with larger productive estimates, claiming that, though olive oil was produced at subsistence levels throughout the region by Late Antiquity, there also existed an 'oil belt,' which stretched from the coast of northern Palaestina I, and up along the coast into Cilicia and the Cilician plane (Decker 2009:163). Decker considers the major olive production areas region by region, and examines historical references as well as archaeological evidence, a large portion of which centres on the oil presses and survey data. The results emphasise the sizable surplus produced in the East, and although regions such as Baetica and Tripolitania in North Africa are more widely recognised for olive cultivation and oil production, the massive amounts of olive oil produced throughout the East should not be overlooked (see

Remesal Rodríguez 1988 on olive oil from Baetica; see Mattingly 1998 on the olive boom in Tripolitania).

4.2.3.2 *Land ownership*

Beyond the agriculture practices and scale, it is also important to consider land ownership patterns, and the identity of people that the agricultural sector was comprised of. Butcher (2003) considers the countryside of Roman Syria in particular detail and describes regions in the East as dominated by villages, as opposed to the villa estates associated with the western empire (138). Lewit expands the area in which villages can be considered the dominant rural settlement type so as to include not only Northern Syria, but Samaria and the Galilee as well (Lewit 2007: 129). The same author emphasises the importance of the independent peasant landowner, akin to the 'pioneer peasant' populations that Tate describes as occupying the Syrian countryside (Lewit 2007: 130; Tate 1997: 67). The Nassana papyri have also been called upon as evidence of this independent peasant farmer type, attesting their existence in an area further south (Lewit 2007: 129- 130; cf Hirschfield 1997 on 'free farmers' of Byzantine period Palestine).

Waliszewski (2014) looks primarily to ancient literary and epigraphic evidence, and paints a different picture of landownership in the region. In discussing agricultural landownership in Syria-Palestine, more emphasis is placed on the role of large landowners, often in the form of elite estates (for detailed discussion, see 269-270). These estates, at times imperially owned, may have relied on a hired workforce, who received daily compensation or who rented land and paid the landowner with a portion of the harvest (Waliszewski 2014: 270). Some variation is acknowledged, with areas such as that around Antioch being ascribed primarily to large landowners, while the more marginalised highlands may have been characterised by smaller landownership.

Waliszewski does, however, recognise that the Limestone Massif serves as an exception of sorts, with small, relatively egalitarian, villages dominating the landscape (Waliszewski 2014: 270; see Tate 1992; see Butcher 2003 for in depth discussion of this region). Considering the size of the region, regional variations in rural settlement patterns in the Roman East certainly seems to be a likely scenario.

4.2.4 *Agricultural intensification*

The settlement expansion and cultivation of new lands is only one aspect of the general trend of intensification and subsequent growth in agricultural productivity that scholars of the Roman, and particularly Late Roman, East have focused on. A number of studies look to shifting technologies in

order to shed light on intensification in the East, with special emphasis on the Late Roman/Late Antique period. Lewit, for example links shifts in press technologies with an intensification of production in the region, indicative of a rise in commercially oriented industry (see Lewit 2007). The adoption of screw press technology in the Late Antique East is of particular interest, as such a mechanism, though maximising yield, also requires an increase in labour, and thus intensification. Lewit discerns that if such a mechanism was being brought into use, then production was certainly aimed at achieving a scale suitable for commercial sale rather than self-sufficiency (Lewit 2007: 121).

Decker also places particular emphasis on Late Roman intensification, pointing to the increase in complex irrigation systems in the Late Roman East (discussed in depth below) as showing a rise in capital investment in the agrarian sector and indicating agricultural intensification (Decker 2009: 204). This intensification in the region can be linked to increased population pressures that required farmers to look to previously marginalised lands, which require the input of increased labour and capital in order to meet new demands (Decker 2009: 204).

Hydraulic features and irrigation systems play an important role in Friedman (2013), which examines shifts in the agricultural field systems of Khirbet Faynan, a settlement in modern day Jordan associated with smelting activity and copper mines, in order to shed light on the interconnectedness of the industrial and agricultural sectors. The study shows that increased industrial activity in the area caused an increase in the demand for food supply and thus heightened pressures on the agricultural sector. The response to this pressure can be seen in the reorganisation of the agricultural fields associated with the site. In the Roman period, fields that appeared previously to be individual plots managed by farmsteads were brought under one centralised system, and independent irrigation was replaced with large irrigation channels that linked the field into a greater hydraulic system (Friedman 2013: 310-311). Ultimately, the implications of Friedman's study indicate that the centralisation of agriculture under Roman imperial administration did occur in some areas in the East, with imperial powers taking measures to reorganise agricultural systems in order to achieve optimum yields. In this way, the relationship between the presence of a colonising power and shifting agricultural systems is illustrated (Friedman 2013: 311).

The major hydraulic constructions in the East during the Roman and, especially, Late Roman period have been more extensively studied by Zena Kamash, who also links such features to intensification. Though the author admits that dating these hydraulic systems poses challenges, still, the evidence examined by Kamash (2012) is consistent with an intensification of irrigation throughout the region, with larger areas of agricultural lands being brought into cultivation, especially in the Late Roman period (Kamash 2012: 68). Notable trends also indicate that environmental variation amongst

different regions has clear effect on irrigation technologies, as particular techniques are suited to different geological settings; irrigation channels, for example, occur near to rivers, while qanats (gradually sloping underground tunnels that bring water from a source, such as an aquifer or a well, to the surface) are used in areas dominated by limestone (Kamash 2012:68). In this way, it is clear that past peoples were conscious of, and impacted by, their environmental and ecological settings, and that human agency and the ability of these peoples to respond to environmental factors should not be overlooked (see also Barker 1998 for changes in the hydraulic systems at Wadi Faynan, which seem to be in response to changes in environment).

However, Kamash (2012) stresses the importance of looking beyond solely environmental challenges, and of also considering the broader social context of hydraulic systems. For example, the apparent Late Roman boom in irrigation and agriculture is contemporaneous with a restructuring of the Roman army in the region; legions were made smaller and were relocated so as to be based primarily in rural areas. This would have shifted the demand to supply these units, as well as the consequential strain put on the surrounding areas, requiring changes in agricultural systems in order to increase productive capacity (Kamash 2012: 71).

Kamash also points to the interconnection between the urban and rural water supply in the Roman Near East by examining the significant number of branch lines that brought water from aqueducts that supply urban centres to agricultural settings (Kamash 2012: 72). In this way, the 'symbiotic development' and interconnectedness of urban and rural environments, particularly in the Late Roman period, is emphasised (Kamash 2012: 72).

4.2.5 Environment and climate change in the Roman East

Work focusing on the reconstruction of past environments and climatic conditions has become increasingly widespread in the last decade. Rather than going through the many various types of palaeoclimatic data, it is the author's view that it would be more valuable to provide an overview of the many studies that synthesise these datasets.

Büntgen et al. (2011) marks an influential study that would impact future climate reconstructions. The paper looks to tree ring evidence in order to examine past climate change and produces a general outline of conditions throughout the Roman period. The authors describe a phase of relative stability, with warm summers and moist conditions during much of the Roman period. This stability then ceases during the 3rd century AD, when cooler and drier temperatures ensue (see Büntgen et al. 2011 for summary of apparent trends). Particularly dry conditions characterise the 3rd century AD, as

well as the 6th-7th centuries AD, and are suggested to be linked to important historical events, including the so-called 'Crisis of the 3rd Century.'

It should be noted, however, that the tree-ring evidence utilised in Büntgen et al. 2011 is from central and northern Europe, and thus the climatic conditions postulated from these data do not necessarily apply to the East. This point is emphasised by Manning (2013), who compares the precipitation evidence in Büntgen et al. 2011 with a number of records from the East, and, by observing periods of correlation and of dissonance, highlights the complications in the 'simple transfer' of the record to other regions (Manning 2013: 143-145).

Subsequently, the same author was involved in the production of McCormick et al. 2012, an important, comprehensive study of climate change throughout the Roman period, which incorporated a wide range of environmental as well as historical evidence. The landmark paper set the tone for many studies to come, which synthesise multiple types of proxy data in order to provide an environmental context for events that befell the Roman Empire (see McCormick 2013; Manning 2013 (below); Izdebski et al. 2016).

Integrating data including, but not limited to, tree rings, ice cores, speleothems, lake levels and sedimentation records, solar activity, glacial records, pollen data, and more, McCormick et al. (2012) ultimately claim that the various climatic conditions experienced throughout the Roman empire (as indicated by proxy data), correlate with and likely aid in explaining, the expansion of the Roman empire and, later, the disparate fates of the western and eastern Roman empires (McCormick et al. 2012: 202). However, though McCormick et al. 2012 does afford a certain level of explanatory power to environmental conditions, the authors do include certain disclaimers, recognising the incomplete state of the datasets at the time, and, thus, the preliminary nature of the resultant observations (McCormick et al. 2012: 206).

Manning 2013 also points to not only the need for more data and increased chronological accuracy, but also the dangers of generalisations when considering climate throughout the Roman empire. In a detailed overview of the paleoclimatic evidence from throughout the Roman world, Manning highlights the variegated nature of the data: not only do results point to different patterns throughout the different regions of the Roman empire, but they also point to the contradictory nature of the various types of the evidence. Some of these contradictions may be due to anthropogenic influence on the data, such as can often be seen in pollen evidence, while others may be indicative of variations in climatic trends at the micro-regional level (Manning 2013: 105). The latter is particularly relevant to the East, where discordance between different regions, particularly Anatolia and the southern Levant, may be observed.

According to the general synthesis presented in climatic reconstructions for the eastern Empire, conditions remained relatively warm and moist in the Levant up to the 3rd century AD, when a period of increased dryness may have occurred during the 3rd- 4th century, followed by a return to moist conditions which prevailed until aridification ensued in the 6th century AD (McCormick et al. 2012: 174-199; Manning 2013: 163-166; see Izdebski et al. 2016 for Late Antique East; for recent synthesis, see Harper and McCormick 2018). Though the Levant was experiencing moist conditions throughout much of this period, the same is not necessarily the case for Anatolia, which appears to have been subject to dryer conditions until around the 6th century AD, at which point the climate became wetter. The data from Anatolia, however, appear to indicate significant variations within the region itself, such as, for example, during the mid-5th to 6th centuries AD, when increased precipitation in the northwest contrasts with dry conditions in the centre of the peninsula. Despite these overarching trends, when examined closer, a general lack of clarity may be observed, and hopefully remedied with the incorporation of additional datasets.

It should be noted that Manning, among many others, raises a topic that plays a central role in discourse on past climate and climate change: the importance of avoiding environmental determinism. In general, historical narratives and human action cannot be attributed entirely to climate, but rather must be acknowledged as complex, and viewed in light of human agency, sociological factors, and political-economic contexts as well. This view is similarly espoused in Horden and Purcell's landmark study, *The Corrupting Sea*, as well as by Rosen and Rosen (2001), who remind readers of human's ability to respond to environmental conditions, and the dynamic nature of societies in general.

This view is further espoused by Kouki (2013), who also emphasises the importance of the role of human agency. Kouki examines settlement patterns in the region around Petra and environmental evidence of climatic conditions in order to assess whether the period of expansion during the 1st-2nd centuries AD, and then the subsequent decline from the 3rd century, can be described in terms of climate change. In the end, the results are inconclusive, and the author instead stresses the faultiness of the general idea of 'favourable climate,' which is prohibitively simplistic (Kouki 2013: 211). Drawing upon rainfall as an example, the author illustrates conceptual shortcomings by pointing out that rather than assuming all rainfall to be indicative of positive conditions, the 'timing, spatial distribution and mode of rainfall' are important considerations (Kouki 2013: 211). Kouki, like others, refers to the dynamism of humans, and the ability of communities to respond to climatic conditions, before ultimately concluding that, in addition to more environmental data, there is also a need for a better understanding of past societies if their relationship with climate change is to be understood (Kouki 2013: 212).

4.2.6 Conclusion

Though it is not within the scope of this thesis to touch on all of the relevant pieces of scholarship related to the Roman East, a number of common trends and themes can now be observed.

Chronologically, it is apparent that much of the research in the East focuses on the Late Roman period rather than the early or high empire. This bias can be attributed to a number of factors: firstly, the Late Roman period saw widespread change in demography, settlement patterns and the agricultural economy, which is made widely apparent in the material remains (although the possibility that earlier remains are obscured by those of the Late Antique period) should also be noted. Though the earlier Roman period was certainly also a time of transition, particularly in reference to political power, the shifts in the Late Roman period appear to have occurred at an accelerated rate. Additionally, this period is also made interesting in the contrast that it provides with the rest of the Empire: while the West saw widespread decline, portions of the East flourished and experienced periods of expansion.

Agricultural expansion and intensification in the Late Roman period have clearly been of primary interest to scholars of the Roman East. A second area of interest has been populations overcoming marginalised environments in the region. The latter is interesting in that it is contradictory to another common theme, the impact of climate change on society, in that it shows the very ability of humans to respond and adapt, which environmentally deterministic approaches fail to acknowledge. In this way, it seems that such topics have been explored extensively, though not conclusively, thus leaving a gap for future studies to come.

4.3 Roman Italy

4.3.1 Historical overview

Around the time of the founding of the Roman Republic in 509 BC, Italy was still dominated by a number of regional powers.⁶ The poleis of Magna Graecia reigned along the coast in the South, while peoples such as the Samnites and Lucanians inhabited areas in south-central Italy. The Etruscans were an important presence, occupying the territories immediately to the North of Rome, and peoples such as the Venetians, Ligurians, and Celts inhabited the North of the peninsula (see Turfa 2013 on the Etruscans). Of the city-states along the Tyrrhenian coast, Rome, which had been

⁶ It should be noted that, as for the Near East, any historical overview able to be provided within the scope of this thesis is unavoidably broad and brief. For further details, consult relevant references.

growing since the 7th century BC, was gaining in prominence by the 4th century BC (Scopacasa 2016: 77).

Following years of warfare between the Latin communities, the Cassian treaty is thought to have been signed in 493 BC (Scopacasa 2016: 77; see Dion. Hal. *Ant. Rom.* 6.95.1-3 for historical source). This treaty bound Roman and other Latin populations, such as the Sabines, Volscians, and Aequi, as military allies (see Cornell 1989). Soon intermarriage bound the aristocratic classes of Latin cities closer, though warfare persisted throughout the following centuries (see Livy 4.1). Eventually the Latin League declared war on Rome in 341 BC, which Livy attributes to anger on their part as they felt they were being treated as Roman subjects rather than as allies (Livy 8.4). This war lasted until 338 BC, with Rome overcoming the Latin League, ultimately paving the way for further expansion of Roman hegemony (Livy 8.13.8). Roman colonies continued to be established throughout Italy from the 4th century BC, and are thought to have been strategically founded as nodes of Roman influence, which Rome sought to expand in the face of competition with the Samnites (Scopacasa 2016: 81).⁷ Construction of the Via Appia, under Roman initiative, began in 312 BC, marking the creation of the first major road in Italy and the beginning of Roman road building, which would further aid in the expansion of Roman influence in the peninsula (see Laurence 1999 on Roman roads in Italy).

Warfare between the Romans and the Samnites continued for many years, and in 298 BC the Samnites joined forces with Etruscans, Umbrian, and Gallic cities, and faced Rome in battle at Sentinum (Scopacasa 2016: 84). Rome was victorious at Sentinum and its victories continued, allowing Rome to encroach further upon Samnite territory and the Italian peninsula in general, establishing colonies throughout. It is thought that when Italy first engaged in extra peninsular warfare with Carthage in 264 BC, Rome controlled about some 20% of the Italian peninsula (Cornell 1989; see Scopacasa 2016: 84, Fig. 2.2).

The Second Punic War, also referred to as the Hannibalic War, broke out in 218 BC, and soon saw Hannibal's army famously cross the Alps, no doubt suffering significant losses along the way (see Ward et al. 2014: chapter VIII). After more than a decade of fighting in Italy, Spain, and the Balkans, Hannibal and the Carthaginians finally surrendered to Rome, and were forced to relinquish their territories outside of North Africa in 201 BC. (Ward et al. 2014: 111).

In the early 1st century BC (91-87 BC), many of Rome's allies throughout central and southern Italy joined forces against Rome in what would come to be known as the Social War (see App. *B Civ.*; Livy

⁷ 'Nodes of Roman influence' is intended in a political sense, rather than referring to the cultural character or identity of the peoples involved, which is too complex to be discussed in a section of this scope.

Book 72). Though there are different viewpoints on whether the war was aimed at obtaining Roman citizenship for Italians or more of a general rebellion against inequality and a lack of freedom, the outcome was the expansion of Roman citizenship, though in many ways this was nominal, as inequality continued for the Italians (see Bispham 2016: 140-142 for discussion).

The reign of the dictator Sulla in the 1st century BC was a tumultuous time in Italy, with Sulla stripping certain communities of their rights and persecuting those who opposed him, but also introducing constitutional reforms (see Bispham 2016: 144-145 for details; see also Seagar 1994 on Sulla). The dictator also settled large numbers of veterans throughout much of the peninsula: Brunt estimates roughly 80,000 veterans were settled, which would certainly have affected local populations as well as settlement patterns and agricultural production (see Brunt 1987).

After military campaigns across the Empire and consulships in Rome, Caesar, Pompey, and Crassus aligned themselves as political allies in the First Triumvirate, which lasted from roughly 60-53 BC (see Wiseman 1994 on the development of the careers of Caesar and Pompey in particular). After the death of Crassus, relations between Caesar and Pompey became increasingly strained until civil war broke out in 49 BC with the famous crossing of the Rubicon by Caesar and his forces (see account in Caesar's *Civil War*, though, of course, note inherent biases by the author). After his defeat, Pompey fled to Egypt, where he was assassinated by the Ptolemies, and Caesar was assassinated in Rome shortly thereafter in 44 BC (see Rawson 1994).

After the assassination of Caesar, his adopted son Octavian, who came to be known as Augustus, joined with Marcus Antonius and Lepidus in the Second Triumvirate (Bispham 2016:151). However, this coalition too was short-lived; civil war again ensued, with Octavian emerging as the victor and assuming the title of Augustus (see Pelling 1996 on this period). Augustus was granted the title of *Imperator* in 29 BC, and what followed was the beginning of the Imperial period (the *Res Gestae* give an account of the many deeds of Augustus, though the record should be viewed in light of its aim to portray the emperor in glorifying light; see Crook 1996: 70-112 on both historical sources for this period as well as a general political history; see Cooley 155-161 on Augustus and impact on Italy).

The ensuing Emperors of the Julio-Claudian and Flavio-Trajanic dynasties were highly variable in terms of their popularity and the overall impact of their reigns (see Bowman et al. 1996 and Bowman et al. 2000 on this period). Notably, Trajan, who came to power in AD 98, marks the first non-Italian born Emperor (Cooley 2016: 178). It was under Trajan that the *alimenta italiae* scheme was implemented, encouraging landowners to contribute funding that would go toward the support of children in nearby towns (see Wolf 1990 on *alimenta*).

Septimius Severus rose to power and started the Severan dynasty at the end of the 2nd century. Though he intended his two sons to succeed him and to rule jointly, Caracalla murdered his brother Geta in AD 211 (Campbell 2005: 16). The Severan Dynasty came to an end with the death of Severus Alexander in AD 235, and was followed by an extremely disorderly 50 years, which were some of the most troublesome to plague the Empire (Drinkwater 2005: 28). This time of 'crisis,' ending only with the ascension of Diocletian in AD 284, saw a series of short-lived Emperors as well as successive invasions by Germanic tribes (see Drinkwater 2005: 58-64).

Diocletian, after adding co-rulers, completed the tetrarchy in AD 293, fundamentally altering the nature of imperial power (Bowman 2005: 74). It was during the reign of the First Tetrarchy that the imperial capital was moved from Rome to Milan, though Rome, of course, remained an important city. Constantine I first joined the tetrarchy, and then ultimately rose to power after defeating Maxentius at the Battle of Milvian Bridge in AD 312 (Christie 2016: 191). This represents a major period of change in Roman history, as Constantinople (founded c. 330 AD) rose in prominence and Christianity became officially accepted as the religion of the state (see Cameron 2005 on the reign of Constantine). That is not to say that this represents a clean break from former Roman traditions -- rebuilding efforts from this period can be seen in larger Roman cities (see the Arch of Constantine in Rome, for example) and pagan worship was not outlawed initially (Christie 2016: 192). Formal divisions of the eastern and western empire occurred near the end of the 5th century AD, though the latter would be short lived indeed.

4.3.2 Settlement patterns

In examining settlement patterns in Italy, it is important to note the symbiotic nature of the relationship between urban and rural settlements, with high rates of urbanisation creating demand that provided opportunity for rural settlements and farmers in the region (Marzano 2020: 433). Furthermore, the rural and urban sectors are also linked in that rural settlement types, such as villas, provide opportunity for wealthy urbanites to display social status (see Marzano 2020: 439-440 on elite landownership; see also Purcell 1995). The effects of this can be seen in the results of archaeological survey in certain areas of central Italy, such as the hinterland of Rome as well as southern Etruria, which exhibit evidence of a dense scattering of both farm and villa sites (Goodchild 2013: 61; see Potter 1979 on Etruria). Landownership in this area is thought to have been characterised by a high degree of fragmentation; even large-scale landownership appears to have been fragmented, often consisting of multiple, dispersed plots of land as opposed to extremely large, expansive estates (see Marzano 2013: 93).

With regard to the South of Italy, De Simone, among others, highlights the considerable amount of elite and senators that owned land in Campania, and points to the possibility of a model for the region in which wealthy landowners – who are interested in making profit rather than in supplying local populations with staple goods -- accumulate large estates (though not necessarily comprised of contiguous plots of lands) focused on specialised agricultural production (De Simone 2017: 35).

The north of Italy has received attention due to its uniquely low rate of urbanisation, especially considering that much of the land, such as in the Po Valley, is particularly suitable for arable agriculture and has potential for high yields (Marzano 2020; Maiuro 2017). Maiuro seeks to explore the disparity between the economic models that link high urbanisation rates with high agrarian outputs, and the apparent reality of northern Italy in Roman times, which is characterised by potential for high agrarian outputs, but low rates of urbanisation (see Maiuro 2017). Among other possible contributing factors, Maiuro emphasises the possibility that settlement patterns in the region, and its disparity from other areas of Roman Italy, were influenced by Pre-Roman settlements and local populations, though the author is not able to make any definitive conclusions (see Maiuro 2017: 124-131 on effects of cultural diversity of settlement patterns).

In general, due emphasis must be placed on the high degree of regional and intraregional variation that characterised settlement patterns in Roman Italy. Because of this diversity, it is difficult to summarise such a topic in the scope of this work, and thus the matter cannot be discussed in particular depth. However, a few more points should be touched upon.

In reference to the studies discussed above, it is important to bear in mind some of the possible limitations. Goodchild (2013), for example, points out the flawed nature of interpretations maintaining a strict dichotomy between villas concerned with producing for the market, and small subsistence-based farms. Not only were small farms able to produce surplus and large villas were not always concerned with market production, there also existed a range of settlement types in between, including nucleated rural settlements from which rural farmers may have commuted to their fields, as well as medium sized farms (Goodchild 2013: 211). In this way, the author brings into focus the importance of avoiding the strict categorisation of sites, which leads to oversimplified results that neglect the complexity of the human experience.

Another phenomenon that merits consideration is the practice of tenancy, in which wealthy landlords rented out portions of land to tenant farmers. Though in general such a practice is somewhat difficult to detect archaeologically, Goodchild and Witcher (2009) note certain relevant trends in the distribution of rural sites relative to land quality in the *ager Veientanus*, which they determine using crop sustainability mapping. Interestingly, from the Early Imperial period, newly

established farms tend to appear on better land than newly established villas, though previously this was not necessarily the case (Goodchild and Witcher 2009: 215). The authors propose that this trend may be the manifestation of a rise in tenancy, with large villa estates becoming increasingly willing to divide up excess plots of their land in order to rent them out to tenants (Goodchild and Witcher 2009: 215). Such a system would have been beneficial to all parties, with landlords profiting from increased production and rent on land they were previously unable to exploit to its full potential, while tenant farmers were able to work better quality land whilst benefitting from ties to (and the protection of) their new patron landlords (Goodchild and Witcher 2009: 215). Still, though a compelling suggestion, this model would benefit from further testing in order to assess its applicability in other and/or larger regions. It would also be interesting to incorporate archaeobotanical evidence in order to shed light on variances in the agricultural strategies utilised among the different site types. Furthermore, as is emphasised by the authors themselves, the assumed dichotomy between villa and small farm sites deserves reassessing, with greater variability being taken into account (Goodchild and Witcher 2009: 216).⁸ Kron points to another possible benefit of tenancy: that is, the potential of such a system to disguise the massive amounts of land owned by a given wealthy landowner, particularly in light of the considerable amount of legislation aimed at protecting the smallholder (Kron 2017: 115; see also Kehoe 1997 on tenancy).

4.3.3 Agrarian crisis

A common research theme has emerged in the agrarian crisis that struck Italy during the Mid- and Late Republican periods. This crisis has been described in a number of ways, but in general, a decline in small-scale free farmers is ascribed to shifting military regimes and warfare. In this model, military service had formerly been seasonally coordinated so as to allow farmers to return to their fields for harvest. However, during the Punic Wars, farmers were no longer able to return to the plough, and thus their farms were unable to be sustained; after accumulating debt, the families eventually lost their land (Brunt 1971). Toynbee maintains that warfare had a particularly long-term effect on southern Italy, with the region never quite able to recover from the Hannibalic War, both demographically and in terms of economic functioning (see Toynbee 1965; Cornell 1996).

In recent years, however, traditional views of such crises have been increasingly reevaluated. Rosenstein (2004), for example, assessed the impact of military service on the workings of small

⁸ It is important to note that the authors stress that, though tenancy is an interesting possibility, the point in their research is not to argue for its existence, but rather to demonstrate the explorative value of the exercise of modelling (see discussion in Goodchild and Witcher 2009).

farm sites, using models to estimate the amount of caloric intake necessary to sustain families of differing sizes, and the corresponding amount of land and labour necessary to achieve this.

Rosenstein ultimately claims that farms may have been able to continue operating despite required military service, particularly if males married closer to the age of 30, and that this is thus not a sufficient explanation for a decline in rural sites in the late republic (see Rosenstein 2004 for detail). Erdkamp (1999) even argues that, contrary to models of rural decline, the Late Republican period may actually have seen rural expansion. Though the Hannibalic War would have initially caused a decrease in rural populations, this would have led to conditions favourable for demographic growth, with more farmland becoming available for surviving populations (see Erdkamp 1999 for full discussion).

Importantly, there has also been movement away from overly generalising models, with increased emphasis being placed on regional variation. Regional studies, often utilising survey data, have highlighted that the distribution of rural sites differed regionally before the Late Republican/Early Imperial period, and continued to do so after, displaying disparate developmental trajectories.

Fentress (2005) paints a picture of war-torn southern Italy, in which coastal areas were subject to colonisation by absentee landlords and the building of large villa estates with extensive, slave-based viticulture, while inland, the rural economy was based on animal husbandry and the production of textiles (see also Arthur 1991 on the difference between the development of rural economies of inland and coastal areas in Campania). In central Italy, the hinterland of Rome appears to have seen an increase in rural sites throughout the late republican and Early Imperial period, with an especially dense scatter of rural sites that would have been able to capitalise on increasing demands in the city of Rome (see Morely 1996; see Witcher 2006b on further variation in the case of Etruria). Moreover, Patterson (2006), who has long questioned the pan-Italy application of the 'agrarian crisis' paradigm in favour of regionalism, provides a dense overview, bringing together survey data from multiple regions in order to demonstrate the different trajectories of rural development in Campania, Etruria, Lucania, and Samnium (see Patterson 2006).

In general, though the debates surrounding the 'agrarian crises' remain unresolved, the criticism of overgeneralisations and increased attention to regional variations appear to indicate movement in the right direction. It would also be interesting to incorporate additional types of evidence in the debate, perhaps looking to archaeobotanical remains in order to better discern if any shifts in agricultural practices are (or are not) able to be detected.

4.3.4 Demographic growth

Another longstanding debate amongst Roman scholars concerns population size and demographic growth in republican to imperial Italy. Though there is not enough space to discuss the matter in depth in this overview, the question has received much attention and thus should not be overlooked completely. The debate centres around the census data reported for the years 70/69 BC and 28 BC, which sees the population of the Italian peninsula growing from just over 900,000 to over 4 million (for overview, see Kron 2005; Scheidel 2008; de Ligt 2012). This massive growth has been explained in a number of ways, with two basic schools of thought standing out. The first group maintains that the surge in population is due to undocumented shifts in census criteria, which expanded to including women and children in the 28 BC census, though previously only men were counted (see Beloch 1886; Brunt 1987).

According to the other school of thought, there were no undocumented shifts in qualifying populations, but rather in the manner that the census was carried out: that is, rather than requiring citizens to travel to Rome as in the former census, for the 28 BC census, the figures themselves were sent to Rome. Thus, in this view, the 28 BC census, which continued to count only adult males, is a better representation of the true population of Roman Italy, while the figure from the earlier census is a gross underestimate (see Lo Cascio (1994; 1999) and other works by this author; Kron 2005; Launaro 2011; see Hin 2013 for extensive coverage of the demography debate).

Scholars often look to survey data in order to inform upon demographic growth as well as the previously discussed 'agrarian crises,' examining settlement patterns and shifts in distributions. However, rather than taking interpretations for granted, it is important to consider the complications with survey evidence that may lead to biases and difficulties in interpretation (see Witcher 2006a; Patterson 2006 13-24 discusses many of these issues). As Bowes et al. (2017) points out, numerous rural sites and scatters that may initially be interpreted as small houses or settlements may in fact have had very different functions, such as for temporary or seasonal work, housing of livestock, storage and crop-processing activities and drainage. In this way any demographic growth in Italy as represented by an increase in rural sites is brought into question. If many of these small sites were used by the same people that occupied other sites, then they do not indicate demographic shifts, causing debates around rural growth to become further complicated (Bowes et al. 2017: 181).⁹

⁹ Interestingly, Bowes et al. (2017: 181) instead suggests that the increase in variety in site types observed represents 'greater human control over productive landscapes' as supported by installation of drains and water management constructions.

4.3.5 Agricultural economy

In addition to demographic growth and settlement patterns, it is important to consider the agricultural economy supporting the inhabiting populations. Scholars have expressed shifting viewpoints in regard to agricultural regimes in Roman Italy, with primitive models of cereal-based monoculture often being replaced by intercultivation -or polycropping- with vines and olive among other crops accompanying and complementing cereal production (see Kron 2012). The incorporation of livestock as well as pasture/fallow fields into such regimes is also emphasised (Kron 2000; Goodchild and Witcher 2009; Bowes et al. 2017). In addition to being described in the works of the ancient agronomists, polyculture-based regimes also have numerous practical benefits: such techniques would have facilitated higher yields and greater overall productivity, thus enabling even small-scale farmers to achieve a level of surplus production that would have allowed them to build stores of crops as well as sell their produce on the market (Kron 2017: 127). Marzano, too, has recently highlighted the universality of polyculture in ancient agricultural regimes; even large villa estates that specialised, to a degree, in the production of cash crops such as olive, or particularly vine, would have produced other crops (Marzano 2020: 436). Not only would such a strategy serve to offer some measure of risk reduction, but the crops could also contribute to the diet of the inhabitants and workforce (Marzano 2020: 436).

Some wealthy landowners/villas specialised in finer specialty products- *pastio villatica*- which included items such as fish, game, and honey among other luxurious goods (see Kron 2017 on wild game, for example; see Marzano 2007: 88-90, Marzano 2015 on alternative villa production, especially natural resources and fish; see Varro, *Rust.* Book 3 for elaboration on further *pastiones villaticae*). This would have been a rather profitable enterprise, and though initially only wealthy landowners would have had sufficient capital to invest in the necessary equipment and facilities, it may have become more accessible to a range of farmers as products and techniques became more widespread (Kron 2017: 116).

4.3.5.1 Agricultural productivity and surplus production

Another longstanding debate is based on the productive potential of small farmers in Roman Italy. On the one hand, some scholars maintain a viewpoint that paints smallholders in a more primitivist light, as engaging in subsistence-based farming with little participation in the local market (see, for example, Frayn 1979 on subsistence farming). The opposing view emphasises that the productive potential of such farms is greater than previously recognised, especially if the use of certain intensified techniques is taken for granted (see Kron 2000; 2012; see 4.3.5 above on said

techniques). Such a view has been emphatically supported in the work of Geoffrey Kron, who often focuses on the farming techniques that would have amplified production, such as the aforementioned practices of polycropping, ley farming and convertible husbandry (Kron 2000; 2012).

Kron has long been in favour of the prominence of small to medium farms in Roman Italy as opposed to a landscape that came to be dominated by vast estates and slave-dependent *latifundia* (see Kron 2008 in particular, though the topic is touched upon in many works by this author, including Kron 2017). Though the scale and additional labour, both hired and slave, would have allowed for increased specialisation at larger estates, Kron maintains that not only were small to medium scale farmers the primary actors in agricultural production in Roman Italy, but also that the agricultural regimes employed by wealthy estate owners were based on the same practices (i.e. 'intensive mixed farming') but on a larger scale (Kron 2017: 126).

Kron highlights the potential for small farmers to cultivate a wide range of non-staple goods, which were sold at higher prices, in order to generate a profit. They then were able to outsource staples such as cereals, which could be purchased at much lower prices, in order to supplement their own dietary needs (Kron 2017: 114). The author points to the expansion of small farms, as well as their adornment with mosaics and frescos, as highlighting the success of small farmers in such a system and indicating that 'intensive mixed farming oriented to urban markets' should be viewed as characterising Roman agriculture more widely rather than being associated with only large villa estates (Kron 2017: 126).

Modelling crop yields and rural populations has been a fruitful technique that has allowed scholars such as Erdkamp and Rosenstein to explore the productive potential of rural sites in Italy, and to consider whether they alone were able to provide sufficient sustenance for their inhabiting populations (see above on Rosenstein 2004; Erdkamp 2005 on cereals; see Goodchild and Witcher 2009 for useful discussion of models by Erdkamp and Rosenstein). Goodchild and Witcher (2009) use GIS and survey evidence to model the population size and productive potential of rural sites in *ager Veientanus* in order to assess the ability of land to sustain the occupant population (see above for discussion of tenancy from same paper; see also Goodchild 2013). Ultimately, the authors suggest that, to varying degrees, both large villa sites and smaller farms were able to produce surplus in increasing amounts from the Middle Republican to the Early Imperial period. Large villas were able to produce surplus to such a degree that they would have been able channel produce into stores as well as to the market. It is notable that Goodchild and Witcher's model has rural sites producing more surplus and being able to sustain larger populations than previous models, possibly supporting positive views espoused by Kron (see above). Still, the authors point out that, with much of the

surplus being exported out of the local region, this does not necessarily indicate that sites sustained the largest populations possible.

4.3.5.2 *Specialisation*

Olive oil and wine production were major industries in the Italian peninsula, with the latter perhaps receiving more attention in part due to the focus on wine production in the ancient literature produced by the Roman agronomists. The supposed crisis that befell the rural economy during the 1st century AD, has often been associated with a decline in the oil and, particularly, wine industries in Italy, as well as an overall crisis in the villa system, in the face of competition from the provinces (see Rostovtzeff 1957). However, this has long been contested by many a Roman scholar, including Purcell (1985), who draws on literary evidence, ultimately suggesting that, not only was there no crisis, but the Italian wine industry actually expanded in the 1st century AD (Purcell 1985). Tchernia, too, disputes the decline in Italian wine production, pointing to the increased use of degradable containers, such as barrels, which would explain the decrease in archaeological visibility of some Italian wine as indicated by amphora evidence (see Tchernia 1986).

A number of studies focusing on production in particular regions have been produced in recent years (Marzano 2013; Van Limbergen et al. 2017). Marzano 2013, for example, focuses on the wine and oil industries in the *suburbium* of Rome. Examining the distribution of press remains, Marzano contrasts wine production in central Italy and Gaul, pointing out that the increase in concentration of wine production at large villa estates that is apparent in the Gallic provinces does not seem to occur in Imperial Italy, where production facilities remain less centralised (Marzano 2013: 91). Indeed, press facilities are not limited to large villa estates in the region, but have also been uncovered at what appear to be small to medium sized farm sites. However, it remains unclear if these smaller properties were owned by independent farmers or if they were smaller outposts of large estates (Marzano 2013: 92). In any case, it is clear that the fragmented nature of landownership patterns in the region did not allow for the concentration of wine (or oil) production at large centralised facilities (Marzano 2013: 93).

Utilising ceramic evidence and models that estimate wine production in the *suburbium* of Rome, Marzano points to the considerable productive potential of the region, and the sizable surplus that would have allowed the region to make a significant contribution to supplying the city of Rome (Marzano 2013: 93-95; see De Sena 2005 for modelling). Additionally, the ceramic evidence suggests that the wine supply from central Italy would have contributed a larger percentage (more than 50%) than that imported from Narbonensis (Marzano 2013: 94). In this way, the author contributes to debates surrounding crises in the agricultural sector in Imperial Italy, as this evidence contradicts

claims that the villa system and wine production in Italy declined in the face of competition from the provinces (Marzano 2013: 94-95). Van Limbergen et al. (2017) also contributes to the argument against a decline in Italian wine production, illustrating that the apparent decrease in exports from the region of the Potenza Valley actually attests to increased internal demand in the region rather than decreased production.

Marzano (2013) also examines the productive potential of olive oil in the hinterland of Rome, comparing the distribution of press remains with that of other known oil producing regions such as the Guadalquivir Valley in southern Spain, to demonstrate that biases in excavation practices as well as in the archaeological record, have caused presses to be grossly underrepresented (Marzano 2013: 100). This, together with the likely use of perishable containers rather than amphorae, have caused olive oil (in addition to wine) production in the region to be underestimated (Marzano 2013: 101).

De Simone (2017) looks to a different region, examining the surrounding countryside of Pompeii in order to assess the degree to which the hinterland was able to supply the city and produce surpluses.¹⁰ The author examines landscape and settlement patterns in the hinterland in order to estimate productive potential. He also relies on literary sources to inform upon land use and agricultural regimes as well as the scale of wine production in the region (De Simone 2017: 23-30; 32-40). De Simone then attempts to estimate the rural population as well as the population in the city of Pompeii itself (De Simone 2017: 30-32). Based on his estimates, the author proposes that many of the cities in Campania would have had demands that exceeded the productive potential of local agriculture, and thus would have necessitated the importation of certain staples (such as grain and fuel). Furthermore, specialisation in wine would have been far more profitable to local landowners than the cultivation of cereals and arable agriculture, particularly considering the affordability of grain on the market (De Simone 2017: 48). Thus, the author points to regional specialisation, and the regularity of interregional economic exchange in the supply of necessary goods and staples (De Simone 2017: 48). He further suggests that 'degree of dependence' is a useful conceptual framework in the consideration of relationships between cities and regions (De Simone 2017: 48). Though De Simone presents an interesting model and the emphasis on specialisation and regional interdependence is useful, the highly tentative nature of many of these calculations is worth bearing in mind. In this way, the utility of such an exercise is demonstrated, though it is important to remember that the estimates should be taken with due speculation and caution.

¹⁰ Note: This shows a continuation of this interest in of carrying capacity, though here it is with regard to city/hinterland rather than individual settlements.

4.3.6 Environmental/Climate change

Though, as previously discussed, there are many issues inherent in the use of paleoclimatic data to reconstruct past climate change, certain patterns have been largely accepted as characterising Roman Italy (see 4.2.5 on palaeoenvironmental reconstruction). Although the effects of climatic phenomena on the Italian peninsula would have varied greatly by region, scholars often describe a warmer, wetter period from the 2nd century BC to the 2nd century AD (the ‘Roman Climatic Optimum,’) followed by a period of greater variability in precipitation.

This variable precipitation has recently been explored by Bosi et al. (2019), who examine evidence from Late Roman (3rd-6th centuries AD) levels of the colony of *Mutina* and the surrounding environs of the Po Plain. Looking to environmental evidence including pollen data, non-pollen palynomorphs, as well as archaeobotanical macro remains, the authors confirm that the landscape is marked by hydro-geological imbalance, with floods not only causing a build-up of sediment layers in the settlement itself, but also leading to shifts in vegetation, with the spread of wetlands as well as hygrophilous woodland in the area from the late 3rd century AD (see Bosi et al. 2019: 20-21). The authors also note a decline in the diversity of flora from the Imperial period to the Late Roman period, which may be evidence of homogenisation, as certain species, unable to cope with shifting climatic conditions, die out while more adaptable species survive (Bosi et al. 2019: 21).

Scholars such as McCormick et al. (2012) point to the correlation between this less climatically stable period and the political upheaval that plagued the Roman Empire, particularly Italy and the West, during the 3rd century AD (see especially Harper 2017). Though a period of less favourable climatic conditions cannot be used to explain this time of crises alone, disruption of normal crop production and supply chains certainly would not have made it any easier.

Still, despite the important place of climate change in scholarship of Roman Italy, research such as that of Ermolli et al. (2013) points to the effects of human agency, which should not be wholly dismissed in favour of environmental influences and climate change. The authors use case studies, examining the geomorphology of ports as well as pollen evidence to show that shifts and sedimentation that affected the ports of *Neapolis* and *Velia* between the 3rd and 7th centuries AD were not solely due to proposed climatic deterioration, but were also linked to anthropic influences, particularly a decline in management of the surrounding landscape (see details in Ermolli et al. 2013). Ultimately the study emphasises that, though the alluvial strata and sedimentation do appear to indicate severe flooding in the 3rd century AD, it seems that the flooding events worked hand-in-hand to enhance the effects of human action (Ermolli et al. 2013: 231; see also Amato et al. 2012 on

the importance of human influence rather than climatic factors with regards to the shifting geomorphology of Roman ports in Italy).

In examining water management in central-southern Italy, Keenan-Jones also points to the role of human action in the persistent river flooding during the Roman period (see Keenan-Jones 2013). The author indicates that the flooding of rivers including the Tiber and the Po should not be attributed solely to climatic factors such as increased rainfall. Deforestation and reduction of vegetation in river valleys leads to flooding, as less water is being retained by plants, and the water is able to flow more freely into rivers (and streams) (Keenan-Jones 2013: 237). This also increases erosive processes, causing bodies of water such as lakes to fill and flood – leading channels to fill with silt, thus rendering them less able to aid in the prevention of flooding as their capacity is reduced (Keenan-Jones 2013: 237). This, together with the author's examination of large-scale water management projects undertaken in Roman Italy, highlights the importance of anthropogenic influence and the considerable extent to which ancient peoples were able to manipulate their landscape and resources.

4.3.7 Conclusion

Settlement patterns, demography, and the functioning of the agricultural economy in Roman Italy have all proved to be highly complex matters to investigate. Efforts at quantifying population growth, surplus production and productivity in general have received a privileged place in the research agenda in recent years. However, emphasis has rightly come to be placed on the inherent diversity characterising all of these matters, particularly with regards to the considerable degree of regional variation existing throughout the Italian peninsula.

Archaeobotanical evidence has not contributed greatly to many of these topics, due to the scale of most of the archaeobotanical studies in the region. As it is difficult, if not negligent, to generalise the patterns exhibited by individual datasets to the whole of the peninsula, and as little large-scale synthetic work has been carried out, the potential for bioarchaeological evidence to contribute to the debates outlined above remains largely elusive. It is the hope of the author that with further data synthesis, this situation will soon be remedied.

Chapter 5. Methodology

This chapter focuses on the methodology used in data collection and analysis, and details the various methodological decisions that were made in order to standardise and aptly interpret the data that were collated for this thesis.

5.1 Evidence

This study utilises archaeobotanical remains to track changes in crop choices, agricultural production, and plant consumption with the advent of the Roman Empire. In terms of the archaeobotanical remains that will be included, macroremains will be of primary interest. Not only is this type of data particularly well suited to studies concerned with diet and the consumption of plant foods, but it also has a relatively long history of sampling, despite changes and innovations in sampling strategy, and is a widely occurring type of remain that can be found preserved in a variety of different site types and environments.

As previously discussed (see Chapter 3), archaeobotanical macroremains may be subject to a number of preservation processes, which occur in different environmental settings; while waterlogging is common in the wet environs of the United Kingdom, carbonised remains are more prevalent in the Near East, where, apart from in exceptional contexts, the climate is typically too dry for waterlogging, and not sufficiently arid for desiccation. While it is tempting to include all plant remains regardless of how they were preserved, this would overlook consideration for differential preservation, in which certain types of preservation favour particular remains, and would not provide for comparable datasets (see van der Veen et al. 2007; see also Livarda and van der Veen 2008, in which, the authors note that, for the sake of consistency, only waterlogged plants have been included in analysis). As such, carbonised remains are focused upon in this study.

5.2 Selection of study area

In order to assess regional variation in plant consumption and crop choices, data were collated from any sites that reported archaeobotanical remains from two selected regions: The East and Italy. For the purposes of this study, the East refers to the eastern portion of Roman Empire, and is defined as east of the Bosphorus, including coastal Anatolia but excluding the North African province of *Aegyptus*, modern day Egypt. *Aegyptus* was excluded, as it is environmentally different and so rich in desiccated remains, a type of preservation that is rather uncommon in the rest of the selected

regions. It should also be noted that the eastern boundary of the study area is based on the Roman Empire at its greatest extent (see Fig. 5-1 below).

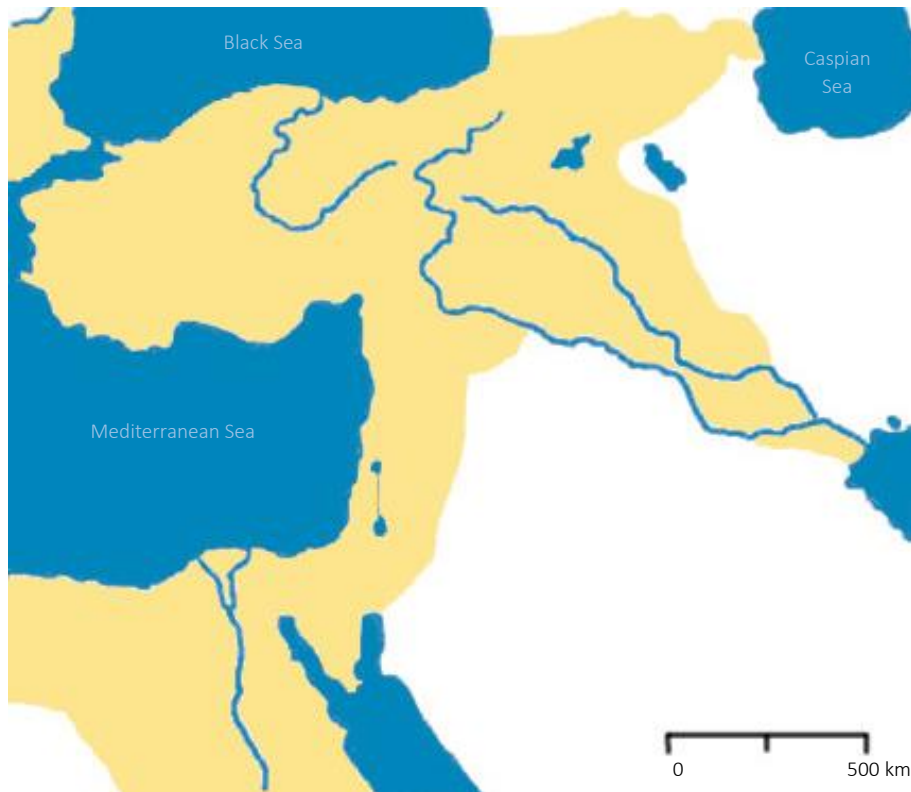


Figure 5-1 Map showing extent of Roman Empire in the East, c. AD 117. Areas shaded with tan were included in Empire, though not necessarily the study area, which excludes shaded areas in North Africa and west of the Bosphorus.

The East is of primary interest as not only is the region so geologically, historically, and culturally diverse, but it has also never been subject to archaeobotanical meta-analysis. In order to facilitate appropriate comparison of like-datasets, the region with which the East will be compared must be environmentally suited so as to also yield considerable amounts of carbonised archaeobotanical remains. As such Italy was chosen as a viable candidate for comparison as, unlike many other Roman provinces that are environmentally better suited to yield either waterlogged or desiccated remains, both regions have semi-arid, Mediterranean climates.

The selected regions are also optimal in terms of their geographical locations, which allow for a comparison of plant consumption on the eastern edge of the empire with those detectable at the centre of the Roman world in Italy. Each of these regions also have long histories of population migrations and cross-cultural contact, as well as of economic connectivity, which led to complex processes of dietary change, and (presumably) intricate patterns of variation.

Furthermore, though regions such as Britain and north-western Europe have been approached synthetically in publications such as van der Veen et al. (2008), Livarda and van der Veen (2008),

Bakels and Jacomet (2003), and Zech-Matterne (2009), Italy and the East have received far less scrutiny in terms of broader dietary patterns, and thus represent a research gap that the author hopes to address (Peña-Chocarro et al. 2017 marks a recently published exception for the Iberian Peninsula).

It should also be noted that studies utilising plant remains in order to assess 'Roman identity' in the north western provinces have often looked to literary evidence in order to define a Roman baseline of comparison, as no large-scale archaeobotanical studies have been carried out in Italy. Thus, not only will the regions selected here facilitate comparison between the centre and eastern extent of the Empire, but in including Italy, a better understanding of 'Roman' plant consumption may be developed.

5.3 Data collection

The evidence utilised is mostly secondary, having been previously published in journal articles, archaeological reports, and other academic volumes. Key words were used to search through journals and online databases in an effort to locate archaeobotanical remains dating to the appropriate time periods. In order to gather the largest dataset possible, sites with varying quality of data were included (see sections 7.1 and 8.1 for data overview and details of data quality).

Individual datasets were often found in articles published in academic journals, which were searched using keywords when online, and by hand when located in a library. Long periods were devoted to searching publications including *Vegetation History and Archaeobotany*, *Environmental Archaeology*, *Israel Journal of Plant Sciences*, *Anatolian Studies*, *Israel Exploration Journal*, *Journal of Near Eastern Studies*, *The Annals of the American School for Oriental Research*, *Journal of Field Archaeology*, *Journal of Roman Archaeology*, *Mediterranean Archaeology and Archaeometry*, *'Atiqot*, and the *Journal of Roman Studies*. In other cases, archaeobotanical material was located within archaeological reports for particular sites and excavations, which were often found while searching through reports in the stacks at The Institute of Classical Studies Library (ICLS), UCL's Institute of Archaeology Library and The Bodleian's Sackler Library in Oxford.

A number of bibliographies and websites also proved to be extremely valuable in the searching for and gathering of archaeobotanical data, including Dr. Naomi Miller's bibliography of *Archaeobotanical Reports from sites in the Near East*, *The Brain network and database*, and Dr. Simone Riehl's *Archaeobotanical database of Eastern Mediterranean and Near Eastern sites* (ADEMNES).

In addition to a synthetic analysis of the published data, archaeobotanical samples were collected from the sites of Hippos-Sussita, located in modern Israel on the eastern shore of the Sea of Galilee, as well as Jerash in modern-day Jordan. The inclusion of primary data provides for valuable case studies, against which the larger trends detectable in the regions can be accessed and compared (for secondary data, see site catalogue in Appendix A; for primary data, see Chapter 6).

5.3.1 Collection of primary data

Nine samples were taken from Hellenistic and Roman layers at Jerash, which is located in modern day Jordan, and 71 samples were taken from Hellenistic, Late Roman, and Byzantine contexts at Hippos-Sussita in modern day Israel. In both cases, bulk samples were collected from single contexts, and were approximately 10 L in size, unless the context or feature necessitated otherwise. Every effort was made to sample as many contexts as possible, though certain areas yielded far more samples than others, due to the more intensive excavation efforts in these areas.

The samples were processed by means of bucket flotation, using 1 mm mesh for the heavy fraction and down to .25 mm for the light fraction. After dried, the heavy fraction was 100% sorted in the field by the author, while the flots (light fraction) were transported back to the lab at the University of Reading for analysis.

Flots were first assessed, and then sorted using 4mm, 1 mm, and 300-micron sieves. Identifications were made with a Leica binocular microscope at (10-40x). In the interest of time, particularly large samples were subsampled using a riffle box. 100% of the material from the 4 mm sieve was sorted and analysed, and the material from the 1mm and 300-micron sieve were analysed in varying proportions depending on sample size and productivity; these proportions are indicated in Appendix C.

Remains were identified by comparing the morphology of the carbonised specimens with reference collections at the University of Reading and University of Oxford School of Archaeology, as well as using identification catalogues (including Jacomet 2006, Neef et. al. 2011, and Cappers et al. 2012). When possible, identifications were made to the species level, though this was inhibited at times due to poor preservation. In such instances, identifications were made to the genus, or even family, level.

Cereal grains were quantified by the number of embryo-ends or fragments in less saturated samples. Olive stones were plentiful, particularly in a number of the Hippos-Sussita samples, and thus alternative measures were taken. Due to the high volume of olive remains in a number of the

samples, fragments were weighed rather than counted. The number of whole olives represented by the fragments was then estimated using the average weight of 10 olive stones from the site (see Rowan 2014 for use of this method). These estimates are shown in brackets in the data tables, while the real number of whole stones is unbracketed.

5.4 Data entry

After collection, the archaeobotanical data were entered into the ARBODAT Microsoft Access database, facilitating standardisation. ARBODAT was created in the early 2000s by the Archaeobotanical Department at the 'Kommission für Archäologische Landesforschung in Hessen e.V.' (KAL).¹¹ Using Microsoft Access, the programme is suitable for large-scale data entry, and includes a broad range of details, such as ecological characteristics and information regarding specific archaeological contexts and associations that may be entered to further describe the data (see Kreuz et al. 2005 for example of a comparative interregional study that successfully utilises the ARBODAT database programme).

Not only does the programme provide a platform for large-scale data entry, it also facilitates regional/interregional research, as well as studies concerning the distribution of particular plant taxa (Kreuz and Schäfer 2002: 177). Furthermore, the database allows for the exchange of large quantities of standardised raw data, increasing accessibility and encouraging scholarly collaboration. As such, data entry requires the use of standardised plant codes, or 'pcodes,' and quantification method, facilitating comparisons of data produced by different excavations and archaeobotanists. The authors adopted the pcodes from the work of Stefanie Jacomet and the workgroup of Integrative Prähistorische und Naturwissenschaftliche Archäologie (IPNA) at the University of Basel, and thus it is this taxonomy that is used in this study as well (Kreuz and Schäfer 2002: 177). When data were obtained from reports using alternative taxonomies, *The International Plant Names Index* (IPNI), as well as a number of regional floras were consulted (Post 1932; Beijerinck 1947; Davis 1965-1988; Zohary 1966, 1972, 1982; Feinbrun-Dothan 1978, 1986; Bolós et al. 1993; Tutin et al. 1996; Pignatti 2003; Danin 2004).

Using the ARBODAT programme, researchers can perform queries and create tables in order to quantify and analyse data at different levels and/or based on choice criteria (examples include the number of plant remains per sample or at particular sites, as well as present taxa lists and

¹¹ Though the programme is under continuous development, the 2017 English version was used in this thesis, as this was the most recent at the time data entry began.

concentration values) (Kreuz and Schäfer 2002: 178). In using such a database program, it is my hope to further explore and demonstrate its utility in an interregional study focusing outside of northwest and central Europe, as well as to better allow future scholars access to the data utilised in this study.

5.4.1 Quantification

As in all synthetic studies incorporating secondary data, choosing a standardised quantification method was an important consideration. Though many large-scale syntheses rely on presence/absence values, studies such as McKerracher (2016) illustrate that in utilising a combination of approaches, it becomes more possible to overcome limitations posed by disparate quantification methods (For studies that use presence/absence see, for example, Livarda 2011; Peña-Chocarro et al. 2017; van der Veen et al. 2008; Wiethold 2003). McKerracher (2016) aptly includes both presence/absence data, as well as a smaller subgroup of fully quantified datasets, which can then be utilised for additional methods of analysis (such as relative abundance). This is not possible when only presence is reported.

In accordance with such a model, fully quantified material was recorded and entered into the ARBODAT database when available. However, if a site produced less than 10 remains, it was included only in the presence/absence-based analysis. When reports indicated sub-sampling, efforts were made to ensure the counts were multiplied to the equivalent of 100% sorted before analysis. Otherwise, in efforts to include as much data as possible, when full quantification was lacking, presence was indicated by entering an estimated value of '1' in the database.

Quantified data for every site have been recorded so as to highlight the heterogeneity extant among the sites and avoid overgeneralisations, despite certain similarities such as in site type or geographical location (see van der Veen et al. 2008 for example of study that reports data for each type of site rather than by individual sites; see Peña-Chocarro 2017 for study that reports data by geographical clustering rather than by individual sites). Such a method also serves to highlight the strength of individual datasets, which may be masked by the inclusion of qualified data alone. This study also includes species level data (in the raw data) rather than reporting only by plant food groups (see Bakels and Jacomet 2003 for example of the latter). All of these decisions were made so as to incorporate as much detail as possible in the data, and to facilitate its use for future scholars so that they may build upon the work undertaken in this thesis in future research.

5.4.2 Species reassignment and standardisation of data

The individual datasets entered into ARBODAT were as detailed as possible, but often had to be transformed and standardised prior to analysis. To this end, 'cf.' identifications were combined with securely identified remains, so that two *Vitis vinifera* and two cf. *Vitis vinifera* were combined and counted as four *Vitis vinifera*, for example. Free-threshing wheat varieties were combined under one more general category, *Triticum aestivum/durum/compactum*, as were *Hordeum distichon* and *Hordeum vulgare*, both of which were classified in a more general 'Barley' category.

It was also necessary to make decisions concerning the categorical placement of certain plants/species. For example, while free-threshing wheats, olive, and peach are all obvious examples of cultivated foodstuffs, plants such as *Beta* sp. (beet) could be placed under wild/weed species or may be counted as a vegetable. In such cases, the author sought evidence, typically in the archaeobotanical record, that indicated that the plant in question was indeed consumed as food. The evidence may be contextual, such as the inclusion of the uncategorized species in question among definite food plants or in contexts associated with food preparation or consumption, or it may be in the form of large quantities of a certain species, indicating that the plant was kept in caches in food stores (see cache of over 300 *Beta* sp. at site 39 for example). Furthermore, ancient literature may offer an additional source of advice as to the uses of particular food plants, as may modern publications, which can offer precedence and thus inform categorization. A list of all plants not included in the wild/weed category was compiled and may be found in Tables 7-2 and 8-2 for the East and Italy respectively.

5.6 Chronological divisions

In order to explore how variation in plant consumption was or was not affected by the advent of the Roman Empire in the regions of concern, the sites in which the assemblages were located were divided by chronological period, illuminating changes that occurred over time (For other studies featuring chronological divisions in order to track change over time, see, for example, Bakels and Jacomet 2003, Zech-Matterne 2009). The chronological divisions include pre-Roman periods, such as the Iron Age, as well as Persian and Hellenistic periods, which serve as a baseline in order to highlight shifts associated with the Roman period. It should certainly be noted that each of the regions had unique trajectories of chronological development, and a Roman presence was established in each region at different times. Because of this, a rather broad timeline has been adopted so as to better facilitate comparison and allow for the placement of data that were not

reported with detailed dating information, but rather in more general terms. As such, the following chronological groupings have been devised:

Table 5-1 Chronological divisions utilized in data entry and analysis.

I	Early Pre-Roman	11 th - 5 th century BC Generally considered the Iron Age across much of the Mediterranean though includes the Archaic and Republic periods in Italy. Note: time period only applies to the Eastern dataset
II	Pre-Roman	5 th -1 st centuries BC. Includes the Hellenistic period in the East, and the Late Republican period in Italy
III	Roman	1 st -3 rd centuries AD
IV	Late Roman	3 rd -5 th centuries AD
V	Roman (General)	Records are Roman (General) when the reports do not give more detailed dating information.

As indicated in the table above, it should be noted that the ‘Early Pre-Roman’ period only applies to the data from the East, while the study period for the Italian Peninsula begins around the 5th century BC, with the ‘Pre-Roman Period.’ This decision was made in order to limit the scope of the thesis, and, as the overall aim is to study change in the East with Italy acting as a baseline for comparison, certain sacrifices were necessary.

Of course, significant portions of both study areas- much of Italy in particular- were ‘Roman’ prior to the 1st century AD. As such, it should be noted that the ‘Roman’ period as here utilised largely refers to the Roman *Imperial* period. Furthermore, by the 1st century AD, Roman occupied areas had been greatly expanded, and the cultural influences and political-economic networks associated with imperial integration would have presumably affected local crop choices and consumption patterns throughout the study regions by this point in time.

Though ideally the sites included in this study would yield remains from each of the chronological periods here considered, such sites were unfortunately exceptional, with some sites providing data from just one or two time periods. In the case of a multi-period site that yielded evidence from more than one of the chronological periods, it was counted in both (or all three) as separate ‘records,’ each assigned their own identification number (see Livarda 2008 for example of an approach utilising such ‘records’).

This use of the term ‘record’ is based on the understanding that an excavation at a single site may produce multiple records, consisting of sets of data that are in some way culturally or chronologically distinct from one another (van der Veen et al. 2007: 183). That is, for example, an excavation at a

multi-period site may produce data from the Early Roman as well as the Late Roman periods, which would be entered as two different datasets, or records (see van der Veen et al. 2007 for further discussion of such terminology).

If a record is dated to a period that spans the chronological divisions, it was placed under the period that it most overlaps with. If the record overlaps equally with two categories, it was placed in the more appropriate category as indicated by the original author: that is, if a record then spans from the 1st century BC through the 1st century AD, but the author of the report describes the data as 'Roman,' it was assigned to the Roman period accordingly.

The fifth category -general 'Roman'- was added so that relevant data from records with exceptionally broad or vague dating information may still be included (see Livarda 2007 for example of inclusion of a general dating category.) Unfortunately, the vague dating for these records prohibited them from being utilised in analysis.

5.7 Division by site type

It is also important to take site type under consideration in order to investigate social consumption patterns, as well as to allow for a better understanding of the biases in each assemblage due to the nature of the context from which they came (see Bakels and Jacomet 2003, van der Veen 2007). As such, sites have been placed under the following divisions:

Table 5-2 Site type categorisations utilized in data entry and analysis.

I	Urban	Includes towns and larger cities, <i>coloniae</i> , <i>civitates</i> capitals
II	Rural	Small settlements, villages, homesteads and farmsteads
III	Villa	(i.e. <i>villae rusticae</i>)
IV	Ceremonial	Sites of ritual nature, including ritual sacrifice as well as temples, shrines, tombs, and burials
V	Military	Includes intra and extramural settlements; <i>vici</i> and forts
VI	Other	Industrial contexts and roadside stations; sites of indeterminate categorisation

Efforts were made to assign sites to one of the categories above, though in the case of particularly vague (or absent) archaeobotanical or archaeological site reports, sites that were unable to be interpreted were classified as 'Other.' The categories are the same for all periods, though the distribution certainly varies (see data overview chapters 7.1 and 8.1 for more details on distribution of different site types in each region). The only exception to this is sites classified as 'Villa,' which are only found in the Italian dataset. The absence of such sites from the Eastern dataset was not due to

differences in the categories utilised, but rather to a lack of archaeobotanical remains from such sites in the East.

5.8 Regional divisions

In order to assess intraregional variation in plant consumption and crop choices, the records from both Italy and the Near East were further divided into subregions. The Italian dataset was simply divided into the North, Central Italy, and the South; Table 5-3 below indicates into which subregion each of the Italian provinces was placed.

Table 5-3 Regional divisions utilised for analysis of the Italian dataset.

Region	Provinces
North	Aosta Valley, Emilia Romagna, Friuli-Venezia Giulia, Liguria, Lombardy, Piedmont, Trentino Alto-Adige, Veneto
Central	Abruzzo, Lazio, Tuscany, Umbria, Marche
South	Molise, Campania, Basilicata, Puglia, Calabria, Sicily

The Eastern dataset was divided into the Levant, Anatolia, which is actually restricted to the Anatolian peninsula, and the 'Greater Middle East.' These divisions were loosely based on environmental characteristics as indicated by the Zohary (1973)'s geobotanical zones.

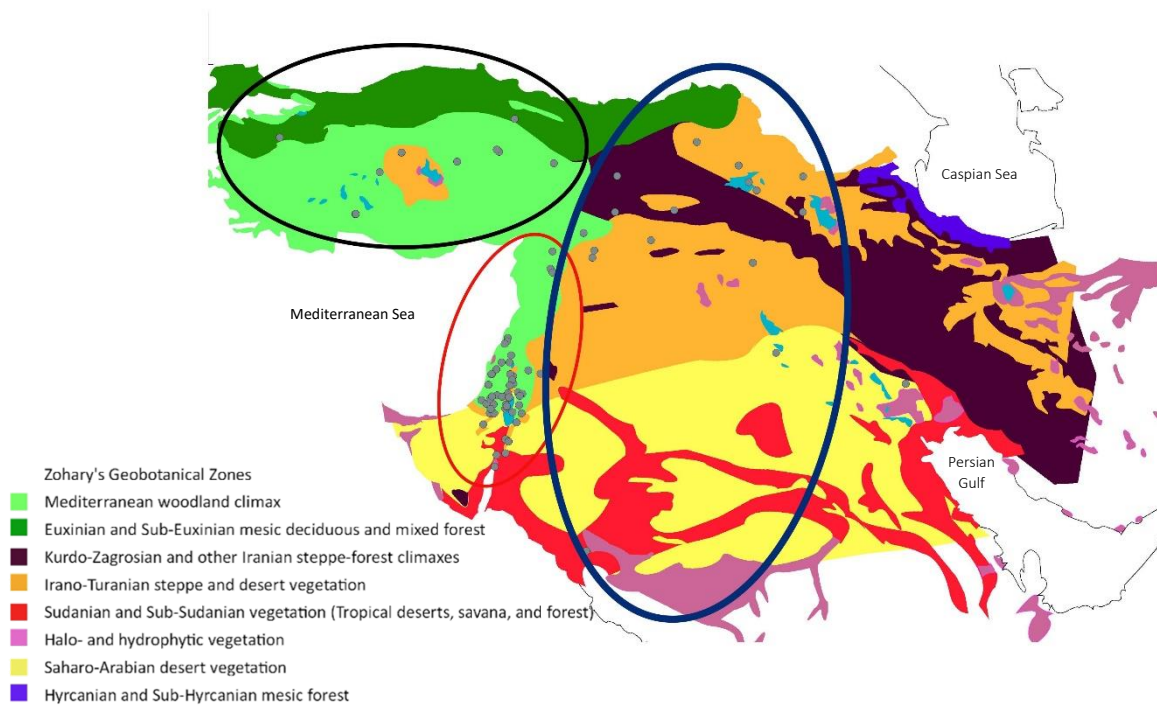


Figure 5-2 Map depicting regional division utilized for the Near East (based on Zohary 1973). The blue ellipse indicates the 'Greater Middle East;' the red indicates the Levant, and the black encompasses Anatolia. Grey markers represent sites.

5.9 Data analysis

As reports utilising different types of data reporting and quantification are included in this thesis, multiple types of analysis are necessarily used. The result is a two-tiered approach to data analysis, which facilitates the incorporation of both presence/absence and fully quantified data.

All of the archaeobotanical data were assessed in terms of frequency, allowing for the consideration of variations in the frequency of occurrence of plant taxa between site types, periods, and regions. However, as nearly all evidence is preserved by carbonisation, and as certain types of remains/species are prone to such a process, carbonised assemblages often exhibit marked homogeneity in terms of the species present, thus making it particularly useful to augment frequency analysis by also looking at relative abundance in order to address importance and overall dietary contribution (van der Veen 2007: 978). Furthermore, considering relative abundance also allows minor occurrences to be distinguished from larger concentrations, and allows for shifts in the prevalence of particular species to be better examined (McKerracher 2016: 90).

Frequency and relative abundance calculations were used to track a number of patterns, with analysis based on site type, chronology, and spatial distribution (For similar methods, see Bakels and

Jacomet 2003; van der Veen et al. 2008). Comparisons of data from different chronological periods allows for the tracking of change over time. Comparing the data from different site types, facilitates the detection of any variations that indicate differential social access, or even preferences among different population groups within a given region. Furthermore, mapping the regional distribution of particular species is useful in assessing the effects of both economic connectivity, as well as the impact of localised, environmental factors (Riehl 2008, for example, uses distribution maps to express shifts in frequency and relative abundance of particular crops). Such analysis was performed for each of the case-study regions, and then interregionally, so as to highlight the different ways in which variation occurred.

5.9.1 Taphonomy and formation processes

It should also be noted that efforts were made to mind the specific taphonomies and formation processes affecting the data, and, as such, records were considered on an individual basis, and then categorised according to the specific actions represented (see Appendix B for categorisation protocol and categorisation of individual records). In order to facilitate this, the author created eight main categories for the assemblages, including: Ceremonial deposits, crop processing, food/food preparation, refuse, food stores, fodder/dung, fuel, and background noise. Each category is described according to context indicators, typical densities, specific plant indicators, and any other identifying characteristics, all of which are displayed in Appendix B. Not only does such an exercise highlight biases affecting the data, but it also aides in data interpretation.

5.9.2 Crop-processing analysis

Grain-to-chaff ratios were utilised for records with at least 10 items representative of either barley, free-threshing wheat, or glume wheat (either *Triticum monococcum* or *Triticum dicoccum*) in order to track crop-processing activities (see Table 5-4). The 10 items could be comprised of some combination of cereal caryopses and chaff; records with less than 10 items of a particular cereal type were not subject to crop-processing analysis. Table 5-5 (below) indicates the numbers that qualify as 'high' or 'low' values. The ratio utilised for glume wheats is based on Emmer (*Triticum dicoccum*) due to the dominance of the species in the dataset, with Einkorn (*Triticum monococcum*) being a significantly rarer occurrence. It should be noted that records containing either only chaff or only caryopses of a particular cereal type were excluded regardless of whether the number of items reached 10 or more, as such analysis is described as hardly necessary in order to determine the stage of crop processing of such an assemblage.

Table 5-4 Grain to chaff ratios utilised to identify crop-processing stages. Based on van der Veen and Jones 2006: 233, Table 2. 'High' and 'Low' values refer to the degree of difference from the original cereal crop (see Table 5-5 below).

Ratio	Crop-processing stage	
	High value	Low value
Free-threshing wheat rachis internodes/grains	By-product from early processing stage	Grain product
Barley rachis internodes/grains	By-product from early processing stage	Grain product
Glume wheat glume bases/grains	By-product from late processing stage	Grain product

Table 5-5 Values used in crop-processing analysis. Ratios and equivalent value represent the original cereal plant. Low and high values indicate figures that can be taken to represent significant deviation.

Cereal	Ratio	Equivalent value	Low value	High value
Free-threshing wheat	1:3 (Rachis: Grain)	0.33	< 0.2	>1
Barley	1:3 (Rachis: Grain)	0.33	<0.2	>1
Glume wheat	2:2 (Glume base: Grain)	1	<0.6	> 1.5

5.9.3 Weed seed analysis: autecology

In examining the wild/weed seeds present in the dataset, the author employed the use of autecological analysis. Autecology looks to the ecology of particular plant species and can be used in order to shed light on past environmental conditions. In such an approach, sets of indicator values, often known as Ellenberg numbers, are ascribed to each species according to the climate and ecological conditions in which they thrive (see Ellenberg 1974 for early work on such values; Ellenberg et al. 1992). L, for example, indicates ideal light regimes, while F, or M depending on the set of indicator values used, refers to moisture levels, and T to ideal temperatures. N, or nutrient availability, was the primary value utilised in this study, in an effort to detect the implementation of measures affecting changes in soil quality.

However, the Ellenberg values were produced for *central* European flora; as the values express the optimal conditions for a given species when in competition with other species, this may vary from region to region as the plant repertoires do (see Pignatti et al. 2001: 282 for discussion of synecological requirements). As such, sets of indicator values have been produced for other regions as well. Borhidi (1995), for example, published values intended for use in Hungary, Böhling et al. (2002) a set for the southern Aegean, and Pignatti et al. (2005) for Italy. It is the latter that is used in

this study in analysing the weed seed assemblage in the Italian dataset (see Appendix D). Such a method was, unfortunately, not adopted in examining the data from the Near East, as, not only are indicator values lacking for the region, but species level identifications are less prominent as well.

Now that the methodological approach has been outlined above, the results may be presented in the following sections.

Chapter 6. Primary Data from Jerash and Hippos-Sussita

This chapter focuses on the primary data collected and examined by the author, which will be integrated into the regional, meta-analysis in the chapters that follow. The primary dataset consists of archaeobotanical macroremains from two archaeological sites in the East: Jerash and Hippos-Sussita. In the chapter that follows, the author will briefly introduce the sites, as well as the samples and the contexts that they derive from, before detailing the results and analysis, and, finally, interpreting the remains in the discussion.

6.1 Jerash

Jerash, or Gerasa, is located to the north of Amman in modern day Jordan and has been described as possibly being the best-preserved Roman city in the East (Ball 2016: 217). Jerash was one of the Decapolis cities, which were located in an area spanning modern day Israel, Jordan, and Syria. These 10 city-states functioned as *poleis* and the inhabitants are thought to have been Hellenised, and distinct from the largely Semitic populations in much of the surrounding areas (see Segal 2008 for an overview of the Decapolis). The sites are characterised by monumental architecture, typical of Greco-Roman cities, with observable remains of temples, bath houses, theatres, and colonnaded streets. Jerash illustrates this exceptionally well due to the preservation of a wide array of Roman architectural forms (see Ball 2016: 2016-220). The samples included here were taken during the 2017 excavations by the Late Antique Jerash Project.



Figure 6-1 Location of Jerash.

6.1.1 Jerash: Contexts

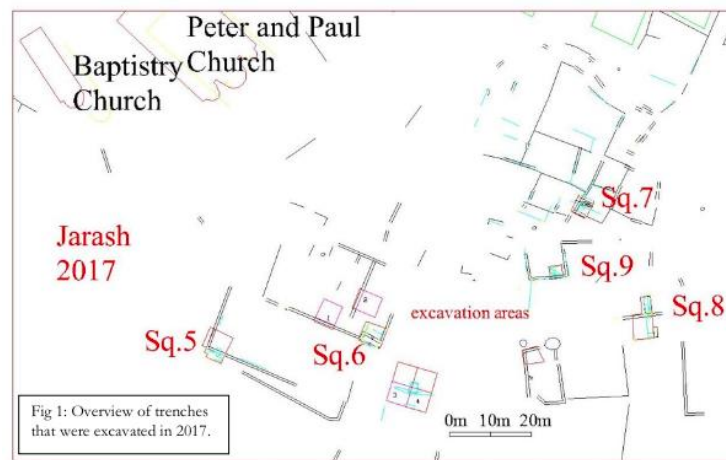


Figure 6-2 Excavation areas during the 2017 season (Blanke 2017:6).

Area 5

Area 5 is comprised of a trench used to explore a sizable rock-cut reservoir dating to the Hellenistic period and continuing through the Roman period (for details, see Martínez Jiménez (2017: 12-24). 7 samples were taken in area 5, from loci including 38, 42, 46, 55, 56, and 59. The phasing of the loci date to the Hellenistic II (2nd century BC), Early Roman, and Roman imperial periods (specifically to the age of Augustus). The samples are mostly derived from fill material, which served various purposes, including levelling in the vicinity (46), blocking former access points (38 and 55), and backfilling over burials (56) (Martínez Jiménez: 2017 13-15).

Area 6

Area 6 was excavated in order to examine a street that led southward from the *decumanus* (for details see Brunner (2017: 25-33). Though the street appears to have gone into disuse in the later periods, the single sample from this area (sample 36) dates to the Hellenistic period, when it still would have been in operation. The sampled material of locus 23 has been interpreted as a thick layer of construction fill (Brunner 2017: 26).

Area 8

A single sample was taken from area 8, locus 15, which dates to the Early Roman period. Excavations in area 8 sought to confirm the location of a street that was detected in geophysical surveys, though the results, and the location of the street, were inconclusive. The sampled material from locus 15 has been interpreted as a surface layer.

6.1.2 Jerash: Samples

A total of nine samples were taken at Jerash during the 2017 season. The phasing of the samples spans the Hellenistic through the Roman Imperial period (c. 2nd century BC- 2nd century AD) and have been included in the Pre-Roman and Roman period datasets in the regional analysis in the following chapter. The uncovered remains were preserved by carbonisation, with cereals, pulses, fruit, economic taxa, and wild/weed species all represented.

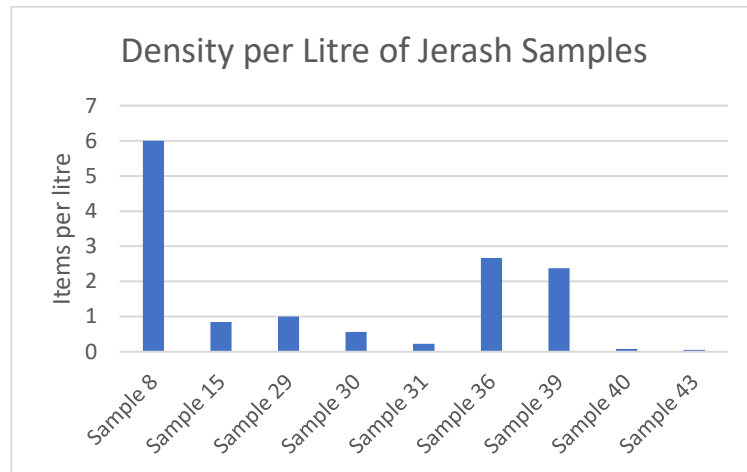


Figure 6-3 Density per litre of samples from Jerash.

Sample sizes vary between 3.5 and 19 litres, with the average sample size being around 12 litres. The samples are characterised by relatively low densities, with an average of just over 1.5 items per litre (see Fig. 6-3 for Jerash densities). This correlates well with archaeobotanical samples from other sites throughout the region (see below for density of Hippos-Sussita samples; see Supplementary data for densities of secondary data samples).

6.1.3 Jerash: Results

Table 6-1 Results of Jerash samples.

Sample number	8	15	29	30	31	36	39	40	43
Locus	15	46	38	42	55	23	59	56	56
Period	Early Roman	Roman-Augustan	Hellen. II (2nd c. BC)	Early Roman	Hellen. II (2nd c. BC)	Hellen.	Hellen. II (2nd c. BC)	Hellen. II (2nd c. BC)	Hellen. II (2nd c. BC)
Sample size	3.5 L	7 L	11 L	12.5 L	13 L	9 L	13 L	13 L	19 L
Density per L	6	0.85	1	0.56	0.23	2.67	2.38	0.08	0.05
Cereals									
Hordeum sp. (hulled)	1								

Hordeum sp.		1					3		
cf. Hordeum sp.							3		
Triticum sp. (free-threshing)							1		
cf. Avena							2		
Cereal indet.			1			3	2		
Pulses									
cf. Lens culinaris	1						1		
Lens culinaris							2		
Vicia/Lathyrus/Pisum							3		
Large pulse indet.	2 frag								
Fruit/Nut									
Vitis vinifera	1	1	4						
Olea europaea	1		1	1					
Olea europaea, estim. from frags	6	3	3	2	1	5	3	1	1
Ficus carica	5		1	2		15			
cf. Ficus carica	2			1		1			
Fibre/Oil Plants									
Papaver cf. somniferum							1		
Papaver sp.							1		
Wild/Weed									
Boraginaceae	x								
Urtica sp.							1		
Silene sp.	1								
Malva sp.							2		
Medicago/Trifolium							2		
Cf. Anthemis sp.							1		
Poaceae	1						1		
Seed indet.		1	1				1		
Other									
Bread/Dung				1	2		1		
Total	21	6	11	7	3	24	31	1	1

6.1.3.1 Cereals

Barley (hulled and unidentified), cf. *Avena* (oat), and free-threshing wheat were all uncovered in the samples from Jerash. *Avena* may instead be considered a wild/weed seed rather than a cultivated

cereal, as was the case in much of the Roman world (Plin., *HN* 18.44 refers to oat as a disease in the wheat crop; see Dalby 2003: 236 for further reference).

6.1.3.2 Pulses

Pulses are not especially common in the samples from Jerash. *Lens culinaris* is the most common pulse uncovered, though this is also the only pulse able to be identified to species, or even secure genus, level. Otherwise, pulses are represented by unidentifiable pulse fragments, and two items identified more generally as *Lathyrus/Pisum/Vicia*.

6.1.3.3 Fruit

Fig and olive are the most represented fruit remains, though this may be skewed by overrepresentation of fig due to the large number of seeds per fruit, and of olive due to the high fragmentation of the stones. The majority of the olive remains occur as stone fragments, though three whole stones were uncovered from various contexts. Grape can also be observed and is present in three samples, with one sample (sample 29, area 5, locus 38) containing four seeds.

6.1.3.4 Flavouring and vegetables

No flavourings or vegetables were uncovered in the samples from Jerash.

6.1.3.5 Other economic taxa

One sample (sample 39, from Area 5 locus 59) produced two items that were classified as economic taxa: one *Papaver* cf. *somniferum*, and one *Papaver* sp.

6.1.3.6 Wild/Weed species

Wild and weed seeds present in the Jerash material include: *Medicago/Trifolium*, *Silene* sp., *Malva* sp., *Urtica* sp., cf. *Anthemis* sp., as well as plants more generally identified as Poaceae and Boraginaceae. With the exception of sample 39 (area 5 locus 59), wild and weed species are not especially common in the samples.

6.1.4 Jerash: Analysis

The characteristic low densities of the Jerash samples indicate that the seed assemblage was likely built up over time rather than deposited in a single destructive event (see van der Veen and Jones 2006). The samples are comprised of material that appears to be preserved by incidents of accidental charring, likely during activities such as food preparation or waste disposal via burning (as in a hearth). The remains would then have been redeposited gradually as trash (or possibly in middens), or else may have been windswept away from their place of primary deposition.

Fruit is the dominant type of remain in the Jerash samples, forming 60% of the collective assemblage (see Fig. 6-4). Cereals are the next most abundant type of remain, comprising 17% of the assemblage, followed by wild/weeds (12%), pulses (9%), and, finally, oil/fibre plants (2%).

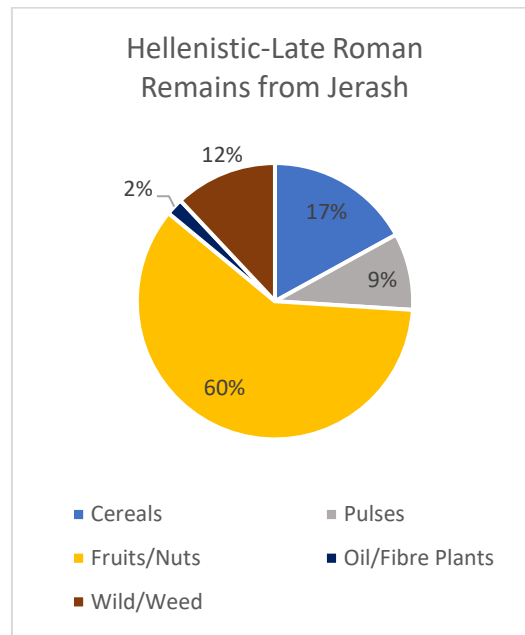


Figure 6-4 Proportions of plant types in the Jerash assemblage.

Only four of the samples from Jerash produced 10 or more items, and the composition of these samples is displayed below in Figure 6-5. In general, they vary in their composition, as well as in the dominant plant type in each sample. Olive remains are ubiquitous, and are among the most abundant types of remains in two samples (Sample 8 and 29). Cereals, too, occur in every sample, though they are not abundant, apart from in Sample 39, where they are the dominant plant type. Fig is present in considerable quantities, particularly in Samples 8 and 36, and wild/weed seeds are absent only in Sample 36. Pulses have a visible presence, but are not dominant, in two samples (Sample 8 and 39), while oil/fibre plants form only a small proportion of Sample 39. Unfortunately, due to the small number of samples that contain at least 10 items, further analysis remains obstructed.

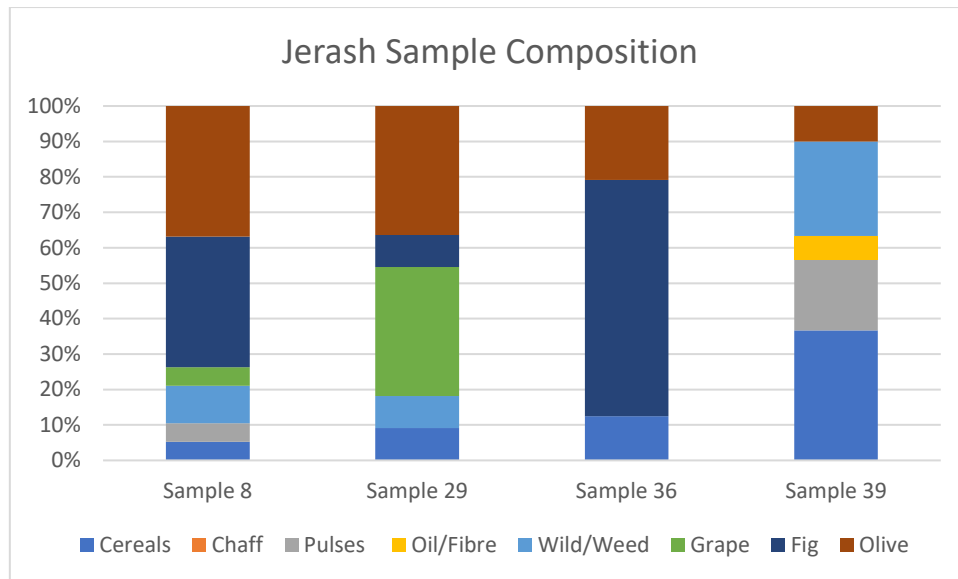


Figure 6-5 Composition of samples from Jerash. Note: only samples with at least 10 items are featured.

6.1.5 Jerash: Discussion

In general, the remains uncovered in the Jerash samples conform well with other assemblages from the region (see Bouchaud et al. 2017 on Petra; see Ramsay et al. 2015 on Huqoq; compare also with Hippos-Sussita below).

With regard to cereal remains, barley is common in most archaeobotanical samples from the region and can be used as fodder or for human consumption, particularly in times of drought and famine. The Jerash assemblage proves no exception, as barley is the most common cereal remain uncovered with five *Hordeum* and three cf. *Hordeum* identified. Though the paucity of cereal remains in general prevent the detection of further patterns, it can be noted that the absence of *Triticum monococcum/dicoccum* agrees with a general decline in glume wheats and a shift toward free-threshing wheats that started prior to the Roman period in the region (see 7.2.2). Chaff is conspicuously absent from the Jerash material, which, together with the low cereal frequencies, may indicate that crop-processing activities were taking place outside of the city during the periods represented here.

The fruit remains are all representative of common fruit in the region, with no evidence for more exotic fruits uncovered from the sampled contexts. *Lens culinaris* is the only pulse identified to species level and is among the more common pulses found in archaeobotanical assemblages throughout the region (7.2.6). The absence of the rarer plant types, such as flavourings and vegetables, is not surprising as such remains are not commonly preserved by carbonisation.

Though low frequencies prevent detailed weed seed analysis, and poor preservation has inhibited the identification of a number of weed seeds to the species level, limited observations regarding the species present may be made. Two seeds, for example, were identified as *Malva* sp., or mallow. Mallows are a common weed species, which can be found in a variety of settings, including disturbed habitats and waste grounds, but also can be consumed as a leafy green or herb. The plant has been known to be used medicinally due to its anti-inflammatory properties: Hippocrates, for example, includes mallow leaves as part of a treatment to be applied to inflamed ulcers (*Ulc.* 4). Numerous ancient authors also make reference to mallow as a garnish, as well as to the plant's ability to stave off hunger and thirst (see, for example, Plut., *Conv. sept. sap.* 14).

Some of the weed seeds, such as *Silene* sp., and some species of *Urtica* sp. can be classified as agriculture weed seeds. *Anthemis* sp. can include species associated with cereal cultivation, as well as with the grazing of animals (Rosenzweig 2016: 326). Furthermore, cf. *Avena* sp. may actually be an arable weed seed rather than representative of cereal consumption, particularly due to its association with plants such as *Vicia/Lathyrus*, *Medicago/Trifolium*, *Poaceae*, and *Anthemis* sp., all of which are suitable for use as forage as well.

A limited amount of information regarding the surrounding environment may also be gleaned. As mentioned, *Malva* sp. includes ruderals that favour growth in disturbed habitats, while species such as *Silene* sp., *Medicago/Trifolium*, and *Papaver* sp. belong to the Secalineatea class, as defined by Zohary (1973), which includes weeds that grow in non-irrigated crop fields. No weed seeds indicative of irrigation were uncovered, though a similar result was achieved in an attempt to use Zohary's phytosociological criteria for weed seed analysis at the nearby site of Petra (see Bouchaud et al. 2017; Zohary 1973: 636-643). As in the case of the Jerash data presented here, such analysis was performed with little success at Petra due to the limited weed seed assemblage that the samples produced.

6.2 Hippos-Sussita

The site of Hippos-Sussita, or *Antiochia Hippos*, is located in modern day Israel, on top of a mountain about two kilometres east of the Sea of Galilee (see Fig. 6-6 below). Like Jerash, Hippos-Sussita was a city of the Decapolis, and is thought to have been the enemy of surrounding Jewish populations, particularly in the city of Tiberias which lay just across the Sea of Galilee (Eisenberg 2015).



Figure 6-6 Location of site, with both Hippos-Sussita and Jerash indicated.

Founded in the early Hellenistic period under the Seleucids, Hippos-Sussita was relatively autonomous under Roman rule, and was initially incorporated into the province of Syria from the time of Pompey (Segal 2008). The city was temporarily removed from this province in the 1st century BC, when reign over Hippos-Sussita was granted to Herod the Great (Segal 2008). Hippos-Sussita continued to be incorporated into different Roman provinces, including the province of Arabia as well as of Palaestina, and is generally thought to have flourished during the Roman and Byzantine periods (Eisenberg 2015). Several churches, some overlaying earlier pagan structures, were erected during the Byzantine period, demonstrating the importance of Christianity at the site, which eventually became the seat of a bishop in the mid-4th century AD (Segal 2008; Frankel and Eisenberg 2018: 57). The city saw varying degrees of occupation until it was eventually destroyed by an earthquake in AD 749. (Eisenberg 2015). Today, the site is complete with remains of typical urban architecture, including a central forum, Hellenistic temple (temenos), bathhouse, kalybe (temple to the Imperial cult), as well as a Roman period aqueduct and fortification.

As archaeobotanical sampling had not previously been carried out at Hippos-Sussita, a campaign began in 2017 and was continued through the 2018 field season.

6.2.1 Hippos-Sussita: Contexts



Figure 6-7 Site view of Hippos-Sussita ([Hippos-Sussita Excavation Project - About \(haifa.ac.il\)](http://hippos-sussita-excavation-project-about.haifa.ac.il)).

The Southern Bathhouse (SWL I)

SWL I consists of the bathhouse area to the south of the forum. With 47 samples in total, it is by far the most sampled area, as it was the focus of much of the excavation efforts during the 2017 and 2018 field seasons. Samples were taken from the layers overlaying the bathhouse, as well as in the bathhouse itself, from contexts including the furnace, the hypocaust system, and a large dump situated adjacent to the bathhouse.

The majority of the samples from SWL I date to what is considered the Late Roman period for the purpose of this thesis. There are also three samples that have been attributed to the Roman period, and a number of samples that date to the later Byzantine and Umayyad period occupations, up to the 8th century AD.

The Hellenistic Compound (HLC)

The large Hellenistic Compound, also referred to as the *temenos* or Hellenistic Sanctuary, lies to the north of the forum, and is thought to have continued to be in use alongside later structures into the Roman period (Eisenberg 2015: 30). 11 samples were taken from this area during the 2017 season.

Five of samples from the HLC are from contexts dated to the 1st century BC, and another five have been dated to the early 3rd century AD. One sample dates to the 1st century AD.

The *Decumanus* East (DME) and *Decumanus* West (DMW)

Samples were taken from both sides of the *decumanus maximus*, which was the main street running through the city; seven from the eastern end, and two from the west.

Three samples from the DME span the 1st centuries BC to AD, while the remaining four are later in date, representing the Late Roman/Byzantine periods. The two samples from DMW date to the 1st century BC-AD.

The Theatre (THR)

One sample was taken during the excavation of the theatre in 2018. The sample, however, produced no carbonised plant remains, and instead was entirely comprised of modern material.

North Dump

Providing comparison with the samples from the southern dump adjacent to the bathhouse, three samples were taken from the dump situated on the northern face of the mountain during the 2018 season. These samples differ from the homogenous samples from the SWL I dump that appear to be comprised entirely of fuel material and are characterised by lower densities and more diverse remains.

The samples from the North Dump are unable to be assigned to specific phasing as the area has not been excavated, and instead are comprised of material which may date to the Hellenistic period through the Byzantine periods.

6.2.2 Hippos-Sussita: Samples

36 samples were taken during the 2017 field season and an additional 35 samples were taken in 2018. In general, sample size was approximately 10 litres, though in certain contexts where soil was limited, smaller samples were taken. Samples vary in phasing, with the Hellenistic (c. 3rd-1st centuries BC), Roman (1st-3rd centuries AD), and Late Roman/Byzantine (4th-6th centuries AD) periods all

represented. A number of samples have been assigned to later periods (up to the 8th century AD), and thus were not able to be included in the regional analysis in the following chapter.

The majority of the samples contained carbonised material, while other types of preservation were far less common, with five samples producing mineralised remains and no waterlogged material recovered. The charred remains encompass a variety of plant types, including cereals, chaff, fruits, pulses, as well as wild/weed seeds.

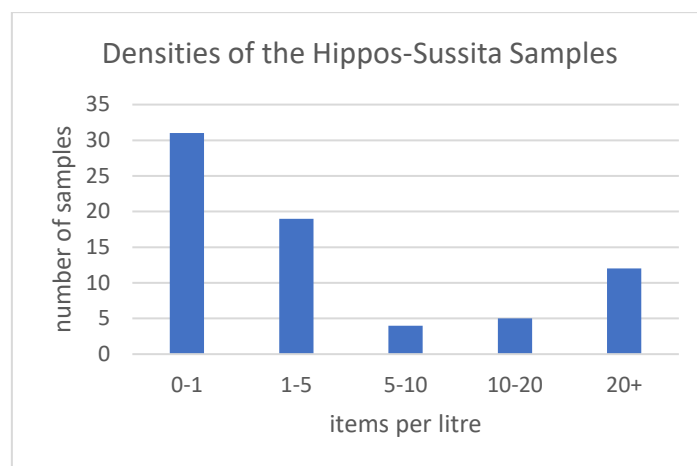


Figure 6-8 Densities of the samples from Hippos-Sussita.

Most samples are characterised by relatively low densities, as is typical of archaeobotanical samples in the region (Fig. 6-8; see Fig. 6-3 for Jerash densities; see 7.3.6 on densities in secondary dataset from greater region). The average density for the Hippos-Sussita samples is approximately 7.2 items per litre. However, the samples taken from the dump area in SWL I (see below for area description) are exceptionally rich in charred material (charcoal and olive), which may skew this figure slightly. If the bathhouse dump samples from loci 2880, 2881, and 2882 are removed, the Hippos-Sussita samples have an average density of 3.5, which, still, may be somewhat inflated by samples from SWL I that are particularly rich in olive.

6.2.3 Hippos-Sussita: Results

The results from the Hippos-Sussita samples have been summarised by period in Table 6-2 below; the raw data for each individual sample can be seen in Appendix C.

Chapter 6 Primary Data from Jerash and Hippos-Sussita

Table 6-2 Results from the 2017 and 2018 excavation seasons at Hippos-Sussita, indicated by period. Note: 'x' indicates presence. Figures are extrapolated to account for subsampling.

	Pre-Roman	Roman	Late Roman- Byzantine	Byzantine- Umayyad	Indet. (Hellenistic- Umayyad)
Number of samples	9	11	30	10	9
Cereals					
<i>Hordeum</i> sp.			1		1
cf. <i>Triticum dicoccum</i>		1	4		
<i>Triticum</i> sp. (free-threshing)					1
<i>Triticum</i> sp.	1				2
cf. <i>Triticum</i> sp.		2	2	1	
Cereal indet.		1		1	1
Cereal chaff					
<i>Hordeum</i> sp. (rachis)					1
<i>Triticum monoccum/dicoccum</i> (spikelet base)		1			1
<i>Triticum</i> sp. (free-threshing cf. hexaploid rachis)					11
<i>Triticum</i> sp. (free-threshing rachis)					17
cf. <i>Triticum</i> sp. (rachis)					6
Cereal indet. (rachis)	0				4
Cereal indet. (awn)			1		
Cereal indet. (culm node)			4		
Pulses					
<i>Lens culinaris</i>			4		
cf. <i>Lens culinaris</i>		1	1		
<i>Vicia</i> cf. <i>faba</i>					1
<i>Vicia/Lathyrus/Pisum</i>			4		
Large pulse indet.		1	3		1
cf. Large pulse indet.			1		
Fruit/Nut					
<i>Ficus carica</i>	5	18	5	4	28
cf. <i>Ficus carica</i>		8	9	3	2
<i>Vitis vinifera</i>		3	9	3	9
<i>Vitis vinifera</i> , mineralised			1	3	
<i>Olea europaea</i> , whole	3	15	247	10	5

<i>Olea europaea</i> , estim. from frags	11	100	3421	172	27
<i>Olea europaea</i> , mineralised		1	1		
Fruit skin indet.				x	
Fruit stone indet.				x	
Fruit flesh indet.			x	x	
nutshell indet.			x		
Other cultivated					
cf. <i>Linum usitatissimum</i> type		1			
Wild/Weed					
cf. <i>Chenopodiaceae</i>		1			
<i>Caryophyllaceae</i>			1	1	1
<i>Vicia/Lathyrus</i>			1		8
cf. <i>Vicia/Lathyrus</i>			2	1	2
<i>Medicago/Trifolium</i>		1	2	4	
cf. <i>Medicago/Trifolium</i>			2		
small legume indet			2		
cf. small legume indet			2		
<i>Fabaceae indet</i>			1		
<i>Boraginaceae, uncharred</i>			x		
<i>Asteraceae</i>	1		4		
<i>Cyperaceae</i>				1	1
<i>Poaceae</i>			1	2	
Small <i>Poaceae</i> indet.		9			
Large <i>Poaceae</i> indet.			1		
Seed indet.		4	16	2	1
seed indet (round)	1				
Seed indet, mineralised			1		
Other					
cf. Dung			x		
Bread/dung			x		
Amorphous charred lump indet.	x	x		x	
Bud				1	
Total	22	168	3754	209	131

6.2.3.1 Cereals

In general, few cereals were uncovered in the samples from Hippos-Sussita. Furthermore, due to poor preservation, a number of cereal remains were not able to be identified to species, or at times even genus, level.

Only two barley grains (*Hordeum* sp.) were uncovered in the Hippos-Sussita samples: both from SWL I, one from locus 2933, which is of undetermined dating, and the other from Byzantine layers.

Slightly more wheat was uncovered, though eight out of 10 of these grains were unable to be identified to the species level. *Triticum* sp. or cf. *Triticum* sp. was uncovered in the HLC, SWL I, and DME, with phasing spanning from the Hellenistic through Byzantine periods. A single glume wheat (cf. *Triticum dicoccum*) was uncovered in a sample from the Late Roman period dump in SWL I. Only one free-threshing wheat grain was identified, though because it was uncovered in the North Dump samples, the dating is broadly from the Hellenistic through Byzantine periods.

There is no evidence of minor cereals such as millets, rye or oat, and even unidentifiable cereal remains do not greatly increase cereal frequencies, as such remains were observed in only two contexts.

6.2.3.2 Chaff

The samples from Hippos-Sussita produced a limited amount of chaff items. A single *Triticum monococcum/dicoccum* spikelet base was recovered in the 1st century AD layers from the HLC. A culm node and awn from the SWL I dump and hypocaust system, point to the possible inclusion of such material among the fuel sources for the bathhouse. Particularly diverse chaff remains were obtained from SWL I locus 2933, including *Hordeum* sp. rachis, one *Triticum monococcum/dicoccum* spikelet base, as well as 28 free-threshing wheat rachis segments, some of which may be of the hexaploid variety. This sample is exceptional in that it yields uncharacteristically diverse remains and high densities, though, unfortunately, it is of undetermined phasing at this time.

6.2.3.3 Pulses

Like cereals, pulse remains are not especially abundant at Hippos-Sussita. *Lens culinaris* has been identified in samples from the bathhouse, the adjacent dump material, as well as from the eastern portion of the *decumanus*: this amounts to three cf. *Lens culinaris* in total. One *Vicia* cf. *faba* has also been identified in the exceptionally rich sample from SWL I 2933. Due to poor preservation, six pulse remains have not been able to be identified beyond 'large pulse indeterminate.'

6.2.3.4 Fruit

Olive is by far the most represented fruit in terms of both frequency and abundance. Apart from the large quantities of olive remains, the fruit assemblage is typical, with fig and grape also represented.

6.2.3.5 Flavourings and vegetables

Neither flavourings nor vegetable plant remains were found in the Hippos-Sussita samples.

6.2.3.6 Other Economic taxa

Flax (*Linum usitatissimum*) was uncovered in one 1st century AD sample from DME.

6.2.3.7 Wild/Weed species

The wild/weed assemblages are not especially diverse or prevalent in the Hippos-Sussita samples, and a significant number of identifications were only able to be carried out to the family level due to poor preservation. Among the identified wild plants present are: *Medicago/Trifolium*, *Vicia/Lathyrus*, Asteraceae, Caryophallaceae, Poaceae, as well as uncharred Boraginaceae.

6.2.4 Hippos-Sussita: Analysis

The Hippos-Sussita assemblage is the product of a number of formation processes. While the samples from most excavation areas (i.e. the HCL, DME, and DMW) appear to contain material that – in a similar vein to the Jerash material- has been accidentally deposited and accumulated over time, this does not apply to all of the samples from the SWL I bathhouse and dump, nor the North dump. The samples from the hypocaust system, for example, likely represent in-situ deposits of material that was burnt as fuel, while the material from the SWLI dump adjacent to the bathhouse may be comprised of remains that were burnt as fuel, and then redeposited when raked out of their place of primary deposition (the bathhouse). Similarly, the material from the North dump certainly does not represent the gradual accumulation of accidentally charred material, but rather refuse disposal.

In terms of overall sample composition, fruit remains are by far the most abundant type of remain in the Hippos-Sussita samples, forming over 96% of the recovered archaeobotanical material, with olive accounting for nearly 94% of the fruit remains. Wild/weeds are the next most abundant at 1.7% of the total assemblage, followed by chaff (1%), pulses (0.3%), and cereals (0.4%).

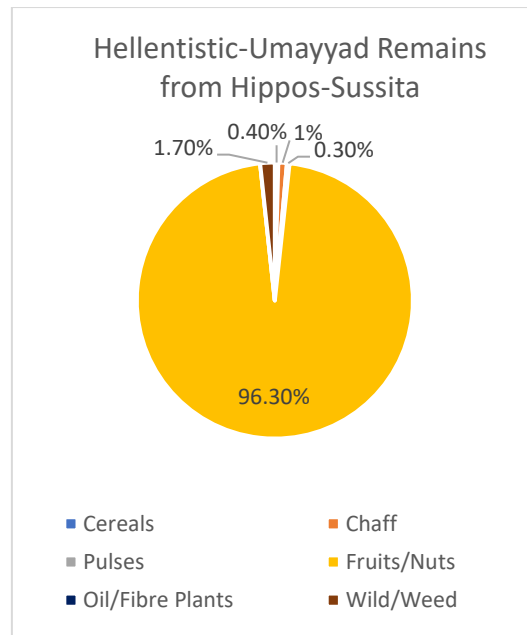


Figure 6-9 Composition of botanical assemblage from Hippos-Sussita.

Though the olive assemblage from the SWL I dump certainly contributes to the prominence of fruit in the samples, it should be noted that even in other contexts, the dominance of fruits, and especially olive, is notable (see figures 6-10 and 6-11 below for the composition of individual samples from the 2017 and 2018 excavation season). In general, fruit remains tend to be more common than other types of plants: multiple (Roman-Late Roman) samples from the HLC, for example, contain fig, grape, and olive, though are lacking in other plant types.

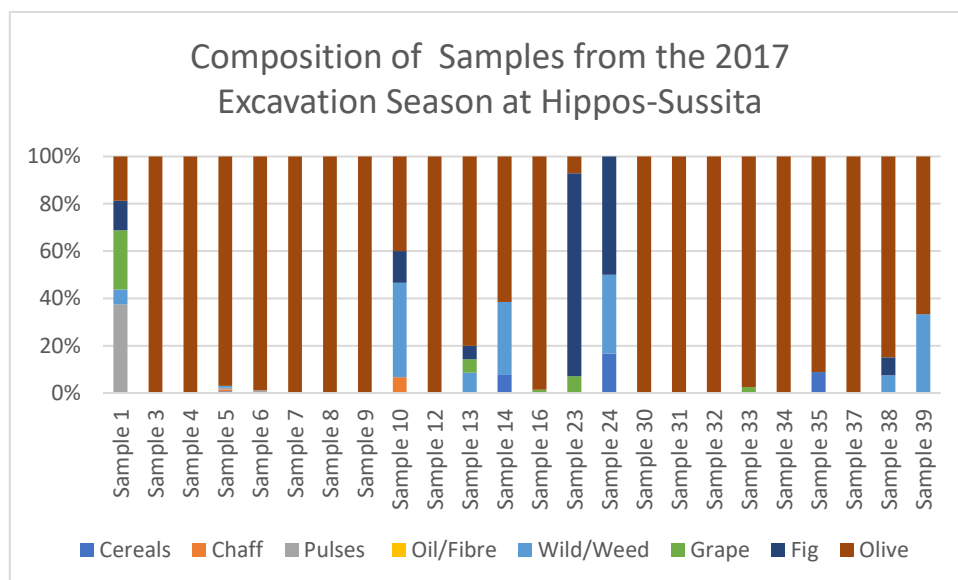


Figure 6-10 Composition of samples taken during the 2017 excavation season at Hippos-Sussita. Note: only samples with at least 10 items are included.

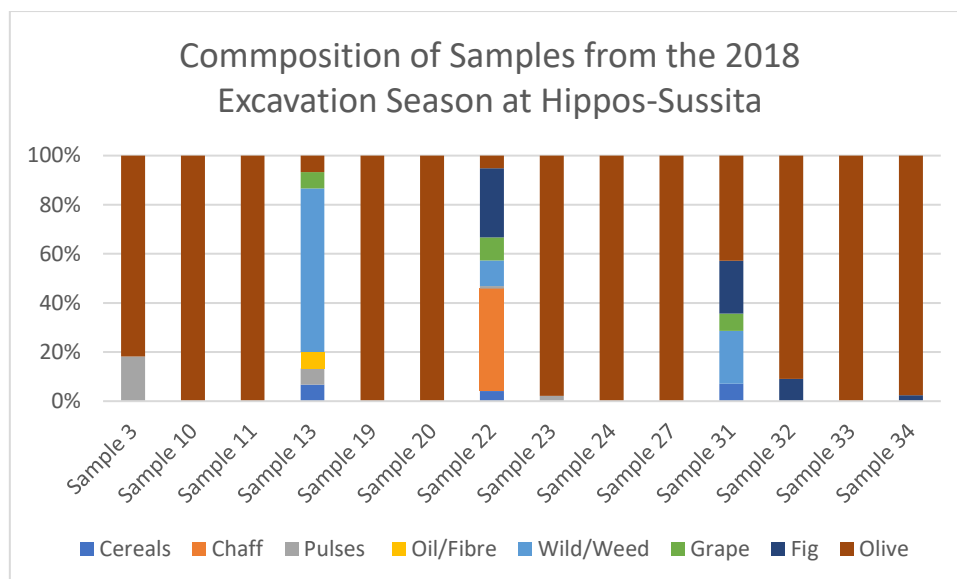


Figure 6-11 Composition of samples taken during the 2018 excavation season at Hippos-Sussita. Note: only samples with at least 10 items are included.

The prominence of fruits is illustrated further by comparing the frequencies of other common plant remains with that of fruits, as can be seen in Fig. 6-12 below. The results indicate that, even when olive is discounted, fig and grape remains occur in just under 27% and 14% of samples respectively, whereas lentil is found in 4%, and barley in under 3% of samples.

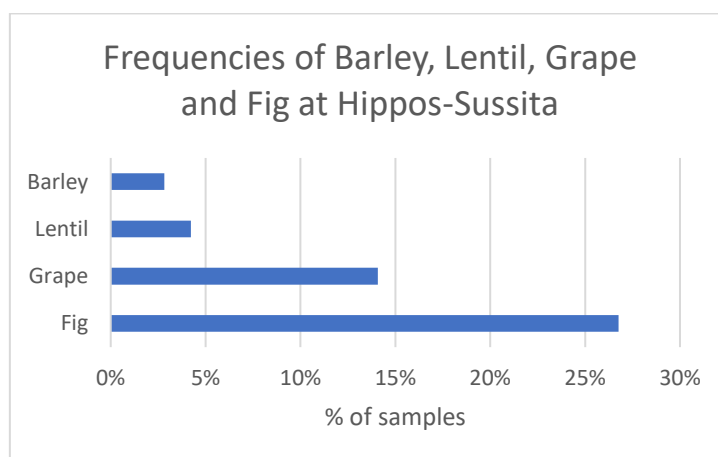


Figure 6-12 Frequencies of common crops including barley, lentil, grape and fig at Hippos-Sussita.

6.2.5 Hippos-Sussita: Discussion

The abundance of olive remains at Hippos-Sussita highlights that olive cultivation was undoubtedly taking place in the relative vicinity of the site, and, as indicated by the presence of an olive press, processing was taking place within the city itself, at least in the later phases of occupation, though

possibly earlier (see Frankel and Eisenberg 2008: 58 on presence of screw press in the centre, though this particular press appears to date to the later Early Islamic occupation).

The low cereal frequencies observable in the Hippos-Sussita data may be reflective of the contexts that were sampled, highlighting that there is little representation of crop-processing activities, waste from household food preparation, or food stores. Given that the majority of the samples were taken from bathhouse layers and the associated refuse, which is largely comprised of fuel material, as well as from other public areas such as the *decumanus* and Hellenistic compound, the lack of cereals is unsurprising as they are not likely to have been processed or consumed in such settings.

Additionally, the paucity of cereal chaff in the samples provides further testament to the fact that cereal processing does not appear to have taken place in the sampled areas at Hippos-Sussita and was perhaps carried out outside of the centre.

The pulse frequencies are prohibitively low, and, due to the low densities of the samples, it is difficult to discern whether the pulse remains are representative of refuse, accidental deposition, or fodder/dung. Similarly, poor preservation, which necessitated more general identifications, together with low frequencies of wild and weed species, prohibits detailed analysis of such remains.

Furthermore, as the majority of the wild/weed species were only able to be identified to the family level, Zohary's phytosociological criteria could not be applied to the Hippos-Sussita material (Zohary 1973).

It can, however, be noted that forage crops such as *Vicia/Lathyrus* and *Medicago/Trifolium* are the most common among the wild/weed seeds uncovered. This may support that such remains have become preserved in the archaeobotanical record in the form of dung, possibly burned as fuel. The distribution of these remains supports the latter supposition, as the majority of such remains are derived from bathhouse contexts, including in samples from the hypocaust system, where large quantities of fuel would have been necessary (see 2017 Sample 10 in Appendix C for a sample from the hypocaust system that contains a diversity of wild plants that is uncommon in the Hippos-Sussita samples). However, it is worth noting that two samples from the *decumanus* (east) also contained these plants, and that the samples are skewed toward the bathhouse area, which was sampled more than any other area. Still, though it is reasonable to view the presence of these plants in the bathhouse contexts, at least, as potentially indicating dung fuel, such an interpretation remains highly hypothetical, as the paucity of such remains inhibits efforts to check the material against the dung fuel indicator criteria stipulated by Miller and Smart (1984), and later expanded upon by Charles (1998).

6.3 Hippos-Sussita olive remains in context: a closer look

The prominence of olive remains in the Hippos-Sussita data is widely apparent, and a large proportion of the olive comes from the dump in SWL I. The homogenous composition of these samples (almost entirely comprised of wood charcoal and olive remains), together with the high densities exhibited as well as the contextual evidence, indicate that the remains likely represent fuel used to provide heat in the hypocaust system in the adjacent bathhouse. This is supported by finds of similar material (i.e. carbonised charcoal and olive remains) within the hypocaust system itself (see Samples 10 and 11 from 2017 season).

The use of olive remains, or pomace, as fuel has been widely attested throughout the empire (see Rowan 2015: 469 for table detailing sites with evidence for the use of pomace as fuel). The Near East, and more specifically the Levant, is no exception, with the use of pomace fuel observed at sites including Sepphoris, Petra, as well as in the Iron Age layers at the nearby site of Tel Beth-Shean (see Fischer and McCray 1999 for use of pomace to fuel furnaces at Sepphoris; Bouchaud et al. 2017 on Petra; Simchoni and Kislev 2008: 679-686 for discussion of Tel Beth-Shean material).

Elsewhere, examples such as Leptiminus and Utica in North Africa have pointed to the use of pomace fuel in industrial contexts such as pottery kilns, while olive remains were used to fuel a bathhouse at La Garde in France (Smith 1998; Rowan 2018; Brun et al. 1989). It is thought that the constant and high temperatures at which such remains burn, together with the fact that they produce less smoke than other materials including wood, would have made olive remains a particularly desirable fuel source (Rowan 2015: 466). Certainly, the bathhouse at Hippos-Sussita would have been no exception: constant high temperatures would have proved useful in the heating system and surely less smoke would have been beneficial in an urban setting. Additionally, it is also worth considering that pomace would have been made more attractive by fuel availability issues in the region, which is less heavily forested than other parts of the Roman world.

While typically the residue from olive oil extraction is described as being comprised of many small fragments of olive stones that had been crushed prior to pressing, whole olive stones have a significant presence in the Hippos-Sussita data, as do halves and stones of only minimal levels of fragmentation (see Neef 1990: 298-299 on pomace, or 'jift' comprised of many fragments). Thus, though the use of olive as a fuel source is widely known and documented in the archaeobotanical record, further analysis is necessary to better understand the Hippos-Sussita material.

There has been some debate amongst scholars in recent years as to whether the stone was crushed in ancient olive oil production. Those who believe that the stone was not crushed due to the negative effect this would have on the taste of the oil often look to literary evidence from ancient

authors such as Cato (*Agr.*, 66.1) and Columella (*Rust.*, 12.56.6) (see, for example, Brun 1986, who supports the ancient literature with evidence of complete olive stones from Toulon, France). Others discredit the ancient authors, maintaining that not only would it have been very difficult and time consuming to avoid crushing the stones, but it is also impractical as the kernel and stone contain significant amounts of oil themselves (Mattingly 1988; Foxhall 1993; see also Frezzotti and Manni 1956).

In examining the carbonised olive remains from the Hellenistic Greek site of Tria Platania, Margaritis and Jones (2008a) note a significant amount of whole olive stones characterising the assemblage (Margaritis and Jones 2008a: 398). In interpreting the remains, the authors examine both the scholarly debate surrounding the fragmentation of olive stones as well as of the archaeological evidence, focusing particularly on the *trapetum*, the rotary crusher used to reduce the olives into a paste, as described in ancient literature and observed at sites such as Pompeii and Toulon (Margaritis and Jones 2008a: 398-400; see Drachmann 1932 on details of *trapetum*; Brun 1986). Despite their useful examination, the authors were ultimately unable to resolve questions regarding the ability of the *trapetum* to crush the olive flesh without breaking the stones. They do, however, conclude that whether by use of the *trapetum* or another technique, the milling method used was indeed able to leave a notable portion of the stones uncrushed (Margaritis and Jones 2008a: 399-400).

In an effort to assess the relative prominence of whole olive stones in the Hippos-Sussita data, the proportions of whole olives and olives estimated from fragments will be considered and compared with data from other sites (see methodology on this quantification). Previously, the smoothness, or roundedness, of the edges has been suggested as a way in which to discern whether fragmentation occurred pre- or post-deposition during processing (see Neef 1990). However, recent scholarship has cast doubt on the utility of such a method, and experimental work by Braadbaart et al. (2016), has demonstrated that such a criterion is not a reliable basis for interpretation. As such, it was decided that such a method would not be utilised in examining the Hippos-Sussita assemblage.

In order to facilitate appropriate comparison, the author selected sites that use similar methods of quantification as was used for Hippos-Sussita: that is, if comparable ratios are to be produced, the data must be reported with both the number of whole olive stones as well as the number of stones estimated from fragments indicated. Though initially weight was used to estimate the amount of whole stones represented by fragments in the Hippos-Sussita data (as in the data tables above), archaeobotanical reports using such a method for olive oil pressing residue were scarce. As such, efforts were made to expand the comparable datasets by counting the Sussita fragments and

including those that record the number of fragments as well. These counts were converted to number of whole stones represented using the figure of 11.2 fragments per stone, as proposed by Simchoni and Kislev (2008) and re-tested and confirmed by Margaritis and Jones (2008a). The results are indicated in Table 6-3 below.

Table 6-3 Fully quantified archaeobotanical assemblages of olive oil pressing residue.

Site	Whole Stones	Halves	No. estim. from halves	Fragm.	No. estim. from fragm.	Total estim.	% whole of total estim.	% estim. from fragm.	Reference
Hippos-Sussita	217	301	151	8633	771	1139	19.1%	80.9%	
Tell Beth-Shean	47				822	869	5.40%	94.60%	Simchoni and Kislev 2008
Petra ez-Zantur	29			2677	239	268	10.80%	89.20%	Bouchaud et al. 2017
Tria Platania	1524			30492	2723	4247	35.90%	64.10%	Margaritis and Jones 2008a
Utica	9	23	11	5674	507	527	1.70%	98.30%	Rowan 2018
Pompeii, bakeries	735	645	322	19218	1716	2773	26.50%	73.50%	Coubray et al. 2019
Obulco	1016	431	215	15367	1372	2603	39%	61%	Voropaeva and Stika 2015

In comparing the Hippos-Sussita dump material to other pomace assemblages, it becomes clear that the proportions of whole stones to fragments in the Hippos-Sussita data does not appear to be entirely different from that of other sites with residue of olive oil pressing. What is remarkable, however, is the variety that characterises such assemblages, with a wide range in the proportion of whole to fragmented olive stones able to be observed.

This variety seems to have been masked previously in a number of ways. In examining other pomace datasets, the author noticed some inconsistency in the method used for calculating the percentage of fragmented/whole olive stones in many of the assemblages considered here: a number of the reports calculate the proportion of fragmented stones by simply taking the raw count of the fragments, rather than first converting the raw count to the number of whole stones represented, whether by means of the 11.2 figure or by using the weights of whole olive stones. As a result, the proportions of fragmented olive in the assemblages appears to be significantly higher than it would

if the figure was converted so as to take into account that, as a single olive stone can produce many fragments, the number of fragments is not a comparable value to the number of whole stones.

This issue can be exemplified by taking a closer look at the olive assemblage obtained from bakeries at Pompeii. Coubray et al. (2019) describe the material as ‘very fragmented,’ indicating that the 735 complete stones comprise 4% of the assemblage, 645 halves 3%, while the 19,218 fragments form the bulk of the assemblage at 93% (Coubray et al. 2019: 123). However, if the number of fragments is converted to number of whole stones represented using the 11.2 estimation, the percentage of the assemblage formed by fragmented stones falls to 61.9%, or 73.5% if the halves are counted amongst the fragments as in Table 6-3 above. In this way, it becomes apparent that whole stones have a more significant presence in the assemblage than the original figure implies.

Furthermore, the manner in which pomace material is described may also lead to an underestimation of the presence of whole olive stones in such assemblages. As mentioned, Coubray et al. (2019) describe the Pompeii bakery material as highly fragmented, and, like others, Rowan (2015) indicates that the ‘fragmentary nature of the endocarps’ is one of the key features allowing for the identification of pomace fuel (Rowan 2015: 467). While this does not explicitly rule out that some olive stones may be preserved whole, the implication is that the vast majority of remains should be fragments. Similarly, Simchoni and Kislev (2008) describe the pomace remains from Tell Beth-Shean as being comprised of many small fragments and only ‘a few’ whole stones, and, though fragments do form a greater percentage than in most of the other assemblages considered here, the (at least) 47 whole stones exceeds the bounds of what can generally be described with such terminology (Simchoni and Kislev 2008: 679).

Thus, qualifications such as those described here may not sufficiently account for the variation that can be observed in the datasets examined; instead, it is apparent that greater emphasis on the variety in fragmentation levels amongst charred olive oil pressing residue may be justified.

Furthermore, the above analysis highlights the general lack of a standardised quantification method for olive oil pressing residue. The standardisation of quantification would not only facilitate inter-site comparison, it would also foster a better understanding of olive oil pressing residue, and of the variation among such assemblages.

6.4 Conclusions

In general, the remains from both Jerash and Hippos-Sussita are typical of charred archaeobotanical assemblages from the region in terms of the range of taxa represented, though, in the case of the

latter, not necessarily in composition. The dump material from Hippos-Sussita, in particular, highlights the oleiculture and olive oil production that were practiced in the region. Furthermore, the remains emphasise the importance of alternative fuel sources at the site, and the utility of olive remains as a fuel source, as has been demonstrated throughout history. Whether or not olive oil was processed on site, certainly cultivation took place in the surrounding areas. In this way the archaeobotanical material from Hippos-Sussita highlights the important link between cities and their hinterlands, attesting to a considerable degree of connectivity in the region. It should also be noted that, in analysing the Hippos-Sussita olive remains in their greater context, the significant degree of variation in the fragmentation levels that characterise olive oil pressing residue has been highlighted.

Chapter 7. Results: The East

7.1 Data overview

Prior to analysis, it is important to look at the broad patterns affecting the data in order to shed light on any potential biases that may skew the data and subsequent interpretation.

The dataset for the East is comprised of 138 records, from 97 sites (see Fig. 7-1 below for distribution). The individual datasets that come from these sites vary in quantity as well as in quality, and in viewing the data overall, trends can certainly be observed.

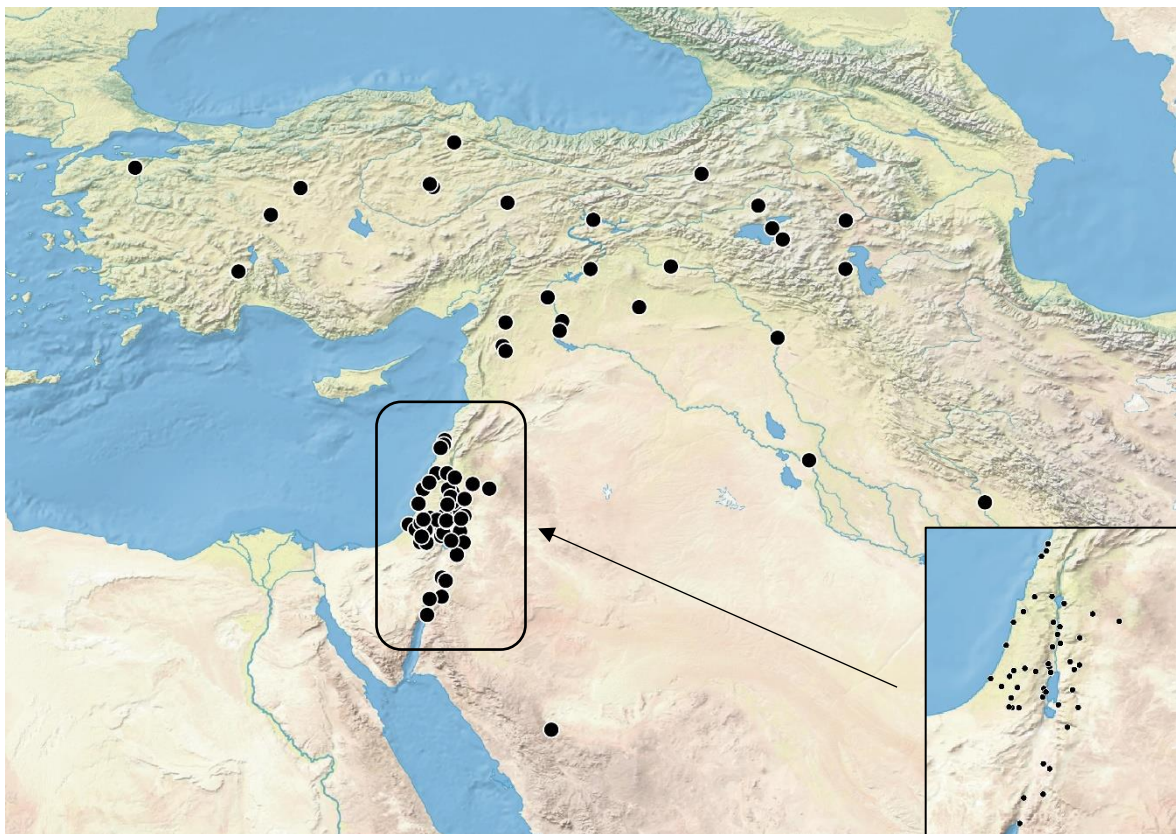


Figure 7-1 Map with all sites in the Eastern dataset indicated.

7.1.1 Geographical distribution of data

Records have been collected from sites within the modern nations of Turkey, Lebanon, Israel, Syria, Jordan, Iraq, as well as parts of Saudi Arabia and Iran (see 5.2 on study area). Rather than being evenly distributed, certain patterns and biases in the regional distribution of sites/records can be observed.

Israel, Jordan, and Turkey far surpass the other nations included in this study in terms of number of records, with Israel and the Palestinian territories yielding the most, at 44 or roughly 32% of all records. There are 40 records from Jordan, and 27 from Turkey (see Fig. 7-2). With the land mass of Turkey, for example, vastly surpassing that of Israel, the area encompassed by modern day Israel firmly represents the highest concentration of sites throughout the entirety of the East.

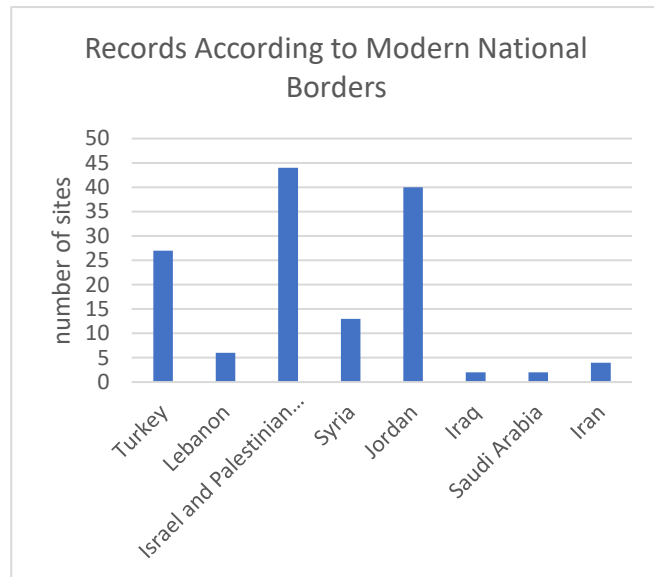


Figure 7-2 Records in the Near Eastern dataset according to modern national borders.

Israel's prominence is clear for all of the chronological divisions, though the number of records from Turkey gradually decreases from the Early Pre-Roman period, possibly reflecting a stronger interest in earlier sites in the region.

Lebanon appears to be underrepresented; it is one of the least sampled places in terms of records per modern national divisions, which is unfortunate due to the rich regional history and strategic coastal location. Though Saudi Arabia and Iran yield few sites (in the case of Saudi Arabia, one), this is expected, as the Roman Empire did not occupy as much of the land now located within these nations. In Iran, for example, there are additional sites that yield macoremain, which were deliberately excluded from this study, as they technically were never a part of the Roman world.

The modern political climates in countries such as Iraq and Syria, have certainly affected archaeological expeditions to these countries, which may have limited the amount of material from each nation that has recently been examined. This may be supported by the fact that none of the data from Syria postdates the beginning of the Syrian Civil War in 2011, and the material from the two sites in Iraq was likely collected prior to the Gulf War (1990-1991). That is not to say that archaeological excavation has been halted completely, for certainly some projects have been carried out, but in general, conflict would cause logistical problems for excavation. Furthermore, many of the excavations that have been undertaken in recent years seem to focus on earlier periods (such as the Neolithic layers), which may be further from the surface and thus subject to less damage and disruption (see recent work in Matthews et al. 2019, 2020 for early Neolithic excavations in Iraqi Kurdistan, which included environmental sampling).

In terms of the subregions utilised in the data analysis, the Levant is by far the most represented, with 96 records (~70%). The region referred to as the Greater Middle East produced 26 records, and

the remaining 16 records are from Anatolia (see methodology for regional divisions).¹² As such, the results will certainly be skewed, with much of the observable patterns being most reflective of the archaeobotanical record in the Levant.

7.1.2 Chronological distribution of data

The Early Pre-Roman period (11th-5th century BC) has produced the most records, with 43 total (see Fig. 7-3). This may be due to a number of factors, including the larger time span that this division covers. The Roman period has the second most, with 38 records, and the Late Roman period has the least of the four main chronological divisions, producing 23 records in total. In general, the later periods receive far less attention in the region, so the prominence of the Roman period in terms of number of records is somewhat surprising (see 2.3.3).

In terms of number of samples per period, the highest amount is 546 samples for the Early Pre-Roman period, with the amount decreasing with each period (see Fig. 7-4). It is interesting to note, however, that though the Pre-Roman period has more samples (308) than the Roman period (212), the Roman period yields more remains total by over 930,000 items. This can be explained by

the reports, which feature data at the sample level less often for the Roman period, and instead group the material by period or excavation area (here, referred to as ‘sumsampling’). Still, the Early

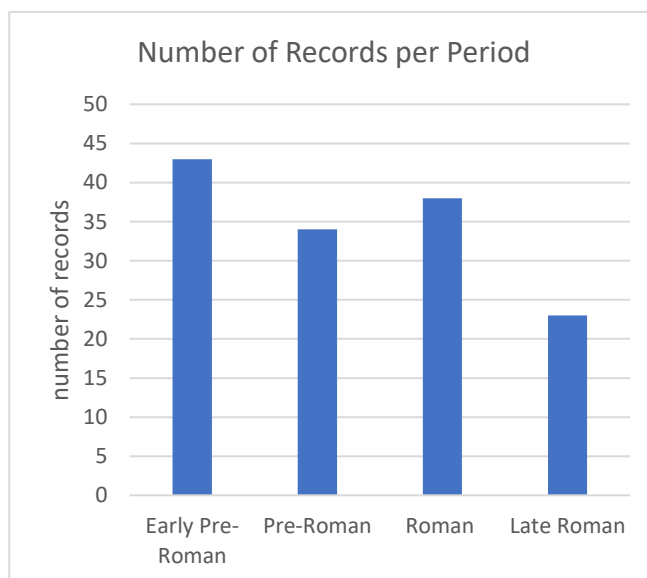


Figure 7-3 Number of records in Near Eastern dataset by period.

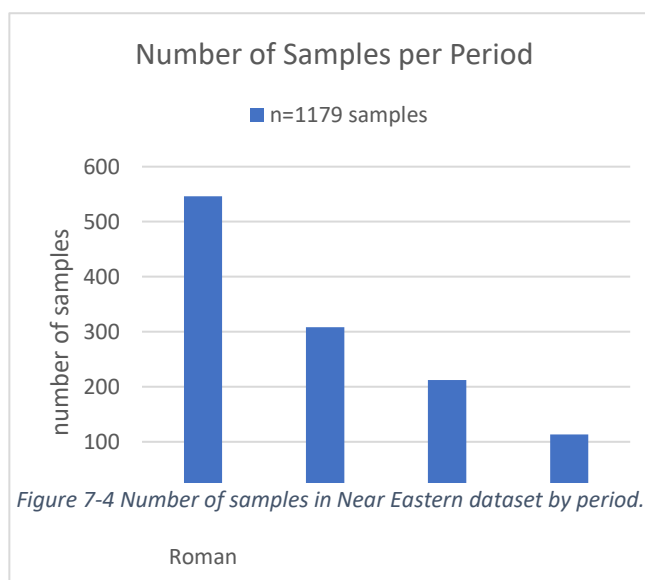


Figure 7-4 Number of samples in Near Eastern dataset by period.

¹² Note the distinction between the modern nation of Turkey and the geographical subdivision of ‘Anatolia’ as utilised in this study; Anatolia, as here utilised, refers to the Anatolian peninsula only. As such, some sites located in modern Turkey, but not on the Anatolian peninsula, are included in the ‘Greater Middle East’ for the sake of this study (see 5.8)

Pre-Roman period yields the most items by large margins, with well over 1,800,000,000 more items than any other time period.

It should be noted that eight sites were not able to be placed in more specific chronological divisions, but are more generally classified, with one Pre-Roman to Roman site, three general Pre-Roman sites, and four general Roman sites. These sites span multiple periods within the study, and thus were not able to be included in the analysis that follows.

7.1.3 Distribution of data by site type

Urban sites are the most prominent site type by large margins in every region and time period, comprising roughly 55% of the records, or 76 urban records total (see Fig. 7-5). This

picture differs from studies in Roman Britain, for example, where material from rural sites dominates the greater body of archaeobotanical data for the region (see Livarda 2008). This is in part due to developer-funded excavations necessitating the excavation of rural settlements, though rural sites have also had a more privileged place on the research agenda in the UK in recent

years, with projects such as the joint enterprise between the University of Reading and Cotswold Archaeology 'The Rural Settlement of Roman Britain' deliberately focusing on these smaller sites (Allen et al. 2018).

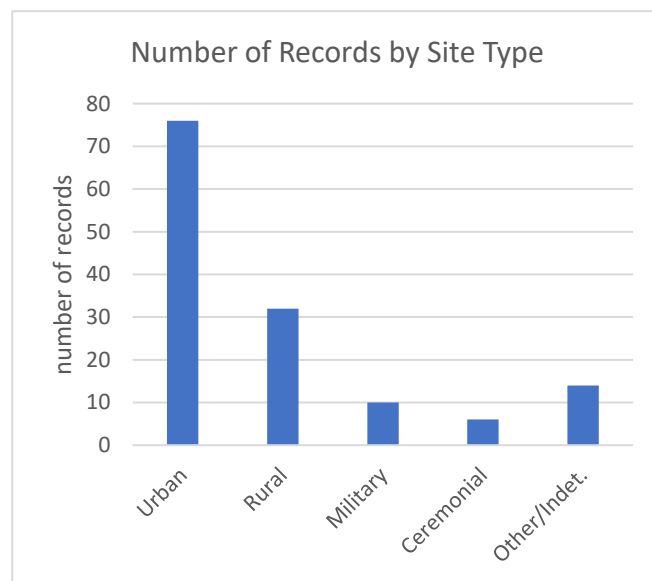


Figure 7-5 Number of records by site type.

Excavations in the East, however, have long favoured large, often multi-period, sites. This pattern is not entirely surprising, as these sites are not only the most easily detected, often indicated by the presence of large Tells, they are also often excavated in efforts to locate sites mentioned in ancient texts. This pattern may also be linked to the urbanised nature of the East, as opposed to Britain, before and during Roman imperial rule; the East already had a long history of urbanisation, which is not necessarily the case for much of the western empire (see Wolf 1993: 13, who, despite emphasising urban growth during the Roman period, recognises that urbanism had a long history in the East prior to the arrival of the Roman Empire into the region; see also Ball 2016: 173 for reminder that the great Eastern cities of the Roman period were not actually new foundations).

In all periods, reports at times do not clearly indicate the nature of the site, though, after consultation of further site reports, it seems that this is due to limited excavation and publication of results. In Israel, for example, sites are often excavated by the Israel Antiquities Authority, and full excavation reports may not be published in academic journals or monographs, with excavators instead producing only internal documentation.

7.1.4 Modes of preservation

The majority of the remains from the East are preserved by means of carbonisation. As such, much of the dataset is comprised of seeds of crops such as cereals, olive, pulses as well as weed seeds (see van der Veen 2007: 193 on nature of assemblages according to preservation type). There are a few exceptions, such as the waterlogged remains from Caesarea and the harbour at Caesarea, though, in general, waterlogged material is scarce (see Ramsay 2010; Giorgi 1999). This prohibits detailed analysis of dietary components that do not often survive carbonisation, such as the more fragile flavourings and vegetables (van der Veen et al. 2007: 185). A number of cave sites have yielded desiccated remains, but most of these sites were not subject to systematic sampling and yield relatively few items (see the Cave of the Pool, Cave of the Spear, and Cave V/49 [Sites 17, 18, and 20 in Appendix A]).¹³

Remains subject to biomineralisation form a notable presence in the Eastern data. The biomineralised data are comprised of remains of the Boraginaceae family, the fruit of which produces inorganic minerals itself that prevent decomposition (Shillito and Almond 2010: 225). This process is not the same as mineralisation by means of ‘replacement,’ in which, given the right conditions, minerals replace the organic material, preserving the same form (see Shillito and Almond 2010 for comparison). This process has long been known as one of the main preservation types for archaeobotanical materials, though biomineralisation has received less attention previously. Biomineralised remains- particularly Boraginaceae- are the most commonly encountered type after carbonised remains, and are often described as ‘uncharred’ in the reports.

¹³ Though archaeobotanical macroremains subject to preservation by waterlogging, mineralisation, and desiccated were occasionally encountered, for the sake of data standardisation, these were not included in the analysis in Chapters 7 and 8. This data were, however, noted and is included in Appendices F and G.

7.1.5 Data quality

The quality of the data is greatly affected by a number of factors pertaining to how samples were taken as well as how the material is reported.

7.1.5.1 *Sampling strategy*

One of the first decisions that affects data quality is the method of sampling and sampling strategy. As such, including this information in reports is highly important, though, unfortunately, rather rare amongst the Eastern data.

In terms of methods of retrieving the samples, the records contain data that were obtained by both hand-picking and bulk sampling. The majority of the remains were obtained by bulk sampling; 113 records indicated bulk sampling was used, while 19 employed handpicking, and six indicated both methods were used.

Though approximately 82% bulk sampling may appear to be a highly desirable margin, it is important to bear in mind that some reports from these sites were so brief, that the method of sampling is rather unclear; if handpicking was not the obvious course of action, such sites were assumed to have used bulk samples, and comprise a portion of this 82%. Furthermore, some of the so-called 'bulk' samples are, at times, under a litre in size, if the size of the sample is indicated at all. As low densities characterise the carbonised assemblages found throughout the region, small samples generally produce few specimens, and thus are insufficient for statistical analysis and generally do not offer significant contribution to a greater understanding of the archaeobotanical record in the region (see van der Veen et al. 2007: 203, who indicate that at least 100 items per sample are necessary for statistical analysis; see also Campbell et al. 2011: 8-14 for Historic England guidelines, which stipulate that samples should ideally be 20-40 litres in size).

Though it was expected that the methods used would change over time, with handpicking being the method of choice only in earlier reports, this pattern cannot be observed in the data; handpicking was used as the sole sampling method as early as 1962, but also as late as 2013, when scientific methods and systematic sampling strategies had long been in existence (see early publications on flotation such as Struever 1968 and French 1971).

There were no observable trends according to sampling strategy per nation; though all the records that feature handpicking are from sites in Israel and Jordan, these two countries also yield the highest number of records per country, making any possible implication of negligible importance.

7.1.5.2 Quantity of samples

Quantity of samples initially taken during excavation, as well as the quantity of samples that the archaeobotanists chose to analyse are both important considerations in assessing data quality. Little consideration can be given to the latter, however, as reports often fail to include negative results, and many do not indicate the difference between the number of samples taken and the amount chosen to be analysed.

With regard to sample numbers, the distribution of sites at which over 20 samples were taken was assessed. As few as 15 of the 138 records had 20 or more samples analysed. All of these records were published after the year 1985, and only four (~27%) were published before the year 2000, which may show an increase in sampling in recent decades. However, due to the low numbers, the statistical significance of this is questionable. Records containing only one sample, however, are abundant, with 61 of the records (~44%) featuring only one sample, which either does not sufficiently allow for interpretations regarding the plant repertoire at the site or, in the case of sumsampling, inhibits any detailed analysis, as discussed further below.

Still, van der Veen 2007 indicates the appropriate number of samples per record to be a minimum of 30, with fewer than 10 being problematic, except when the samples are from a region where archaeobotanical datasets are scarce. Thus, though many, if not most, of the records from the East have fewer than 10 samples, archaeobotanical evidence in the region is such a relative rarity that all the data offer valuable contribution in terms of 'group-value' (van der Veen 2007: 203).

7.1.5.3 Level of analysis

There are other confounding factors that may cause the number of samples not to be indicative of the amount of data in each report; archaeobotanists have often reported their finds not for each individual sample, but by excavation area or time period, as is seen for sites including Caesarea (Site 15), Humayma (Site 40), and ez-Zantur at Petra (Site 57) among others. These 'sumsamples,' as they have been termed here, may be comprised of any number of samples, though this number is a detail that is often omitted, and thus may cause a site with what appears to be only a few samples in the data tables to yield significantly more remains than some sites that have far greater numbers of samples.

It is notable, and unfortunate, that over 60 records do not report at the sample level, but rather use these 'sumsamples,' with numerous sites producing only one 'sumsample' for all the remains found overall at a given site, regardless of chronology or context. Unfortunately, such reporting prohibits detailed contextual analysis, and renders interpretation difficult if not impossible, as different

taphonomic processes affecting the data remain undetermined, and variances in the relative importance of different plants/plant foods are masked.

7.1.5.4 Number of items

An additional consideration in assessing data quality is the number of items found. Van der Veen (2007: 203) states that for samples to be suitable for statistical analysis, they should ideally contain at least 100 specimens per each mode of preservation present (see also van der Veen and Fieller 1992). This, however, is rarely the case in the Eastern data, unless the assemblage is representative of a storage cache. The same author indicates that should this not be the case, sample sizes should be increased in order to achieve the desired number of specimens. While this would be a desirable course of action, there are often natural constraints or a lack of resources that prevent this from being a feasible possibility. Limited water supply in the arid regions, for example, may inhibit the processing of large samples, and, at times, the use of a flotation machine. (see, for example, Ramsay and Smith 2013, who indicate that the lack of water contributed to the decision to use bucket flotation for the material from Bir Madhkur; see also Ramsay and Bedal 2015 on water procurement issues at Petra necessitating bucket flotation as well).

This may be a part of the reason that many of the records yield relatively small sample sizes in comparison to other regions, with 10 litres being common, and as little as 1 litre, occasional. Sample size is often left undisclosed, however, making assessment of sample size in the region a somewhat futile exercise.

7.1.5.5 Sample context

The details of the contexts and features that the samples were taken from are highly instrumental for understanding the implications of the samples and the materials that they yield. Still, a large portion of the reports do not disclose detailed, or at times any, information regarding the context of the samples, instead reporting as though in a vacuum (see van der Veen and Jones 2006 on importance context in data analysis). Such a practice limits exactly what kind of questions may be asked of the data, and precludes the possibility for site-based studies of distribution and comparison of feature types.

Numerous publications report only samples taken from contexts and feature types that are most likely to yield rich assemblages, such as storage caches and ovens or tabuns. This causes the data to be biased toward a few specific features, which are likely the exception in terms of their productivity, rather than a true representation of the density of plant remains present at a given site (see van der Veen 2007: 202 for discussion of this phenomenon). Furthermore, favouring one feature type will yield data that represent like depositional events; if all of the samples come from

ovens and tabuns, all of the data will be representative of cooking and food preparation activities, which is important to bear in mind when interpreting the assemblages.

7.1.5.6 Presentation of data

The varying levels of identification that archaeobotanists provide also have an impact on the quality of the data. Failing to use scientific terminology can lead to over simplification of data, as any secondary use of the data must be reliant on the most basic level of identification, so as not to make false assumptions. As such, for the numerous reports that indicate finds using plain terms such as 'barley' or 'wheat,' a more basic level of identification (i.e. *Hordeum* sp. and *Triticum* sp. with no species given) has necessarily been assumed.

More generally, the manner in which authors present the Eastern data is extremely variable, and deserves comment as well. The clear representation of data in tables is an important aspect that should be a universal practice in archaeobotanical reports. However, this too often is not the case, with many reports listing species present in paragraphs or simply referencing them throughout the texts (see Site 69 and Site 71 for example; see van der Veen 2007: 201 for similar observation in archaeobotanical reports from Britain). Nor is it sufficient to have only a table (often in the appendix of an excavation report) with no text providing additional information regarding sampling strategy (see Site 77 and Site 89).

As a whole, the Eastern dataset is highly variable, but has the potential to yield interesting results. The East, in general, is less likely to yield an abundance of remains in comparison with regions such as Britain and Northwest Europe, where other modes of preservation are more prevalent and archaeobotanical sampling is more common. Because remains are somewhat less abundant in the region, it seems that archaeobotanical macroremains have received less attention, particularly in terms of large scale, regional synthesis. However, when considered as a collective whole, there is actually a substantial amount of data suitable for meta-analysis, the results of which, will, hopefully, prompt further archaeobotanical studies to be undertaken in the region.

7.1.6 Conclusions

A number of general points may be taken from the data overview, and these impact the type of analysis that may be undertaken in the following chapters. Firstly, the scarcity of waterlogged, mineralised, and desiccated remains in the dataset, combined with effort to maintain consistency, supports the omission of such data from the analysis that follows. The lack of contextual information inhibits a more detailed level of analysis, and thus a broader meta-analysis, focused on large-scale patterns will follow. Similarly, as the datasets produced by individual sites are often rather small in

terms of sample number and number of items, analysis will largely focus on regional and chronological variations, as opposed to more detailed site-based comparison. With these points in mind, analysis may now be undertaken.

7.2 The East: Presence and absence data

Table 7-1 below indicates the distribution of records per region according to each chronological period. The number of records by period, as well as the distribution of records by site type per period are displayed in the figures in the following sections (see also Fig. 7-3 for number of records by period).

Table 7-1 Number of records per region by chronological period in the Near Eastern dataset.

Period	Levant	Anatolia	Greater Middle East
Early Pre-Roman Period	25	6	12
Pre-Roman Period	25	4	5
Roman Period	28	2	7
Late Roman Period	17	3	1

All plants in the Eastern dataset that are edible or cultivated for economic purposes are indicated in Table 7-2, with the presence of each species recorded by period (for wild/weed species, Table 7-6).

*Table 7-2 Edible and economic plants present in the Eastern dataset by period. * indicates plants that may also be classified in other categories.*

	Common name	Early Pre-Roman	Pre-Roman	Roman	Late Roman
Cereals					
<i>Avena sativa/Avena</i> sp.	Oat	X	X	X	X
<i>Hordeum</i> sp.	Barley undif.	X	X	X	X
<i>Hordeum distichon</i>	Two-row barley	X	X	X	X
<i>Hordeum vulgare</i>	Six-row barley	X	X	X	X
<i>Hordeum/Triticum</i>	Barley/Wheat	X	X		
<i>Oryza</i>	Rice		X	X	
<i>Panicum miliaceum</i>	Common millet	X	X	X	X
<i>Panicum miliaceum/Setaria italica</i>	Common/Foxtail millet	X			
<i>Setaria italica</i>	Foxtail millet	X	X	X	
<i>Secale cereale</i>	Rye	X	X		
<i>Sorghum</i> sp.	Sorghum				X
<i>Triticum</i> sp.	Wheat undif.	X	X	X	X
<i>Triticum monoccoum/dicocum</i>	Glume wheat undif.	X	X	X	
<i>Triticum monoccocum</i>	Einkorn wheat	X	X	X	X
<i>Triticum dicocum</i>	Emmer wheat	X	X	X	X
<i>Triticum spelta</i>	Spelt wheat				
<i>Triticum aestivum/durum/turgidum</i>	Free-threshing wheat undif.	X	X	X	X
<i>Triticum aestivum</i> s. str.	Bread wheat	X	X	X	X
<i>Triticum compactum</i>	Club wheat	X		X	X

<i>Triticum durum</i> s. str.	Hard wheat/Durum wheat/Macaroni wheat	X	X	X	X
<i>Triticum parvicoccum</i>		X		X	
<i>Triticum turgidum</i>	Rivet wheat				
Pulses					
<i>Cicer arietinum</i> / <i>Cicer</i> sp.	Chickpea	X	X	X	X
<i>Lathyrus</i> sp.		X	X	X	X
<i>Lathyrus sativus</i>	Grass pea	X	X	X	X
<i>Lathyrus cicera</i>	Vetchling, Red pea/Vetchling				
<i>Lathyrus cicera/sativus</i>	Grass pea/Reg pea/Vetchling	X	X		
<i>Lathyrus clymenum</i>	Spanish vetchling	X			
<i>Lens culinaris</i>	Lentil	X	X	X	X
<i>Lupinus albus</i>	White lupine				
<i>Pisum arvensis</i>	Field Pea				
<i>Pisum sativum</i>	Common pea	X	X	X	X
<i>Vicia</i> sp.	Vetches	X	X	X	
<i>Vicia ervilia</i>	Bitter vetch	X	X	X	X
<i>Vicia faba</i>	Faba bean	X	X	X	X
<i>Vicia sativa</i>	Common vetch	X		X	X
<i>Lathyrus/Pisum/Vicia</i>	Pea/Vetches/Vetchlings	X	X	X	X
Fruits/Nuts					
<i>Berberis vulgaris</i>	Barberry				
<i>Castanea sativa</i>	Chestnut				
<i>Ceratonia siliqua</i>	Carob			X	
<i>Citrullus</i> sp.				X	
<i>Citrullus colocynthis</i>	Colocynth, Bitter apple/Cucumber		X		X
<i>Citrullus lanatus</i>	Watermelon				X
<i>Citrus</i> sp.	Citrus				
<i>Cornus mas</i>	Cornel, Cornelian cherry				
<i>Corylus avellana</i>	Hazelnut				
<i>Cucumis</i> sp.		X			
<i>Cucumis melo/sativus</i>	Muskmelon/ Chate melon/Cucumber				
<i>Ficus carica</i>	Fig	X	X	X	X
<i>Fragaria vesca</i>	(Wild) Strawberry				
<i>Hyphaene thebaica</i>	Doum palm			X	
<i>Juglans regia</i>	Walnut		X	X	X
<i>Malus domestica/sylvestris</i> / <i>Malus</i> sp.	Apple			X	
<i>Malus/Pyrus</i>	Apple/Pear				X

<i>Morus</i> sp.	Mulberries			X	
<i>Olea europaea</i>	Olive	X	X	X	X
<i>Pinus pinea</i>	Stone pine			X	X
<i>Phoenix dactyifera</i>	Date palm	X	X	X	X
<i>Pistacia</i> sp.	Pistachio	X	X	X	
<i>Pistacia lentiscus</i> *	Mastic	X			
<i>Pistacia terebinthus</i> *	Terebinth/ Turpentine tree			X	
<i>Prunus</i> sp.	Stone fruits	X	X	X	X
<i>Prunus armeniaca</i>	Apricot	X			
<i>Prunus avium</i>	Sweet cherry				
<i>Prunus avium/cerasus</i>	Cherry				
<i>Prunus cerasus</i>	Sour cherry			X	
<i>Prunus cerasifera</i>	Plum cherry				
<i>Prunus domestica</i>	Plum				
<i>Prunus dulcis</i>	Almond	X	X	X	X
<i>Prunus mahaleb</i> *	Mahaleb cherry				
<i>Prunus persica</i>	Peach	X		X	X
<i>Prunus spinosa</i>	Slow				
<i>Punica granatum</i>	Pomegranate	X	X	X	X
<i>Pyrus communis</i>	Common pear				
<i>Pyrus</i> sp.	Pear				
<i>Rubus</i> sp.	Brambles	X			
<i>Rubus ideaus</i>	Raspberry				
<i>Sambucus</i> sp.	Elder/Elderberry		X		X
<i>Sabucus nigra</i>	Black Elder				
<i>Sambucus nigra/racemosa</i>	Black/Elderberry/ Red Elderberry				
<i>Sorbus domestica</i>	Sorb, Service tree				
<i>Vitis vinifera</i>	Grape	X	X	X	X
<i>Ziziphus</i> sp.			X		X
<i>Ziziphus jujuba</i>	Jujube			X	
Vegetables/Flavourings					
<i>Allium sativum</i> / <i>Allium</i> sp.	Garlic	X	X	X	X
<i>Beta vulgaris</i> / <i>Beta</i> sp.	Beet	X		X	X
<i>Brassica/Sinapis</i>	Cabbage/Mustard				
<i>Brassica oleracea</i>	Cabbage				
<i>Carum caravi</i>	Caraway	X			
<i>Coriandrum sativum</i>	Coriander	X			
<i>Cuminum cyminum</i>	Cumin	X			
<i>Daucus carota</i> / <i>Daucus</i> sp.	Carrot	X		X	
<i>Foeniculum vulgare</i>	Fennel	X			
<i>Lagenaria siceraria</i>	Bottle gourd				

<i>Lactuca sativa</i>	Lettuce	X			
<i>Laurus nobilis</i>	Bay	X			
<i>Lepidum sativum</i>	Garden Cress	X			
<i>Mentha</i> sp.	Mints	X	X		X
<i>Nigella sativa</i>	Black cumin	X	X		
<i>Petroselinum crispum</i>	Parsley	X			
<i>Raphanus raphanistrum</i>	Radish	X		X	X
<i>Ruta</i> sp.	Rue			X	X
<i>Sinapis</i> sp.	Mustards				
<i>Trigonella foenum-graecum</i>	Fenugreek	X			
Oil, Fibre Plants and Other Economic Taxa					
<i>Brassica</i> sp.	Cabbage/Mustards	X		X	
<i>Camelina sativa</i>	Gold of pleasure/ False flax	X	X		
<i>Gossypium</i> sp.	Cotton		X	X	X
<i>Humulus lupulus</i>	Hops				
<i>Linum usitatissimum</i> / <i>Linum</i> sp.	Flax/Linseed	X	X		
<i>Papaver</i> sp.	Poppies	X	X		X
<i>Papaver somniferum</i>	Opium poppy		X		
<i>Sesamum</i> sp.	Sesames	X			
<i>Sesamum indicum</i>	Sesame				
<i>Sesamum orientale</i>	Sesame	X			
Possible Cultivated or Gathered Plants					
<i>Acacia</i> sp.	Acacia		X		X
<i>Borago officinalis</i>	Borage		X		
<i>Crataegus</i> sp.	Hawthorns		X	X	
<i>Portulaca oleracea</i>	Purslane	X			
<i>Sorbus acuparia</i>	Rowan				
<i>Lathyrus aphaca</i>	Yellow pea/vetchling				
<i>Myrtus communis</i>	Myrtle				
<i>Capparis spinosa</i>	Caper	X	X	X	X

7.2.1 Overall plant composition

7.2.1.1 Chronological variation in overall plant composition

In all periods- with the exception of wild plants- cereals, fruits and pulses are the most prominent three plant types, though all plant types occur. In the Early Pre-Roman period, fruits and cereals are the most frequent remains, both occurring at nearly 85% of sites, with pulses close behind at just over 80% of sites. Fruits and cereals continue to be the most frequent plant types in the Pre-Roman period, with the former slightly overtaking the latter, though pulses drop by roughly 20%. Then, in the Roman and Late Roman periods, fruits increase slightly and continue to be the most frequent plant type, though cereals remain a close second. Pulses are the third most common plant type in both of the later periods, though they never increase to the frequencies exhibited in the Early Pre-Roman dataset.

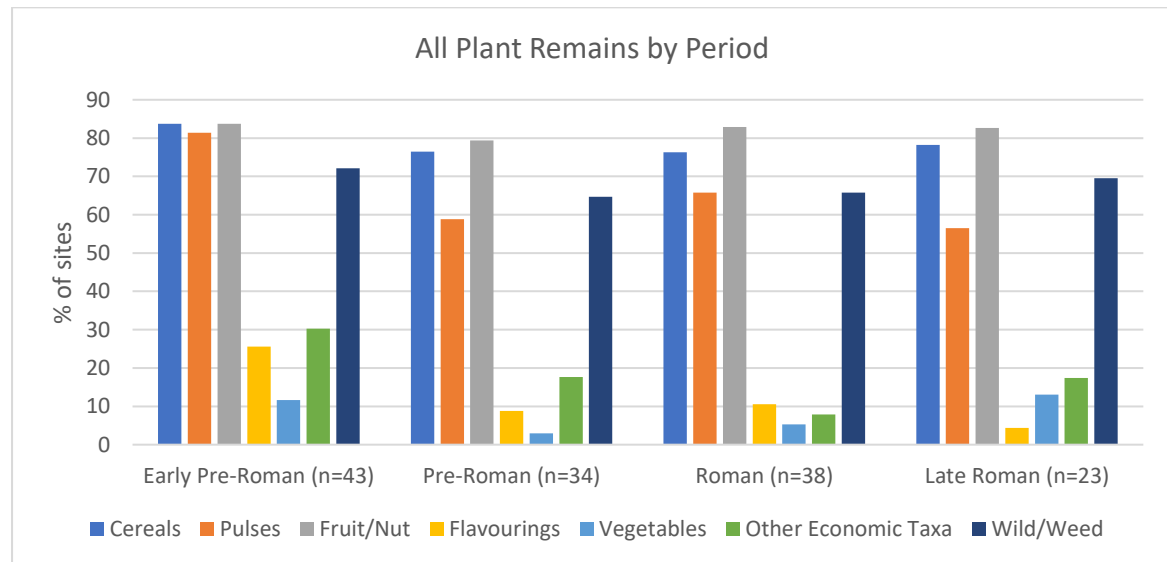


Figure 7-6 Frequencies of all plant remains by period.

7.2.1.2 Regional variation in overall plant composition

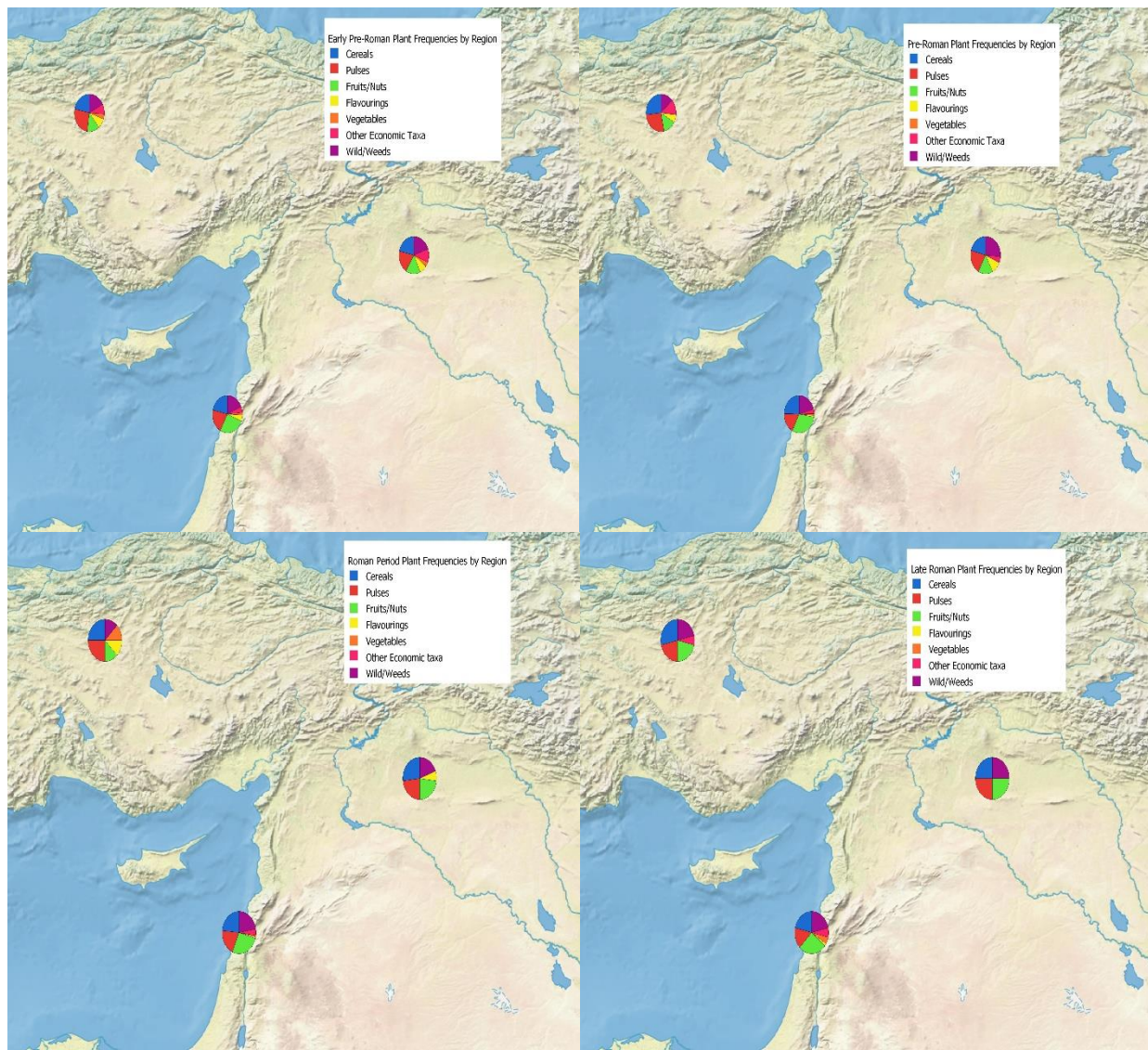


Figure 7-7 Frequencies of all plant remains for the Early Pre-Roman, Pre-Roman, Roman, and Late Roman datasets by region. See Table 7-1 for number of records per region by period.

Early Pre-Roman period

There are no particularly strong regional trends detectable in this period; a variety of plant types are represented in each of the three regions, including minor occurrences of vegetables and flavourings, which are less commonly preserved in a carbonised state. Fruit, however, appears to be more common in the Levant, where it is the most frequent plant type, as opposed to in the Greater Middle East and Anatolia, where cereals and pulses are more frequent.

Pre-Roman period

The data exhibit little change in this period, apart from a slight increase in cereals and especially fruits in the Levant. Cereals and pulses continue to dominate in Anatolia and the Greater Middle East, and fruit continues to be the most frequent remain in the Levant.

Roman period

The Levant remains relatively stable, with fruits continuing to dominate the assemblage. Fruits and, to a lesser degree, cereals increase in the Greater Middle East as wild species and other economic taxa decrease. The proportions of the most prominent plant types remain stable in Anatolia, though vegetables increase in frequency, taking the place of oil/fibre plants and other economic taxa.

Late Roman period

Fruits continue to dominate the Levantine assemblages in the Late Roman period. In Anatolia, there is a slight increase in fruits as well as in cereals, as the less frequently occurring plant types decrease. Flavourings and vegetables nearly disappear in this period in all regions.

7.2.1.3 Variation in overall plant composition by site type

Early Pre-Roman period

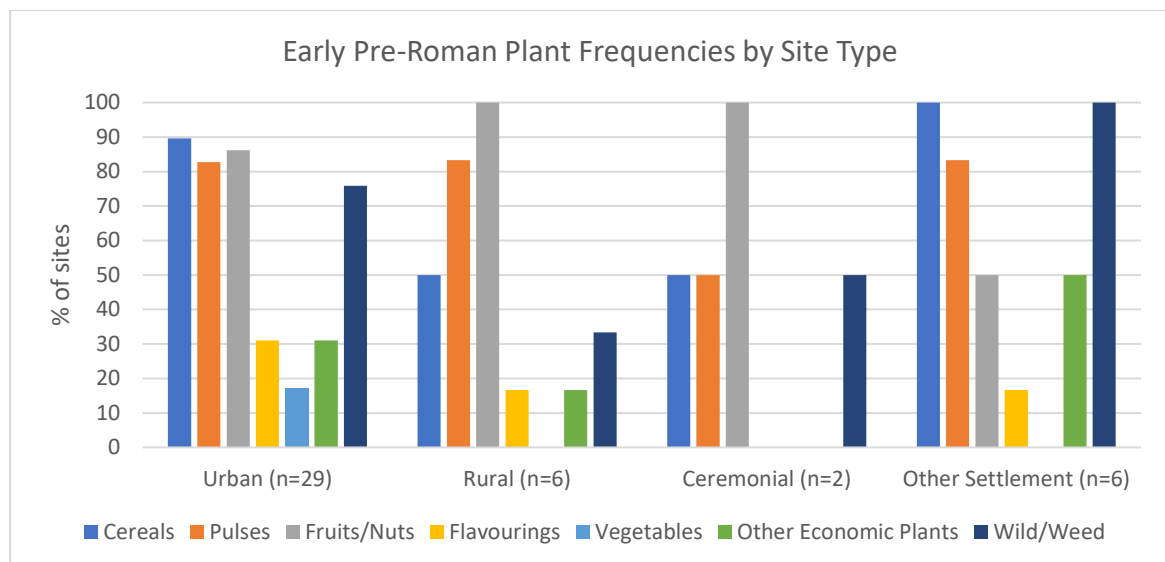


Figure 7-8 Early Pre-Roman plant frequencies by site type.

In the Early Pre-Roman dataset, fruits/nuts are the most frequent plant type at rural as well as at ceremonial sites, while cereals are more frequent at urban, and especially at sites described as other, which, in this period, includes large, centralised ‘proto-urban’ settlements. Pulses are among the more prominent plant types at all site types, even surpassing cereals in frequency at rural sites. Urban sites exhibit the most diverse plant assemblages, with flavourings occurring at around 30% of urban sites and vegetables occurring at just over 15%.

Pre-Roman period

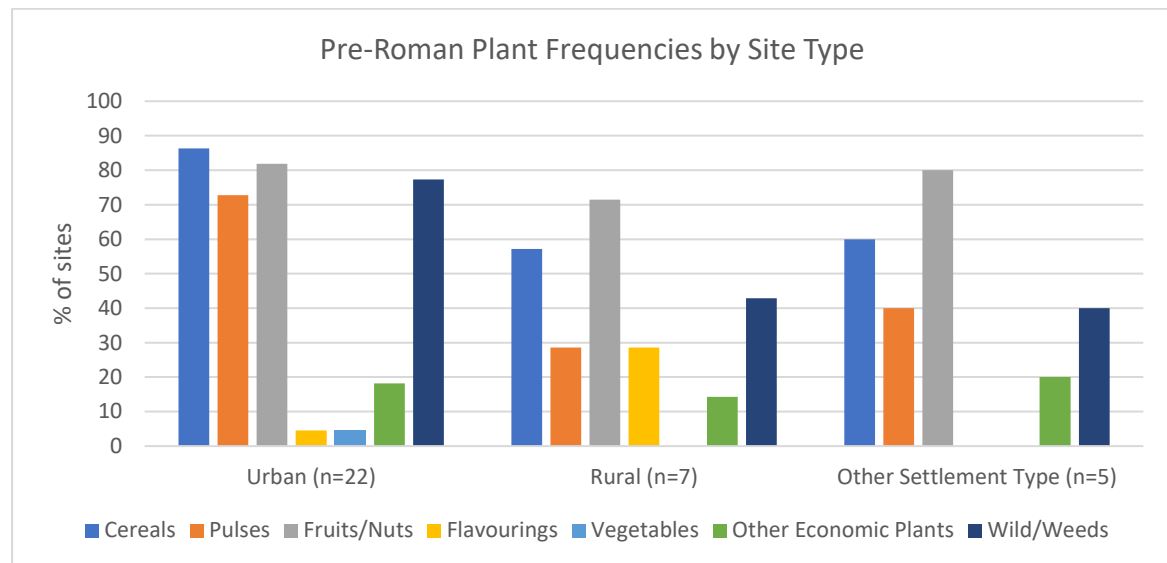


Figure 7-9 Pre-Roman plant frequencies by site type.

There appears to be an overall decrease in frequencies in the Pre-Roman period, with plants occurring at a lower percentage of sites in general, particularly at rural and sites categories as 'other.' As in the previous period, cereals are the most frequent remain at urban sites, though fruit remains continue to be only slightly less common. At rural and at 'other settlement types,' fruits continue to surpass cereals as the most frequent plant type. Urban sites are, again, the only site type to have all of the plant types, though flavourings occur at a notably larger percentage of rural sites.

Roman period

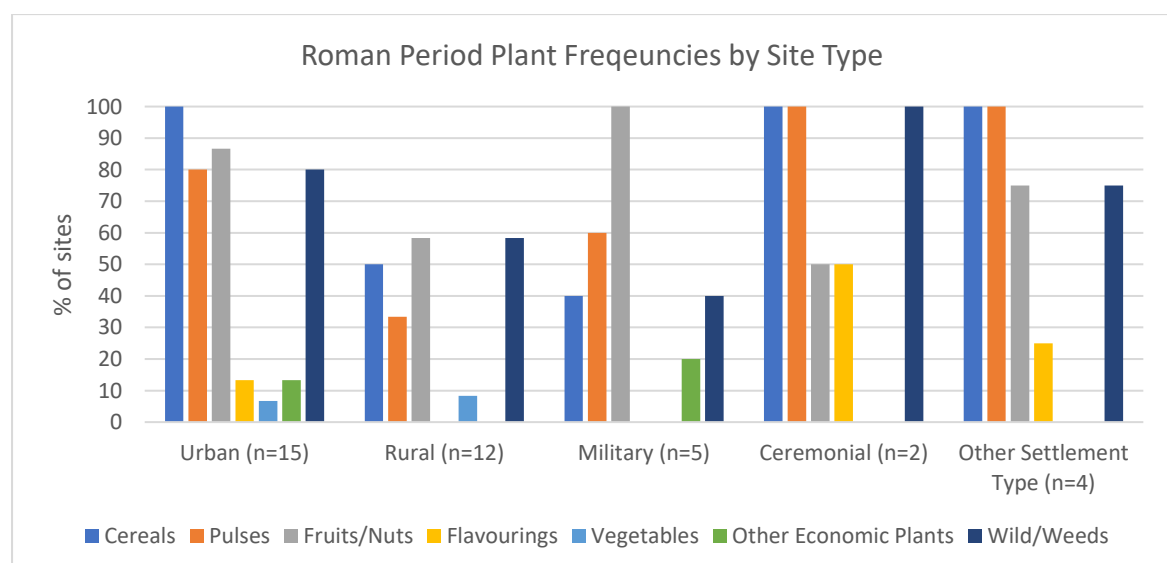


Figure 7-10 Roman period plant frequencies by site type.

Overall frequencies of cereals, pulses and fruits appears to increase again in the Roman period and occur at higher percentages of sites at most of the site types. A number of trends continue in the Roman period: fruit remains are the most frequent plant type at rural sites, while at urban sites, which, again, have all plant types represented, cereal remains are the most frequent. Fruits are by far the most frequent type of remain at military sites, though both pulses and cereals are more frequent at ceremonial and other site types.

Late Roman period

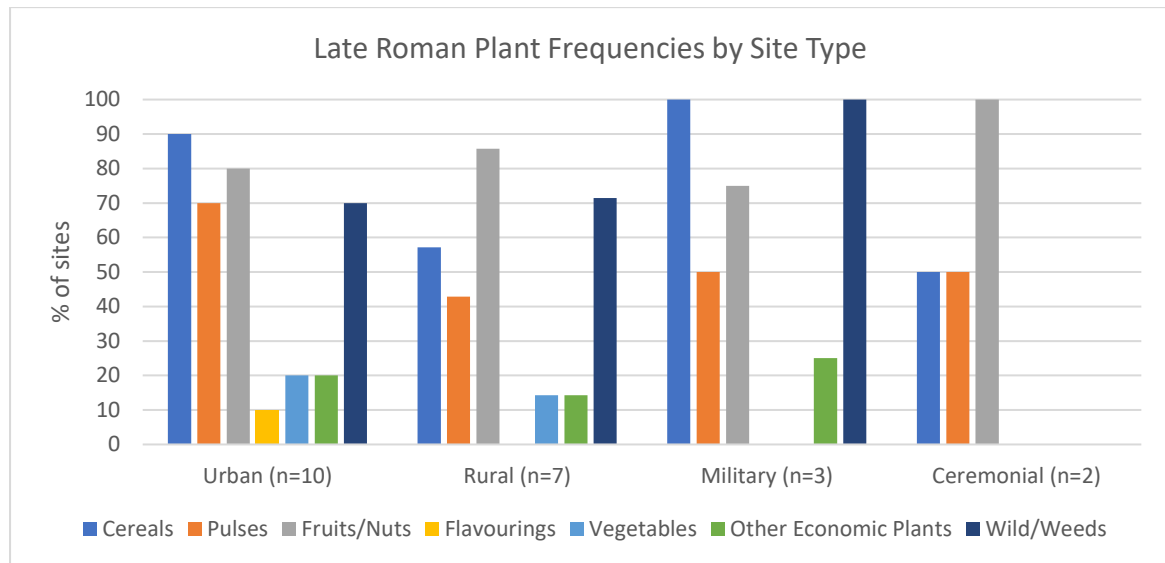


Figure 7-11 Late Roman plant frequencies by site type.

The trends in the data for the Late Roman period, in general, resemble that of previous periods. Urban sites continue to be the most diverse, and are the only sites with all plant types represented. Fruit is the most frequent remain at rural and ceremonial sites, while cereals are the most frequent at urban, as well as at military sites in this period.

7.2.2 Cereals

7.2.2.1 Cereals: Chronological variation

In general, the relative proportions of the most frequently occurring cereals remain similar in all periods. Barley is the most frequent type of cereal in all periods, always occurring at at least 10% more sites than the next most common cereal, which, in all periods, is free-threshing wheats. Glume wheats (here, *Triticum monococcum* and *Triticum dicoccum*), however, do exhibit certain chronological variations: while they occur at just over 40% of sites in the Early Pre-Roman period, they then decrease by about 30% in the Pre-Roman and Roman periods. However, this general decrease overtime does not appear to continue into the Late Roman period, when glume wheats

increase by between 5-10% (however, the significantly lower amounts of sites for this period should be noted). Otherwise, the minor cereal crops, including millets, oat, and rye, occur at far fewer sites in all periods, with the exception of rye, which is absent in the Late Roman period.

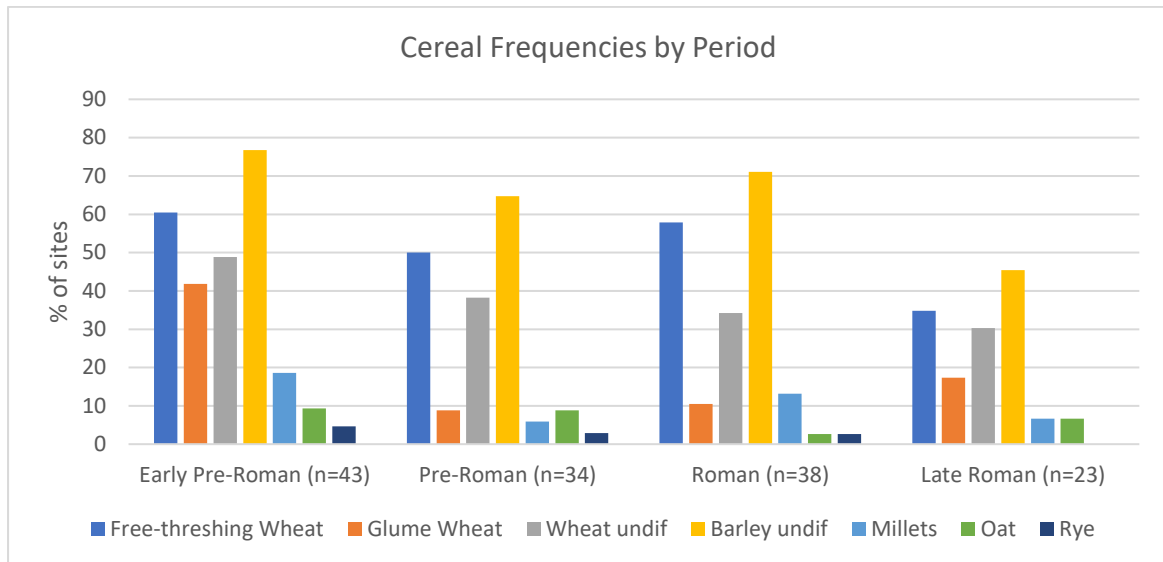


Figure 7-12 Cereal frequencies by period.

7.2.2.2 Cereals: Regional variation

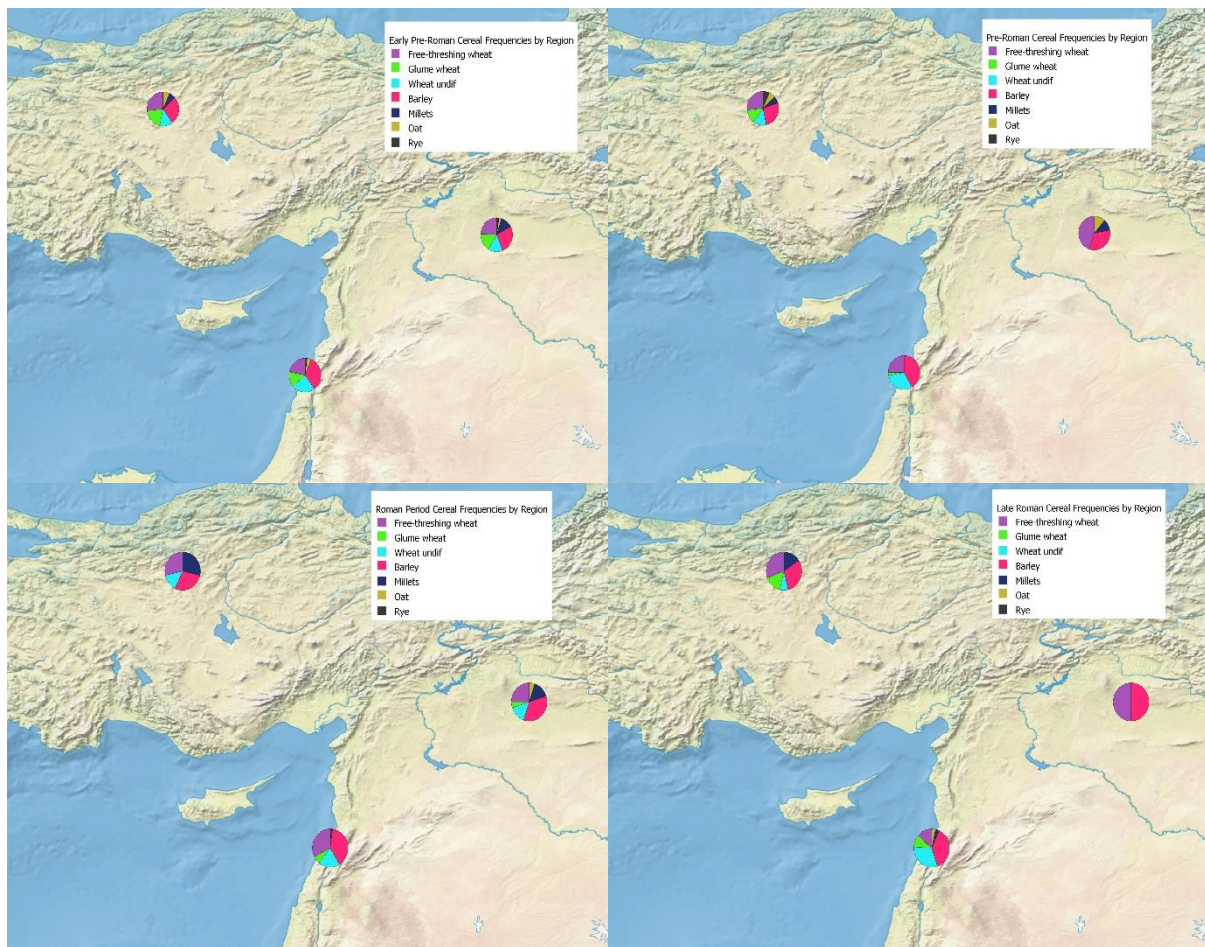


Figure 7-13 Frequencies of cereal remains for the Early Pre-Roman, Pre-Roman, Roman, and Late Roman period datasets by region. See Table 7-1 for number of records per region by period.

Early Pre-Roman period

During the Early Pre-Roman period, barley is the most common cereal type in all regions. Free-threshing wheat appears to occur at similar proportions in all regions. It is possible that glume wheats are slightly less common in the Levant, though the difference is marginal. Millets and oat occur in all regions, though millets are more frequent in the Greater Middle East and Anatolia than in the Levant.

Pre-Roman period

In the Pre-Roman period, barley becomes even more dominant in the Levant and in the Greater Middle East. The Greater Middle East and Anatolia both see an increase in free-threshing wheat, which is particularly notable in the former. Glume wheats are absent from the Greater Middle East, and are minimal in the Levant. While glume wheats are still present in the Anatolian Peninsula, it is

at a reduced proportion. Millets remain present in Anatolia and the Greater Middle East, though they are absent in the Levant in this period.

Roman period

Barley continues to dominate in the Levant and in the Greater Middle East in this period, though in Anatolia, although still the most frequent cereal, it is present in almost equal proportions to free-threshing wheats and millets. This increase in millet can also be seen to a much lesser degree in the Greater Middle East, and just barely in the Levant, where millets are at least present again. Glume wheats have disappeared from Anatolia, but are present in low proportions in the other two regions in this period. Free-threshing wheats are prevalent, though second to barley in all regions.

Late Roman period

In the Late Roman period, barley remains the most common cereal type in all regions. Only barley and free-threshing wheats are present in the Greater Middle East, though this region has only one site during this period, so results are inconclusive. Glume wheats reappear or are present at higher proportions in both Anatolia and the Levant, and this correlates with a notable decrease in free-threshing wheat in the latter. Millets are present in the Anatolian peninsula though at a lower frequency than in the former period, and they are present, though only a minor occurrence, in the Levant.

7.2.2.3 Cereals: Variation by site type

Early Pre-Roman period

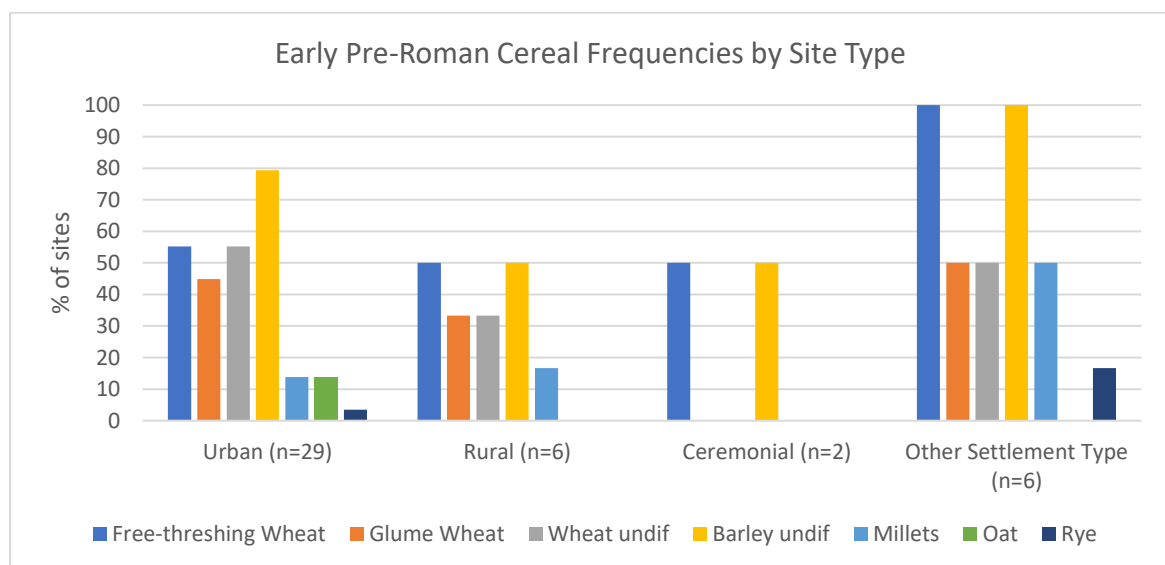


Figure 7-14 Early Pre-Roman cereal frequencies by site type.

In the Early Pre-Roman period, barley and free-threshing wheats are tied for the two most frequent cereal types at all site types apart from urban sites, where barley is notably more frequent. Glume wheats have a notable presence, occurring at between 30-50% of sites for all categories except ceremonial sites, of which there are only two.

Pre-Roman period

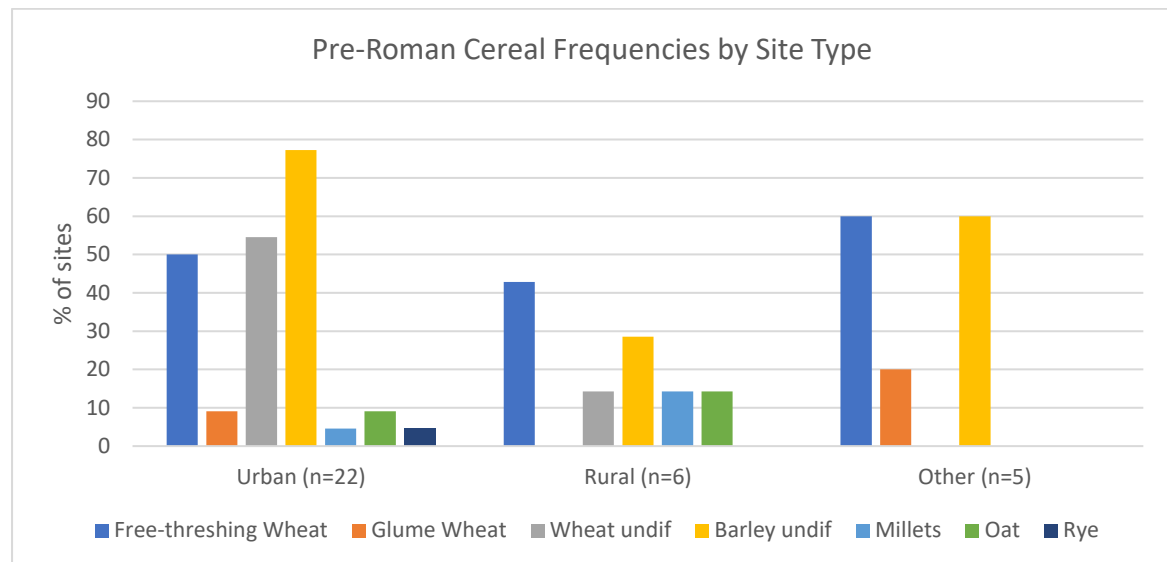


Figure 7-15 Pre-Roman cereal frequencies by site type.

There appears to be a general decrease in cereal frequencies in the Pre-Roman period. Barley, however, continues to dominate at urban sites and occurs at a similar percentage of sites (nearly 80% of urban sites). Free-threshing wheats overtake barley as the most frequent remain at rural sites in this period, though the two cereals remain tied at sites labelled as 'other.' Glume wheats decrease in this period; they are present at urban and at 'other' sites, occurring at about 9% and 20% respectively, and are absent from rural sites all together.

Roman period

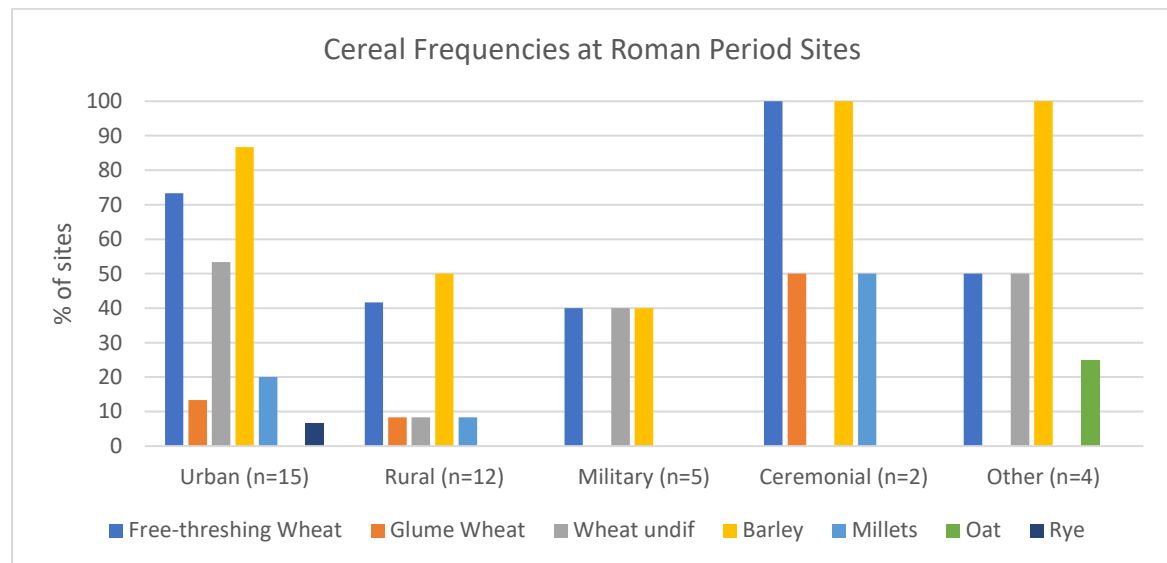


Figure 7-16 Roman period cereal frequencies by site type.

Barley is the most common cereal at all site types in the Roman period, overtaking free-threshing wheats as the most frequent cereal at rural sites. Ceremonial sites are an exception, with barley and free-threshing wheats both occurring at 100% of sites, though there are only two of this site type in this period. Similarly, glume wheats, occurring at 50% of ceremonial sites, is not particularly significant, as this equates to one occurrence. Otherwise, glume wheats occur at low frequencies at urban and at rural sites, with millets occurring at the same or at a greater frequency.

Late Roman period

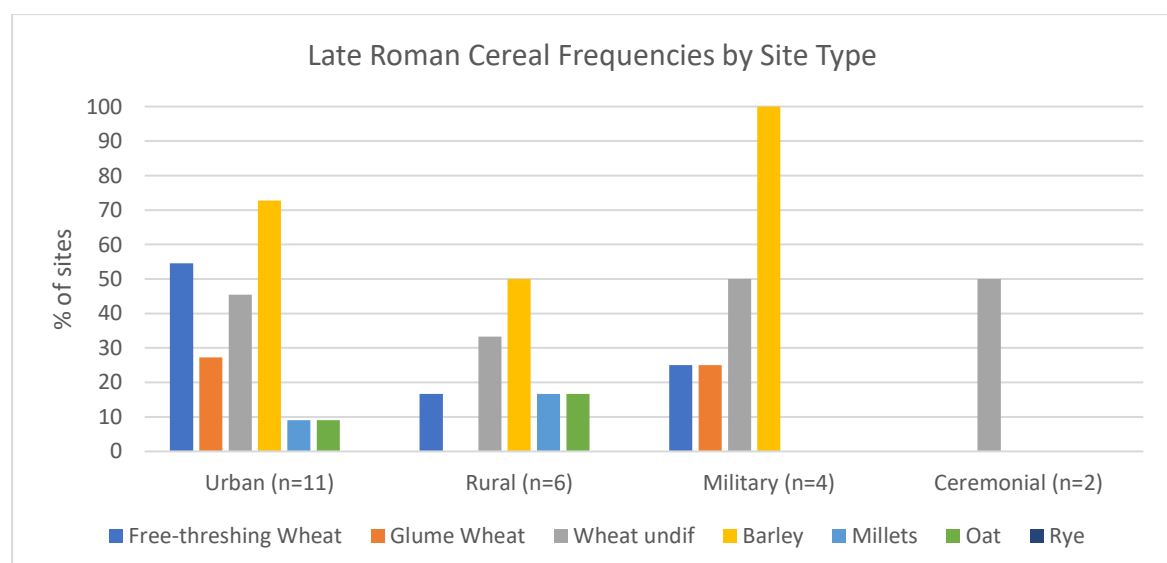


Figure 7-17 Late Roman cereal frequencies by site type.

Barley continues to be the most common cereal at all site types in the Late Roman period, except for at the two ceremonial sites, where only *Triticum* sp. was identified. The margins by which the frequency of barley exceeds other cereal types appears to be greater in this period, occurring at nearly 20% more sites than the next most common cereals at urban, rural and military sites. Apart from urban sites, free-threshing wheat appears to be less frequent during this period, with *Triticum* sp. surpassing it in frequency at rural and military sites. (This, however, could be due to a lack of detailed reporting or to poor preservation preventing species level identifications). Glume wheats appear at a greater proportion of urban and military sites than in the previous period, though are absent from rural sites.

7.2.3 Glume Wheats

Triticum dicoccum is the dominant glume wheat throughout all regions and periods, and is roughly twice as frequent as *Triticum monoccocum* overall. *Triticum dicoccum* is present at 21 sites; the majority of these sites are located in the Levant, though sites from this subregion far outnumber sites from the other two sub-regions. Glume wheat is present at 12 sites in the Levant, five sites in the Greater Middle East, and four sites in the Anatolian Peninsula. The chronological distribution of *Triticum dicoccum* shows decrease overtime, occurring in 15 records from the Early Pre-Roman period, and three records from the Pre-Roman, Roman, and Late Roman periods. The significantly smaller quantity of sites in the Late Roman period, however, render the records from this period more important as they come from a greater proportion of records overall, and thus may indicate an increase in this period.

Triticum monoccocum has been uncovered at 10 sites total. Like *Triticum dicoccum*, *Triticum monoccocum* is most common in Early Pre-Roman records, with eight dating to this period, followed by two occurrences in Pre-Roman records, and one occurrence in Late Roman records, while it is absent from Roman period records all together. Regionally, *Triticum monoccocum* is more evenly distributed, occurring at four sites in Anatolia, three sites in the Greater Middle East, and three sites in the Levant.

While *Triticum dicoccum* is found in caches at multiple sites, such as at Patnos and, particularly, Ashkelon, no caches of *Triticum monoccocum* have been found. It can also be noted that all caches of glume wheats date to the Early Pre-Roman period.

Triticum spelta is completely absent from all regions and chronological periods, with no occurrences in the Eastern dataset.

7.2.4 Chaff

Chaff items are present at 53 sites in total. They have been recorded at 21 Early Pre-Roman sites, seven Pre-Roman sites, 16 Roman sites, and nine Late Roman sites. When considering the percentage of sites chaff items are present at for each period, calculations indicate 47.7%, 20%, 42%, and 39% respectively.

In terms of representation by site type, in all periods, chaff items are most frequent at urban sites. When considering sites from all chronological periods, chaff remains are found at 37 urban sites, six rural sites, five sites described as ‘other,’ four military sites, and one ceremonial site.

7.2.5 Fruit/Nuts

7.2.5.1 Fruit/Nuts: Chronological variation

In all periods, grape and olive are the most frequent types of fruit remains. Grape is most frequent in the Early Pre-Roman period, when it is present at 60% of sites, and then is present at between 47-53% of sites in the later three periods. Olive is most frequent in the Late Roman period, occurring at just over 65% of sites. Date, and possibly fig appear to increase from the Roman period, while pomegranate is most frequent in the Early Pre-Roman period. *Prunus* fruits are most frequent in the Roman and Late Roman periods, during which they are present at around 21% of sites.

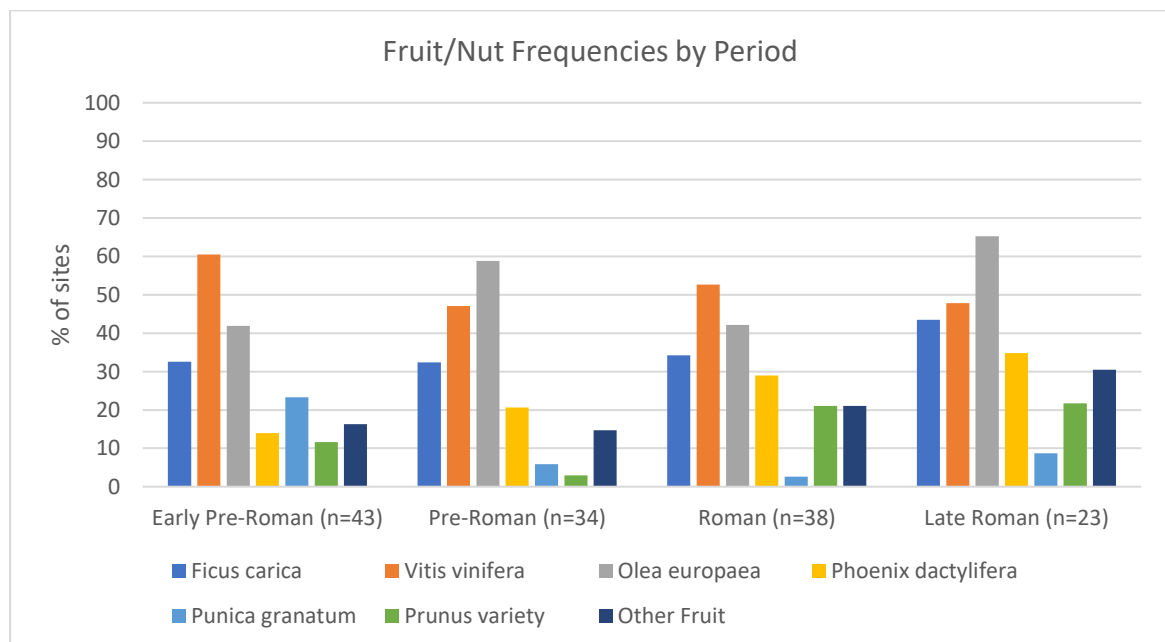


Figure 7-18 Frequencies of fruit/nut remains by period.

7.2.5.2 Fruit/Nuts: Regional variation

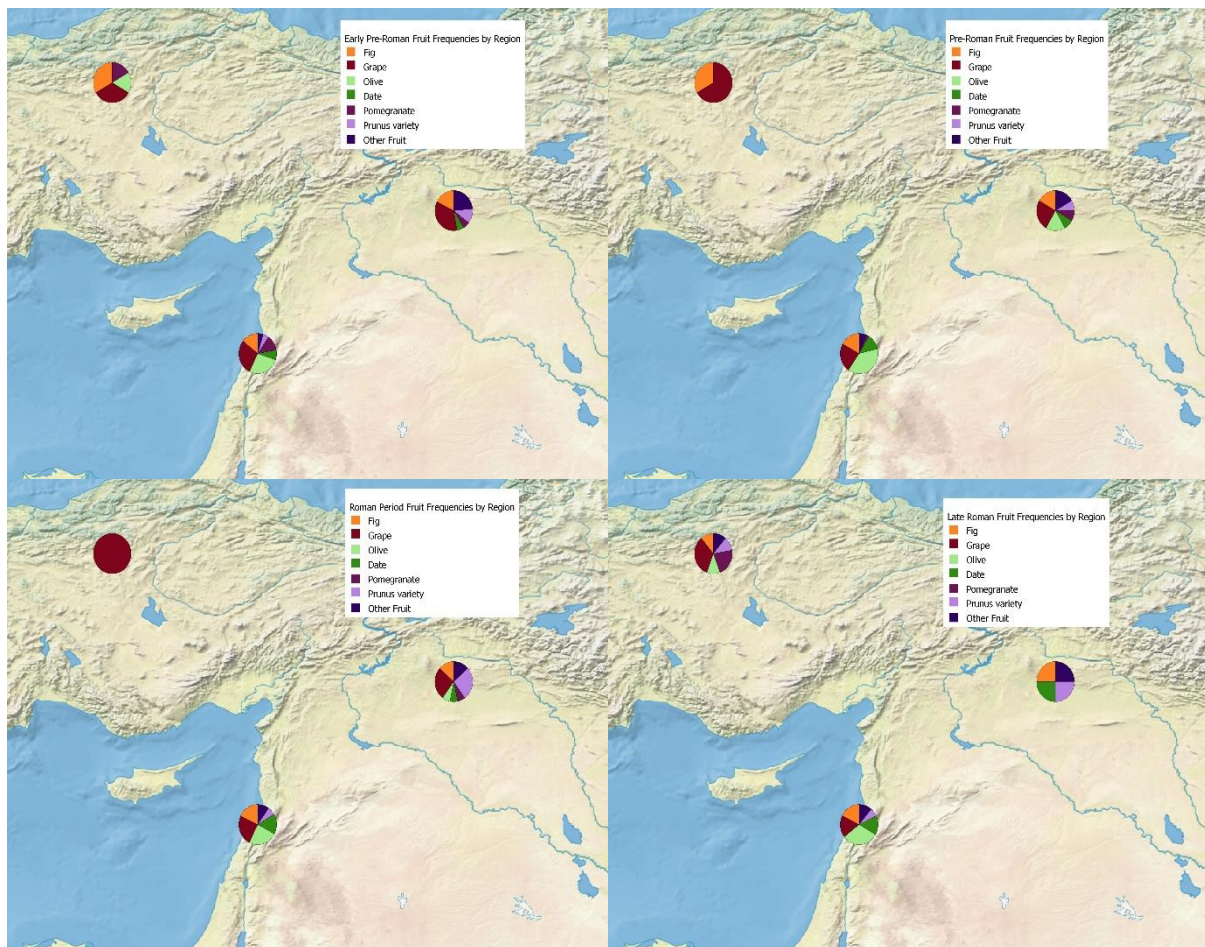


Figure 7-19 Frequencies of fruit remains for Early Pre-Roman, Pre-Roman, Roman and Late Roman datasets. See Table 7-1 for number of records per region by period.

Early Pre-Roman period

Certain regional variations are detectable in fruit presence in the Early Pre-Roman period. Anatolia is the least diverse, as it is lacking in both *Prunus* fruits as well as date. Pomegranate is present in small proportions in all three regions, but is most common in Anatolia. Fig and grape are the most frequent remains in Anatolia, and olive occurs significantly less frequently. Olive is absent from the Greater Middle East, where grape is the by far the most frequent. In the Levant, olive is one of the most frequent remains, tied only with grape, while fig is present in reduced proportions.

Pre-Roman period

The lack of diversity in fruit remains in Anatolia is somewhat surprising in the Pre-Roman period. Though it can be said that the region features only four sites, the Greater Middle East has only one more site than Anatolia in this period, but has a much more diverse fruit assemblage. Olive appears in the Greater Middle East for the first time in this period, and is about equal in frequency to fig.

Grape continues to be the most frequent remain in the Greater Middle East, but by much finer margins than in the previous period. All of the less common fruits (i.e. date, pomegranate, and *Prunus* fruits) are represented in the Greater Middle East, and the Levant lacks only *Prunus* fruits, making the region slightly less diverse. Olive is by far the most frequent species in the Levant, followed by grape and then fig.

Roman period

There are only two sites in Anatolia for the Roman period, and only grape is present at each. The Greater Middle East and the Levant, however, exhibit considerable diversity, with the Greater Middle East having all fruit types and the Levant lacking only pomegranate. Olive and grape are the most frequent species in the Levant, followed by fig and then date, the latter of which has increased from the previous period. Interestingly, *Prunus* fruits are the most frequently encountered fruit type in the Greater Middle East, followed by grape and then fig. Olive has decreased in this region, and is present only as a minor occurrence at a similar proportion to date and pomegranate.

Late Roman period

In the Late Roman period, the Greater Middle East is represented by only one site, at which fig, date, *Prunus*, and 'other' fruits are common, with grape and olive lacking. The Anatolian Peninsula exhibits greater diversity in this period, despite having only two sites. Though all species, apart from date, are represented, grape occurs at the most sites. Olive is the dominant fruit in the Levant, followed by grape, fig, and date, all three of which are present in nearly equal proportions.

7.2.5.3 Fruit/Nuts: Variations by site type

Early Pre-Roman period

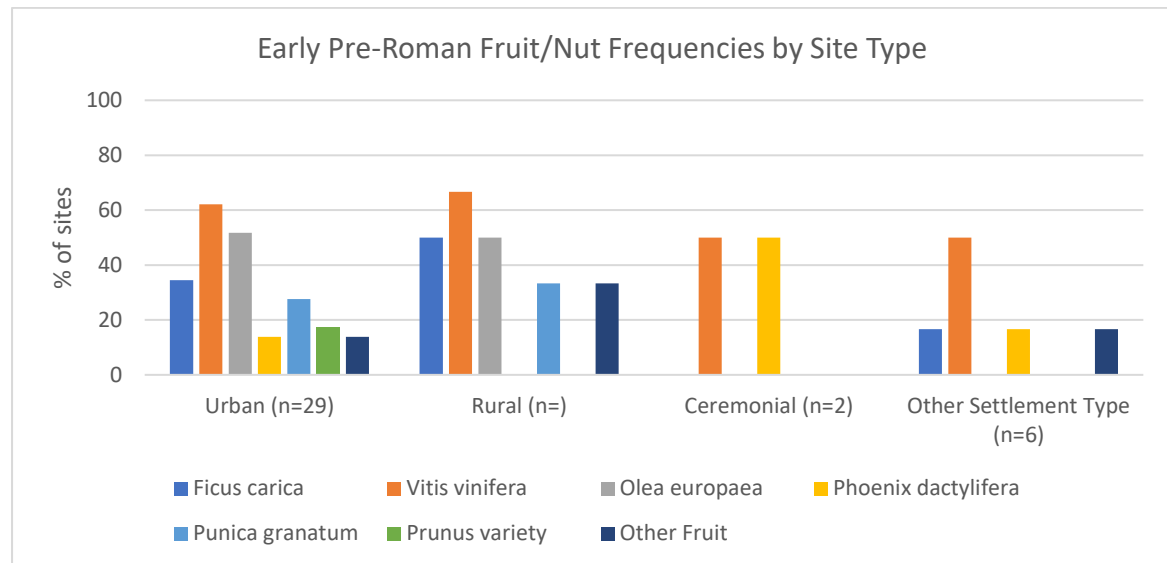


Figure 7-20 Frequencies of Early Pre-Roman fruit/nut remains by site type.

Grape is the most prevalent type of fruit remain at all sites during the early Pre-Roman period (at ceremonial sites grape is tied with date, though there are only two sites in this category). Olive is the second most common remain at urban sites, and at rural sites olive and fig are present at an equal number of sites. Olive is virtually absent, however, from sites labelled as 'other.' Date and *Prunus* fruits are absent from rural sites, and the latter is present only in urban contexts. Pomegranate, however, is most frequent at rural sites, though it is also present at urban sites. Urban sites are the most diverse, and is the only site type where all fruits are represented.

Pre-Roman period

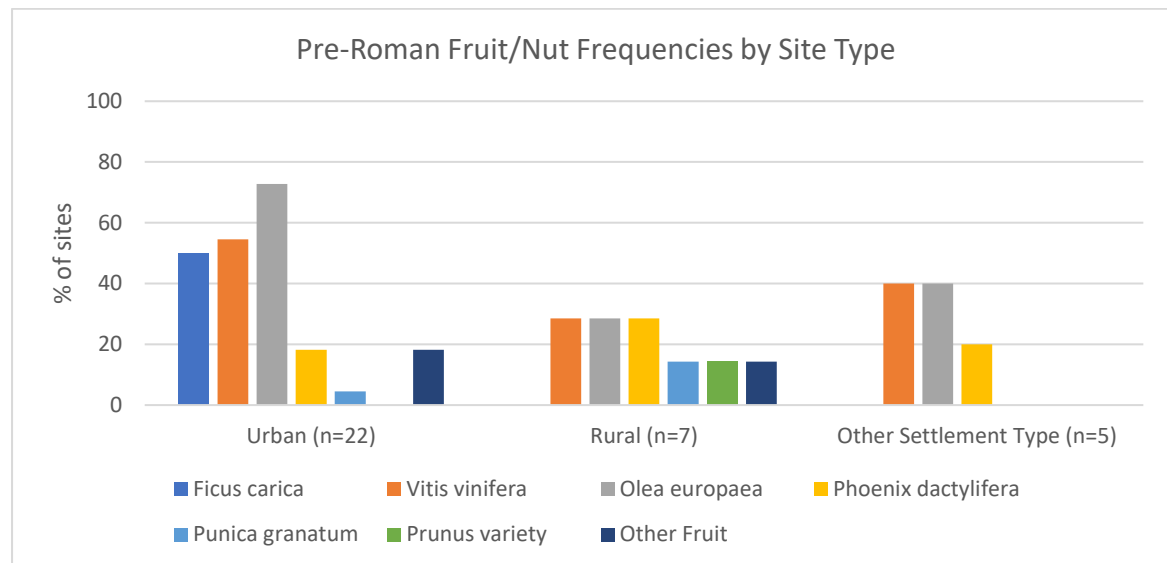


Figure 7-21 Frequencies of Pre-Roman fruit/nut remains by site type.

As is observed with other types of remains, fruits/nuts appear to occur at lower frequencies in this period, particularly at rural sites. Olive is the most common type of fruit in urban contexts, though it occurs at equal frequencies with grape and date in rural contexts, and with grape in 'other' site types. Fig occurs only in urban contexts, while *Prunus* fruits are present only in rural contexts. Date is present in all site types, and pomegranate is present at urban sites and at (a slightly higher percentage of) rural sites.

Roman period

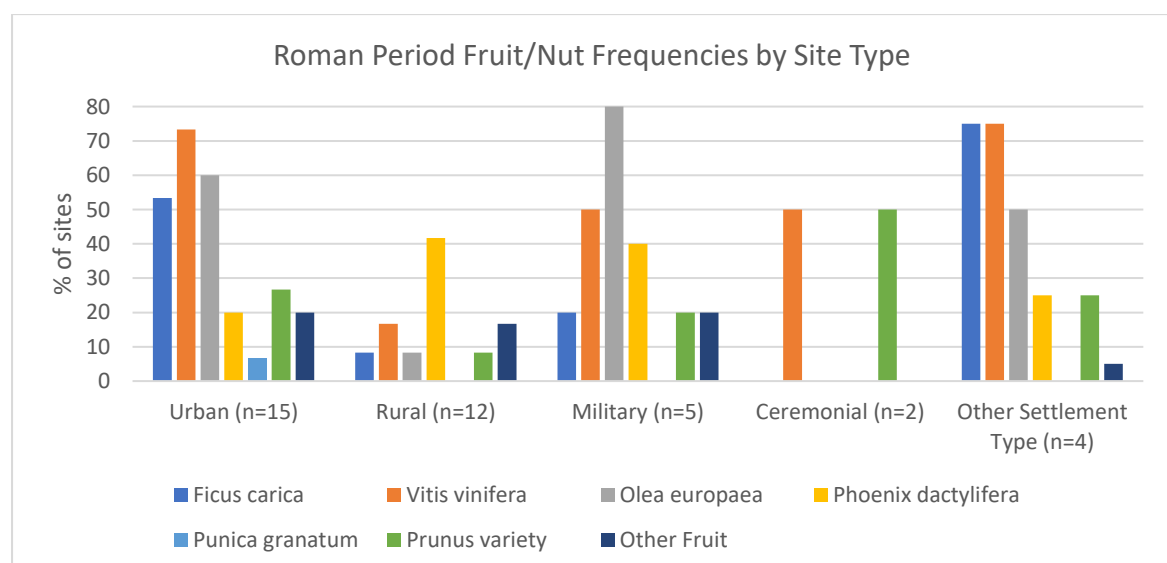


Figure 7-22 Frequencies of Roman period fruit/nut remains by site type.

Urban sites exhibit the greatest diversity in the Roman period, though they are closely followed by rural, military and other sites, each of which have all fruits except pomegranate. Date appears to have increased in this period, at all site types, and is even the most common type of remain at rural sites by considerable margins. *Prunus* fruits also appear to have increased in this period, and are present at all site types. Interestingly, grape, and especially olive, are present at rural sites in very low frequencies: grape is present at only around 16% and olive is present at just over 8% of rural sites. Olive is present at 80% of military sites, however, and at 60% of urban sites. Similarly, grape is present at between 50-75% of sites for all other site type categories, making the low frequencies of these fruits in rural contexts especially anomalous.

Late Roman period

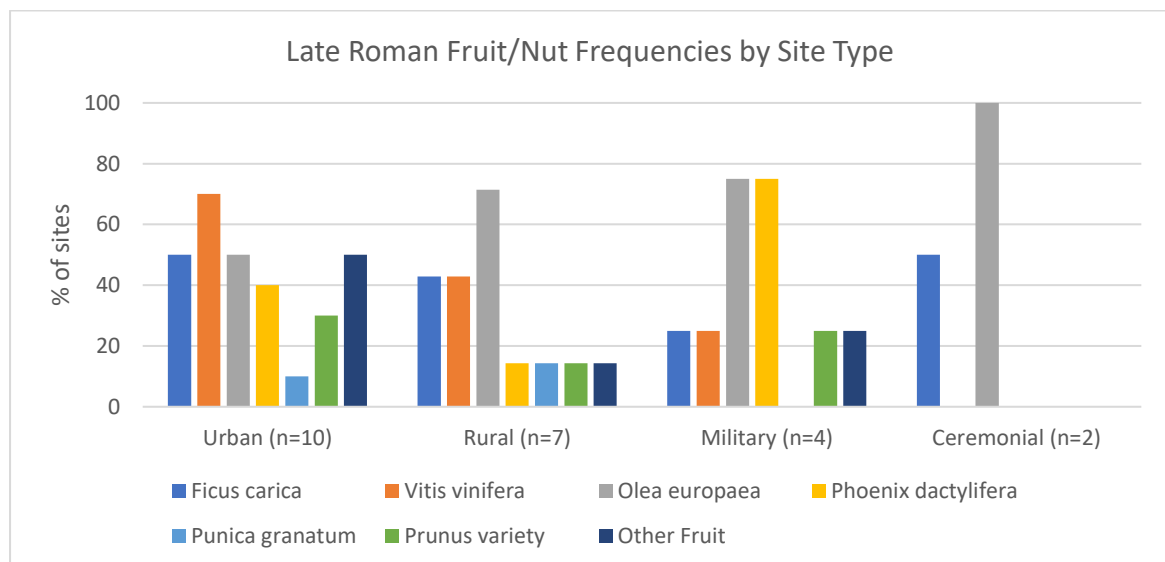


Figure 7-23 Frequencies of Late Roman fruit/nut remains by site type.

Apart from ceremonial sites, of which there are only two, all site types continue to exhibit relatively high diversity of fruits in the Late Roman period. All fruits are present at both urban and rural sites, while military sites are lacking in only pomegranate. Grape is the most frequent remain at urban sites, followed by olive and fig. At rural sites, olive is the most frequent remain at about 71% of sites, which contrast with the previous period, when it was present at only around 8% of sites. Olive continues to be prominent at military sites, though date is present at an equal percentage of these sites.

7.2.6 Pulses

7.2.6.1 Pulses: Chronological variation

Lens culinaris is the most frequent pulse in all chronological periods. In the early Pre-Roman, Pre-Roman and Roman period, the second most frequent pulse is *Vicia ervilia*, though in the Late Roman period this shifts, and an overall increase in *Pisum sativum* makes it the second most frequent.

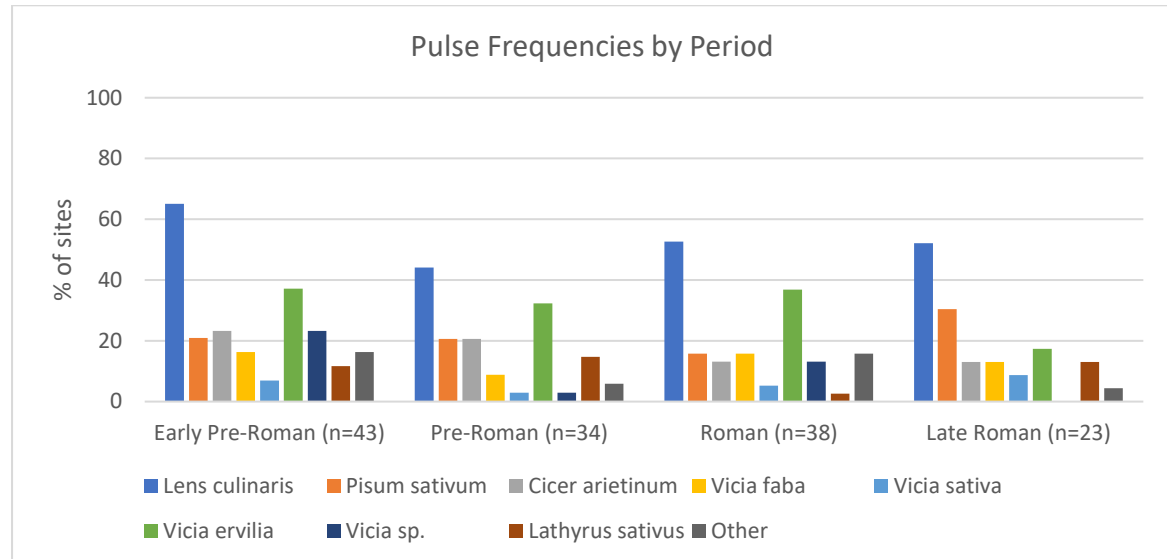


Figure 7-24 Frequencies of pulse remains by period.

7.2.6.2 Pulses: Regional variation

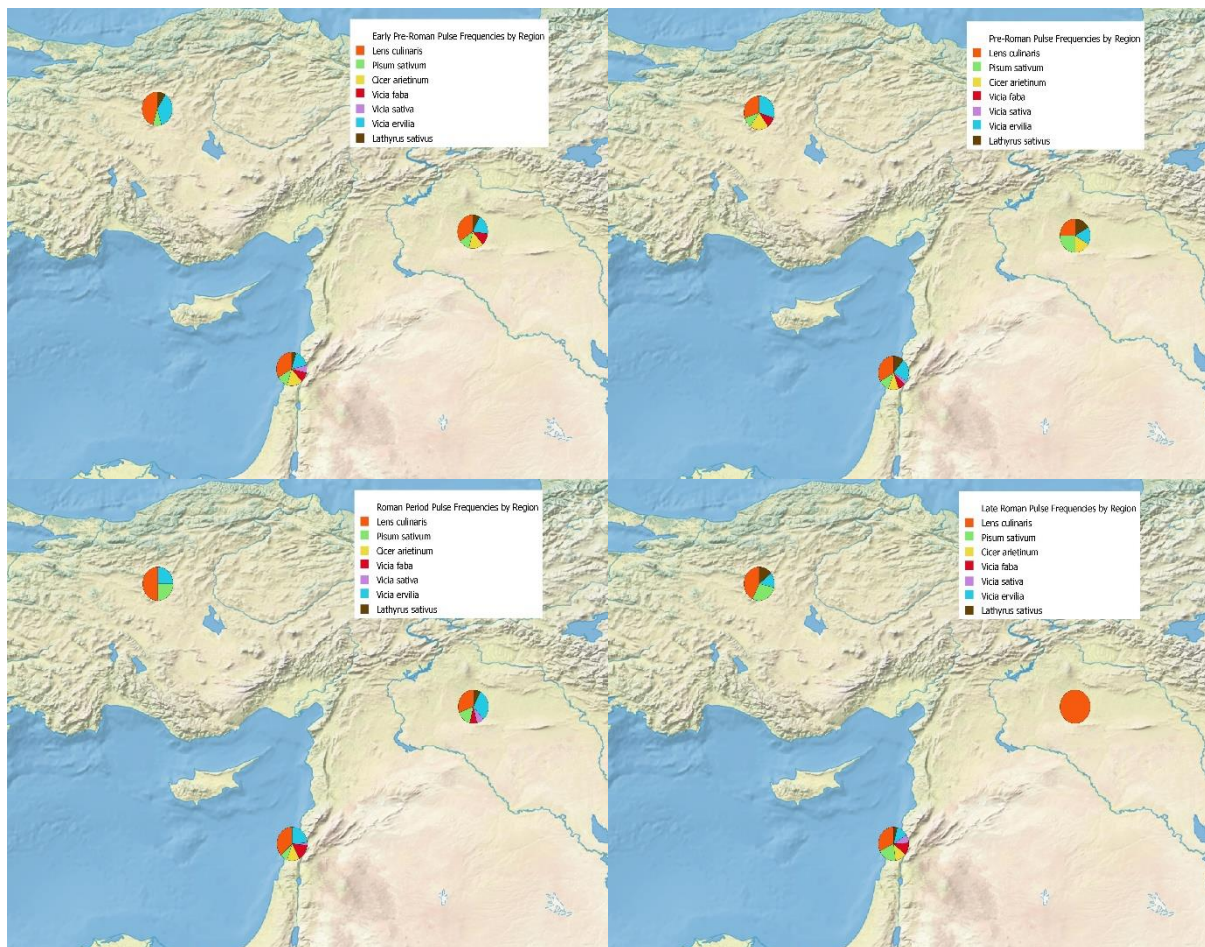


Figure 7-25 Frequencies of pulse remains for the Early Pre-Roman, Pre-Roman, Roman, and Late Roman period datasets by region. See Table 7-1 for number of records per region by period.

In all periods, the highest frequencies are achieved in the dataset from the Anatolian Peninsula, while the Levantine assemblages are generally the most diverse.

Early Pre-Roman Period

In the Early Pre-Roman period, lentil is the most common, and *Vicia ervilia* is among the second most common in all regions, though in the Levant the latter occurs at the same frequency as chickpea (28%). Chickpea and *Vicia faba* are absent from the Anatolian Peninsula, and *Vicia sativa* occurs only in the Levant.

Pre-Roman Period

In the Pre-Roman period, frequencies in the Levant are markedly low overall, though *Vicia sativa* continues to occur only in this region. Most pulses occur in the other two regions, though *Lathyrus sativus* is absent in the Anatolian dataset, and *Vicia faba* is absent from the Greater Middle East.

Otherwise, *Lens culinaris* continues to dominate in all regions, though it is present at equal frequencies to *Vicia ervilia* in Anatolia, and *Pisum sativum* in the Greater Middle East.

Roman Period

In the Roman period dataset, the pulse assemblage from the Anatolian peninsula is limited to *Lens culinaris*, *Pisum sativum*, and *Vicia ervilia*, with lentil being the most common. The other regions exhibit a greater degree of diversity, with lentil, followed by *Vicia ervilia*, being the most common. *Lathyrus sativus* occurs only in the Greater Middle East, at less than 15% of sites, while chickpea occurs only in the Levant, at just over 17% of sites.

Late Roman Period

As there is only one site (producing only *Lens culinaris*) from the Greater Middle East in the Late Roman dataset, little can be said of this region. The Anatolian peninsula continues to produce higher frequencies than the Levant, though the Levantine assemblage is more diverse. *Lens culinaris*, followed by *Pisum sativum* is the most frequent pulse in both regions, and *Cicer arietinum* (chickpea), *Vicia faba*, and *Vicia sativa* occur only in the Levant.

7.2.6.3 Pulses: Variation by site type

Early Pre-Roman period

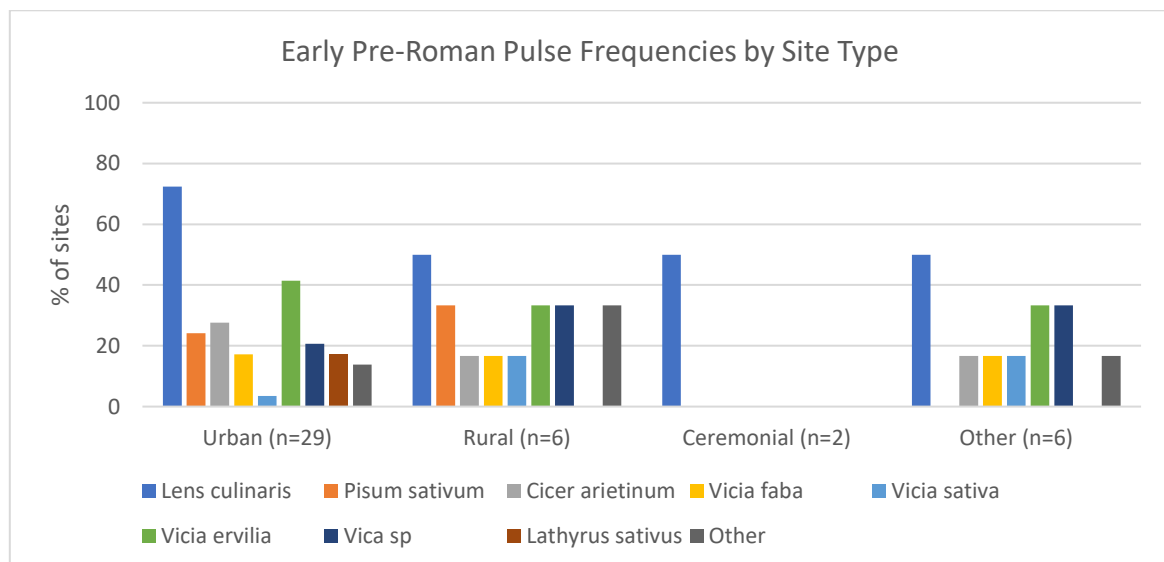


Figure 7-26 Frequencies of Early Pre-Roman pulse remains by site type.

In the Early Pre-Roman period, lentil (*Lens culinaris*) is the most frequent pulse at all site types, and the only pulse uncovered at ceremonial sites. Apart from lentil, *Vicia ervilia* features prominently at

most site types, though is absent from ceremonial contexts and occurs at the same percentage of rural sites as *Pisum sativum*. Chickpea (*Cicer arietinum*) occurs at generally low frequencies, and is the most frequent in urban assemblages, at ~27%. *Vicia sativa* and *Vicia faba* are among the less common pulses at all site types, and *Lathyrus sativus* occurs only at circa 17% urban sites.

Pre-Roman period

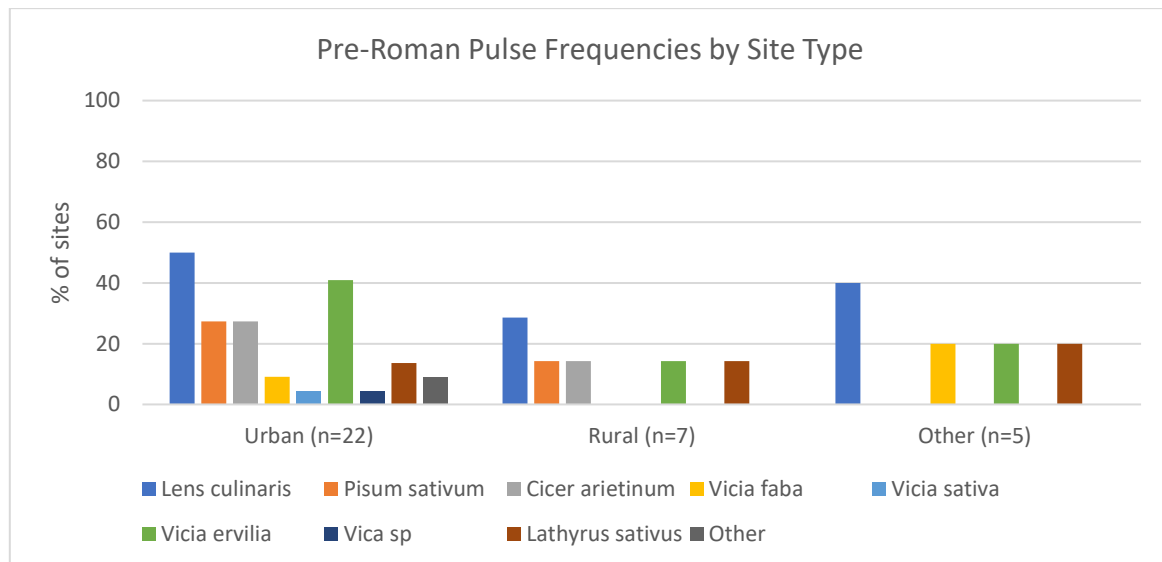


Figure 7-27 Frequencies of Pre-Roman pulse remains by site type.

Lens culinaris continues to be the most frequent pulse at all site types during the Pre-Roman period. In general, pulse frequencies appear to be somewhat lower during this period, with species such as *Pisum sativum* and *Vicia ervilia* occurring at most lower frequencies. Though *Vicia ervilia* does seem to remain the second most common pulse after *Lens culinaris*. Chickpea occurs in low frequencies at urban and rural sites, as in the Early Pre-Roman dataset. *Vicia sativa* appears to decrease from the previous period, occurring at only ~ 5% of urban sites. *Lathyrus sativus*, however, appears to become slightly more widespread, occurring at all site types, though never exceeding 20% of sites in any category.

Roman period

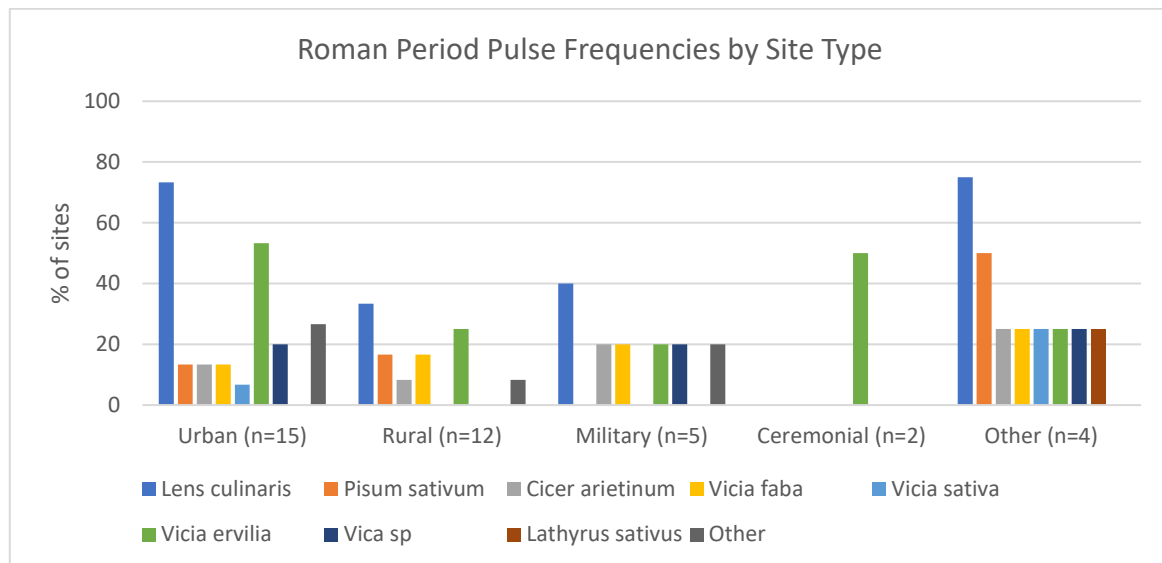


Figure 7-28 Frequencies of Roman period pulse remains by site type.

Pulses exhibit a general increase in the Roman period: *Lens culinaris*, for example, occurs at around 75% of urban and 'other' sites, a value which does not occur in the proceeding period. *Lens culinaris* continues to be the most common pulse remains at all site types apart from ceremonial sites, though there are only two sites in this category. *Vicia ervilia* occurs at high frequencies at urban sites (over 50%), while *Pisum sativum* is more common at sites classified as other (50% of sites). *Cicer arietinum*, *Vicia faba*, and *Vicia sativa* do not achieve high frequencies, and the latter is absent from rural and military contexts. *Lathyrus sativus* is, again, less common, occurring at only one site type (other sites).

Late Roman period

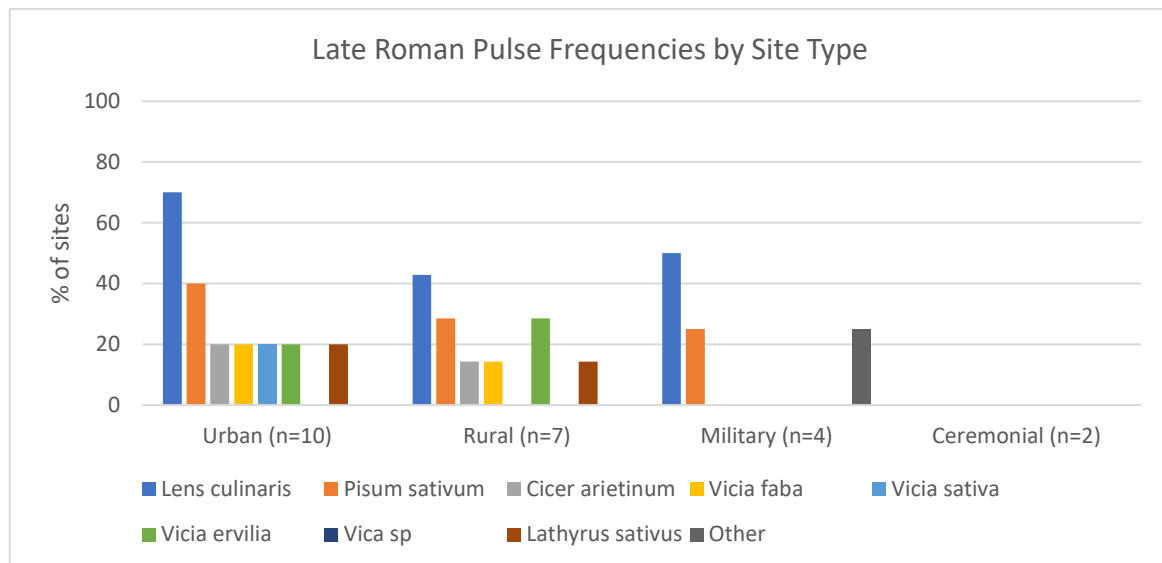


Figure 7-29 Frequencies of Late Roman pulse remains by site type.

Lentil continues to be the most common pulse at all site types yielding pulses in the Late Roman period. *Pisum sativum* appears to overtake *Vicia ervilia* as the second most common pulse at all site types apart from rural sites, where the two species occur at the same frequency (circa 29%). Urban sites have the most diverse pulse assemblage, while only two types of pulses are found in military contexts (*Lens culinaris* and *Pisum sativum*). Neither chickpea, *Lathyrus sativus*, nor any *Vicia* species is especially common at any site type.

7.2.7 Nut Remains

7.2.7.1 Nuts: Chronological variation

As can be seen in Fig. 23 below, *Corylus avellana* (hazelnut) and *Castanea sativa* (chestnut) are absent from the datasets in all periods here considered. In the Early Pre-Roman and Pre-Roman periods, *Pistacia* is the most common type of nut remain, while in the Roman and Late Roman periods, *Juglans regia* (walnut) becomes the most common nut as *Pistacia* sp. decreases. Like walnut, *Pinus pinea* (pine nut) and *Prunus dulcis* (almond) increase in the latter two periods, peaking in the Late Roman period.

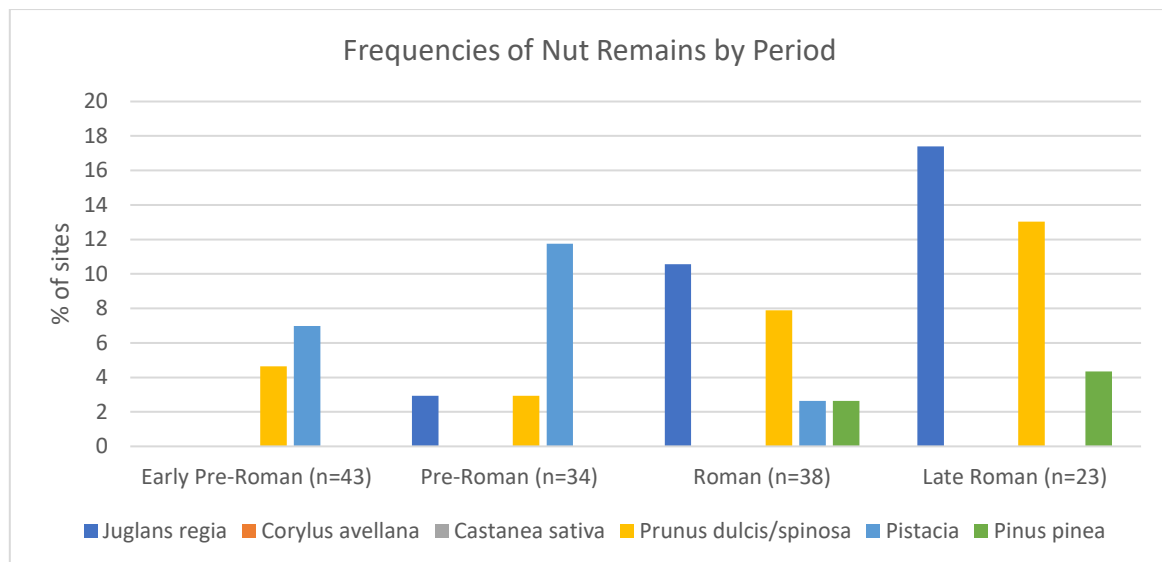


Figure 7-30 Frequency of nut remains by period.

7.2.7.2 Nuts: Other variations

As the nut remains are characterised by what is essentially a low number of occurrences, the distribution of species according to site type and region is less useful. However, a few patterns can be noted.

Walnut is not found outside of the Levant, and occurs mainly at urban sites, with one military context, as well as a find in a cave, being the exception. Almond remains are also more in common in urban contexts, with 70% of almond remains being from urban sites. Almond is found in the Levant as well as in the Greater Middle East, though is absent from the Anatolian dataset. Like walnut and almond, *Pistacia* sp. is also most common at urban sites, with 75% of occurrences being in urban contexts. Notably, *Pistacia* sp. is the only type of nut remain to occur in all three regions. Little can be gleaned from the distribution of pine nut remains, as the nut occurs at only the Levantine port city of Caesarea.

7.2.8 Flavourings and Vegetables

Flavourings and vegetables are rare in the archaeobotanical record of the East, as can be expected in charred assemblages. Notably, the Early Pre-Roman dataset is the most diverse in terms of both flavourings and vegetables, with 16 species represented, compared to the three, five and five in the Pre-Roman, Roman, and Late Roman datasets respectively (see Table 7-2 for list of species represented in each period). A considerable number of the Early Pre-Roman flavouring/vegetable deposits occur in the form of large [storage] caches.

Due to the limited number of occurrences, the distribution of these plant-types is difficult to analyse. However, their distribution can be better understood by examining Tables 7-3 and 7-4 below, which display the number of records containing flavouring and vegetable remains for each period and site type.

Table 7-3 Number of records containing charred flavourings by site type and period.

Flavourings					
Period	Urban	Rural	Military	Ceremonial	Other
Early Pre-Roman Period	9	1	-	0	1
Pre-Roman Period	1	2	-	-	0
Roman Period	2	0	0	1	1
Late Roman Period	1	0	0	0	-

Table 7-4 Number of records containing charred vegetables by site type and period.

Vegetables					
Period	Urban	Rural	Military	Ceremonial	Other
Early Pre-Roman Period	5	0	-	0	0
Pre-Roman Period	1	0	-	-	0
Roman Period	1	1	0	0	0
Late Roman Period	2	1	0	0	-

7.2.9 Oil/Fibre/Other economic taxa

Another rare plant type in the archaeobotanical record of the East consists of plants that can be categorised as oil/fibre plants and other economic taxa. These plants are most diverse in the Early Pre-Roman period, with plants such as poppy (*Papaver sp./Papaver somniferum*), flax (*Linum usitatissimum*), sesame (*Sesamum sp.* and *Sesamum orientale*) all represented. Other species present in the dataset include gold of pleasure/false flax (*Camelina sativa*), which occurs in the Early Pre-Roman and Pre-Roman periods, as well as cotton (*Gossypium sp.*), which is found in the Pre-Roman, Roman, and Late Roman periods (for a complete list of economic plants represented, see Table 7-2).

Table 7-5 Number of Records in Eastern dataset containing oil/fibre plants and other economic taxa, by site type and period.

Oil/Fibre/Other Economic Taxa					
Period	Urban	Rural	Military	Ceremonial	Other
Early Pre-Roman Period	9	1	-	0	3
Pre-Roman Period	4	1	-	-	1
Roman Period	2	0	1	0	0
Late Roman Period	2	1	1	0	-

7.2.10 Wild/Weed Seeds

The frequencies of the top 20 most commonly occurring wild/weed seeds for each period were calculated in an effort to examine shifts in the chronological distribution of said plants more closely (Table 7-6 below). In general, most of the top wild/weed seeds can be associated with arable agriculture, though the overall lack of species level identifications unfortunately hinders more detailed analysis. Though little can be concluded from the results presented here, it is notable that the frequencies of the top wild/weed seeds in the Early Pre-Roman dataset are markedly higher than for any other period (see Chapter 9 for further discussion).

Table 7-6 The most frequent wild/weed seeds by period, and the percentage of sites at which they occur.

Early Pre-Roman (n=45)	% of sites	Pre-Roman (n=34)	% of sites	Roman (n=38)	% of sites	Late Roman (n=23)	% of sites
Fabaceae	44.19	Poaceae	38.24	Fabaceae	36.84	Fabaceae	39.13
Poaceae	41.86	Fabaceae	26.47	Poaceae	34.21	<i>Medicago</i> sp.	39.13
<i>Galium</i> sp.	37.21	<i>Silene</i> sp.	26.47	<i>Galium</i> sp.	26.32	Poaceae	34.78
<i>Lolium</i> sp.	34.88	<i>Lolium</i> sp.	23.53	<i>Silene</i> sp.	23.68	<i>Phalaris</i> sp.	26.09
<i>Medicago</i> sp.	27.91	<i>Malva</i> sp.	20.59	<i>Lolium temulentum</i>	18.42	<i>Galium</i> sp.	21.74
<i>Bromus</i> sp.	25.58	<i>Galium</i> sp.	17.65	<i>Malva</i> sp.	18.42	<i>Plantago</i> sp.	21.74
<i>Polygonum</i> sp.	25.58	<i>Medicago</i> sp.	17.65	<i>Fumaria</i> sp.	15.79	<i>Silene</i> sp.	21.74
<i>Silene</i> sp.	25.58	<i>Phalaris</i> sp.	14.71	<i>Medicago</i> sp.	15.76	<i>Malva</i> sp.	17.39
<i>Chenopodium</i> sp.	23.26	<i>Polygonum</i> sp.	14.71	<i>Phalaris</i> sp.	15.79	<i>Trifolium</i> sp.	17.39
<i>Rumex</i> sp.	23.26	<i>Aegilops</i> sp.	11.76	<i>Plantago</i> sp.	15.79	<i>Astragalus</i> sp.	13.04
<i>Trifolium</i> sp.	23.26	<i>Arnebia</i> sp.	11.76	<i>Vicia</i> sp.	15.79	Asteraceae	13.04
<i>Vicia</i> sp.	23.26	<i>Chenopodium</i> sp.	11.76	<i>Adonis</i> sp.	13.16	Boraginaceae	13.04
<i>Adonis</i> sp.	20.93	Cyperaceae	11.76	<i>Lolium</i> sp.	10.53	<i>Chenopodium</i> sp.	13.04
<i>Malva</i> sp.	20.93	<i>Fumaria</i> sp.	11.76	<i>Rumex</i> sp.	10.53	<i>Fumaria</i> sp.	13.04
Apiaceae	18.6	<i>Lolium temulentum</i>	11.76	<i>Trigonella</i> sp.	10.53	<i>Viola</i> sp.	13.04

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Asteraceae	18.6	Apiaceae	8.82	<i>Astragalus</i> sp.	7.89	<i>Ajuga</i> sp.	8.7
<i>Lolium temulentum</i>	18.6	<i>Asperula/Galium</i>	8.82	Boraginaceae	7.89	<i>Amaranthus</i> sp.	8.7
<i>Phalaris</i> sp.	18.6	<i>Astragalus</i>	8.82	<i>Bromus</i> sp.	7.89	<i>Androsace</i> sp.	8.7
<i>Teucrium</i> sp.	18.6	<i>Astragalus/Trigonella</i>	8.82	<i>Carex</i> sp.	7.89	<i>Asperula/Galium</i> sp.	8.7
<i>Astragalus</i> sp.	16.28	<i>Avena</i> sp.	8.82	<i>Euphorbia</i> sp.	7.89	<i>Bromus</i> sp.	8.7
Caryophyllaceae	16.28	Boraginaceae	8.82	<i>Lathyrus</i> sp.	7.89	Chenopodiaceae	8.7
<i>Centaurea</i> sp.	16.28	<i>Bromus</i> sp.	8.82	<i>Viola</i> sp.	7.89	<i>Euphorbia</i> sp.	8.7
<i>Coronilla</i> sp.	16.28	<i>Centaurea</i> sp.	8.82			Lamiaceae	8.7
		<i>Cerastium</i> sp.	8.82			<i>Lathyrus</i> sp.	8.7
		Liliaceae	8.82			<i>Lolium</i> sp.	8.7
		<i>Melilotus/Medicago/Trifolium</i>	8.82			<i>Melilotus/Medicago/Trifolium</i>	8.7
		<i>Papaver</i> sp.	8.82			<i>Onobrychis</i> sp.	8.7
		<i>Plantago</i> sp.	8.82			<i>Rumex</i> sp.	8.7
		<i>Setaria</i> sp.	8.82			<i>Sambucus</i> sp.	8.7
		<i>Vaccaria</i>	8.82			<i>Setaria</i> sp.	8.7
						<i>Spergula</i> sp.	8.7
						<i>Teucrium</i> sp.	8.7

7.3 The East: Fully quantified data

7.3.1 Overall plant composition

7.3.1.1 Regional variation in overall plant consumption

Early Pre-Roman period

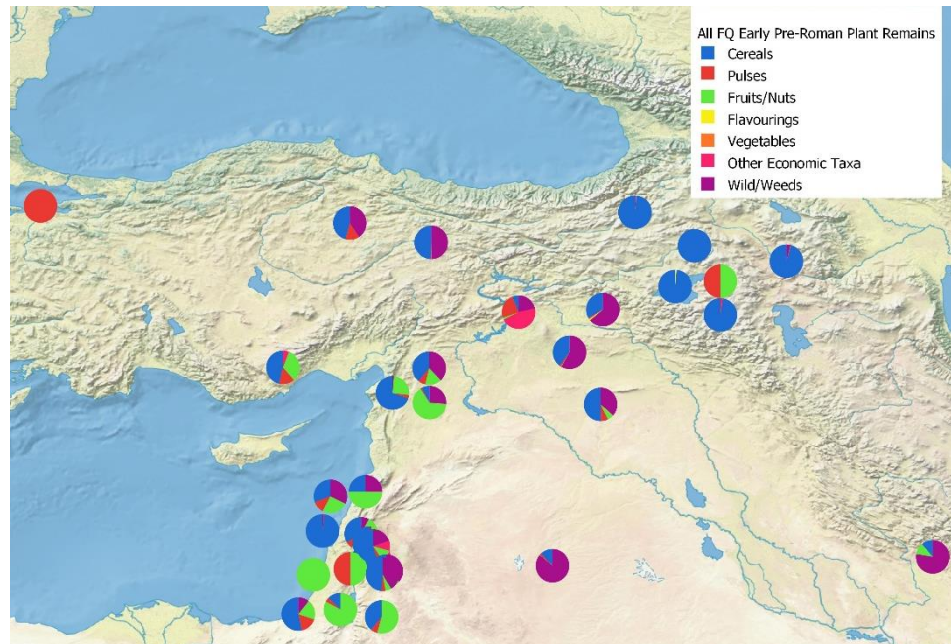


Figure 7-31 All fully quantified Early Pre-Roman plant remains, displayed according to spatial distribution of assemblages at the site level.

In the Early Pre-Roman period, regional variations in the prevalence of fruit remains are distinguishable. Sites with fruit as the most abundant remain are much more common in the Levant, as opposed to in Anatolia and the Greater Middle East, where, although there are fewer sites overall, there appears to be more sites that yield cereal (or wild/weed seed) rich assemblages. Even in the Levant, where fruit remains are more abundant, cereals appear to be represented in at least equal measure.

Pre-Roman period

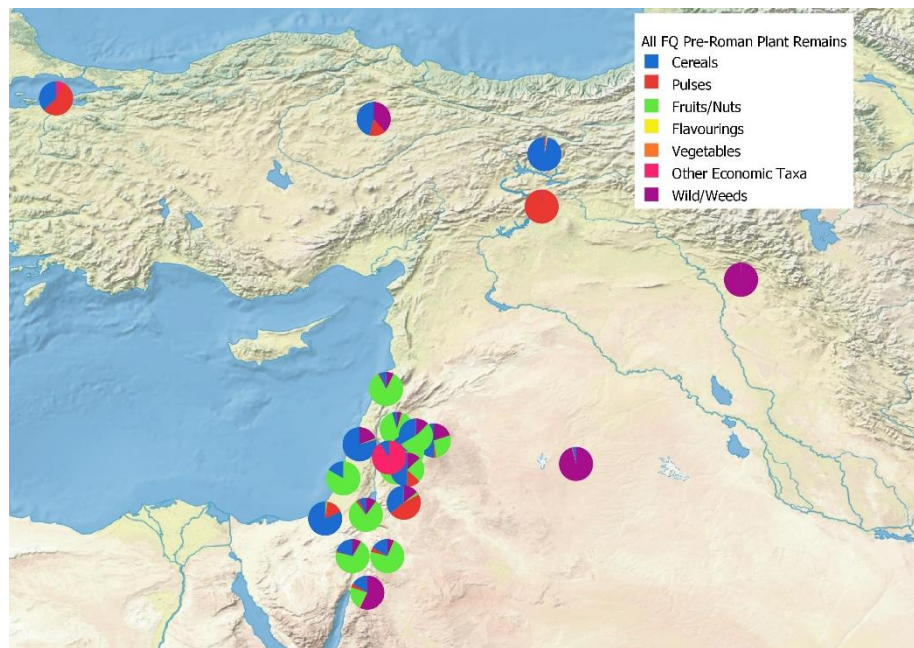


Figure 7-32 All fully quantified Pre-Roman plant remains, displayed according to spatial distribution of assemblages at the site level.

The Pre-Roman plant assemblages appear to reflect trends similar to those of the Early Pre-Roman period. Fruit dominated sites, again are clustered in the Levant, with no fruit remains found outside of the Levant, though sites in other regions are limited in number. It is possible to discern an increase in the amount of fruit dominated sites in the Levant, which previously was more equal to the number of cereal-rich sites.

Roman period

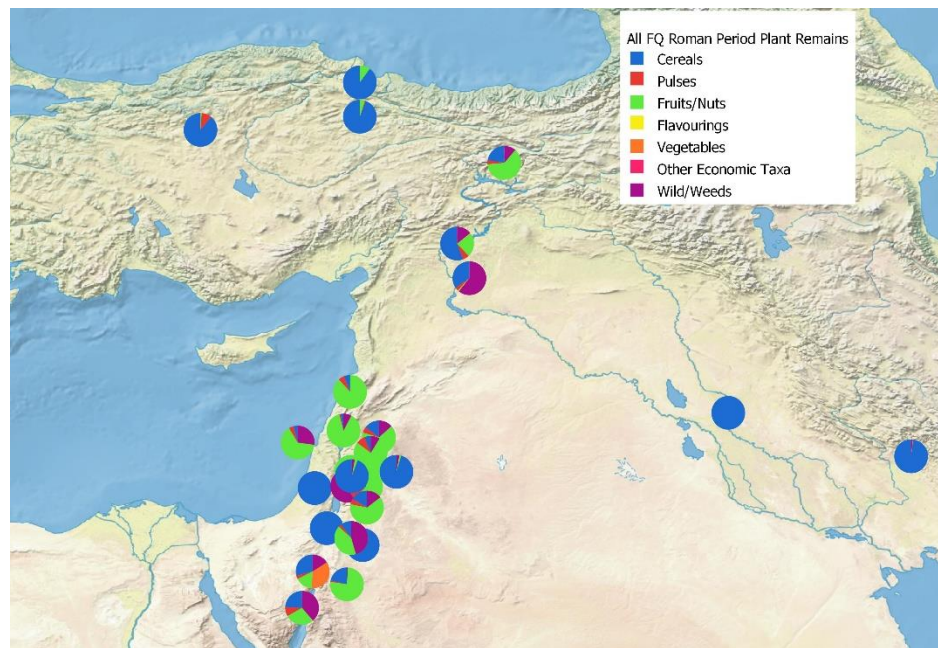


Figure 7-33 All full-quantified Roman period plant remains, displayed according to spatial distribution of assemblages at the site level.

Fruit again seems to increase into the Roman period. There is an increase (by about three to four) of sites in the Levant that are fruit dominated, and fruits even appear to be spreading northward, outside of the Levant, with four sites in other regions yielding fruit remains. Pulses have decreased in abundance, forming only a small portion of the assemblages from sites at which they are present. Wild/weed seeds may also appear to comprise less significant portions of most of the assemblages.

Late Roman period

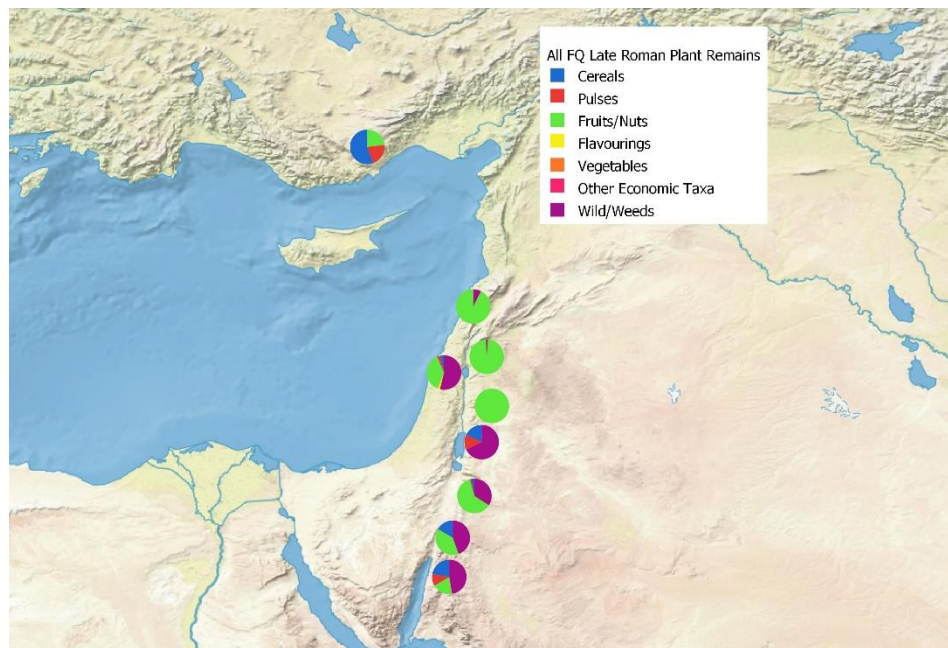


Figure 7-34 All fully quantified Late Roman Plant remains, displayed according to spatial distribution of assemblages at the site level.

The number of sites with full-quantified data for the Late Roman period is extremely limited, and thus any conclusions that can be made are tentative. Still, it is possible to discern a strong correlation with fruit continuing in the Levant; at least four sites are dominated by fruit remains, and two that feature wild/weed seeds as the most common plant type, show fruit remains as a close second. Though there is only one site outside of the Levant in this period, it features fruit remains, which may correlate with the northward spread of fruit seen in previous periods, though this cannot be said with any certainty without more data.

7.3.1.2 Variation in overall plant composition by site type

Early Pre-Roman period

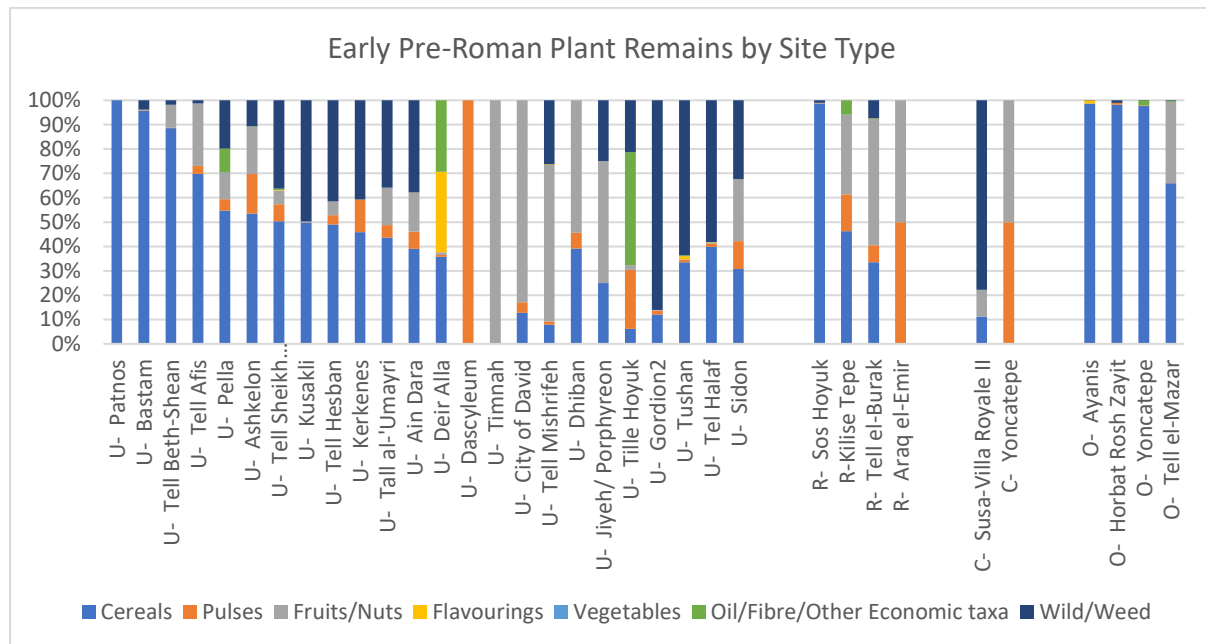


Figure 7-35 All fully quantified Early Pre-Roman plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, C= Ceremonial, O= Other.

When viewing the fully quantified data by site type, it becomes clear that cereals are the dominant type of remain at all site types apart from ceremonial sites. Fruits/nuts, as well as pulses, have a notable presence, but in smaller quantities than cereal remains. Flavourings and oil/fibre/other economic plants can be observed at urban, rural, and 'other' sites, though in generally small quantities. There are a few exceptions, such as at Deir Alla (Site 23), where caches of *Cuminum cyminum* and of *Trigonella foenum-graecum* contributed to the greater relative abundance of flavourings in the assemblage. Similarly, a cache of *Linum usitatissimum* from Tille Höyük (Site 91), increases the relative abundance of oil/fibre/other economic taxa at the site.

Pre-Roman period

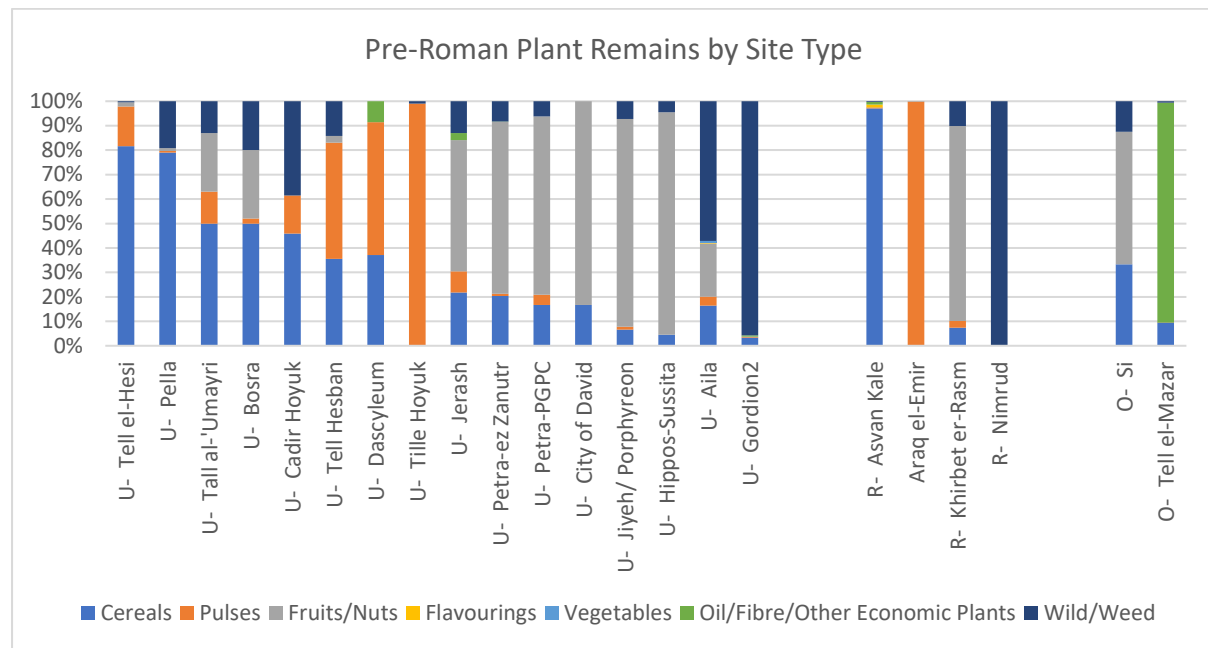


Figure 7-36 All fully quantified Pre-Roman period plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, O= Other.

In the Pre-Roman period there appears to be an increase of fruit dominated sites particularly in urban contexts, though there are more of this site type in general. Pulses, also exhibit greater relative abundance than previously, though this, again, is often the manifestation of caches, such as at Tille Höyük (Site 91), where particularly large caches of *Lathyrus sativus* and *Pisum sativum* skew the data. In general, little variation by site type is discernible in this period.

Roman period

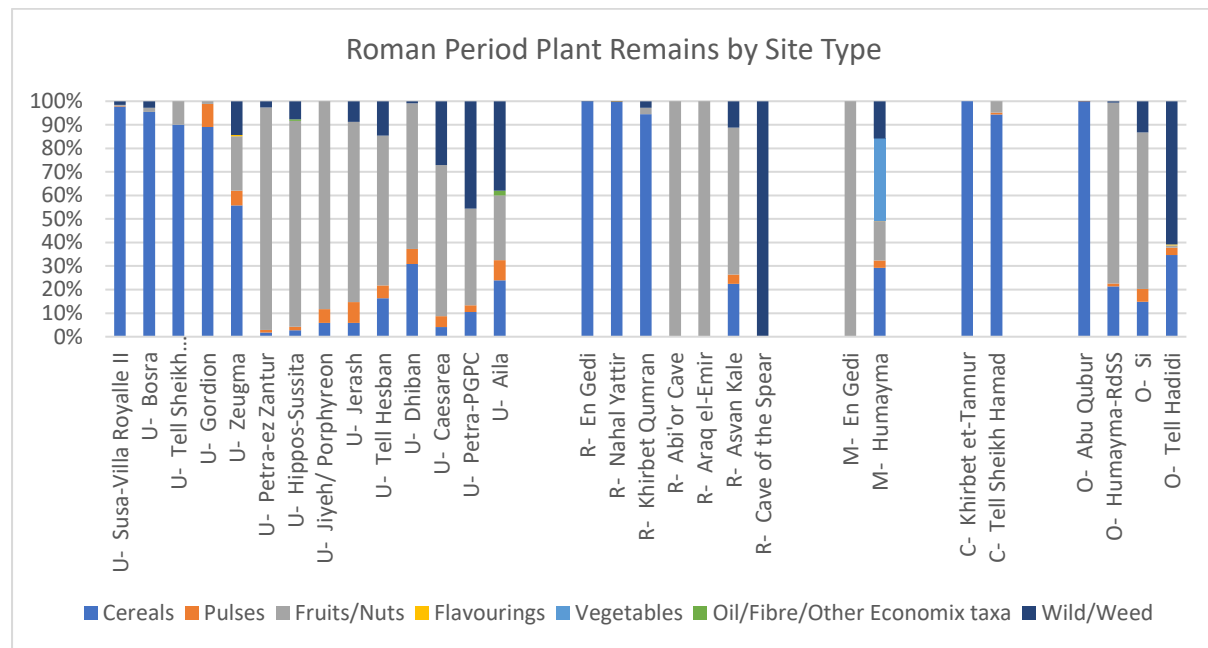


Figure 7-37 All fully quantified Roman period plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, M= Military, C= Ceremonial, O= Other.

When viewing the Roman period data by site type, it becomes apparent that the majority of the urban sites have fruit as the most abundant remain, though there are, of course, exceptions. In contrast, a greater number of rural sites show a strong abundance of cereals. Pulses remain constant, though not abundant, and to a lesser degree at rural sites. The less common plant types, such as flavourings, vegetables, and oil/fibre plants, are present in such small quantities that they are barely visible.

Late Roman period

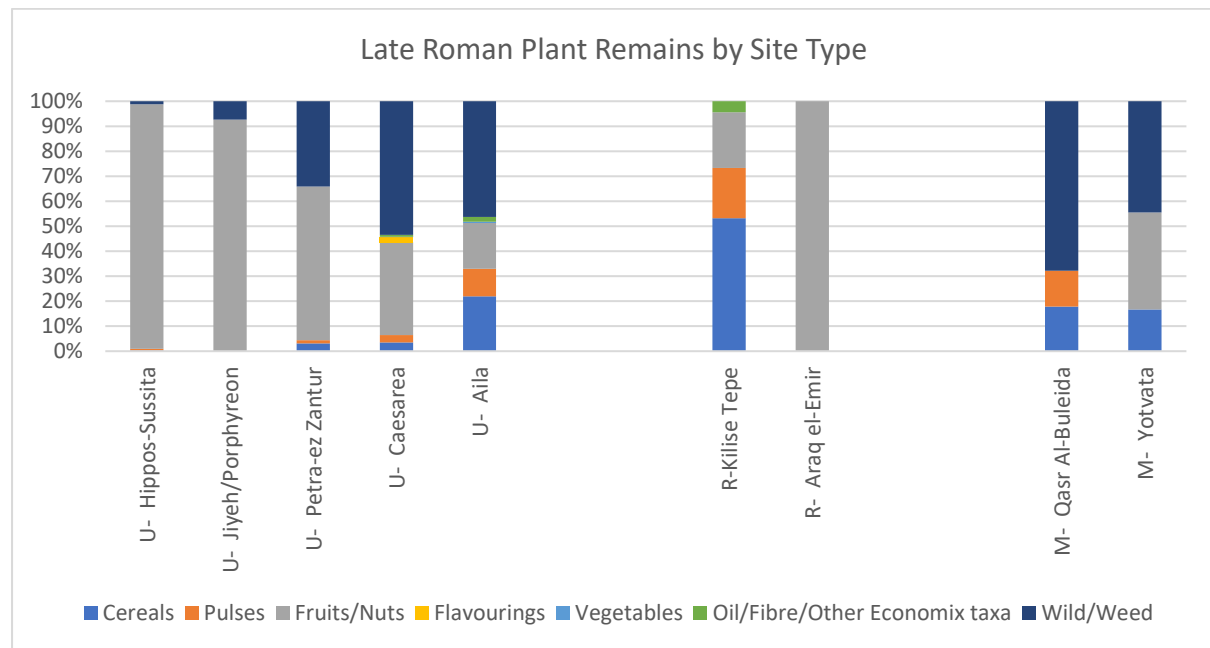


Figure 7-38 All fully quantified Late Roman plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, M= Military.

Though the limited number of Late Roman sites renders detecting patterns somewhat difficult, it appears that fruit remains continue to be dominant at urban sites, and cereal remains decrease even further.

Chapter 7 Results: The East

7.3.2 Cereals

7.3.2.1 Cereals: Regional variation

Early Pre-Roman period

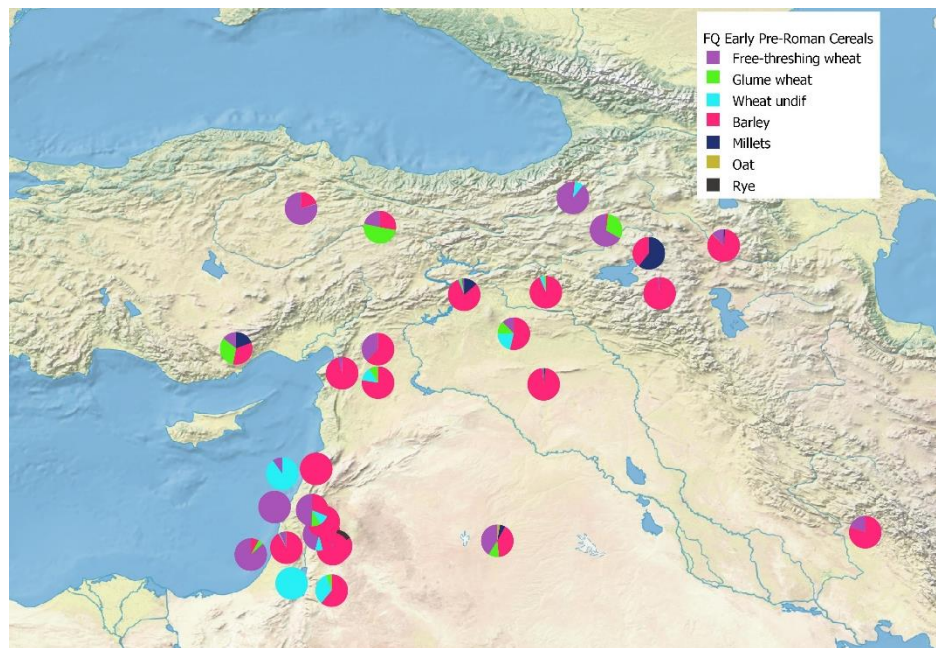


Figure 7-39 Fully quantified Early Pre-Roman cereal remains, displayed according to spatial distribution of assemblages at the site level.

The prominence of barley is highly visible in all regions. Glume wheats can be seen at about seven sites, and are relatively abundant, if not dominant, at three sites, all of which are in the northern regions of the study area. It is also just possible to detect that millets, though limited in general, appear in greater abundance in Anatolia and the Greater Middle East as well.

Pre-Roman period

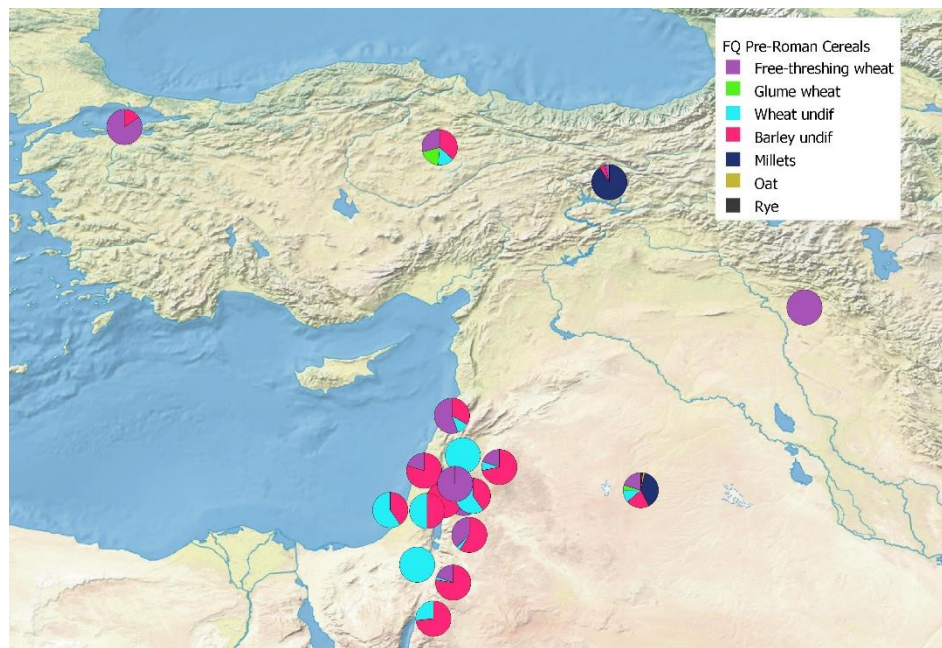


Figure 7-40 Fully quantified Pre-Roman cereal remains, displayed according to spatial distribution of assemblages at the site level.

Barley remains the most abundant cereal throughout the region, though its prominence is less obvious than in the previous period, suggesting a decrease of relative abundance as wheat increases. This may be impacted, however, by the concentration of sites in the Levant. Millets continue to be concentrated in the North and East, and in this period do not occur in the Levantine coastal areas. Glume wheats can only be seen at two sites, both of which, again, are either in the northern or eastern portion of the study area.

Chapter 7 Results: The East

Roman period

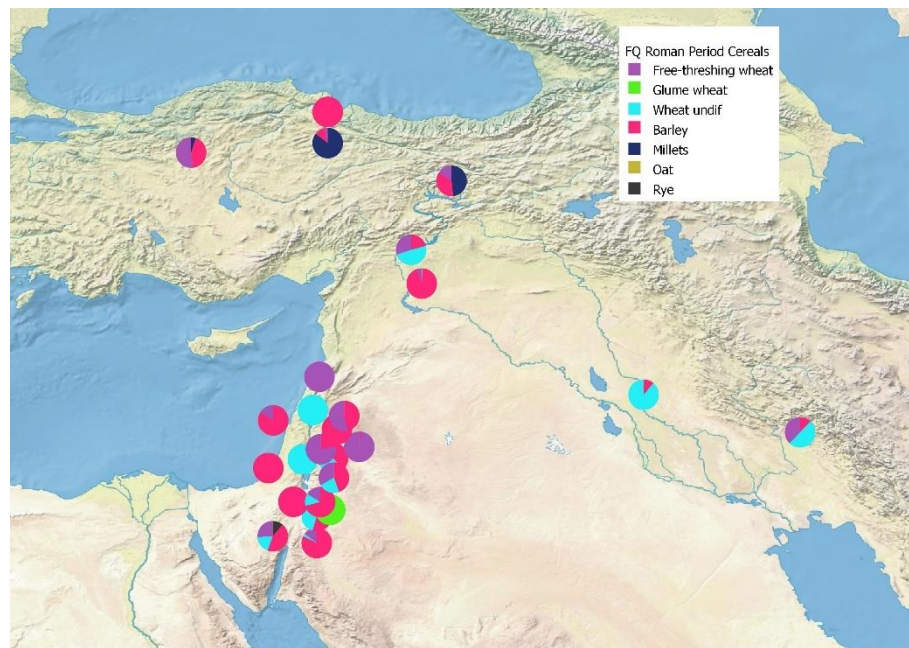


Figure 7-41 Fully quantified Roman period cereal remains displayed according to spatial distribution of assemblages at the site level.

Little change in regional variations in cereal abundances can be observed in the Roman period. Barley and wheat continue to be dominant, with glume wheat appearing at only one inland site. Millets remain observable, though possibly in increased abundance in the Anatolian Peninsula.

Late Roman period

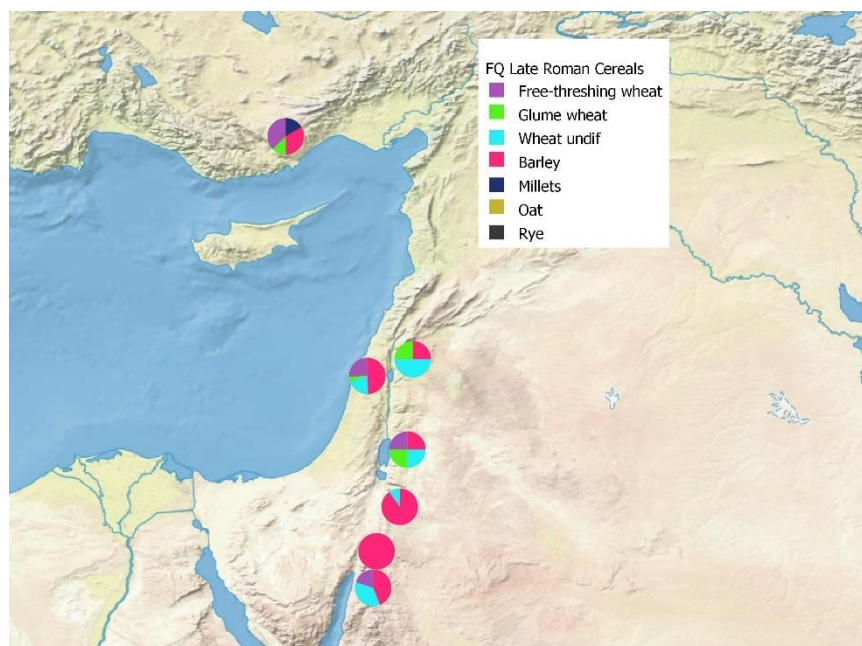


Figure 7-42 Fully quantified Late Roman period cereal remains displayed according to spatial distribution of assemblages at the site level.

Again, as there are only seven fully quantified datasets with Late Roman period cereal remains, conclusions are limited. Still, it can be said that samples from three out of the seven sites produced glume wheats, and two of these sites are in the Levant. This increase in glume wheat abundance, which are not minor occurrences at the sites, is a departure from previous patterns. Millets are present at the single site in Anatolia, though whether this is a continuation of previous regional trends is uncertain.

7.3.2.2 Cereals: Variation by site type

Early Pre-Roman period

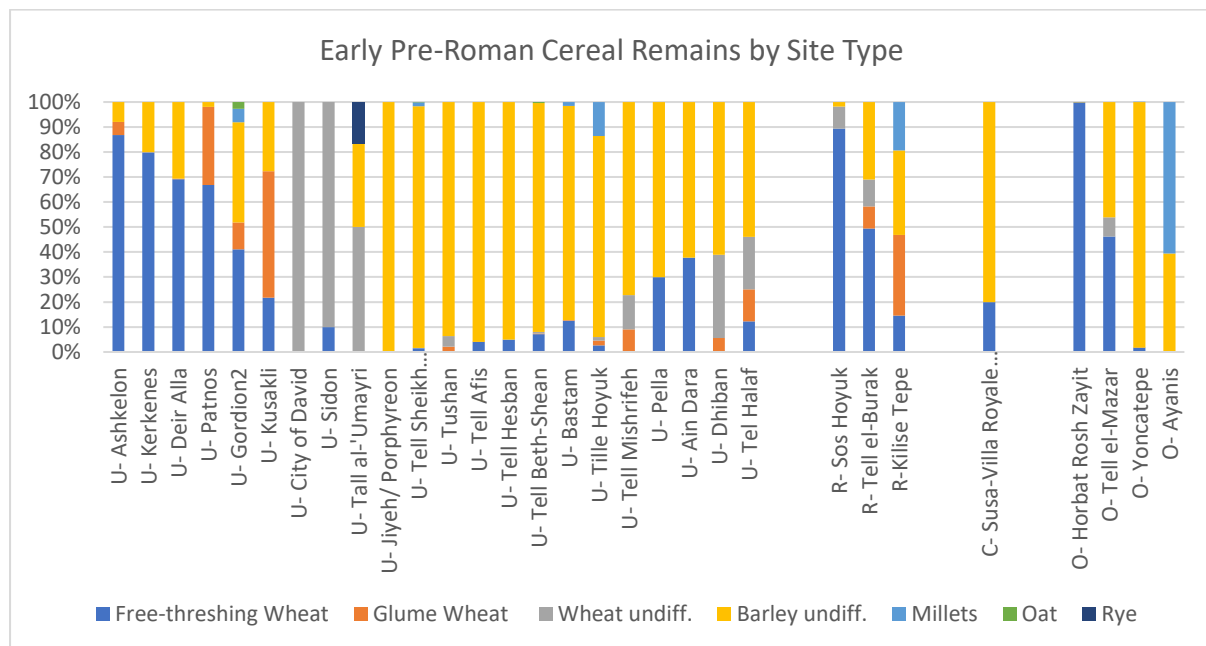


Figure 7-43 Fully quantified Early Pre-Roman cereal remains by site type. Individual sites are ordered by most common cereal type. U=Urban, R= Rural, C= Ceremonial, O= Other.

The prominence of barley is visible at urban sites in this period, where it is the dominant cereal type at nearly 60% of sites, often by large margins. Glume wheats occur at both rural and urban sites, and millets occur at all site types except for at the single ceremonial site.

Pre-Roman period

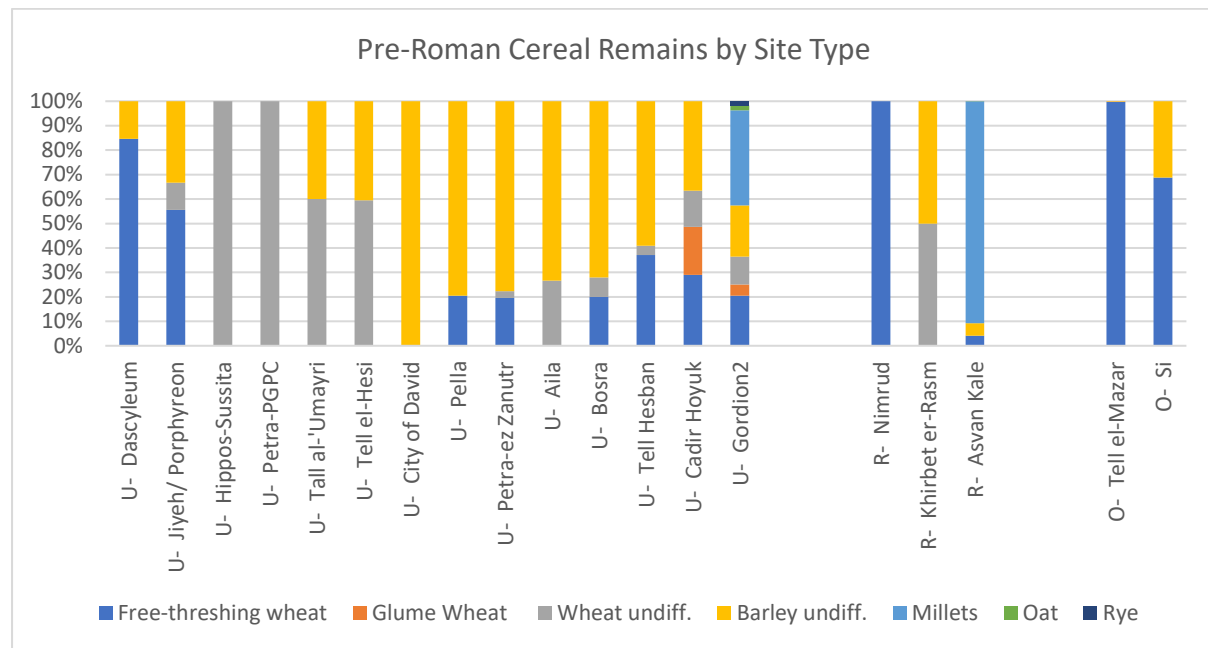


Figure 7-44 Fully quantified Pre-Roman cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, O= Other.

The Pre-Roman period datasets exhibit less clear patterns when viewed by site type. Barley is the most abundant cereal at a fair number of urban sites, though there are also urban sites at which *Triticum* sp. is the most abundant, two at which free-threshing wheats are the most abundant, and even with millets as the most abundant cereal remain. The rural sites each differ in their most abundant cereal, with millets, free-threshing wheats, and barley each featuring. Glume wheats, which are limited to two sites, appear only at urban sites, though there are by far the most sites in this category.

Roman period

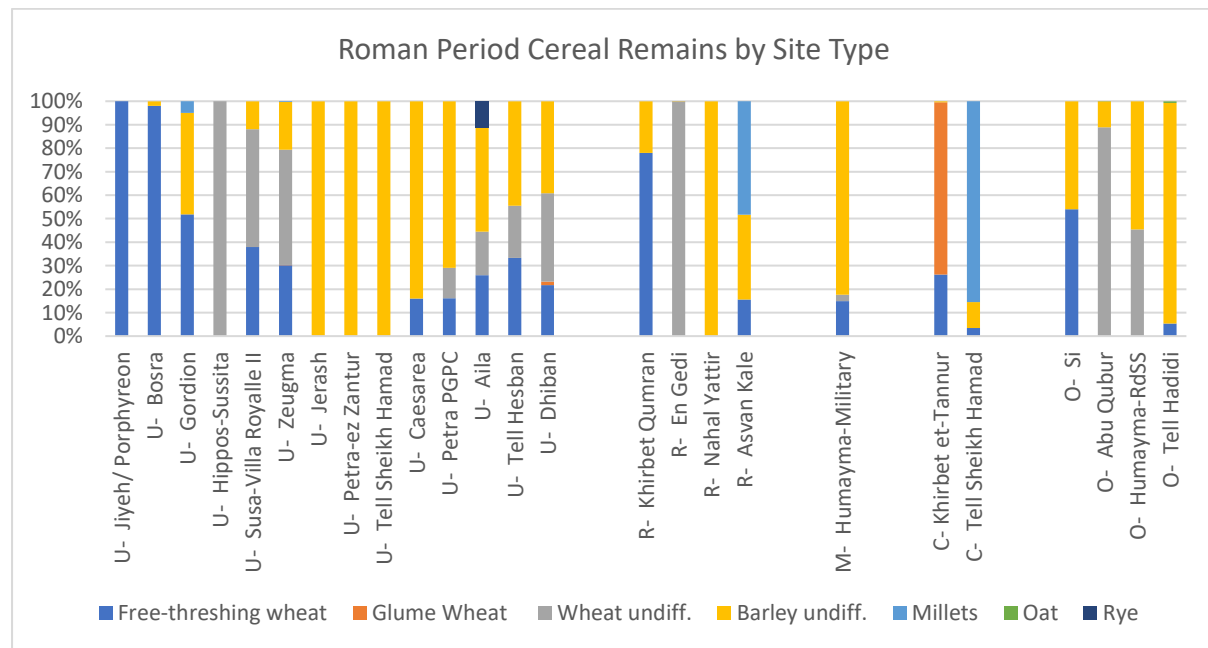


Figure 7-45 Fully quantified Roman period cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, M= Military, C= Ceremonial, O= Other.

Again, in the Roman period, few patterns are observable when viewing the cereal data by site type. Barley, free-threshing wheats, and *Triticum* sp. feature prominently in all categories. Millets are also present in ceremonial, rural and urban contexts. The ceremonial datasets may diverge somewhat, with one being the only site at which glume wheats are the most abundant cereal remains, and the only featuring millets as the dominant cereal type.

Late Roman period

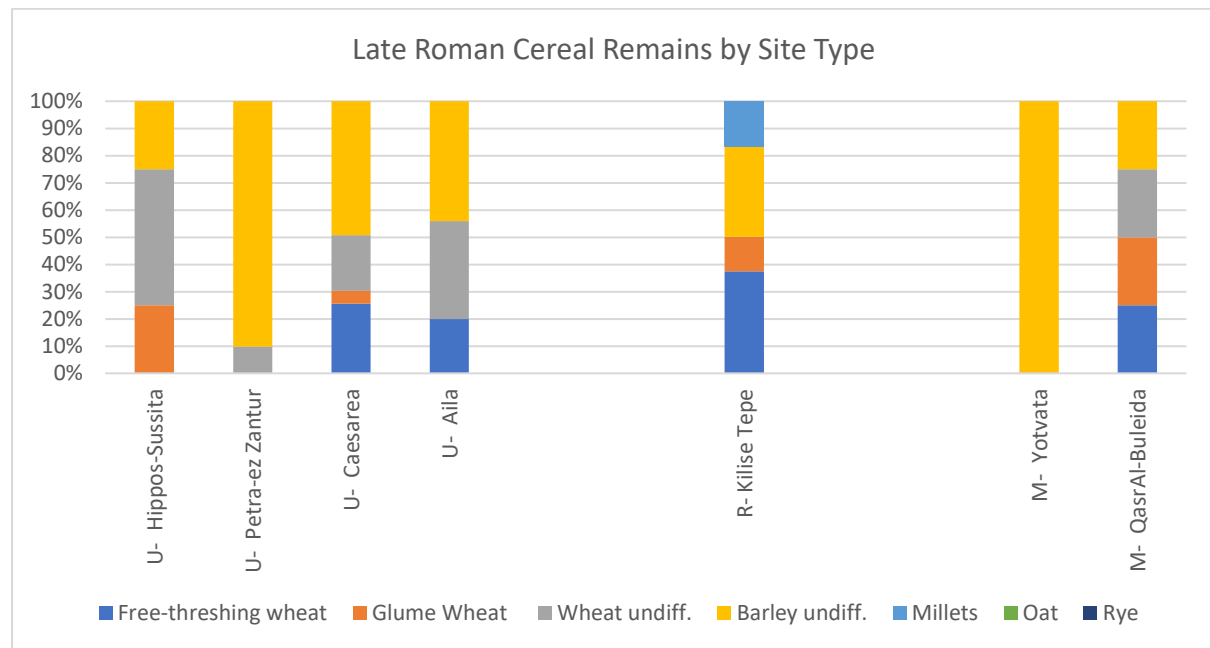


Figure 7-46 Fully quantified Late Roman cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, M= Military.

Glume wheats have a visibly increased abundance at all site types in the Late Roman period. Only one rural site yielded millet. *Triticum* sp., and especially barley, occur at all site types, as does free-threshing wheat, though the latter appears somewhat less prominently.

7.3.3 Fruit/Nuts

7.3.3.1 Fruit/Nuts: Regional variation

Early Pre-Roman period

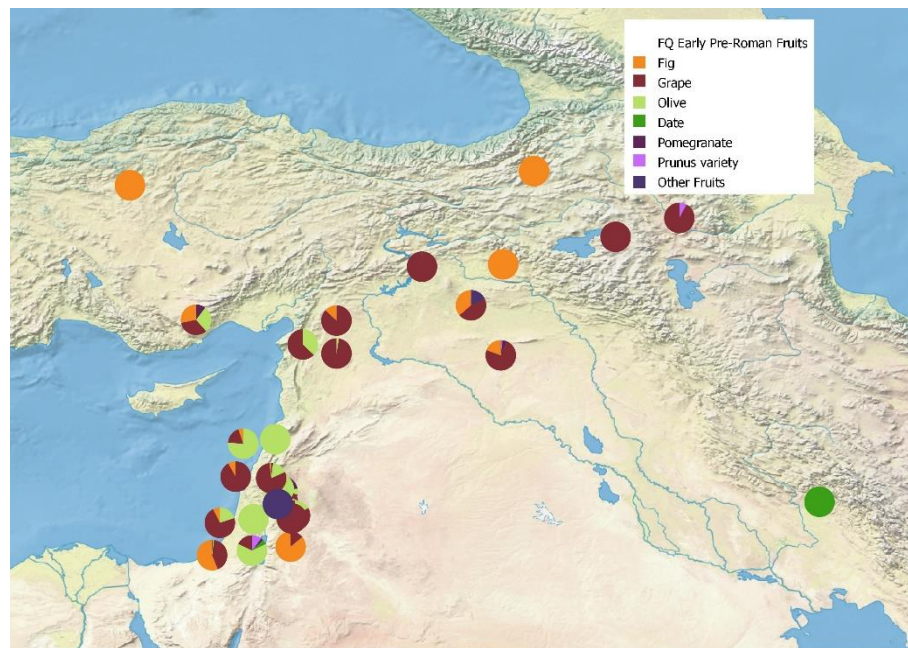


Figure 7-47 Fully quantified Early Pre-Roman fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

There is a certain level of homogeneity visible amongst the most northerly sites, with three sites featuring only fig, and two with only grape remains. Similarly, the site that lies furthest west, has only (six) date remains, which are particularly rare during this period, and present here in a ceremonial context. Olive remains are far more abundant at Levantine sites, as well as at one site on the southern Anatolian coast and grape remains are more abundant overall in the Levant. *Prunus* fruits are visible at only three sites: two in the Levant, and one in the Greater Middle East.

Pre-Roman period

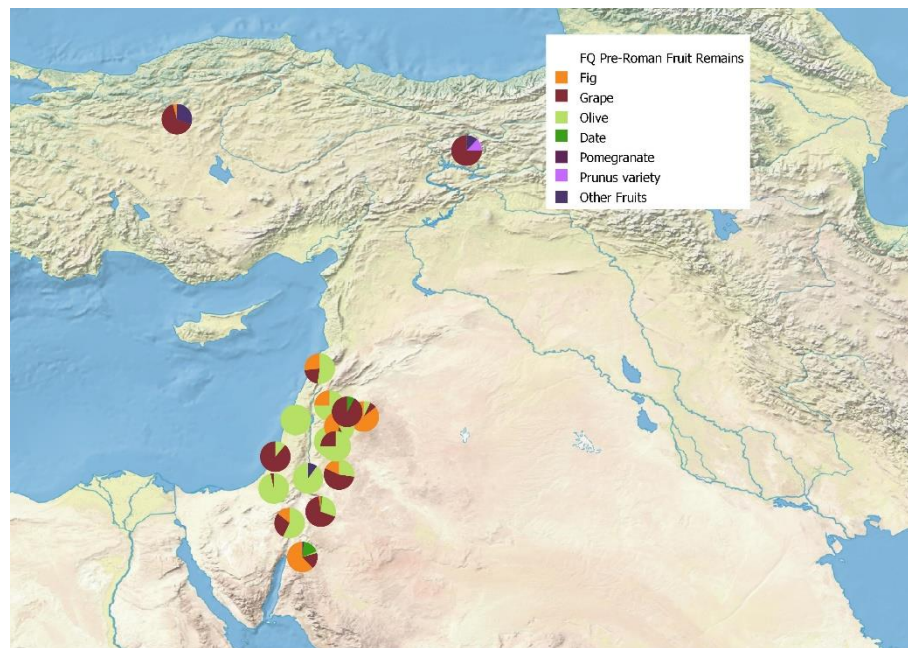


Figure 7-48 Fully quantified Pre-Roman fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

There are only two sites outside of the Levant in this period, and both feature grape as the most abundant remain. *Prunus* fruits are only present at one site in this period, and it is at one of these northerly sites, outside of the Levant. In the Levant, there is an apparent increase in olive remains, which overtake grape as the most abundant type of fruit remain in this period. Date is present at two sites in the Levant, though not abundant enough to be a dominant fruit type.

Roman period

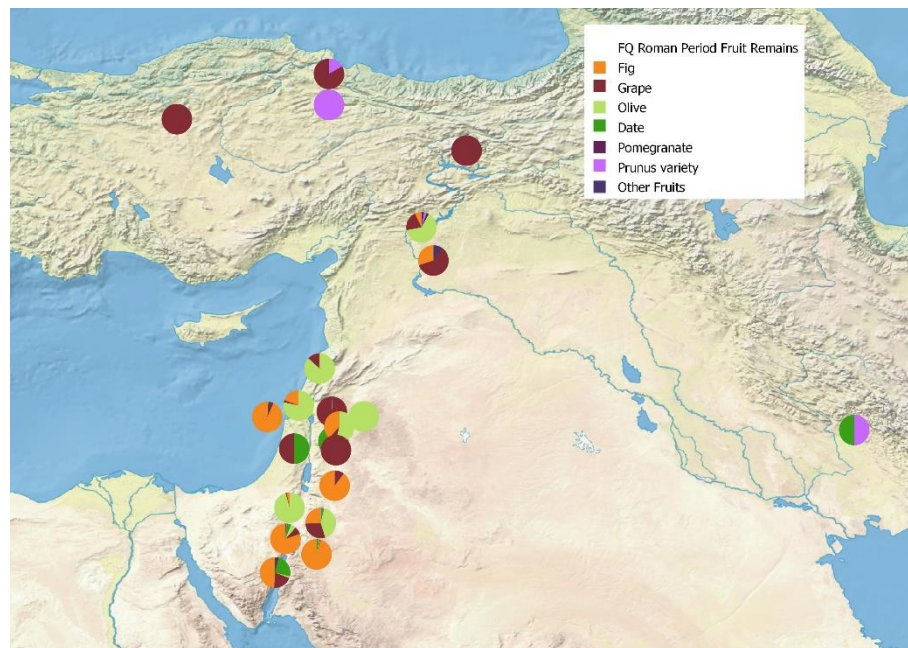


Figure 7-49 Fully quantified Roman period fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

In viewing the Roman period fruit remains, the general impression of diversification is apparent in all regions. The more minor fruits increase in relative abundance in all regions, with *Prunus* fruits even dominating two assemblages in the Greater Middle East and in Anatolia, and date being among the most abundant remains at sites in the Levant and the Greater Middle East. Grape continues to be prominent in the Anatolian assemblages, as well as at a number of sites in the Greater Middle East. It should be noted, however, for the first time, olive is the dominant remain at a site outside of the Levant in this period. In the Levant, there seems to be an increase in date; olive continues to be the most abundant remain, though fig closely follows.

Late Roman period

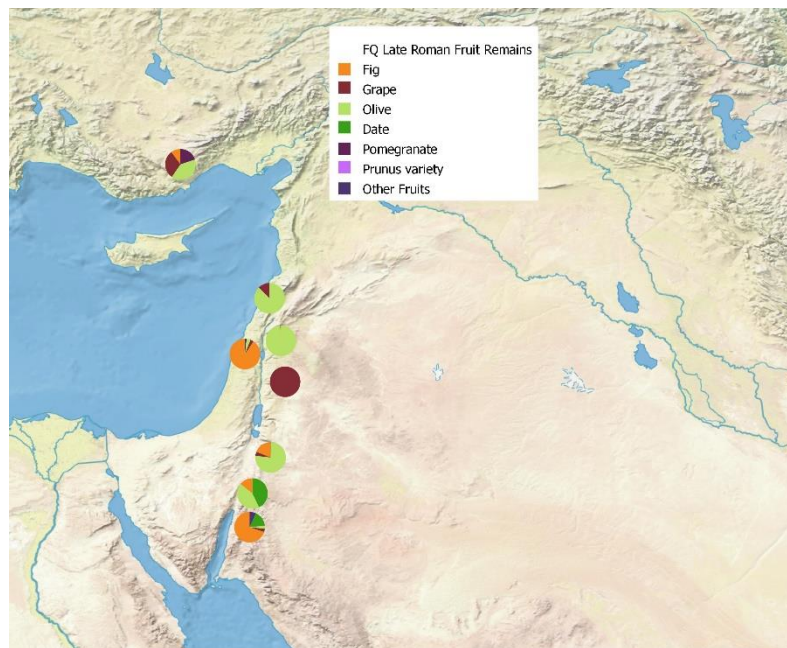


Figure 7-50 Fully quantified Late Roman fruit remains, displayed according to spatial distribution of assemblages at the site level.

Though the number of fully quantified sites is limited in the Late Roman period, the overall dominance of olive, even at the single site in Anatolia, is apparent. Date continues to be notable in the Levant, particularly in the southern portion, and it is possible that there is a decrease in grape, though the lack of sites makes this uncertain.

7.3.3.2 Fruit/Nuts: Variation by site type

Early Pre-Roman period

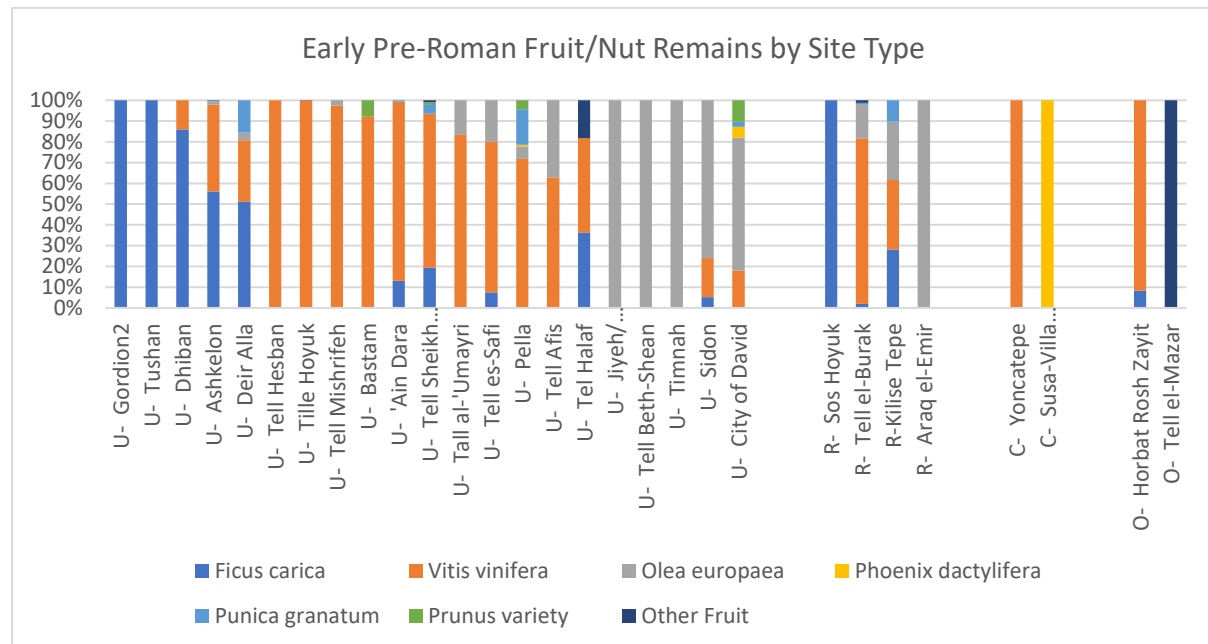


Figure 7-51 Fully quantified Early Pre-Roman fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, C= Ceremonial, O= Other.

Grape is the most abundant fruit remain in the Early Pre-Roman period. This phenomenon is especially apparent, but not limited to, urban sites. Pomegranate is found in low abundances at urban and at rural sites, while *Prunus* fruits are limited to urban sites. Date occurs at one ceremonial site, but is otherwise only found in urban contexts, highlighting the diversity that characterised urban sites in particular during this period.

Pre-Roman period

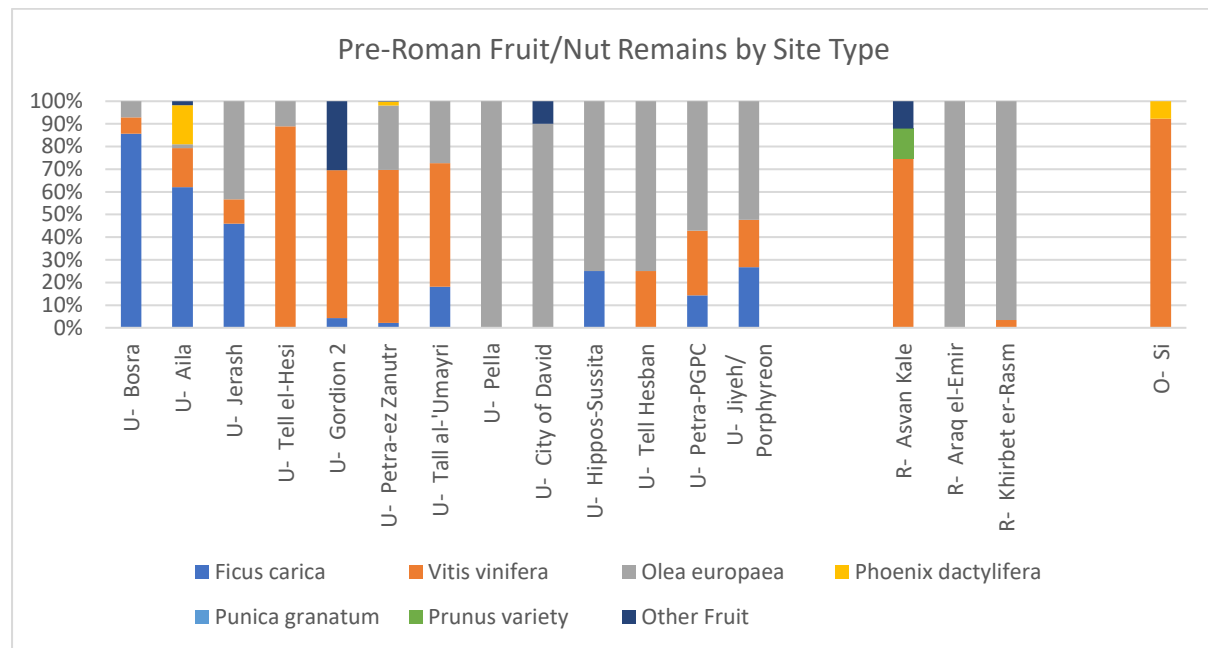


Figure 7-52 Fully quantified Pre-Roman fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, O= Other.

There is an apparent increase in sites featuring olive, which is the most abundant remain in the Pre-Roman period, while grape decreases accordingly. Fig is found only at urban sites during this period. *Prunus* fruits are limited to a single rural site, while date is present at only two sites: one urban and one labelled as 'other.' Pomegranate is absent from the fully quantified dataset in this period (though is present at circa 5% of sites in the presence/absence data).

Roman period

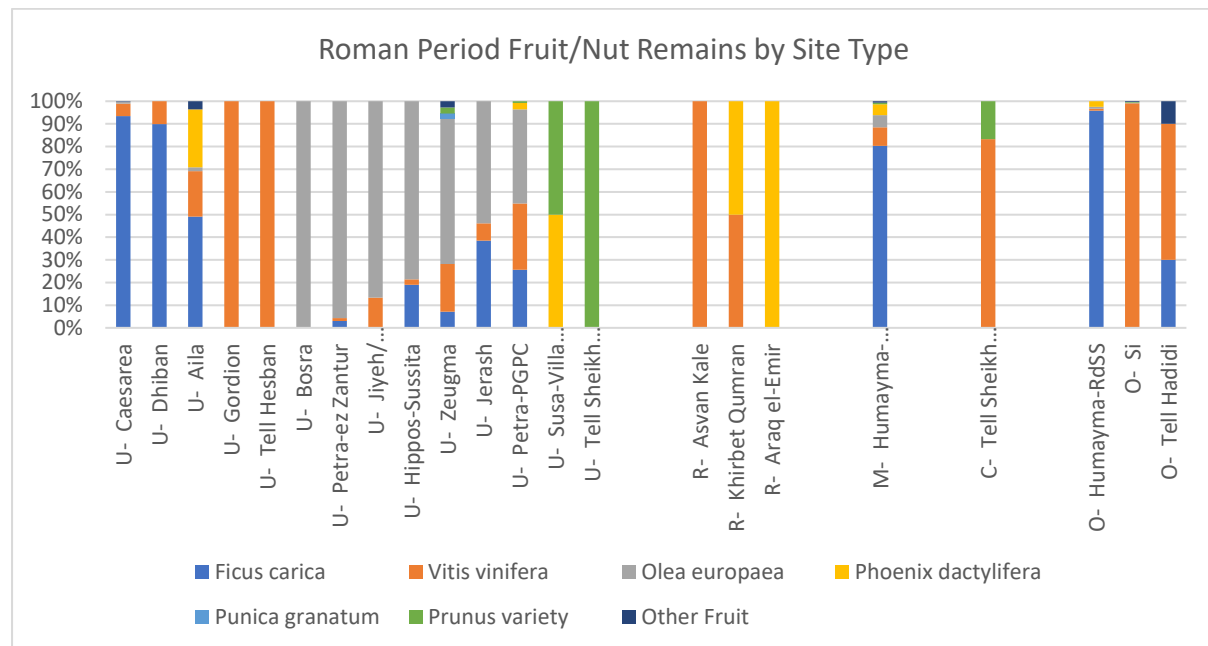


Figure 7-53 Fully quantified Roman period fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, M= Military, C= Ceremonial, O= Other.

The Roman period is characterised by an increased diversity in fruit remains. *Prunus* fruits have a greater relative abundance at urban sites, though they are also present at the single ceremonial site. Date exhibits a notable increase at nearly all site types, and is particularly abundant at rural sites. Interestingly, olive remains appear to shift so as to be concentrated among urban sites, at which they are the most abundant fruit at 50%. Amongst the other site type categories, olive remains are minimal or absent.

Late Roman period

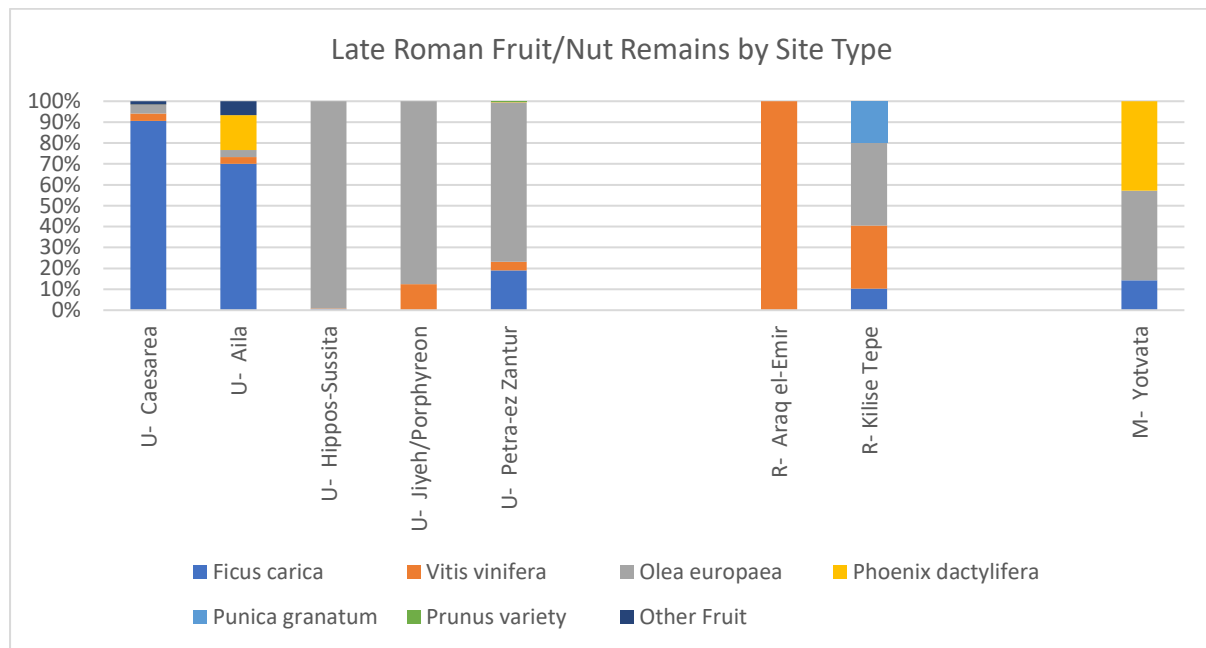


Figure 7-54 Fully quantified Late Roman fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, M= Military.

Due to the limited number of sites with fully quantified fruit remains during the Late Roman period, patterns are difficult to discern. Olive remains continue to dominate at urban sites, but are also apparent at rural sites and the single military site. Grape is the most abundant remain at rural sites. Fig is apparent at all site types, though is most abundant at urban sites. Date is absent from rural sites, while pomegranate is present only at rural sites. *Prunus* fruits are absent from the fully quantified dataset from this period.

7.3.4 Pulses

7.3.4.1 Pulses: Regional variation

As few patterns can be surmised from the regional distribution of the pulse remains, the results will be summarised here.

Lentil is dominant in the greatest number of assemblages in all regions, though it is rivalled by *Vicia ervilia* in Anatolia during the Pre-Roman and Roman periods.

In the Early Pre-Roman dataset, *Vicia sativa* and *Vicia faba* make up significant proportions of assemblages only in the Levant, though even here their presence is limited, with each being the dominant pulse at only one site. This pattern continues into the Pre-Roman period, though the Roman period sees a reduction in these pulses in the Levant as well. Chickpea (*Cicer arietinum*) shows a similar association with the Levant, and forms a prominent proportion of assemblages only

in this region throughout the study period, though this is generally in the assemblages from just one or two sites.

Pisum sativum and *Vicia ervilia* appear to be more prominent in a larger number of assemblages in Anatolia and the Greater Middle East, and, with respect to *Vicia ervilia*, the same can be observed in the Pre-Roman dataset. *Vicia ervilia* appears to become somewhat more important relative to other pulses in the Levant during the Roman period, however, with more assemblages featuring it among the most prominent pulses.

7.3.4.2 Pulses: Variation by site type

Early Pre-Roman period

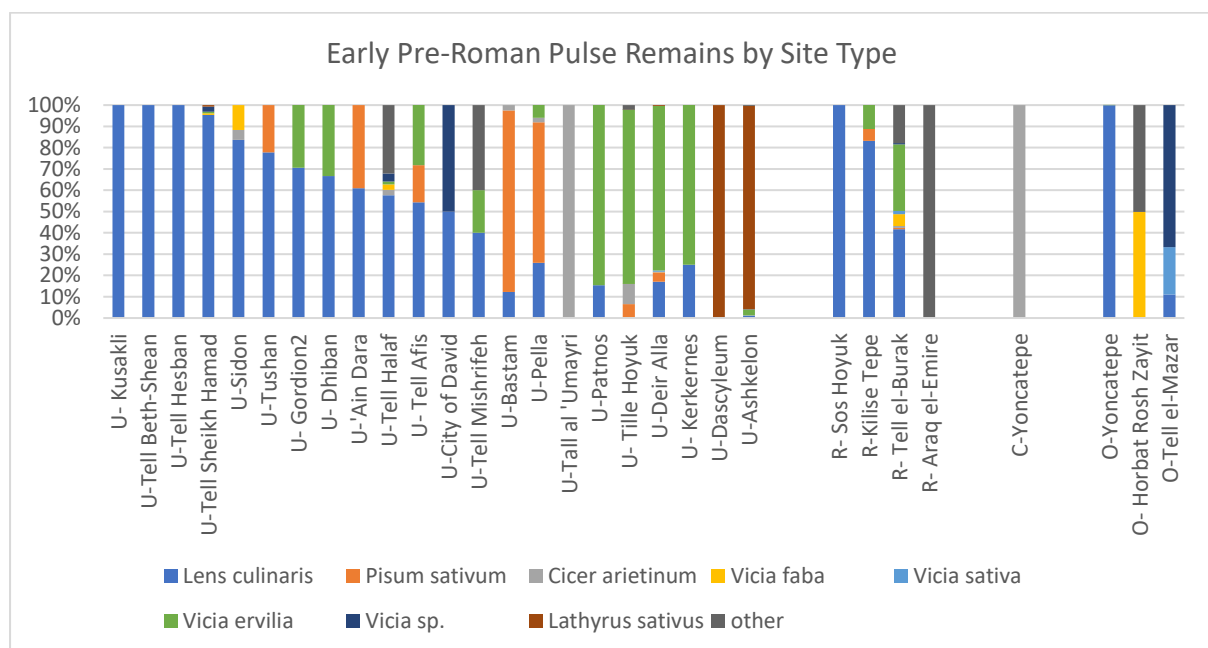


Figure 7-55 Fully quantified Early Pre-Roman pulse remains by site type. Individual sites are ordered by most common pulse type. U= Urban, R= Rural, C= Ceremonial, O= Other.

Caches of *Lathyrus sativus* from Ashkelon, and -especially- *Vicia ervilia* from Tille Höyük, skew the results during this period, and make them by far the most abundant two pulses in the early Pre-Roman period. However, when viewing the results on a site-by-site basis (as above), lentil appears to be the dominant pulse at the most sites, though *Vicia ervilia* remains prominent. *Pisum sativum* has greater relative abundance at urban sites, and *Lathyrus sativus* only occurs at urban sites in this period. Chickpea occurs only in urban and ceremonial contexts.

Pre-Roman period

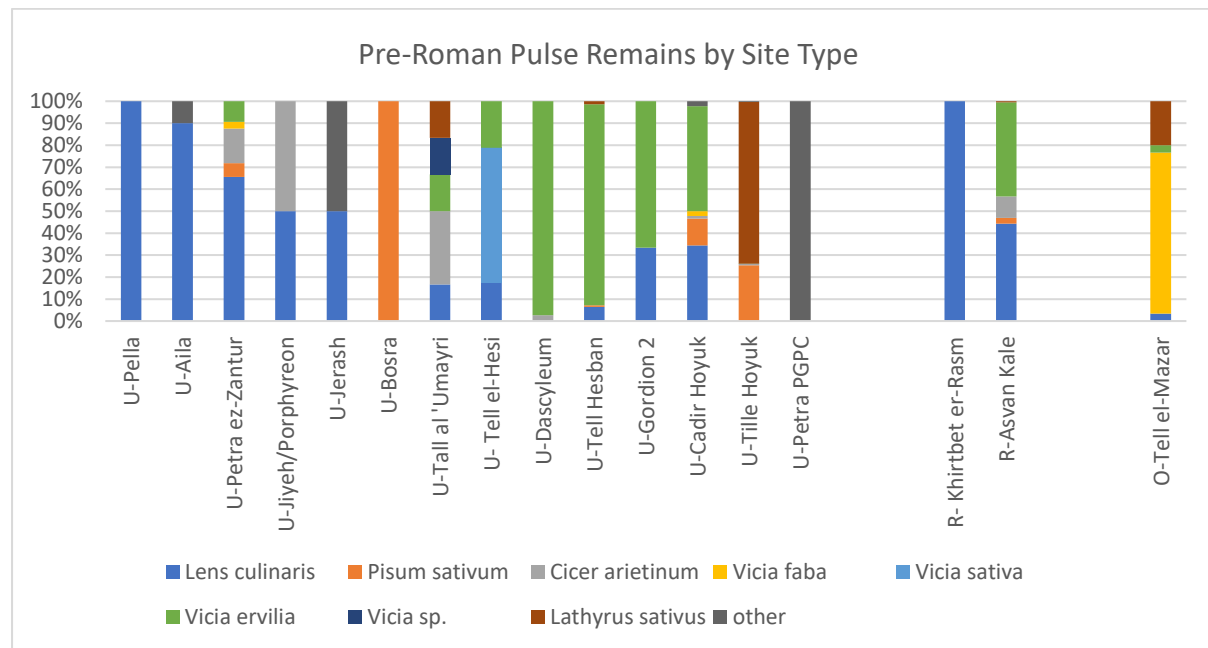


Figure 7-56 Fully quantified Pre-Roman pulse remains by site-type. Individual sites are ordered by most common pulse type.
U= Urban, R= Rural, O= Other.

As in the Early Pre-Roman period, Pre-Roman period caches skew the results, and render *Pisum sativum*, *Lathyrus sativus*, and *Vicia sativa* the most abundant remains. Caches withstanding, *Lens culinaris* and *Vicia ervilia* appear to be the most abundant pulse remain at urban and rural sites. *Lathyrus sativus* is absent from rural sites, though there are only two with fully quantified pulses, so the veracity of this pattern is unclear. *Pisum sativum* is only present in significant proportions at urban sites, and otherwise is limited to a minor occurrence at one rural site.

Roman period

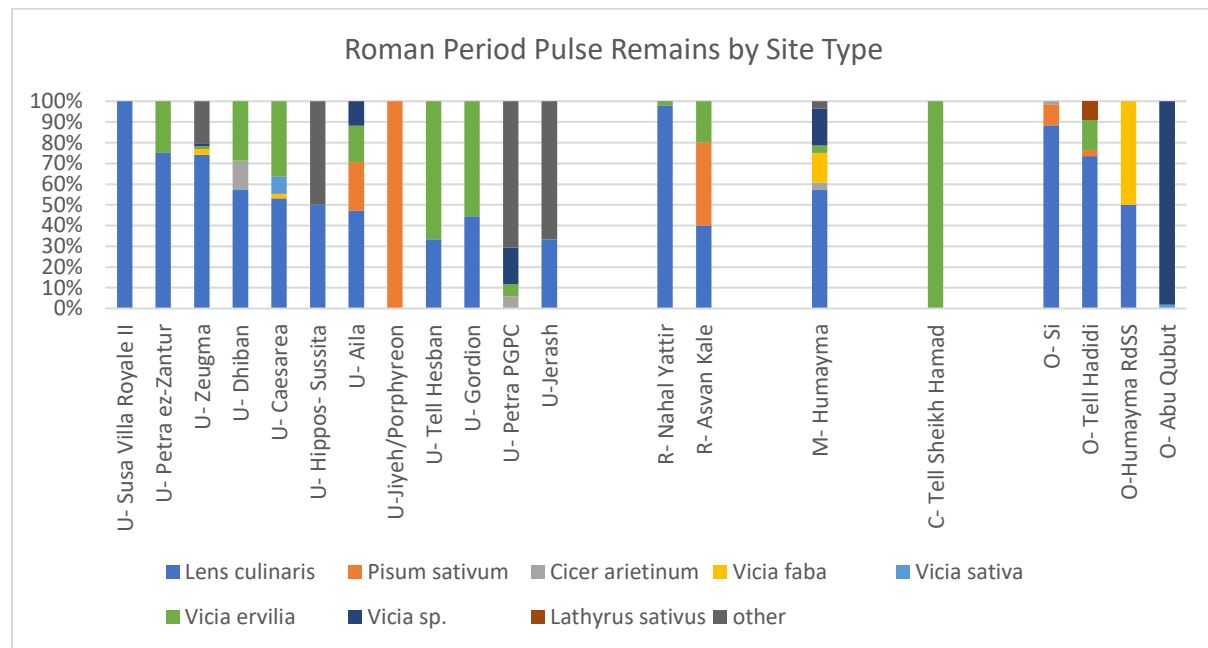


Figure 7-57 Fully quantified Roman period pulse remains by site type. Individual sites are ordered by most common pulse type. U= Urban, R= Rural, M= Military, C= Ceremonial, O= Other.

It should be noted that there are no pulse caches affecting the dataset during the Roman period. Otherwise, this period sees a possible decrease in sites that have *Vicia ervilia* as the most abundant pulse, while sites with *Lens culinaris* as the most abundant remain show a general increase. *Lathyrus sativus* only occurs at one rural site, while *Vicia sativus* is found only at one urban site, though not in significant proportions. Chickpea can be found in small amounts at urban, military, and 'other' sites, but is absent from rural sites as well as from the single ceremonial context.

Late Roman period

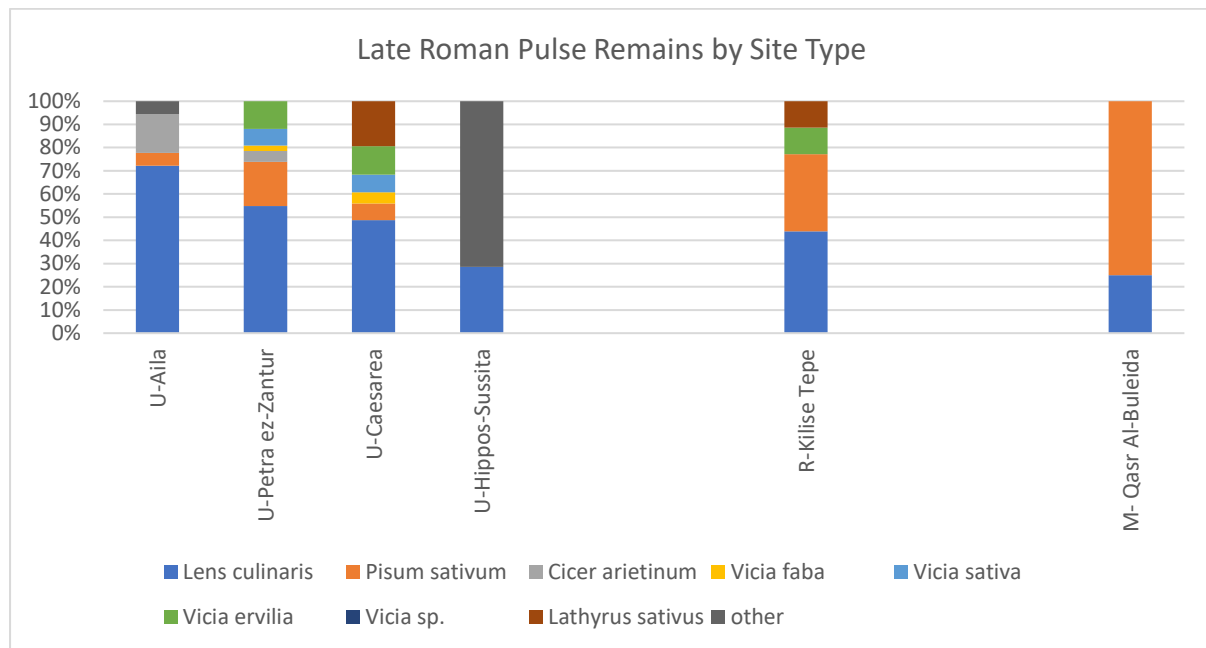


Figure 7-58 Fully quantified Late Roman pulse remains by site type. Individual sites are ordered by most common pulse type.

U= Urban, R= Rural, M= Military.

Lentil continues to be the most prominent pulse in the Late Roman period in all site types, apart from at the single military site, where *Pisum sativum* is more abundant. It is possible that *Pisum sativum* is more abundant than in the Roman period in all site types, though the limited number of Late Roman sites prevents this from being said with any certainty. *Vicia ervilia* may be less abundant overall, though, again, this cannot be said for certain. Chickpea occurs only at two urban sites, though it is never particularly abundant. In general, urban sites exhibit the greatest diversity, with more pulses represented than other categories, though- again- there is only a single rural and military site for comparison.

7.3.5 Nuts

Due to the scarcity of nut remains in the fully quantified dataset, nuts will be examined only in terms of presence/absence (see section 7.2.7 above).

7.3.6 Densities

In an effort to examine evidence of economic specialisation in the archaeobotanical record, the author looked to the concentration (or densities) of particular plant remains (i.e. cultivated food plants) in the archaeobotanical dataset. Due to the lack of archaeobotanical reports indicating sample size, there were only 11 sites out of the total 97 sites in the eastern dataset for which

densities were able to be calculated (Note: this includes the primary data examined by the author from Hippos-Sussita and Jerash). Furthermore, for some of the sites, such as Caesarea (Site 15) and the Petra Pool and Garden Complex (Site 58), the figures produced are based on sumsamples, which confounds any possible interpretations and prohibits the detection of samples indicative of specialised crop production.

In general, densities were relatively low, which is not entirely unexpected for carbonised assemblages. Less than five sites have samples that produced values over seven for any specific type of plant remain, rendering density-based analysis of the Eastern dataset inefficacious (see supplementary data for densities for assemblages from the East; 9.4.1).

7.3.7 Crop-processing analysis

In order to track crop-processing activities, the ratio of chaff to cereal grains was considered for fully quantified records producing more than 10 items (i.e. chaff and caryopses) representative of either barley, free-threshing wheat, or glume wheats (*Triticum dicoccum*/*Triticum monococcum*) (see Table 7-7).

Table 7-7 Results of crop-processing analysis. Values produced per cereal are based on the chaff to grain ratios as indicated in Tables 5.3 and 5.4. 'X' indicates the interpretation of the assemblage.

Period	Site	Site type	Values produced per cereal			Interpretation		
			Free-threshing wheat	Barley	Glume wheat	Grain product	Crop processing by-product	Indet.
Early Pre-Roman	76	Rural	0.01	0.02	0.39	x		
Early Pre-Roman	9	Other	0.19	< .0001		x		x
Early Pre-Roman	33	Other	<.0001			x		
Early Pre-Roman	7	Urban	0.002	0.02	5.3	x	x	
Early Pre-Roman	24	Urban		0.41				x
Early Pre-Roman	31	Urban	0.2	0.16	2.58	x	x	x
Early Pre-Roman	55	Urban	>100	>100	>100	x		
Early Pre-Roman	72	Urban	1.37	0.21	1.71		x	x
Early Pre-Roman	75	Urban		0.0001		x		
Early Pre-Roman	86	Urban		0.12	5.5	x	x	
Early Pre-Roman	88	Urban		0.02		x		

Early Pre-Roman	91	Urban	0.02	0.01	0.35	x		
Early Pre-Roman	93	Urban		0.64				x
Pre-Roman	8	Rural		0.0008		x		
Pre-Roman	14	Urban		0.62	1.86		x	x
Pre-Roman	31	Urban	34.58	9.5	29.62		x	
Pre-Roman	57	Urban	0.22	0.03		x		x
Roman	39	Military	0.19	0.16		x		x
Roman	80	Other	0.35	0.5				x
Roman	40	Other		1				x
Roman	53	Rural		<.0001		x		
Roman	3	Urban		1.75			x	
Roman	15	Urban		0.1		x		
Roman	24	Urban	16.27	1.3			x	
Roman	30	Urban	0.86	0.29				x
Roman	97	Urban	0.02	0.02		x		
Late Roman	3	Urban		0.18		x		
Late Roman	15	Urban	0.72	0.59	0.95			x
Late Roman	57	Urban		0.05		x		

In the Early Pre-Roman period dataset, there were 13 sites that qualified for such analysis. Of these, four sites (circa 31%) produced evidence of crop processing. All of the sites with assemblages indicative of crop-processing activities are urban sites, and all contain evidence of the processing of glume wheats. Only one site (site 72, Tel Halaf) produced evidence of the processing of free-threshing wheats. A total of 10 sites (~ 77%) produced results indicative of grain products, which seemingly were already subject to necessary crop-processing activities.

Only four Pre-Roman records produced assemblages sufficient for crop-processing analysis. Of these sites, two can be interpreted as grain products, and two as crop-processing by-products. Both of the records with by-products are reflective of the processing of glume wheats at urban sites.

Nine Roman period records could be subject to crop-processing analysis. Of these records, four (about 44%) contained grain products, and two (~22%) featured assemblages interpreted as by-products. Unlike in the previous periods, neither of the by-product assemblages consisted of glume wheats, but rather were comprised of free-threshing wheat and barley, both from urban sites.

In the Late Roman dataset, only three (urban) records were sufficient for analysis. Two of the records featured barley grain products, and the third was unable to be interpreted.

Notably, in all periods, none of the assemblages interpreted as by-products were from rural records.

7.3.8 Conclusions

In conclusion, a number of trends should be emphasised. The patterns observable in the cereal remains are rather straight forward:

The overall prominence of barley is apparent in both the presence/absence and the fully quantified data, with free-threshing wheats being the second most prevalent cereal in all periods. Both presence/absence and fully quantified cereal data also emphasise the decrease in glume wheats from the Early pre-Roman period, when they are at their peak, through the Roman period, though glume wheats increase again in the Late Roman period. In terms of regional trends in cereals, millets appear to play a more important role in the northern and eastern portions of the study area than in the Levant.

Other patterns can be observed among the pulse remains. In Early Pre-Roman and Pre-Roman periods, *Lens culinaris* is by far the most frequently occurring remain, though not the most abundant, with no caches of this pulse type being present in the dataset. However, this picture shifts in the Roman and Late Roman period, when *Lens culinaris* becomes both the most frequently found and the most abundant pulse remain by far, though this is not owed to caches, which are not characteristic of the data for the latter two periods.

In addition to the increase in general fruit abundances overtime, which will be discussed below, there are certain trends that affect the fruit assemblage as well. Olive remains, for example, show interesting trends chronologically and regionally as well as according to site type. Though these trends are less clear in the presence/absence data, olive appears to increase in prevalence over time, especially in the Levant and, in the Roman period, begins to show a strong correlation with urban sites.

More generally, there is an overall increase in the less-common fruits, such as *Prunus* fruits and date, during the Roman period, which points to a diversification of fruits in this period.

A number of discrepancies between the fully quantified data and the presence/absence data highlight how the nature of assemblages may vary at certain site types. For example, starting in the Pre-Roman period, and increasingly subsequently, cereals are at least slightly more frequent at urban sites, but fruits are more abundant, dominating a greater number of assemblages. This would seem to indicate that urban sites are yielding greater quantities of fruit remains, though fruits are not necessarily encountered more frequently.

An additional example of this divergence can be seen in the fruit remains: while grape is more frequent in the Roman period overall, olive is more abundant, which highlights the larger amounts of olive in the assemblages from these periods.

Discrepancies between the presence/absence and fully quantified data are also extremely useful in that they may point to anomalies that skew the dataset. This is illustrated by the capability of the two-tiered approach to highlight the overrepresentation of fig in the archaeobotanical record. For example, the fully quantified dataset for the Roman period suggests that fig is the second most abundant remain to olive in the Levant, though when viewing the presence/absence data, the prominence of fig is less apparent, and instead grape appears to be the second most prevalent type of fruit remain, with fig occurring at a similar frequency to *Prunus* fruits.

Thus, the two-tiered approach is useful not only in its potential to shed light on certain intricacies of the dataset, but also in its ability to expose anomalies such as caches and cases of overrepresentation, which might otherwise be overlooked.

Chapter 8. Results: Italy

8.1 Data overview

The dataset for Italy is comprised of 115 records from 100 Sites (see Fig. 8-1 below for distribution).

As in the Eastern case study, it is important to consider the broader patterns in the data before undertaking an analysis. In this way, any biases affecting the results may be recognised and addressed prior to interpretation.



Figure 8-1 Map with all sites in the Italian dataset indicated.

8.1.1 Geographical distribution of data

For the purpose of analysis, Italy has been split into three regions: North, Central, and South. The North includes sites in Emilia Romagna, Friuli-Venezia Giulia, Liguria, Lombardy, Piedmont, Trentino Alto-Adige, and Veneto. This region has yielded the most sites, with 63 records from 58 sites, which is just over double the number of sites in the next most productive region, the South.

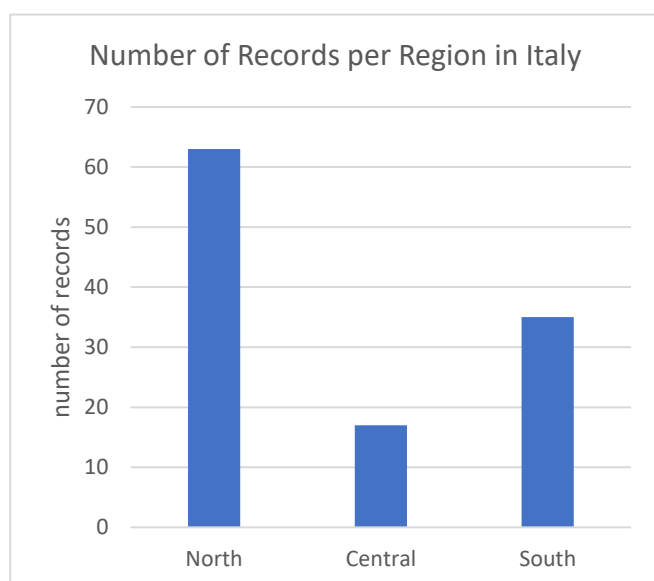


Figure 8-2 Number of records per region in Italian dataset.

The prevalence of northern sites in the dataset may, in part, be attributed to a number of highly active archaeobotany laboratories in the region, including, but not limited to, that at the *Università degli Studi di Trento* as well as the *Laboratorio di Palinologia e Paleobotanica at the Università degli studi di Modena e Reggio Emilia*.

The data from central Italy are from Abruzzo, Lazio, and Tuscany. This region is the least represented, with 17 records from 14 sites. The South is represented by data from Basilicata, Campania, Puglia, as well as Sicily. This region produced 35 records from 28 sites. A notable 19 of the records from the South are from the Vesuvian region, predominately Pompeii/Herculaneum.

Despite the efforts of the author, no data were found for a few regions, such as the Aosta Valley in the North, Marche and Umbria in Central Italy, and Calabria and Molise in the South.

8.1.2 Chronological distribution of data

In terms of the chronological distribution of data, the Roman period far surpasses the Pre-Roman and Late Roman, with 63 records. The Pre-Roman period is the second most productive, with 36, while there are only 16 records for the Late Roman period.

Chronological distribution also varies by region. In northern Italy, Roman sites far surpass sites of other periods, with 44 records, in comparison to the 10 Late Roman, and nine Pre-Roman. In central Italy, however, the distribution is considerably more even, with records from six of each Pre-Roman and Roman sites, and five Late Roman sites. Unlike in the aforementioned regions, Pre-Roman records are the most represented in southern Italy, with 21 records, which comprises 60% of all records for the region. Roman sites are the next most common at 13, followed by Late Roman sites, of which there is only one.

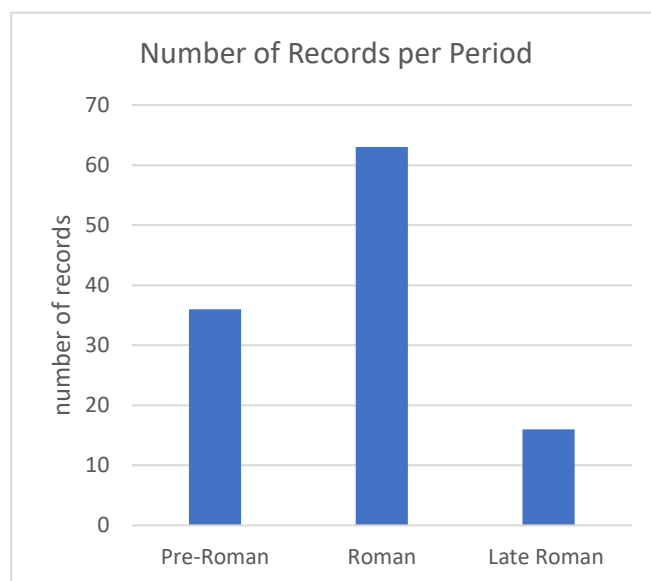


Figure 8-3 Number of records per period in Italian dataset.

The distribution of the Italian data differs greatly from the chronological patterns observed in the East, where archaeological research has placed more emphasis on the earlier periods. The research

agenda in Italy, however, clearly favours the Roman period, which is understandable given the Italian peninsula's place at the heart of the vast empire.

There is some disparity, however, when considering the chronological distribution of records against the number of samples per period. The 465 samples attributed to the Pre-Roman period far surpass that of any other period, including the Roman period dataset, which is comprised of 183 samples. This pattern is reflective of the significant number of records in the Roman period that contain only one sample, amounting to 31 records, or 49% of the Roman period dataset, as compared with 39% of Pre-Roman and 19% of Late Roman period records.

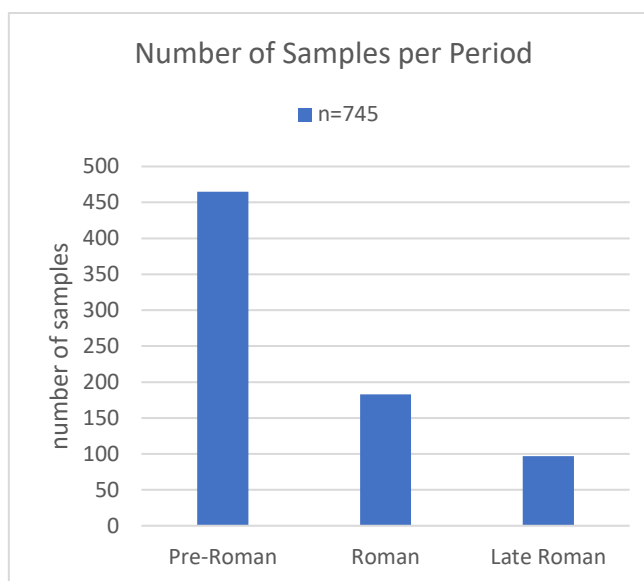


Figure 8-4 Number of samples per period in Italian dataset.

However, the Roman period records feature more items than any other period, with over 80,000 items, while the Pre-Roman and Late Roman period datasets contain over 19,000 and 45,000 items respectively. Thus, in considering the number of items in the data from each period, it becomes clear that the Roman period dataset contains a significant number of larger, more productive sumsamples, while the Pre-Roman dataset has the most samples but the fewest items.

8.1.3 Distribution of data by site type

As with the chronological distribution of data, the distribution of the Italian data by site type differs greatly from that of the East. The most common site type in Italy is ceremonial, which includes inhumations, tombs, domestic ritual offerings, as well as temple and sanctuary sites. With 45 records in total, these sites represent just under 40% of the dataset, which is in stark contrast

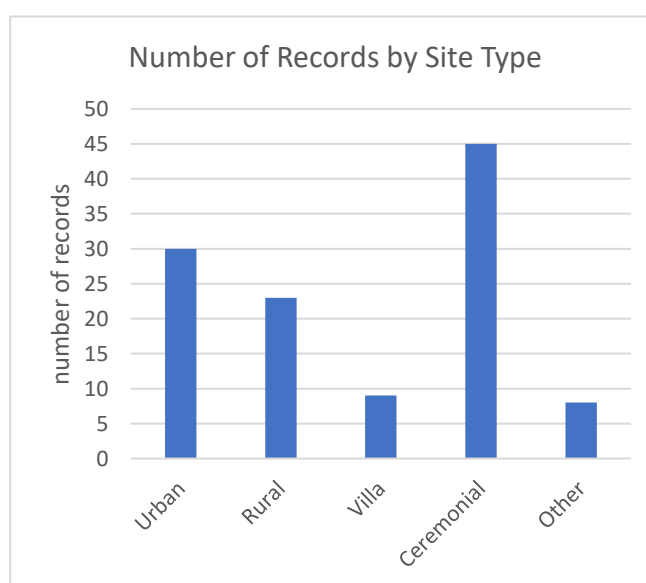


Figure 8-5 Number of records by site type in Italian dataset.

with the East, where ceremonial sites are among the least represented.

The next most common site type is urban, and then rural, with 30 and 23 records respectively. This picture also differs from the East, where urban sites outnumber rural sites to a much greater degree. It may be that rural sites hold a more privileged place on the research agenda in Italy, as is attested by enterprises such as the *Roman Peasant Project*.¹⁴ The least represented site types include Villa sites, and those that have been described as ‘other,’ the latter of which may be less common due to efforts on the part of the author to avoid such a categorisation.

The distribution of site types does, however, vary by region. In the North, the most common type is ceremonial, with 29 records, which is more than half of all ceremonial records in the dataset. This may be due to publication biases, as studies focusing on solely ceremonial sites (burial/cremations) have been produced for this region and no other (see Rottoli and Castiglioni 2011). Urban sites are the second most common site type at 15 records, followed by rural (nine), other (seven), and, finally, villa sites (three).

In central Italy, rural is by far the most common type of site (10 records), followed by urban (four), and then villa (three). Notably, there are no ceremonial sites in the dataset for central Italy, despite this site type’s prevalence overall.

Like in northern Italy, ceremonial sites are the most common site type in the South, with 16 records comprising just over 45% of all records for the South. Urban sites are the next most common type, with 11 records, nine of which are from Pompeii/Herculaneum. There are four records from rural sites and three from villa sites, as well as one record from a site that is categorised as other.

It can be noted that, unlike in the East, large, multi-period sites are less commonly studied in Italy. This difference may at least partially be due to modern settlement patterns; that is, while in the East such sites are commonly large Tells with little to no modern occupation, sites of large Italian settlements in antiquity often remain densely populated today. Furthermore, Italy lacks the long history of urbanism that characterises earlier pre-history in the East.

8.1.4 Modes of preservation

Like in the East, the most prevalent mode of preservation in Italy is carbonisation. However, it can be noted that there are more sites with large amounts of uncharred remains than in the Eastern dataset. This difference in preservation may be attributed to a number of factors, such as the

¹⁴ Project details available at <https://www.sas.upenn.edu/romanpeasants/>

contexts from which archaeobotanical samples were taken, as well as environmental conditions in some regions such as in the North, where sites such as those in modern day Modena (ancient Mutina) are more likely to yield waterlogged remains preserved in ground water and alluvial layers (see Bosi et al. 2015). Waterlogged remains have also been preserved in optimal contexts such as in wells, as well as in a *dolium* as at the Villa Vesuvio site (see Arobba et al. 2013, Ciaraldi 2007).

Sites yielding predominately mineralised remains have a more notable presence in Italy, particularly in the Vesuvian area. This may be attributed to the excavation of certain contexts such as the Cardo V sewer at Herculaneum (Site 118), as well as the drains in the Forum at Pompeii (Site 167), which are especially suited to the process of mineralisation and yield large amounts of such remains (see Rowan 2017). Furthermore, some sites yield remains subject to multiple types of preservation: at sites from Mutina, such as Novi Sad (Site 155), both charred and waterlogged remains are represented, while the Cardo V Sewer at Herculaneum (Site 188) yields carbonised, mineralised, and waterlogged remains.

Though it is worth noting the presence of uncharred remains, this data overview, the figures therein, as well as the results and analysis sections focus on the carbonised dataset, and thus do not include the uncharred material unless explicitly stated (see 5.1 on data selection).

8.1.5 Data Quality

8.1.5.1 Sampling strategy

Though handpicking was less commonly indicated as the primary mode of data collection in Italy than in the East, that is not to say that this practice was not employed, as, like in the East, archaeobotanical reports at times make little reference to a sampling strategy of any sort. That said, indicating sampling strategy does seem to be at least slightly more common in Italy, which may be due to the greater representation of archaeobotanists and archaeobotany labs in Italian academia, as well as a higher frequency of archaeobotanical sampling in public archaeology and rescue excavations.

8.1.5.2 Quantity of samples

The quantity of samples comprising each record varies, though in general, it is rather low. Only 23 (20%) records have more than five samples, while 48 (~42%) have only one sample. Furthermore, there are only five (~4%) records with over 20 samples, three of which are from Pompeii/Herculaneum. This is most certainly in part owed to the fact that, like in the East, many of

the site reports utilised what has been termed 'sumsamples' rather than recording the results per each individual sample.

As previously referenced, van der Veen et al. (2007) provide a general guideline on sample quantity per record, indicating that each record should have at least 30 samples, and that records with less than 10 are likely to pose problems, unless archaeobotanical sampling is particularly scarce. Though ideally one would adhere to these guidelines, as with the East, the paucity of large datasets in the region renders all available material worthwhile in its contribution to 'group value' (van der Veen et al. 2007: 203; 7.5.1.2).

8.1.5.3 Level of analysis

As has been observed in the Eastern dataset, sumsampling is also common in archaeobotanical reports from Italy. Typically, these 'sumsamples' are reported by period, grouping together the data from all samples attributed to a particular chronological phase (see Villandro [Site 196] for example).

At least 34 records report using sumsampling, comprising just under 30% of total records from Italy. Though this is a somewhat lower percentage than that produced for the East (nearly 44%), the figure may actually be higher; in addition to these 34 records, many of the ceremonial contexts are reported by individual burial/cremation - particularly those from Rottoli and Castiglioni (2011) - and it is unclear if the material from these contexts derive from multiple samples, or if the entire burial was taken as one.

8.1.5.4 Number of items

Though van der Veen 2007 indicates a minimum of 100 items per mode of preservation per sample is the ideal standard for statistical analysis, many, if not most, samples from Italy do not make this mark. Though neither the Eastern nor the Italian datasets adhere to this particular guideline/qualification, analysis is worthwhile, as the data still contribute to the little knowledge there is about large-scale variation in plant consumption in these regions.

8.1.6 Conclusions

As outlined above, there are some limitations to the dataset. In spite of this, the similarities in certain aspects of the Italian and Eastern data, particularly prominent preservation type, is a positive finding. It is in this way that the datasets are made comparable. Furthermore, as both regions yielded a large amount of small individual datasets, both are best suited to large scale study, such as the regional and chronological analysis to follow.

Chapter 8 Results: Italy

Now that a better understanding of the dataset has been achieved, it is possible to proceed to the results that the data analysis produced.

8.2 Italy: Presence and absence data

Table 8-1 displays the number of records per region by period. As in Chapter 7, the chronological distribution, and the number of records per site type are indicated in the figures below.

Table 8-1 Number of records per region by chronological period in the Italian dataset.

Period	North	Central	South
Pre-Roman Period	9	6	21
Roman Period	44	6	13
Late Roman Period	10	5	1

Table 8-2 below features the edible and economic taxa present in the Italian dataset in each period. The plants classified as wild/weed taxa, as well as the percentage of sites at which they occur, have been recorded in Table 8-6.

*Table 8-2 Edible and economic plants present in the Italian dataset by period. * indicates plants that may also be classified in other categories.*

	Common name	Pre-Roman	Roman	Late Roman
Cereals				
<i>Avena sativa/Avena</i> sp.	Oat	X	X	X
<i>Hordeum</i> sp.	Barley undif.	X	X	X
<i>Hordeum distichon</i>	Two-row barley		X	
<i>Hordeum vulgare</i>	Six-row barley	X	X	X
<i>Hordeum/Triticum</i>	Barley/Wheat		X	X
<i>Oryza</i>	Rice			
<i>Panicum miliaceum</i>	Common millet	X	X	X
<i>Panicum miliaceum/Setaria italica</i>	Common/Foxtail millet	X		
<i>Setaria italica</i>	Foxtail millet	X	X	X
<i>Secale cereale</i>	Rye	X	X	X
<i>Sorghum</i> sp.	Sorghum			
<i>Triticum</i> sp.	Wheat undif.	X	X	X
<i>Triticum monoccoum/dicocum</i>	Glume wheat undif.		X	
<i>Triticum monoccocum</i>	Einkorn wheat	X	X	X
<i>Triticum dicocum</i>	Emmer wheat	X	X	X
<i>Triticum spelta</i>	Spelt wheat	X	X	
<i>Triticum aestivum/durum/turgidum</i>	Free-threshing wheat undif.	X	X	X
<i>Triticum aestivum</i> s. str.	Bread wheat	X	X	X
<i>Triticum compactum</i>	Club wheat	X		
<i>Triticum durum</i> s. str.	Hard wheat/Durum wheat/ Macaroni wheat	X	X	

<i>Triticum parvicoccum</i>				
<i>Triticum turgidum</i>	Rivet wheat	X		
Pulses				
<i>Cicer arietinum/Cicer sp.</i>	Chickpea	X	X	
<i>Lathyrus sp.</i>		X		
<i>Lathyrus sativus</i>	Grass pea	X	X	X
<i>Lathyrus cicera</i>	Vetchling, Red pea/ Vetchling		X	
<i>Lathyrus cicera/sativus</i>	Grass pea/Reg pea/ Vetchling	x		X
<i>Lathyrus clymenum</i>	Spanish vetchling		X	
<i>Lens culinaris</i>	Lentil	X	X	X
<i>Lupinus albus</i>	White lupine		X	
<i>Pisum arvensis</i>	Field pea			X
<i>Pisum sativum</i>	Common pea	X	X	X
<i>Vicia sp.</i>	Vetches	X	X	X
<i>Vicia ervilia</i>	Bitter vetch	X	X	
<i>Vicia faba</i>	Faba bean	X	X	X
<i>Vicia sativa</i>	Common vetch	X	X	X
<i>Lathyrus/Pisum/Vicia</i>	Pea/Vetches/Vetchlings	X	X	X
Fruits/Nuts				
<i>Berberis vulgaris</i>	Barberry			X
<i>Castanea sativa</i>	Chestnut		X	X
<i>Ceratonia siliqua</i>	Carob	X		
<i>Citrullus sp.</i>				
<i>Citrullus colocynthis</i>	Colocynth, Bitter apple/Cucumber			
<i>Citrullus lanatus</i>	Watermelon			
<i>Citrus sp.</i>	Citrus	X		
<i>Cornus mas</i>	Cornel, Cornelian cherry	X	X	X
<i>Corylus avellana</i>	Hazelnut	X		X
<i>Cucumis sp.</i>				
<i>Cucumis melo/sativus</i>	Muskmelon/Chate melon/Cucumber		X	
<i>Ficus carica</i>	Fig	X	X	X
<i>Fragaria vesca</i>	(Wild) Strawberry		X	
<i>Hyphaene thebaica</i>	Doum palm			
<i>Juglans regia</i>	Walnut	X	X	X
<i>Malus domestica/ sylvestris/Malus sp.</i>	Apple	X	X	X
<i>Malus/Pyrus</i>	Apple/Pear		X	
<i>Morus sp.</i>	Mulberries			
<i>Olea europaea</i>	Olive	X	X	X

<i>Pinus pinea</i>	Stone pine	X	X	
<i>Phoenix dactyifera</i>	Date palm		X	
<i>Pistacia</i> sp.	Pistachio			
<i>Pistacia lentiscus</i> *	Mastic	X		
<i>Pistacia terebinthus</i> *	Terebinth/Turpentine tree			
<i>Prunus</i> sp.	Stone fruits		X	
<i>Prunus armeniaca</i>	Apricot			
<i>Prunus avium</i>	Sweet cherry		X	
<i>Prunus avium/cerasus</i>	Cherry		X	X
<i>Prunus cerasus</i>	Sour cherry			
<i>Prunus cerasifera</i>	Plum cherry			X
<i>Prunus domestica</i>	Plum		X	
<i>Prunus dulcis</i>	Almond	X	X	
<i>Prunus mahaleb</i> *	Mahaleb cherry		X	
<i>Prunus persica</i>	Peach	X	X	X
<i>Prunus spinosa</i>	Sloe		X	
<i>Punica granatum</i>	Pomegranate	X	X	
<i>Pyrus communis</i>	Common pear	X	X	
<i>Pyrus</i> sp.	Pear	X	X	
<i>Rubus</i> sp.	Brambles	X	X	X
<i>Rubus ideaus</i>	Raspberry		X	
<i>Sambucus</i> sp.	Elder/Elderberry	X		X
<i>Sabucus nigra</i>	Black elder		X	
<i>Sambucus nigra/racemosa</i>	Black/Elderberry/Red Elderberry		X	
<i>Sorbus domestica</i>	Sorb, Service tree			X
<i>Vitis vinifera</i>	Grape	X	X	X
<i>Ziziphus</i> sp.				
<i>Ziziphus jujuba</i>	Jujube		X	
Vegetables/Flavourings				
<i>Allium sativum</i> / <i>Allium</i> sp.	Garlic		X	
<i>Beta vulgaris</i> / <i>Beta</i> sp.	Beet			
<i>Brassica/Sinapis</i>	Cabbages/Mustards			X
<i>Brassica oleracea</i>	Cabbage		X	X
<i>Carum caravi</i>	Caraway			
<i>Coriandrum sativum</i>	Coriander			
<i>Cuminum cyminum</i>	Cumin			
<i>Daucus carota</i> / <i>Daucus</i> sp.	Carrot		X	
<i>Foeniculum vulgare</i>	Fennel			
<i>Lagenaria siceraria</i>	Bottle gourd		X	
<i>Lactuca sativa</i>	Lettuce	X		
<i>Laurus nobilis</i>	Bay			
<i>Lepidum sativum</i>	Garden cress			

<i>Mentha</i> sp.	Mints			
<i>Nigella sativa</i>	Black cumin			
<i>Petroselinum crispum</i>	Parsley			
<i>Raphanus raphanistrum</i>	Radish		X	
<i>Ruta</i> sp.	Rue			
<i>Sinapis</i> sp.	Mustards		X	
<i>Trigonella foenum-graecum</i>	Fenugreek			
Oil, Fibre Plants and Other Economic Taxa				
<i>Brassica</i> sp.	Cabbages/Mustards		X	
<i>Camelina sativa</i>	Gold of pleasure/False flax			
<i>Gossypium</i> sp.	Cotton			
<i>Humulus lupulus</i>	Hop		X	
<i>Linum usitatissimum</i> / <i>Linum</i> sp.	Flax	X	X	X
<i>Papaver</i> sp.	Poppies			
<i>Papaver somniferum</i>	Opium poppy	X	X	
<i>Sesamum</i> sp.	Sesames			
<i>Sesamum indicum</i>	Sesame	X		
<i>Sesamum orientale</i>	Sesame			
Possible Cultivated or Gathered Plants				
<i>Acacia</i> sp.	Acaicas			
<i>Borago officinalis</i>	Borage			
<i>Crataegus</i> sp.	Hawthorns			
<i>Portulaca oleracea</i>	Purslane			
<i>Sorbus acuparia</i>	Rowan	X		
<i>Lathyrus aphaca</i>	Yellow pea/Vetchling		X	
<i>Myrtus communis</i>	Common myrtle	X	X	
<i>Capparis spinosa</i>	Caper			

8.2.1 Overall plant composition

8.2.1.1 Chronological variation in overall plant composition

Fruit/nuts and cereals are the most ubiquitous plant type in all periods in Italy, though in the Roman period, fruit/nuts overtake cereals as the most widely occurring. This, however, may be due, in part, to the prevalence of ceremonial sites with fruit dominated assemblages of the period.

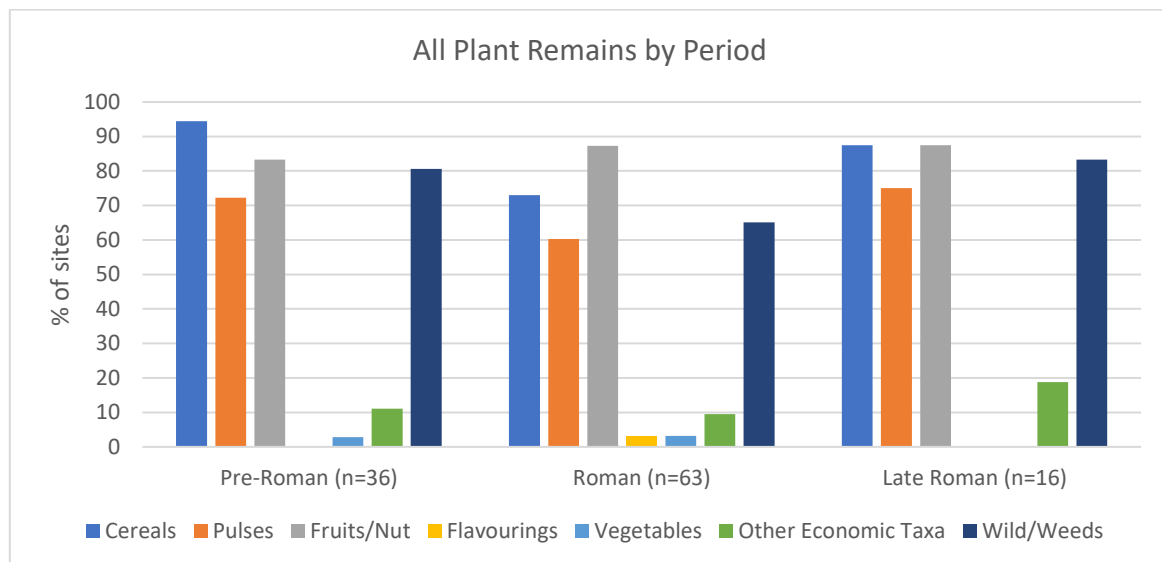


Figure 8-6 Frequencies of all plant remains by period.

8.2.1.2 Regional variation in overall plant composition

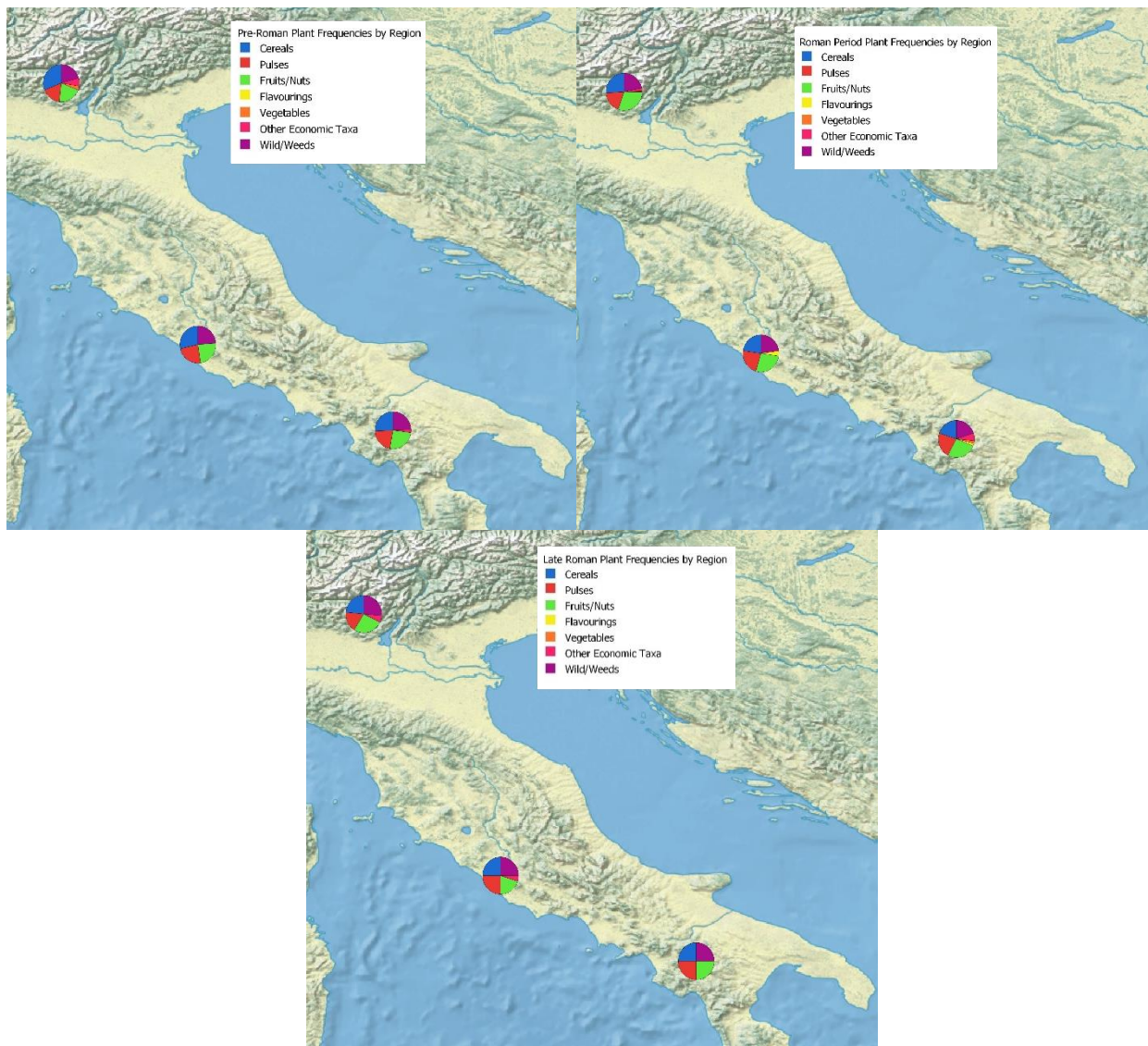


Figure 8-7 Frequency of all Italian plants for Pre-Roman, Roman, and Roman period datasets by region (North, Central, South). See Table 8-1 for number of records per region by period.

Pre-Roman period

In all regions, cereals, fruits, pulses, and wild/weed remains have similar frequencies, though cereals appear slightly more frequent in the North than all other remains. Oil/fibre/other economic taxa are present in the North, though just barely visible in the South. Vegetables are also present, though infrequent, in the North.

Roman period

Fruits, cereals, pulses, and wild seeds continue to be the most frequent plant remains in all regions, though fruits/nuts appear to be slightly more prevalent than other remains. Flavourings appear in

central Italy, as well as in southern Italy, which also has minor occurrences of vegetable and oil/fibre plants. Oil/fibre plants are also present, though rare, in the north.

Late Roman period

In the Late Roman period, all the regions yield datasets that are relatively evenly divided between cereals, pulses, fruits/nuts. Oil/fibre/economic taxa have minor presence in the north and central Italy.

8.2.1.3 Variation in overall plant composition by site type

Pre-Roman period

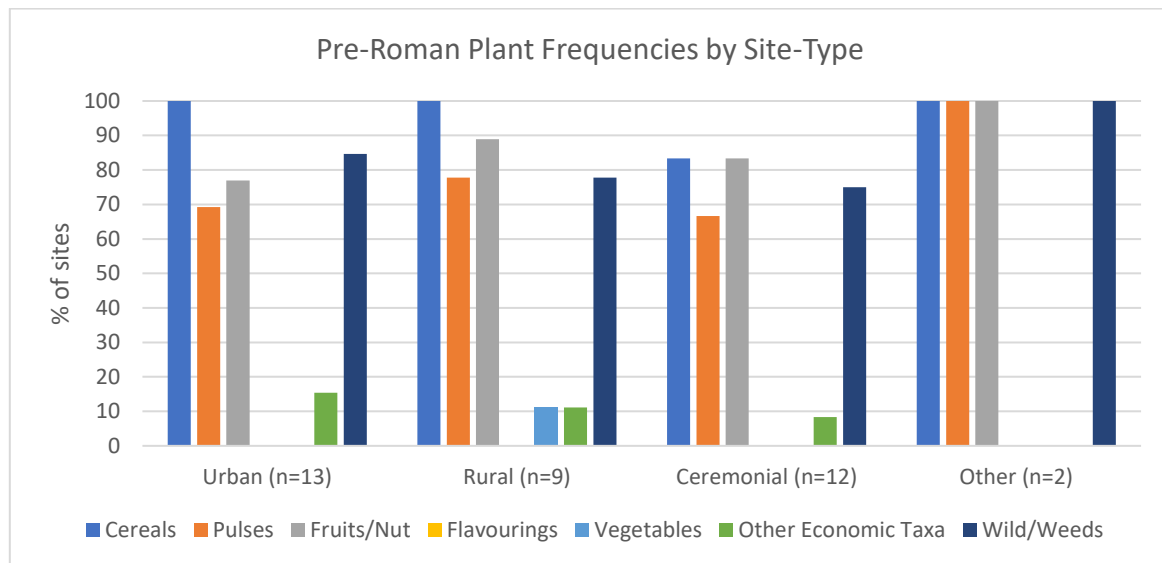


Figure 8-8 Pre-Roman plant frequencies by site type.

Cereals appear to be the most frequently encountered type of remain in the Pre-Roman period and are either encountered with equal frequency as fruits/nut remains, or are more common, as at rural and urban sites. Charred vegetable remains are found only in rural contexts, while flavourings are virtually absent from the archaeobotanical record during the Pre-Roman period.

Roman period

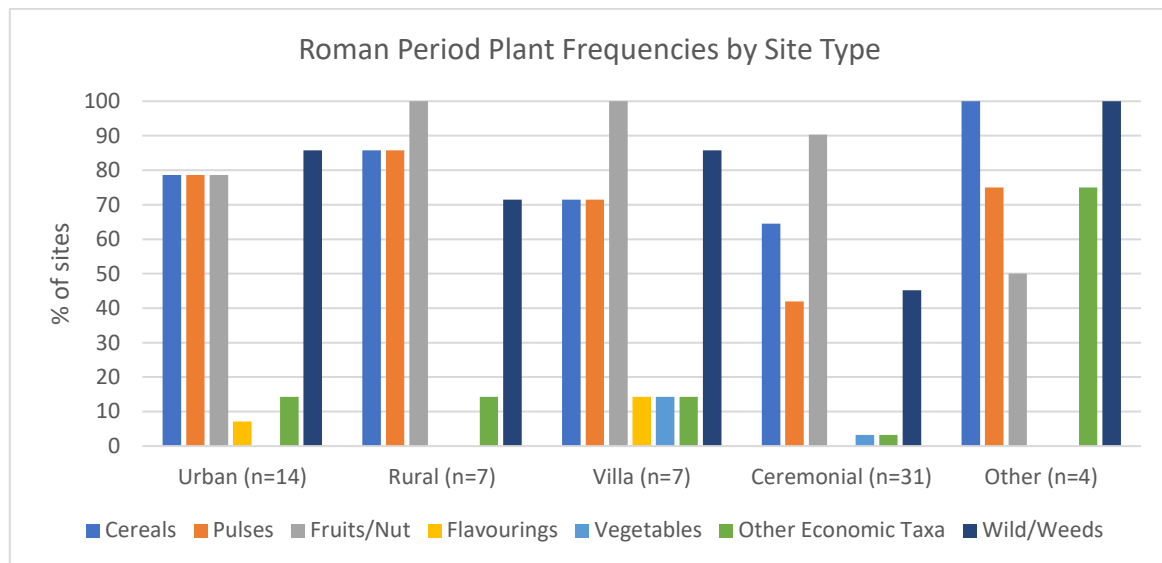


Figure 8-9 Roman period plant frequencies by site type.

Fruit/nut frequencies increase in the Roman period, becoming more prevalent than cereals except for at urban sites, where they occur in equal measure, and at sites that are labelled 'other.' As in the previous period, pulses have a notable presence, though somewhat less than fruit/nut and cereal remains. Flavourings appear in this period, and, though still very rare, occur only at villa and urban sites. Vegetables are also found, though with very low frequencies, at ceremonial and villa sites, which is a departure from the previous period, when they are encountered only at rural sites.

Late Roman period

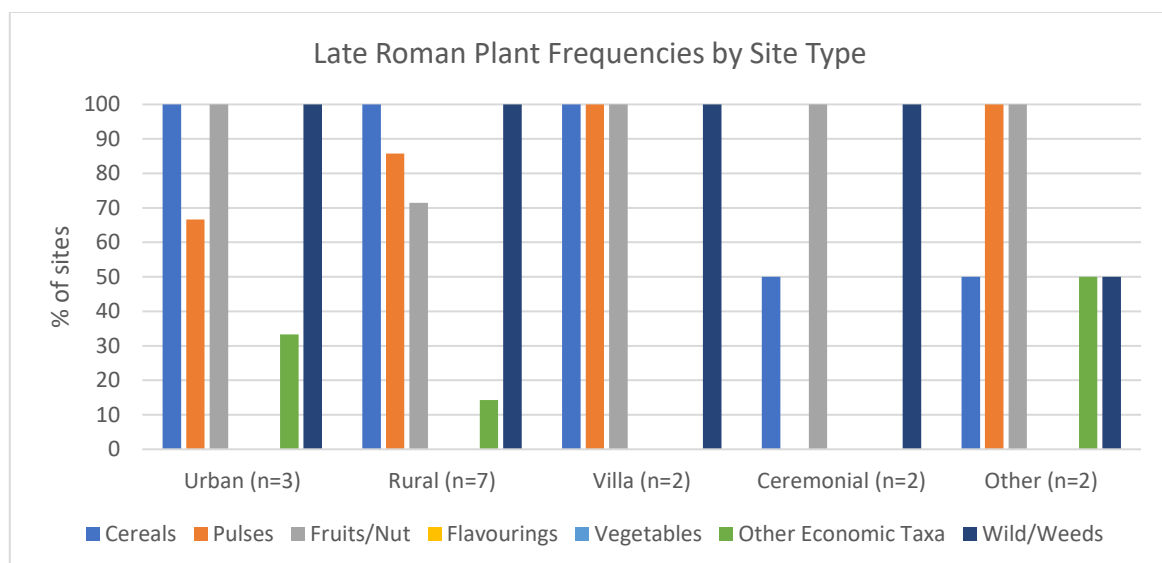


Figure 8-10 Late Roman plant frequencies by site type.

Fruits/nuts are the most frequent type of remain found in the Late Roman period, though at urban, 'other,' and villa sites their frequency is the same as cereals, as well as with pulses at the latter. Fruits/nuts are encountered at 100% of all site types with the exception of rural sites, where cereals are the most frequent, and fruit/nuts are found at around 70% of sites. Rarer plant types, including flavourings and vegetables, are absent during this period.

8.2.2 Cereals

8.2.2.1 Cereals: Chronological variation

When observing cereal frequencies in the Italian peninsula, a number of chronological trends may be observed. Barley is the most frequently encountered cereal in all periods. The frequency of glume wheats, however, decreases over time, though this can be said for most cereals. Free-threshing wheat appears to be somewhat more frequent in the Roman and Late Roman periods relative to the other cereals, though it is found with the same frequency as glume wheat in the Pre-Roman period. The appearance of rye increases slightly over time, though is never especially frequent, peaking at slightly under 20% of sites during the Late Roman period.

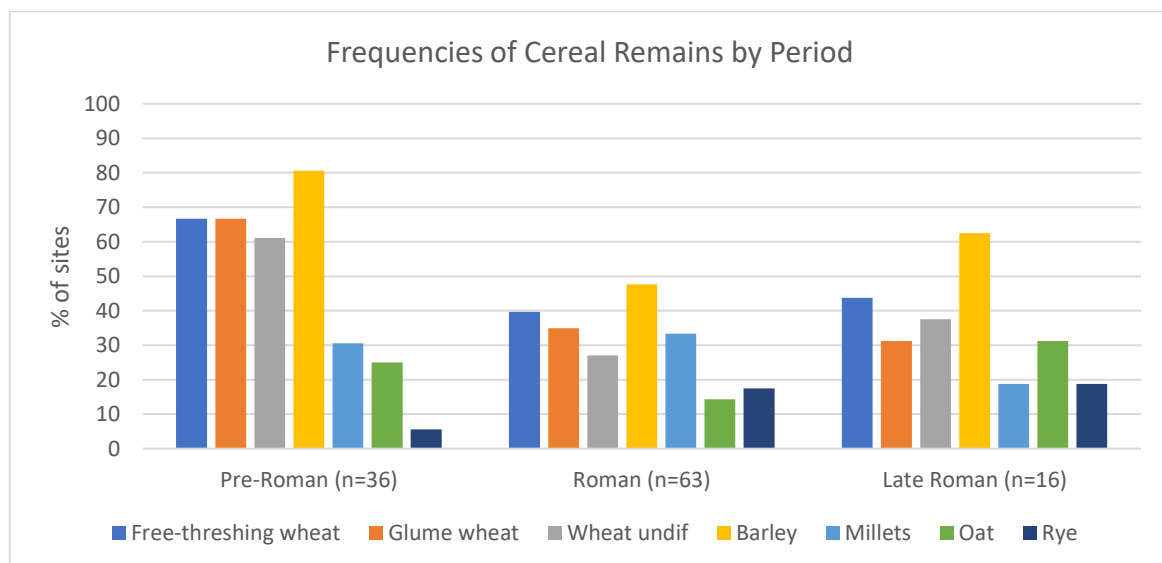


Figure 8-11 Frequencies of cereal remains by period.

8.2.2.2 Cereals: Regional variation

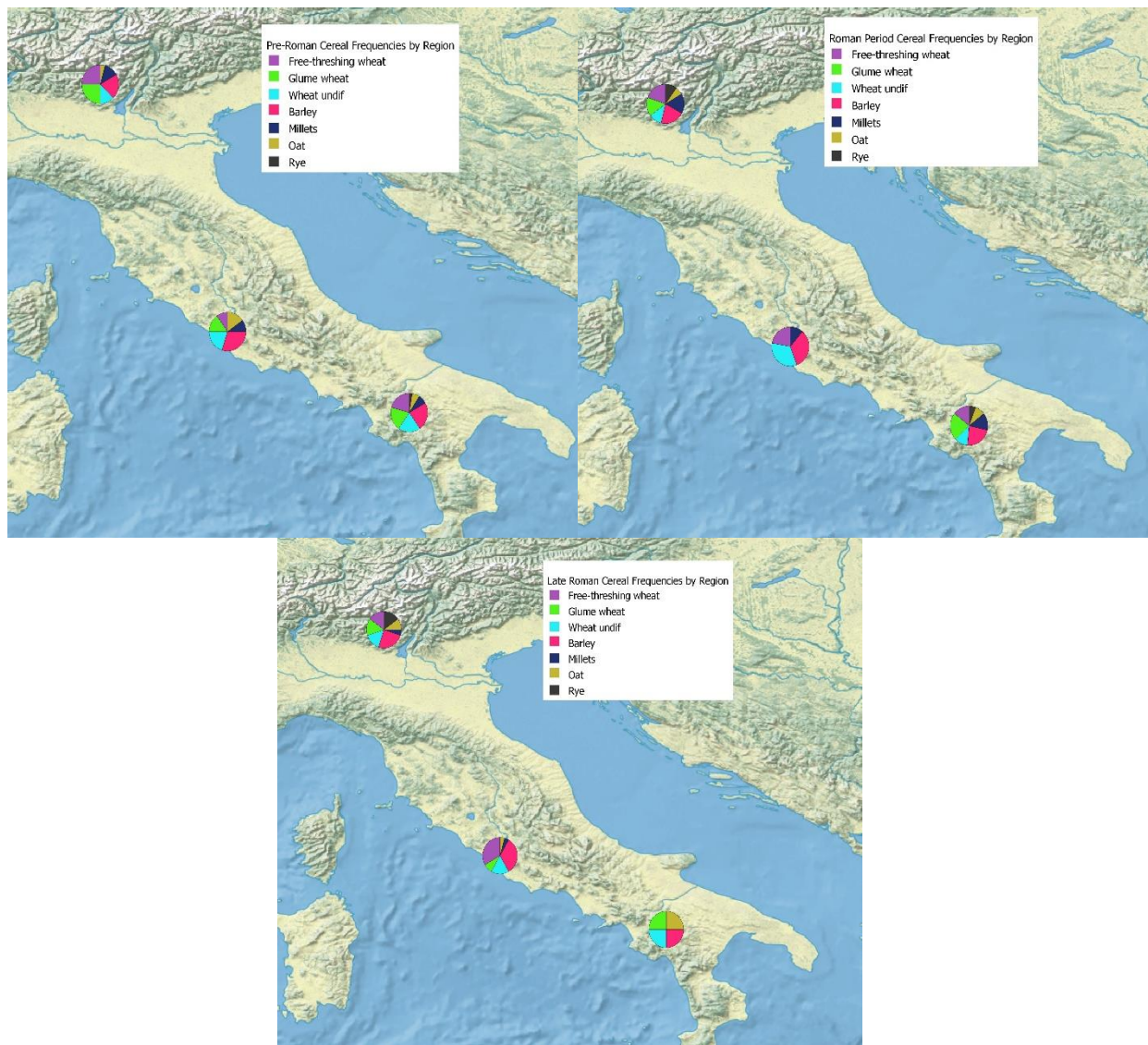


Figure 8-12 Frequency of Italian cereal remains for Pre-Roman, Roman, and Late Roman period datasets by region (North, Central, South). See Table 8-1 for number of records per region by period.

Pre-Roman period

In the Pre-Roman period, glume wheat, free-threshing wheat, and barley are all present at more or less equal frequencies in the North. Barley is dominant in central Italy, as well as in the South, though by much finer margins in the latter. Glume wheats appear to have equal frequencies with free-threshing wheat, if not slightly higher in central and northern Italy, but are less frequent in the South. Millets are present in all regions and appear most frequently in the North. Oat is also present in all regions, while rye is only found in the South.

Roman period

The Roman period sees a decrease in glume wheat in the North, as well as in central Italy, where glume wheats are absent from the botanical record (these are regions where glume wheats were previously more frequent). Central Italy, where barley remains the most frequent cereal, is lacking in oat, as well as rye in this period, and thus appears to be less varied in terms of the cereals represented when compared with the North and the South. Millets appear to become slightly more frequent in all regions in the Roman period.

Late Roman period

In the Late Roman period, there is an increase in the frequency of free-threshing wheat in central Italy, which is nearly as frequent as barley in this region. The cereal assemblage in the North is varied, though barley appears to be the most frequent. The cereal assemblage from the South is from only one site, which has *Triticum sp.*, glume wheat, barley, and oat in roughly equal proportions.

8.2.2.3 Cereals: Variation by site type

Pre-Roman period

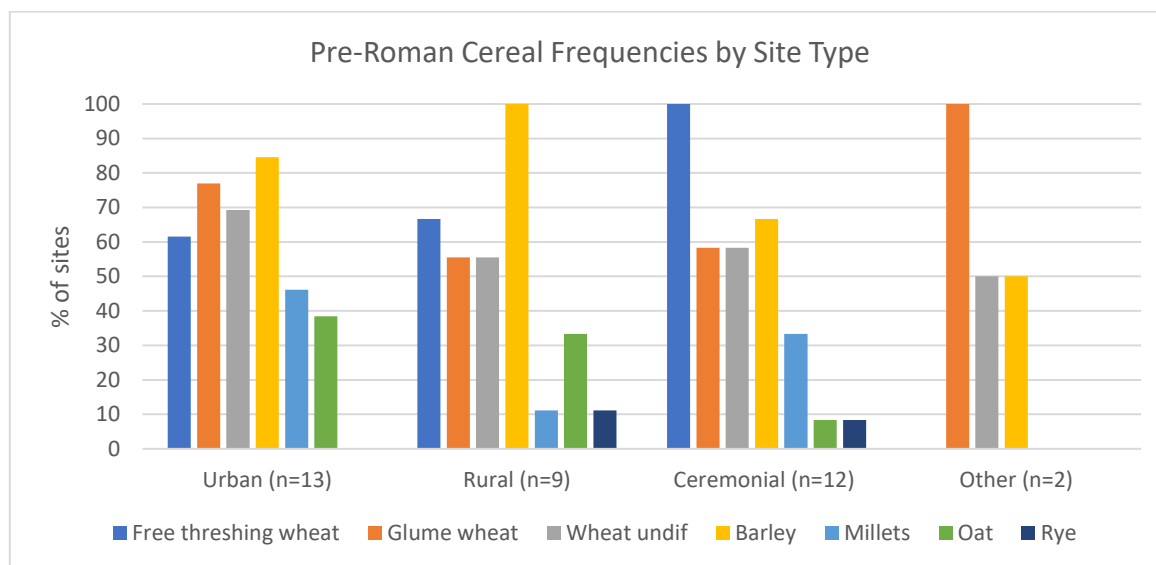


Figure 8-13 Frequencies of Pre-Roman cereal remains, displayed according to site type.

Free-threshing wheat is the most common cereal at ceremonial sites, whereas barley is the most commonly encountered at rural sites. Barley is also the most frequently found cereal at urban sites, though it is followed closely by glume wheats. Oat has a notable presence at urban and rural sites, though this may also be reflective of cereal weeds or fodder. Millets have a notable presence at urban sites in the Pre-Roman period. They are also present at ceremonial and, to a lesser degree, rural sites.

Roman period

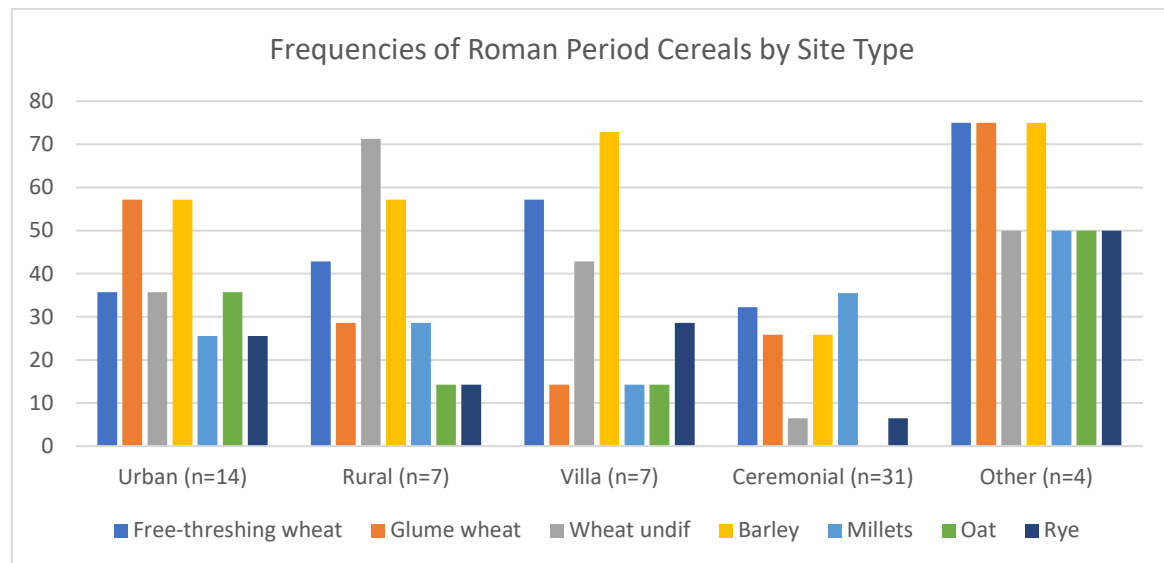


Figure 8-14 Frequencies of Roman period cereal remains, displayed according to site type.

It is interesting that free-threshing wheat is not the most frequently found cereal at any site type, though it is found with the same frequency as barley and glume wheats for Roman period sites categorised as 'other.' Millets are represented at all site types for the Roman period and are the most frequent at ceremonial sites. That said, the frequencies remain rather low, with around 35% of ceremonial sites yielding millet remains. There appears to be a general rise in the frequency of rye at all site types in this period.

Late Roman period

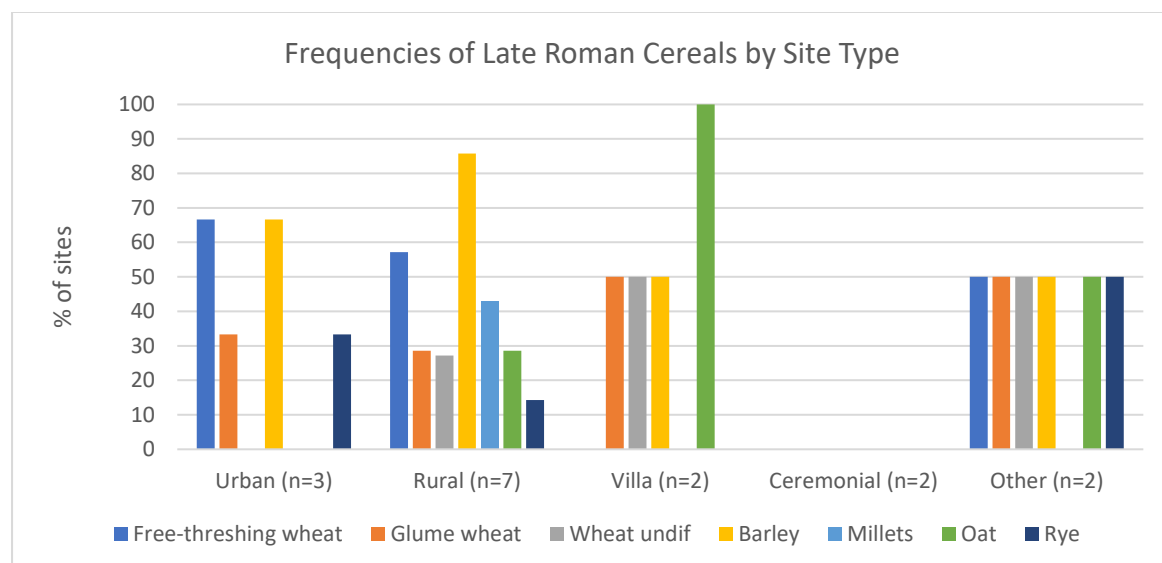


Figure 8-15 Frequencies of Late Roman cereal remains by site type.

Cereals are virtually lacking from all ceremonial sites in the Late Roman period, though it should be noted that there are only two sites in this category. Barley is the most frequent cereal at rural sites and is seen at the same frequency as free-threshing wheat at urban sites. In terms of the less-frequently found cereals, millets only appear at rural sites, though rye is present at urban, rural, and other sites in this period.

Glume Wheats

Triticum dicoccum is the most frequent glume wheat in all periods, followed by *Triticum monococcum*. *Triticum dicoccum* is present at 15 sites in the Pre-Roman period, 13 in the Roman period, and only five in the Late Roman period. *Triticum monococcum* is present at seven sites throughout the peninsula in the Pre-Roman period, seven in the Roman period, and only one in the Late Roman period.

Triticum spelta is the least common of the glume wheats in all periods. In the Pre-Roman period, it is present at only two sites, one in central Italy and one in the North. In the Roman period, *Triticum spelta* is present at four sites, three of which are in the North. There are no spelt wheat remains from the Late Roman period.

Chaff

In all periods, chaff is most frequently uncovered at urban sites (six in Pre-Roman, six in Roman, and two in the Late Roman periods). Otherwise, chaff is present at one ceremonial and one rural site in the Pre-Roman period; one of each ceremonial, rural, and other in the Roman period; and one rural site in the Late Roman period.

8.2.3 Fruit/Nuts

8.2.3.1 Fruit/Nuts: Chronological variation

Grape is the most frequently seen fruit in all periods, apart from the more general 'other fruit' category, which is largely formed by nut species such as *Juglans regia* (walnut) and *Corylus avellana* (hazelnut). Fig is more frequent in the Pre-Roman and Roman periods than in the Late Roman period, while *Prunus* fruits, which also peak in the Roman period, are at their lowest in the Pre-Roman period. Pomegranate is present in the earlier two periods, but is missing from the Late Roman dataset, and date is only present in the Roman period.

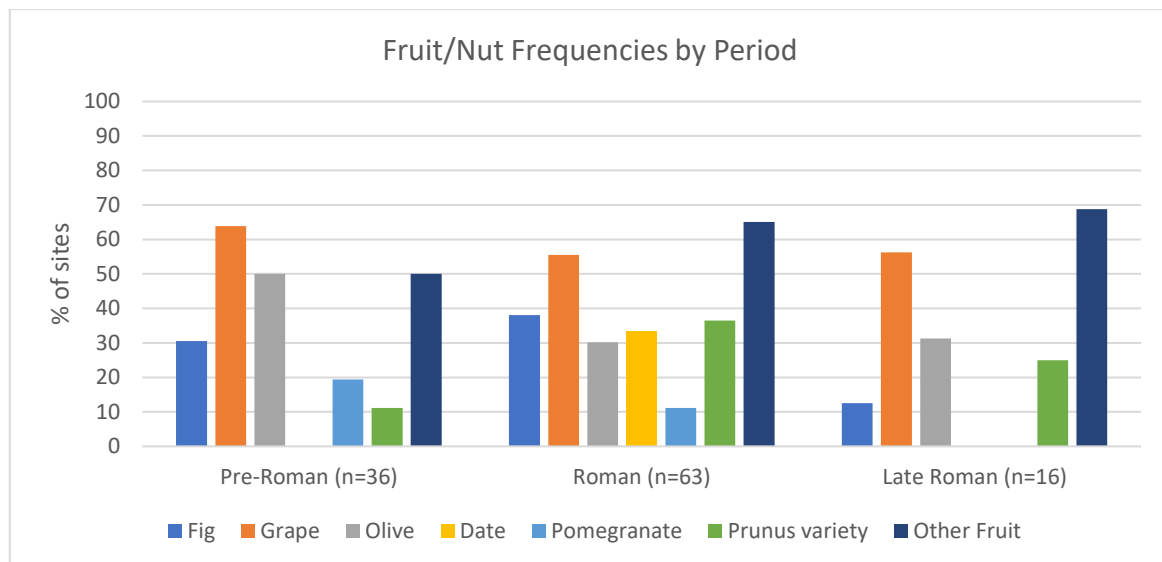


Figure 8-16 Frequencies of fruit/nut remains by period.

8.2.3.2 Fruit/Nuts: Regional variation

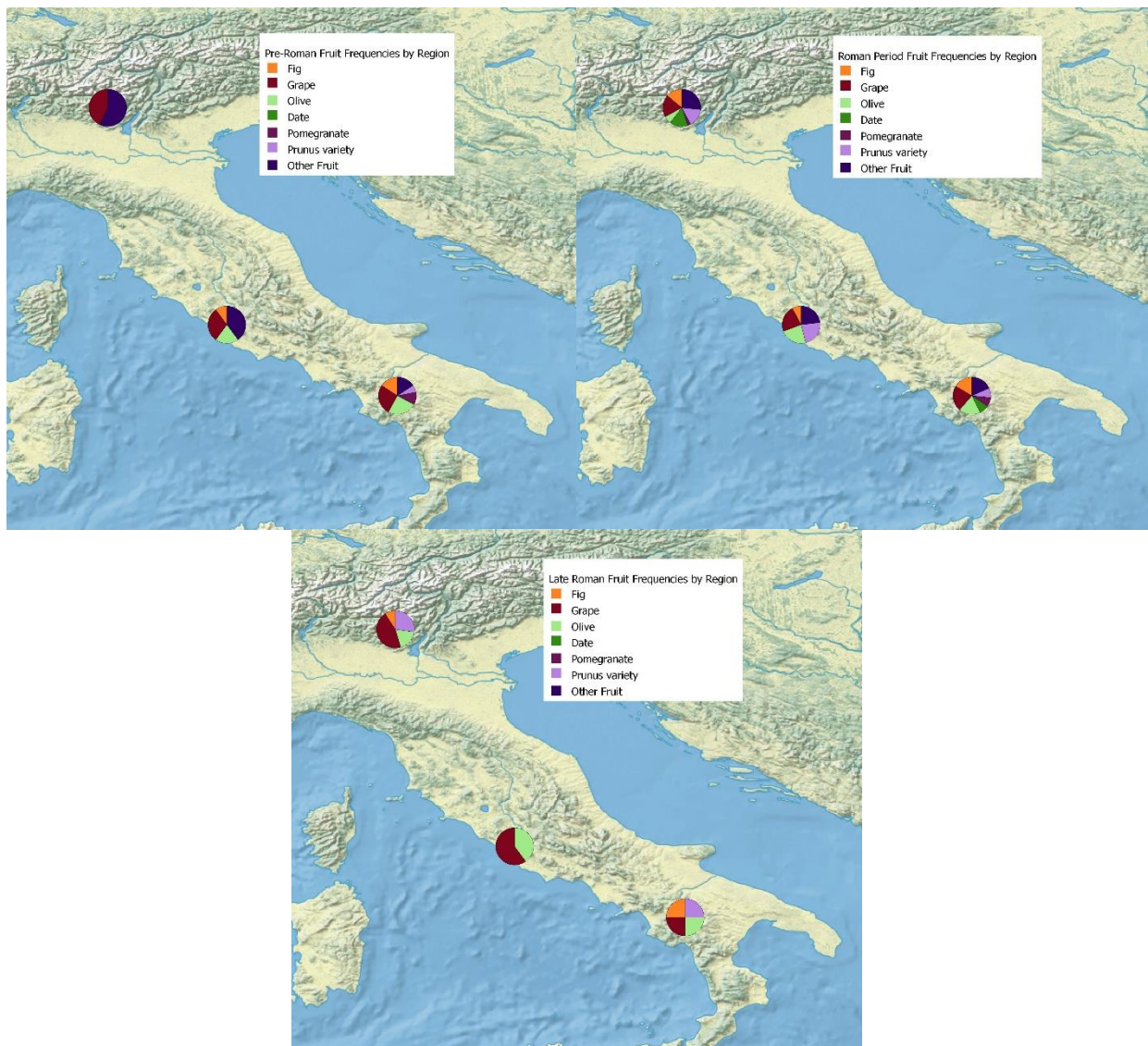


Figure 8-17 Frequencies of Italian fruit remains for the Pre-Roman, Roman, and Late Roman period dataset by region (North, Central, South). See Table 8-1 for number of records per region by period.

Pre-Roman period

The North lacks in diversity of fruits in the Pre-Roman period, with only grape and ‘other fruits’ represented. In central Italy, ‘other fruits’ is still the dominant category, though grape, followed by olive and fig have notable presence as well. The South is the most varied in terms of fruits in the Pre-Roman period, with pomegranate and *prunus* fruits supplementing the dataset. Unlike northern and central Italy, olive surpasses grape as the most frequent fruit type in the South.

Roman period

This period seems to see a diversification of fruits, with *Prunus* varieties spreading to all three regions, and date appearing in the North as well as in the South. This diversification is especially prominent in the North, as pomegranate and fig are also present, though olive remains less frequent in the North than in the other two regions.

Late Roman period

In the Late Roman period, fruits become less diverse again, with pomegranate, date, and other fruits virtually disappearing from the archaeobotanical record. Grape becomes the most frequent fruit in central and northern Italy, followed by olive, or *Prunus* fruits in the North.

8.2.3.3 Fruit/Nuts: Variation by site type

Pre-Roman period

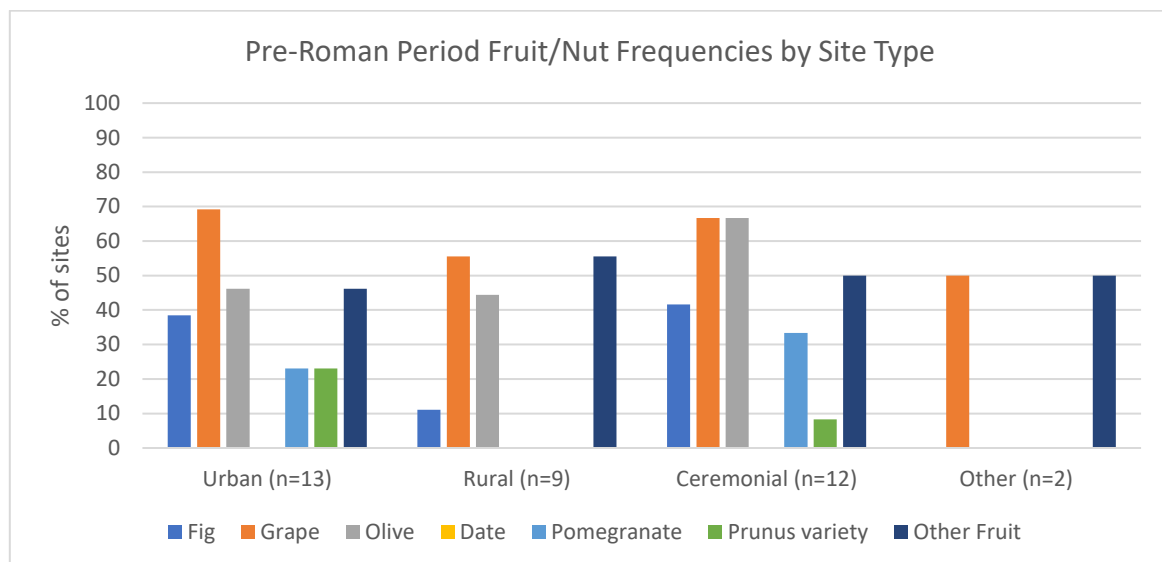


Figure 8-18 Frequencies of Pre-Roman fruit/nut remains by site type.

There is an overall dominance of grape, followed by olive at all site types in the Pre-Roman period. *Prunus* fruits and pomegranate are only present at ceremonial and urban sites. Fig is also less frequent at rural sites than at ceremonial and urban sites.

Roman period

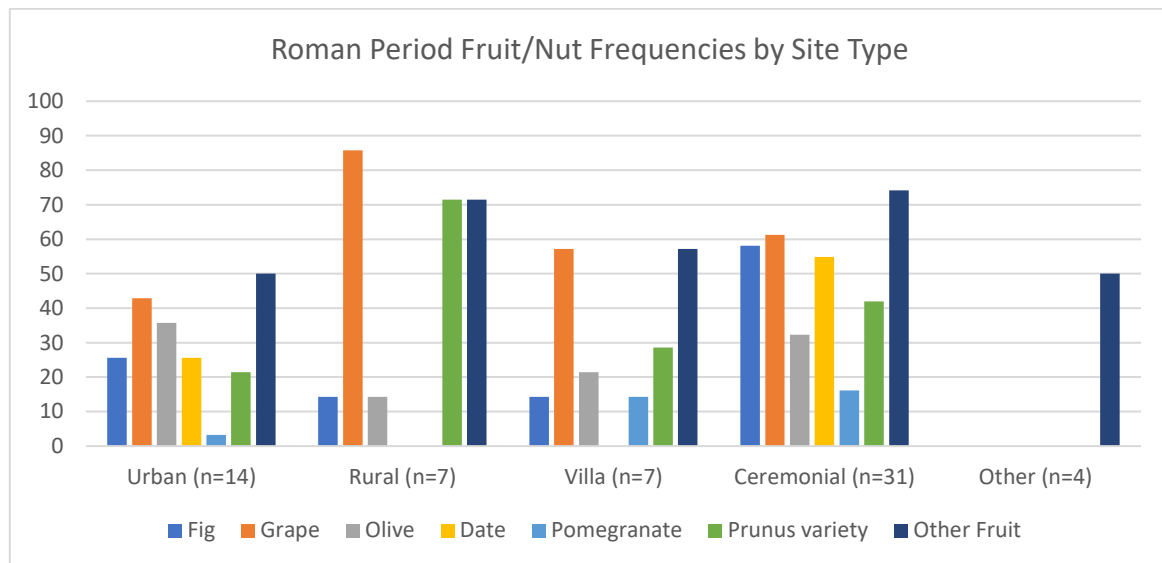


Figure 8-19 Frequencies Roman period fruit/nut remains by site type.

Date is found at urban and ceremonial sites, which supports these two site types as having more diverse fruit assemblages. Grape remains dominant, though is somewhat less frequent at urban sites, at which it is second to 'other' fruit/nut remains. There is a lack of pomegranate at rural sites. In general, olive is not especially frequent; though it is present at all site types apart from 'other', the frequencies are relatively low and peak in urban contexts, where it is present at around 35% of sites.

Late Roman period

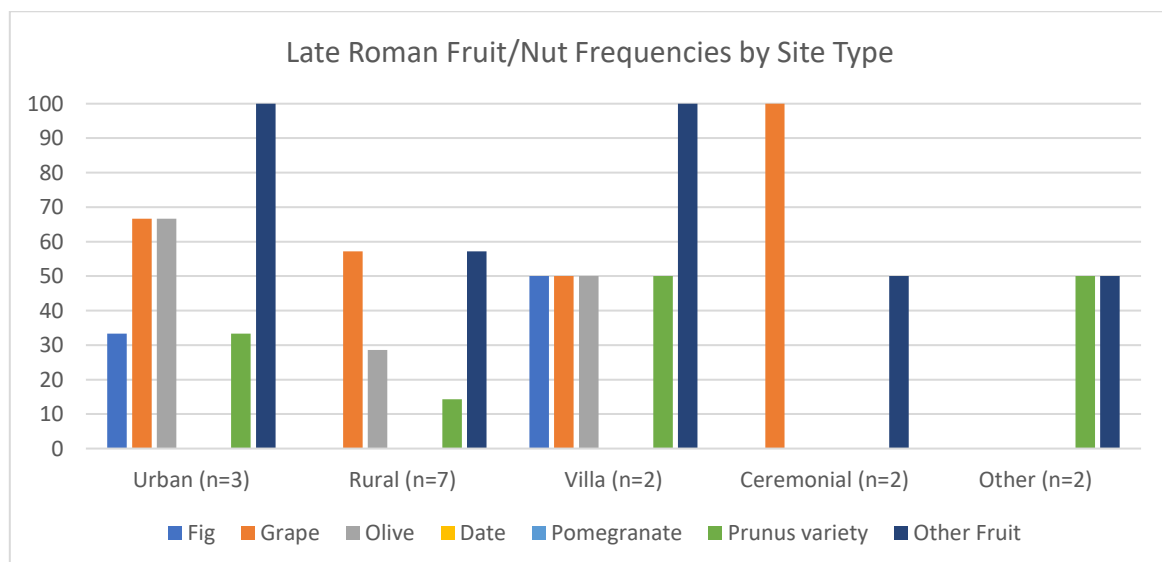


Figure 8-20 Frequencies of Late Roman fruit/nut remains by site type.

Rural sites continue to lack date and pomegranate in the Late Roman period, and do not have high fruit frequencies overall. In general, all site types are characterised by a lower degree of diversity, though the lack of sites, with only two sites in the ceremonial, villa, and other categories, and only three urban sites, should be noted.

8.2.4 Pulses

8.2.4.1 Pulses: Chronological variation

In considering pulse remains from the Italian peninsula, *Vicia faba* is the most frequent in all periods considered here. *Lens culinaris* is the second most frequent pulse in the Roman and Late Roman periods, though *Pisum sativum* is more frequent in the earlier Pre-Roman period. Other trends include a possible decrease in *Vicia ervilia* over time, as well as a slight increase in *Lathyrus sativus*, which appears in the Roman period and increases slightly in the Late Roman period, though it is never present at more than around 7% of sites.

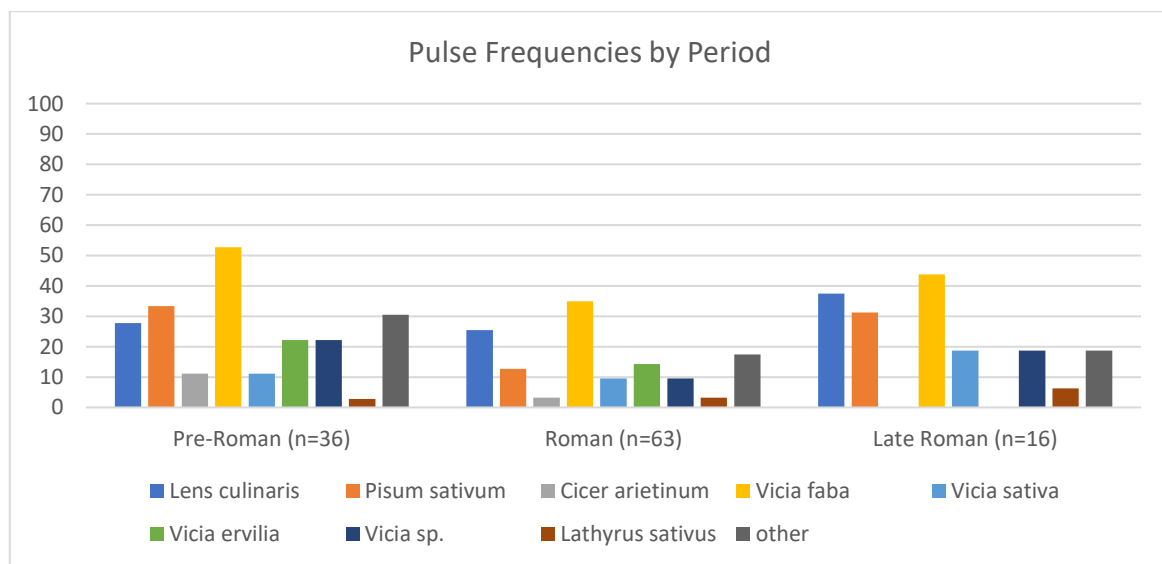


Figure 8-21 Frequencies of pulse remains by period.

8.2.4.2 Pulses: Regional variation

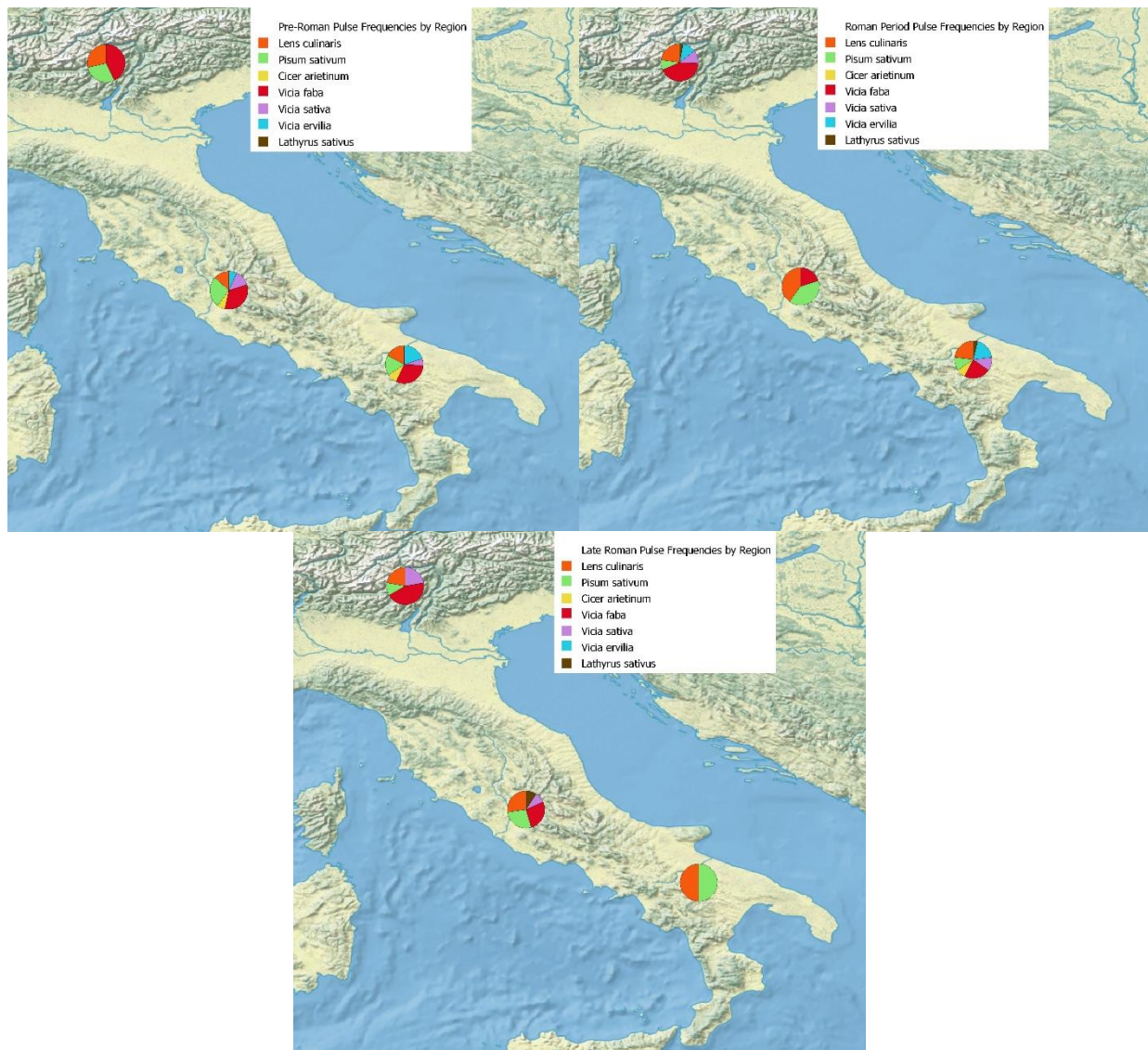


Figure 8-22 Pulse frequencies for the Pre-Roman, Roman, and Late Roman Periods by region (North, Central, South). See Table 8-1 for number of records per region by period.

Pre-Roman period

In the Pre-Roman period dataset, the north of Italy exhibits less diversity in pulse remains than the other two regions, producing only *Lens culinaris*, *Pisum sativum*, and *Vicia faba*, with the latter being the most common pulse in all regions. *Pisum sativum*, and – to a lesser degree- *Vicia sativa*, is more common in central Italy than in the North or the South, while *Vicia ervilia* is most common in the South, where it occurs at 33% of sites. *Lathyrus sativus* is virtually absent from the Pre-Roman dataset.

Roman period

Pulse frequencies are, in general, lower in the Roman period dataset, with no species achieving values over ~46% of sites in any region. The dataset from the North is more diverse than in the preceding period, though most species occur at under 10% of sites, with the exceptions *being Lens culinaris* and *Vicia faba*, which occur at ~18% and 34% respectively. Central Italy exhibits the least diversity in this period, with pulses such as *Cicer arietinum* (chickpea), *Vicia sativa*, *Vicia ervilia*, and *Lathyrus sativus* being absent. Unlike in the other two regions where *Vicia faba* figures among the most prominent pulses, *Lens culinaris* and *Pisum sativum* are the most frequent pulse remains in central Italy. The South exhibits the most diversity in this period, with all pulse types represented. *Vicia faba* and *Lens culinaris* are the most frequent remains, followed by *Vicia ervilia*.

Late Roman period

There is only one site in the South in the Late Roman dataset, and it produced lentil (*Lens culinaris*) and pea (*Pisum sativum*). *Vicia ervilia* is conspicuously absent from all regions in this period, as is chickpea (*Cicer arietinum*). *Vicia faba* is the most common pulse in the North, occurring at 20% of sites, while, in the South, *Lens culinaris*, *Pisum sativum*, and *Vicia faba* all exhibit the highest frequencies, with each occurring at 60% of sites.

8.2.4.3 Pulses: Variation by site type

Pre-Roman period

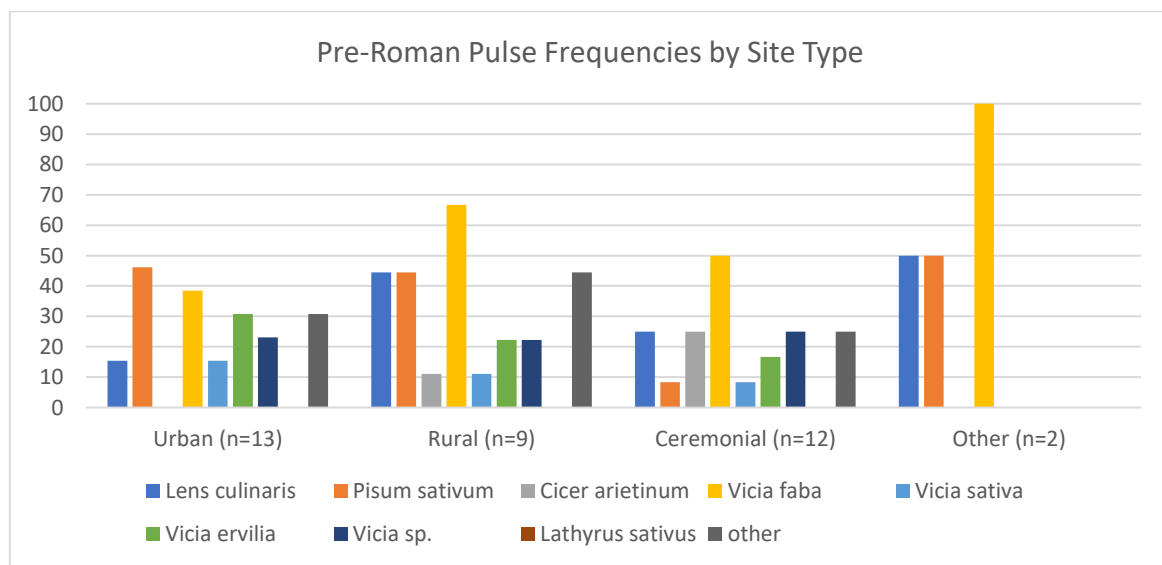


Figure 8-23 Frequencies of Pre-Roman pulse remains by site type.

All site types exhibit relatively low pulse frequencies in the Pre-Roman period, with all pulses rarely exceeding presence of 50% at a given site type. *Vicia faba* is the most frequent pulse in all site types in the Pre-Roman period apart from urban sites, where it is just behind *Pisum sativum*. *Cicer*

arietinum is only present at ceremonial and rural sites. Otherwise *Vicia sativa* appears to be the least frequent pulse and is never present at more than 16% of sites in any site type. *Lathyrus sativus* remains are absent from the dataset altogether.

Roman period

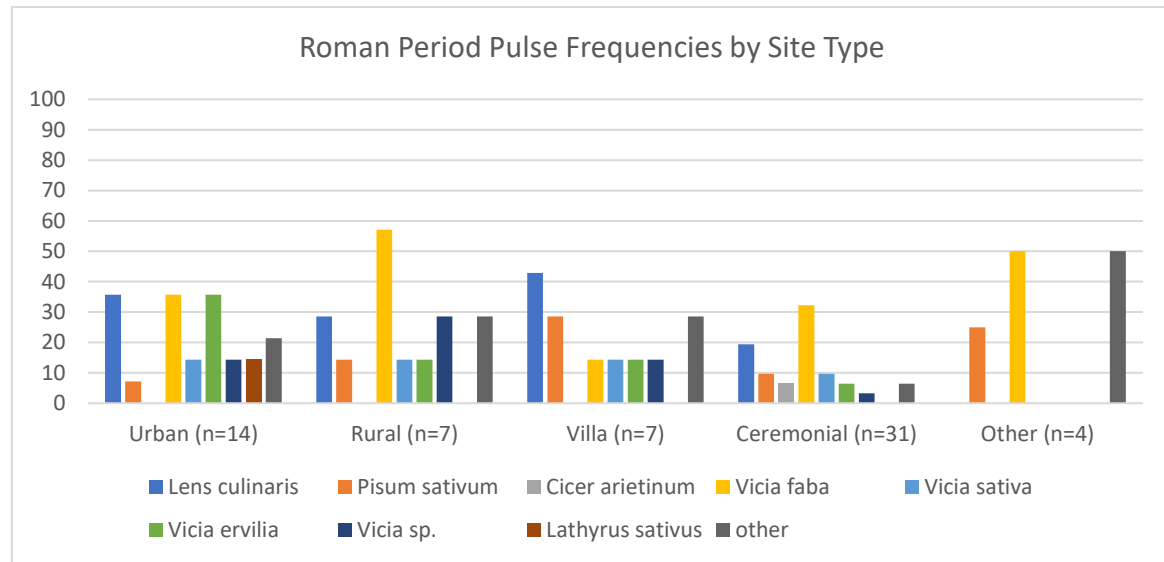


Figure 8-24 Frequencies of Roman period pulse remains by site type.

Vicia faba retains relatively high frequencies, especially at rural sites, where it is present at nearly 60% of sites (this is similar to Pre-Roman patterns, wherein *Vicia faba* is present at just over 60% of rural sites). At urban sites, *Vicia faba*, *Lens culinaris* and *Vicia ervilia* are found the most frequently, with each present at just over 35% of urban sites. *Cicer arietinum* is present only at just over 6% of ceremonial sites, whereas *Lathyrus sativus* is only present at urban sites

Late Roman period

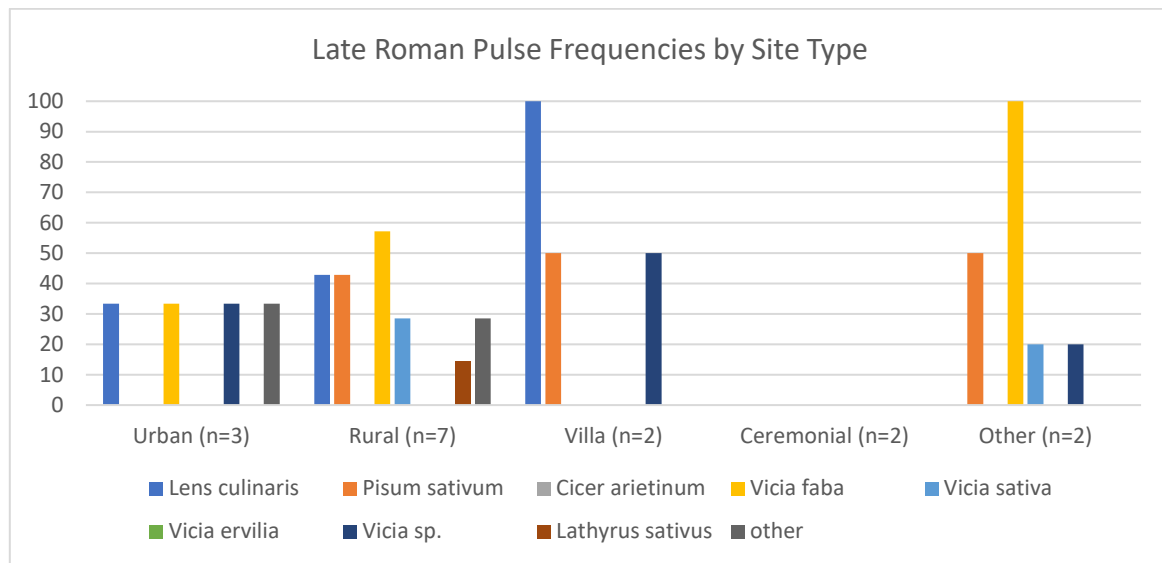


Figure 8-25 Frequencies of Late Roman pulse remains by site type.

Patterns in Late Roman pulses are made somewhat difficult to discern due to the lower number of sites in each category. *Vicia faba* and *Lens culinaris*, followed closely by *Pisum sativum* appear to be the most frequent pulses overall. *Cicer arietinum* and *Vicia ervilia* are absent from all site types in this period, and *Lathyrus sativus* appears only at rural sites. Ceremonial sites yielded no pulse remains in this period, though there are only two of said site type.

8.2.5 Nut remains

8.2.5.1 Nuts: Chronological variation

In examining the distribution of nut remains, it becomes apparent that *Corylus avellana* (hazelnut) and *Juglans regia* (walnut) are the most common nut remains in all periods, though walnut overtakes hazelnut in the Roman period, and is significantly more common by the Late Roman period. The Pre-Roman and Roman periods exhibit greater diversity than the Late Roman period, with only *Castanea sativa* (chestnut) missing from the Pre-Roman dataset, and only *Pistacia* absent in the Roman period. The Late Roman period dataset is lacking in all of the less frequently occurring nut remains, apart from chestnut. *Prunus dulcis* (almond) and *Pinus pinea* (pine nut) both appear to increase in the Roman period, before disappearing in the Late Roman period dataset. Additionally, it should be noted that while frequencies do appear to be somewhat higher in the Roman period in general, the prominence of ceremonial sites during this period also contributes to this pattern.

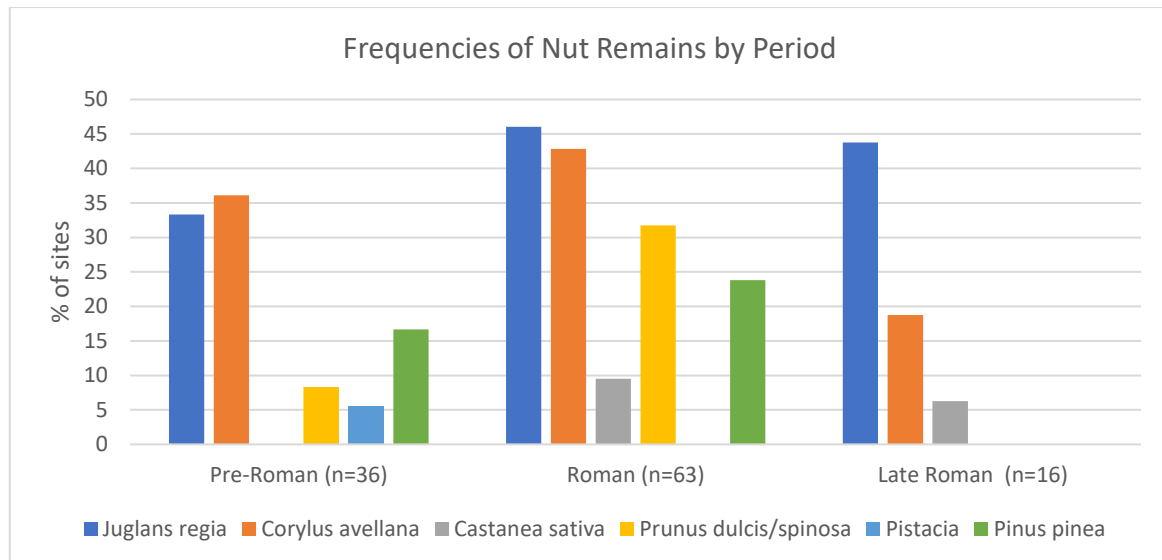


Figure 8-26 Frequencies of nut remains by period.

8.2.5.2 Nuts: Other variations

In examining the distribution of nuts according to site type, a number of patterns may be observed. Pine nut appears to be associated with more prestigious site types such as ceremonial, urban and villa sites in all periods, and is found in a rural context only once in the Pre-Roman period. Similarly, almond and chestnut are also found at only ceremonial, urban, and -in the case of chestnut- villa sites. The distribution of walnut and hazelnut is more widespread in all periods, with the nuts occurring at all site types.

Southern Italy is the most diverse in the Pre-Roman period, with only chestnut missing from the dataset. In the Roman period, the large number of ceremonial sites in the North render this region the most diverse, while the central Italian dataset is the least diverse, and lacks chestnut, almond, and *Pistacia* in all periods.

8.2.6 Flavourings and vegetables

As observed for the East, flavourings and vegetables are not commonly preserved in the charred dataset, though in the Italian data such plants are even rarer. In the Pre-Roman period, only one species is represented (*Lactuca sativa*). In the Roman period there is a slight increase in diversity, with six species represented, before decreasing again in the Late Roman period, when two flavouring/vegetable plants can be observed (for a full list of flavourings and vegetables present in each period, see Table 8-2).

The paucity of flavourings/vegetables in the Italian dataset is also made clear in the distribution of records with these plant types, as is displayed according to chronological period and site type in Tables 8-3 and 8-4 below.

Table 8-3 Number of records in Italian dataset that contain charred flavourings, by site type and chronological period.

Flavourings					
Period	Urban	Rural	Villa	Ceremonial	Other
Pre-Roman Period	0	0	-	0	0
Roman Period	1	0	1	0	0
Late Roman Period	0	0	0	0	0

Table 8-4 Number of records in Italian dataset that contain charred vegetables, by site type and chronological period.

Vegetables					
Period	Urban	Rural	Villa	Ceremonial	Other
Pre-Roman Period	0	1	-	0	0
Roman Period	0	0	1	1	0
Late Roman Period	0	0	0	0	0

8.2.7 Oil/Fibre/Other economic taxa

Plants categorised as oil/fibre plants and other economic taxa are also rare occurrences in the Italian dataset. In Italy, these plants are largely limited to flax (*Linum usitatissimum*), poppy (*Papaver somniferum*), and sesame (*Sesamum indicum*), as well as plants in the genus *Brassica* sp., which are commonly used as oil plants. Hops (*Humulus lupulus*) is an additional notable species and occurs only in the Roman period (see Table 8-2 for complete list of these plants by period).

Table 8-5 Number of records in the Italian dataset containing oil/fibre plants and other economic taxa, by period and site type.

Oil/Fibre/Other Economic Taxa					
Period	Urban	Rural	Villa	Ceremonial	Other
Pre-Roman	2	1	-	1	0
Roman	2	1	1	1	1
Late Roman	1	1	0	0	1

8.2.8 Wild/Weed Seeds

Efforts were made to perform basic weed seed analysis on the Italian dataset. Given that there are more species level identifications in the archaeobotanical reports from Italy than the East, analysis was able to be somewhat more detailed. As such, weed seeds were examined not only by frequency of occurrence, but also by their associated autecological values (see Appendix D for autecological values for the top 20 weed seeds in the Italian dataset; see 5.9.3 for methodology). The results of the autecological analysis are varied, with a range of indicator values represented. Special attention was paid to nitrogen indicator values (N), in an effort to track shifting crop husbandry patterns and shifts in the application of intensive cultivation methods (see Figs. 10-1 through 10-4 for tracking of weed seeds reflecting high and low soil nutrient levels). Notably, weed seeds associated with both high and low nitrogen availability peak during the Roman period (see 10.1.1 for discussion).

In terms of habitat classifications, weed seeds associated with arable habitats feature prominently among the top 20 weed seeds in all periods, and include – but are not limited to – species such as *Chenopodium album* and *Agrostemma githago*. The most frequent weed seeds for Italy also include ruderals, such as *Sambucus ebulus*, while others are not identified to species level and thus are difficult to classify.

The top 20 most frequently occurring for each period are indicated below in Table 8-6.¹⁵ In viewing the frequencies, it becomes immediately apparent that weed seeds occur at lower frequencies in all periods in Italy than in the East.

Table 8-6 The most frequent wild/weed seeds by period, and the percentage of sites at which they occur.

Pre-Roman (n=36)	% of sites	Roman (n=32)	% of sites	Late Roman (n=16)	% of sites
Fabaceae	38.89	Poaceae	25	Poaceae	43.75
Poaceae	27.78	<i>Lathyrus/Pisum/Vicia</i>	21.88	Fabaceae	31.25
<i>Lathyrus/Pisum/Vicia</i>	25	<i>Galium aparine</i>	18.75	<i>Rumex</i> sp.	25
<i>Chenopodium</i> sp.	16.67	<i>Chenopodium album</i>	15.62	<i>Chenopodium album</i>	18.75
<i>Vicia</i> sp.	16.67	Fabaceae	15.62	<i>Galium</i> sp.	18.75
<i>Bromus</i> sp.	13.89	<i>Galium</i> sp.	15.62	<i>Lathyrus/Pisum/Vicia</i>	18.75
<i>Chenopodium album</i>	13.89	Polygonaceae	15.62	<i>Vicia</i> sp.	18.75
<i>Medicago</i>	13.89	<i>Vicia</i> sp.	15.62	<i>Agrostemma githago</i>	12.5
<i>Lathyrus</i> sp.	11.11	<i>Agrostemma githago</i>	12.5	<i>Carex</i> sp.	12.5
<i>Lolium</i> sp.	11.11	<i>Medicago minima</i>	12.5	<i>Chenopodium</i> sp.	12.5
<i>Phalaris</i>	11.11	<i>Rumex</i> sp.	12.5	Lamiaceae	12.5

¹⁵ Note: there are over 30 ceremonial assemblages from the North during the Roman period. As these represent curated assemblages that are unlikely to include weed seeds, and thus skew the frequencies, ceremonial sites were excluded in calculating the figures in Table 8-6.

<i>Polygonum</i> sp.	11.11	Apiaceae	9.38	<i>Lolium</i> sp.	12.5
<i>Quercus</i> sp.	11.11	<i>Bromus</i> sp.	9.38	<i>Picea albies</i>	12.5
<i>Sherardia arvensis</i>	11.11	<i>Chenopodium</i> sp.	9.38	<i>Setaria</i> sp.	12.5
Asteraceae	8.33	<i>Euphorbia helioscopia</i>	9.38		
<i>Cupressus sempervirens</i>	8.33	Lamiaceae	9.38		
<i>Ornithopus perpusillus</i>	8.33	<i>Polygonum convolvulus</i>	9.38		
Panicoideae	8.33	<i>Polygonum persicaria</i>	9.38		
<i>Panicum/Setaria</i>	8.33	<i>Polygonum</i> sp.	9.38		
<i>Plantago</i>	8.33	<i>Sambucus ebulus</i>	9.38		
		<i>Sherardia arvensis</i>	9.38		
		<i>Stellaria media</i>	9.38		
		<i>Veronica hederifolia</i>	9.38		

8.3 Italy: Fully quantified data

8.3.1 Overall plant composition

8.3.1.1 Regional variation in overall plant composition

Pre-Roman period

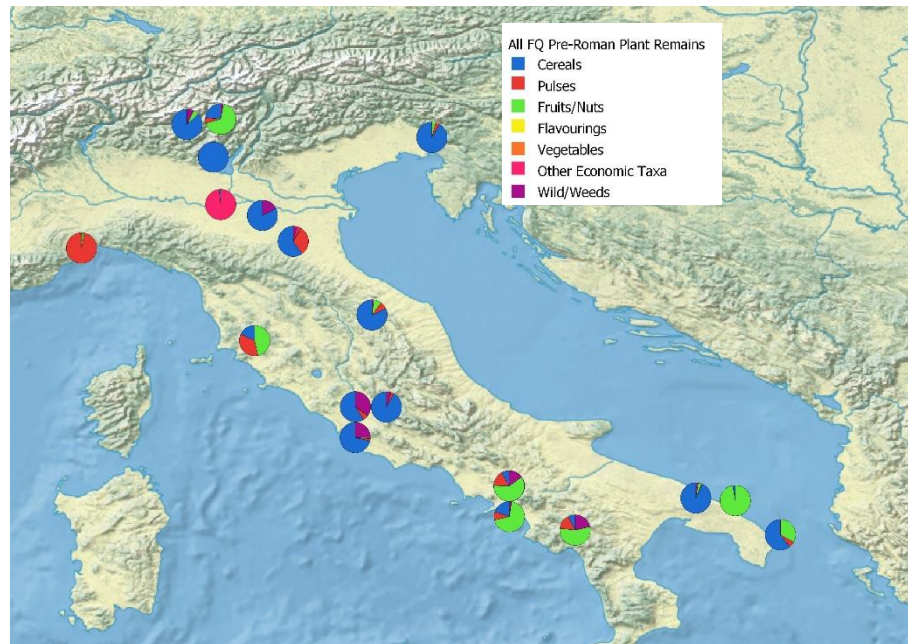


Figure 8-27 All fully quantified Pre-Roman remains displayed according to spatial distribution of assemblages at the site level.

In the Pre-Roman period, the South seems to yield the most sites where fruits are the most abundant type of remain, whereas in central and northern Italy, cereals are more abundant. Flavourings and vegetables seem to be lacking over all in this period, though this may be largely due to preservation biases; such remains have been uncovered at sites such as the House of the Vestals (Site 137), where they were preserved by mineralisation, and Piazza Garibaldi in Parma (Site 161), where flavourings were preserved by waterlogging.

Roman period

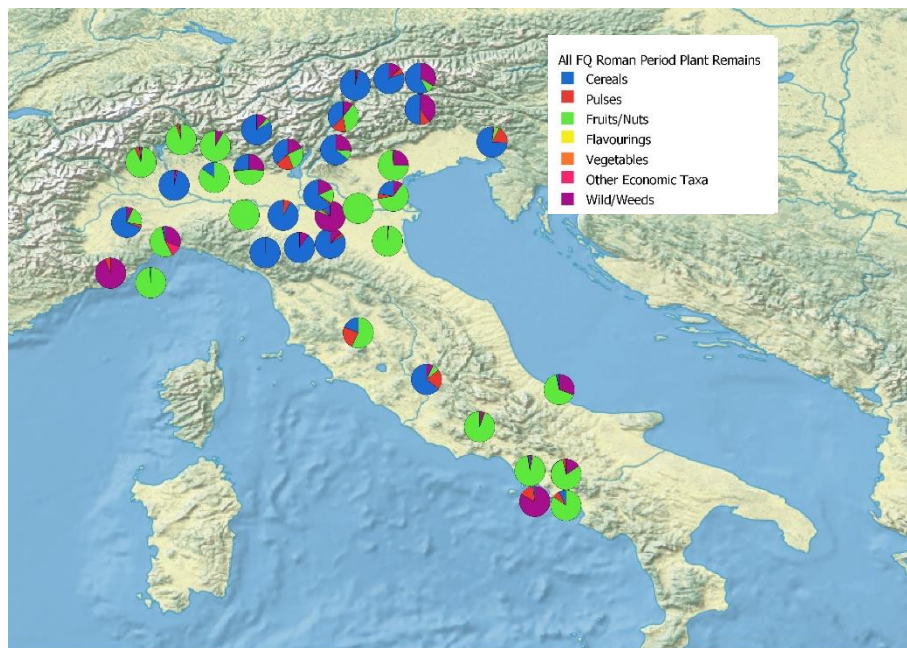


Figure 8-28 All fully quantified Roman period remains, displayed according to spatial distribution of assemblages at the site level.

In the Roman period fruits are more widespread, with an apparent increase in sites with fruit rich assemblages. (This may be partially due to the many ceremonial sites in the North, as fruits are commonly dominant in such contexts.) The lack of cereals in the South during this region is particularly notable.

Late Roman period

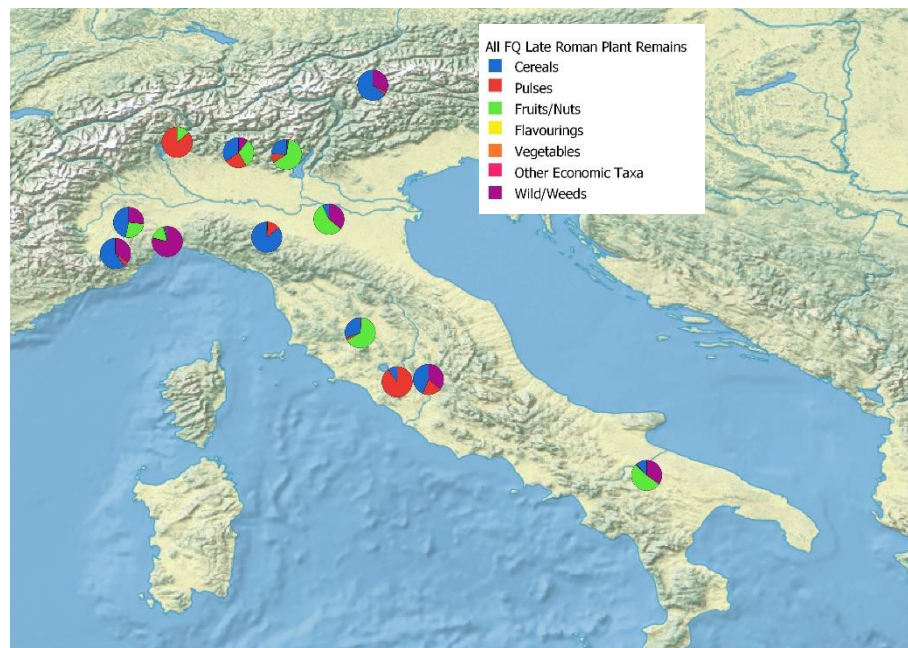


Figure 8-29 All fully quantified Late Roman plant remains, displayed according to spatial distribution of assemblages at the site level.

Due to a lack of fully quantified sites in the South, it cannot be said whether the pattern of fruit dominance in this region continues during the Late Roman period. The sites in central and northern Italy, however, appear to have more varied assemblages than in previous periods, and there is a possible increase in pulses.

8.3.1.2 Variation in overall plant composition by site type

Pre-Roman period

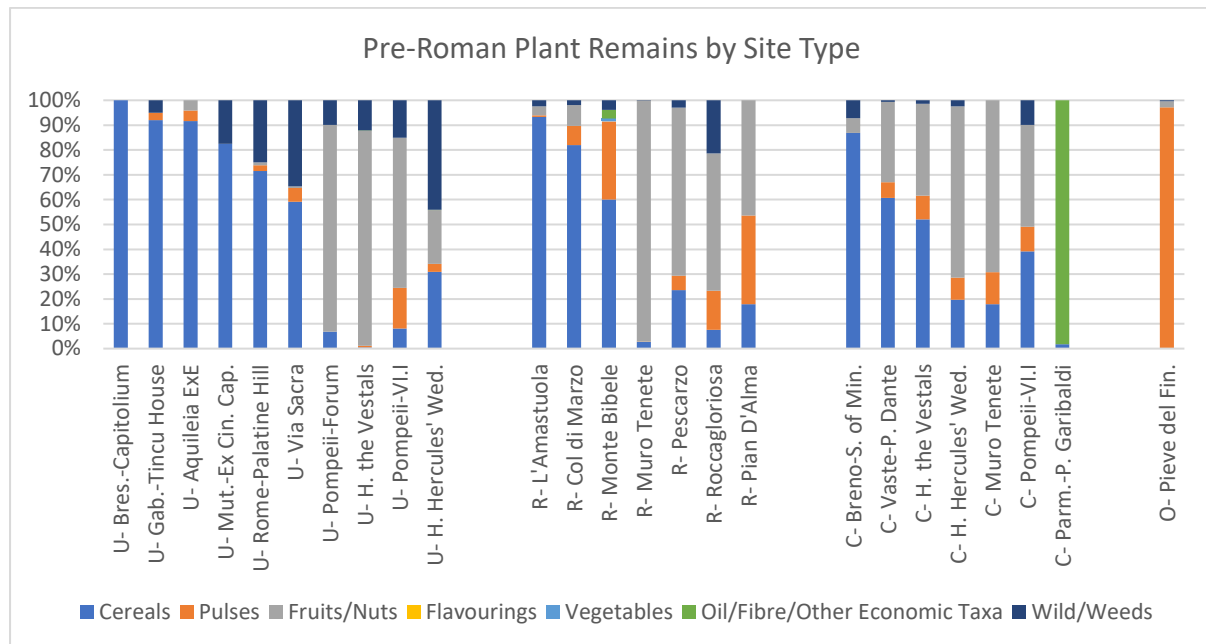


Figure 8-30 All fully quantified, Pre-Roman plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, C= Ceremonial, O=Other.

When sites are considered individually in the Pre-Roman period, cereals have a notable abundance at urban sites, despite fruit being the most abundant remain for this site type overall (see Fig. 8-30). Fruit remains comprise the majority at four out of seven of the rural assemblages, though cereal remains dominate at the remaining three sites. With the exception of one site in each category, chaff items appear to be largely absent from both ceremonial and rural assemblages, while at urban sites, they have a visible presence at six out of 10 sites, and are dominant at two. Pulses have a visible presence in ceremonial and rural sites, and though they are present to some degree in most of the urban sites, they appear to be less abundant relative to other remains.

Roman period

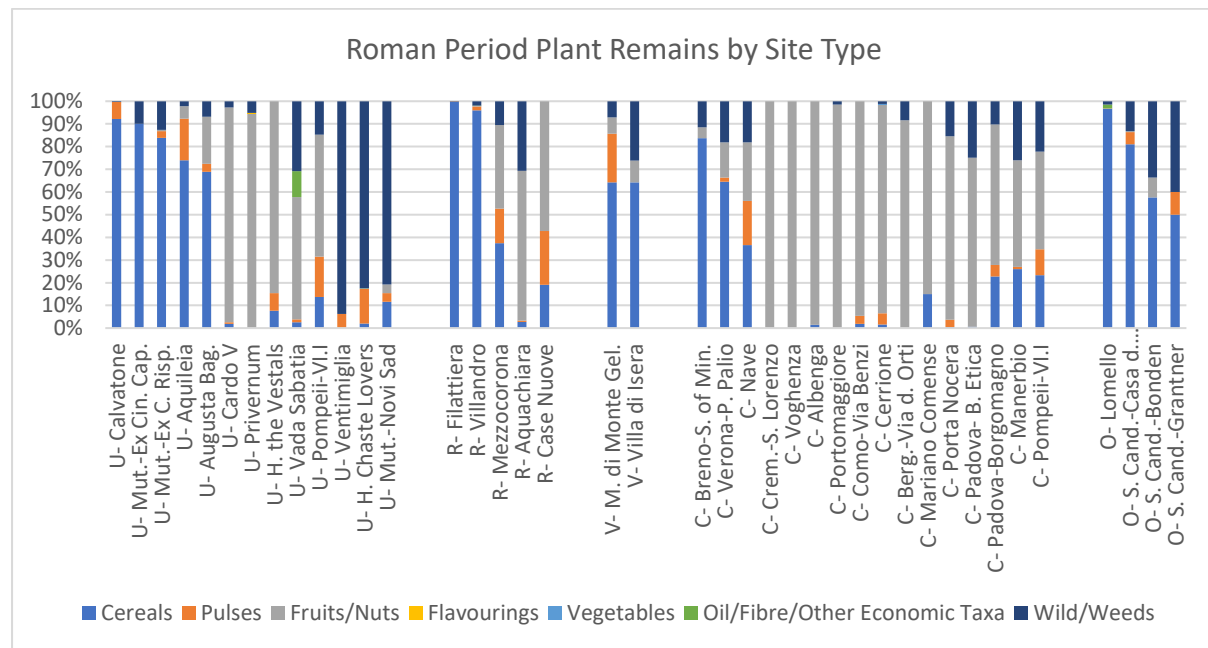


Figure 8-31 All fully quantified Roman period plant remains by site type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, V= Villa, C= Ceremonial, O=Other.

In the Roman period assemblages, cereals have a greater prevalence than previously, with fruit forming the majority at only ceremonial sites. As in the previous period, pulses are present but not particularly abundant at all site types.

Late Roman period

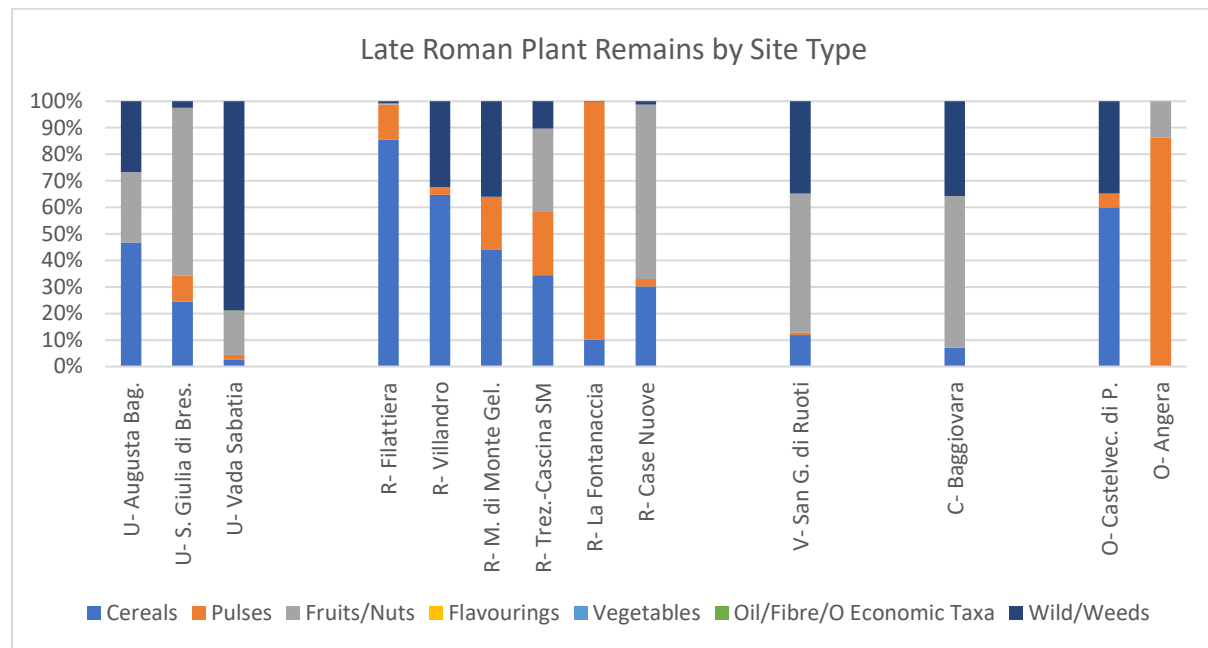


Figure 8-32 All fully quantified Late Roman plant remains by site-type. Individual sites are ordered by most common plant type. U= Urban, R= Rural, V= Villa, C= Ceremonial, O=Other.

In the Late Roman period, cereals appear less prominent at urban sites than at rural sites (this differs from Pre-Roman period, when cereals appear to form a larger portion of the urban assemblages). There is a possible increase in prominence of pulses at rural sites, though this is negligible. In general, there is not a great deal of diversity in the plant types in the Late Roman period.

Chapter 8 Results: Italy

8.3.2 Cereals

8.3.2.1 Cereals: Regional variation

Pre-Roman period

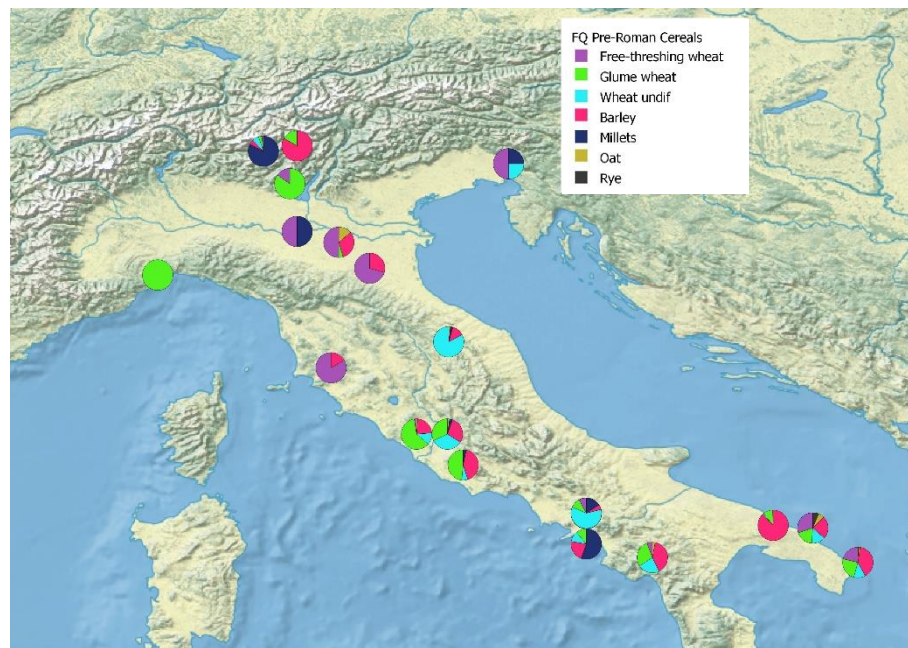


Figure 8-33 Fully quantified Pre-Roman cereal remains, displayed according to spatial distribution of assemblages at the site level.

In the Pre-Roman period, there are more sites at which glume wheats are the dominant cereal in central and northern Italy than in southern Italy. That said, glume wheats do maintain a presence at most sites in the South as well. Additionally, barley appears to be less prevalent in the north.

Roman period

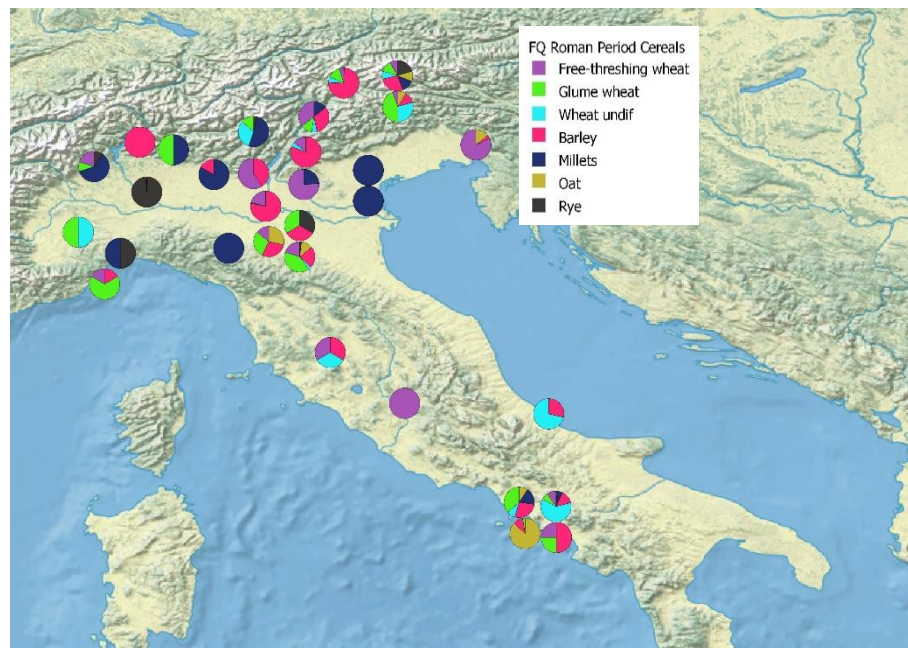


Figure 8-34 Fully quantified Roman period cereal remains, displayed according to spatial distribution of assemblages at the site level.

A few changes in minor cereals can be observed in the Roman period, with a number of sites where rye is more prevalent in the North. Also notable is the increase in the amount of millets in northern sites.

Chapter 8 Results: Italy

Late Roman period

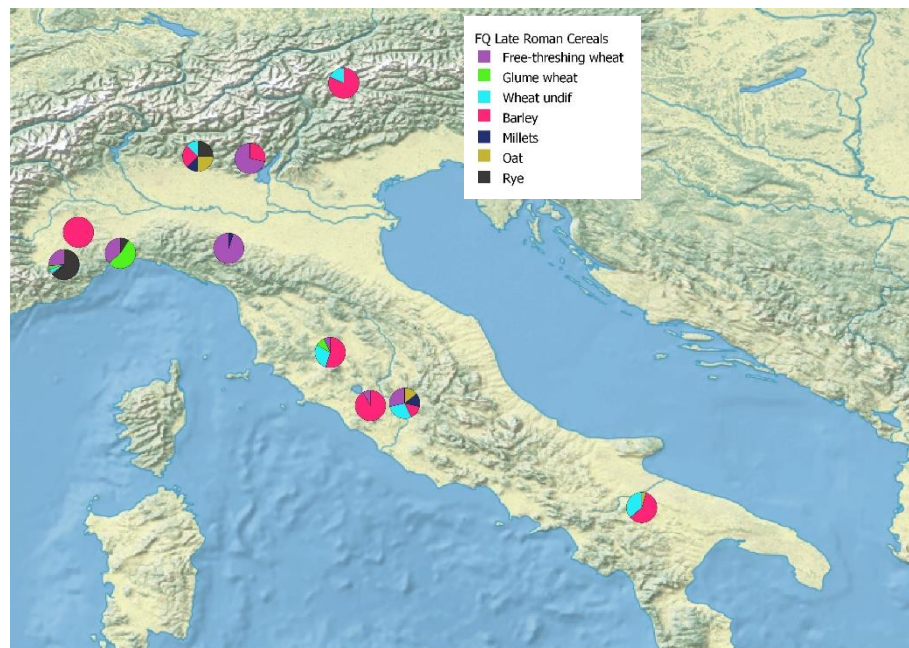


Figure 8-35 Fully quantified Late Roman cereal remains, displayed according to spatial distribution of assemblages at the site level.

In the Late Roman period, glume wheats are present at two and significant at only one site. In general, barley appears to be dominant in all regions apart from the North, where free-threshing wheat is also relatively abundant. It is also possible to discern a continued presence of rye in the north.

8.3.2.2 Cereals: Variation by site type

Pre-Roman period

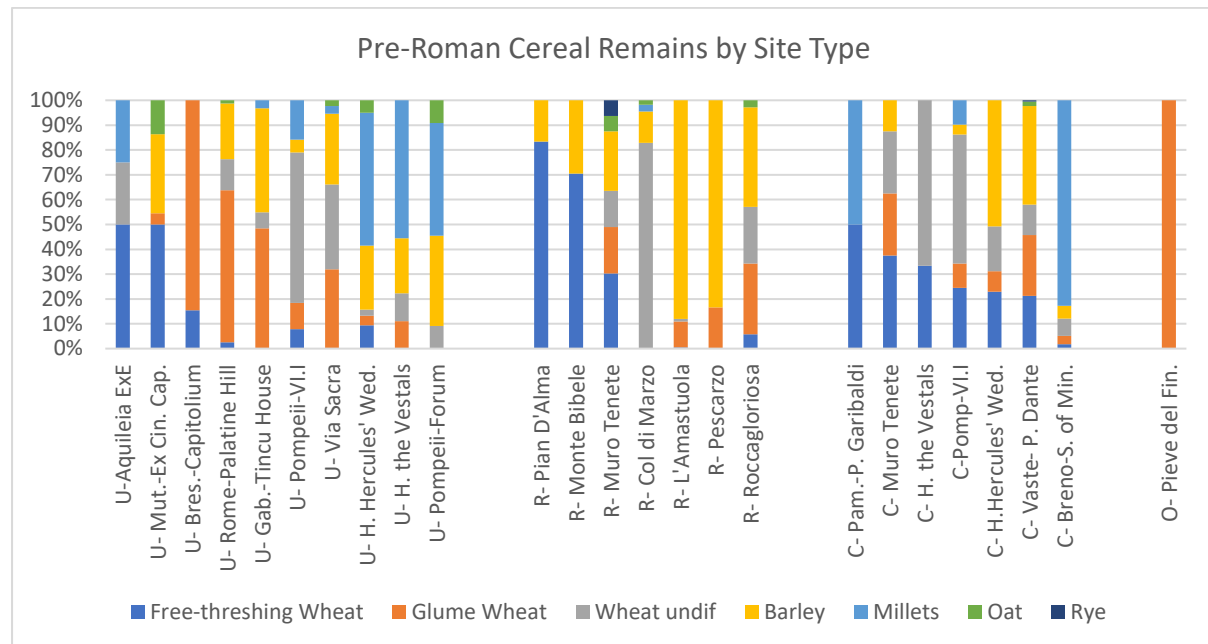


Figure 8-36 All fully quantified Pre-Roman cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, C= Ceremonial, O=Other.

In the Pre-Roman period, barley is the most common cereal at rural sites, possibly because of its use as a fodder crop. Interestingly, with the exception of a minor presence at Col di Marzo (Site 125), millets are at only urban and ceremonial sites, despite their reputation as a poor cereal choice. Rye is present at rural sites though not at urban sites. Glume wheat is the most abundant wheat -and possibly cereal- at urban sites, though at rural and ceremonial sites, free-threshing wheat is more abundant than glume.

Roman period

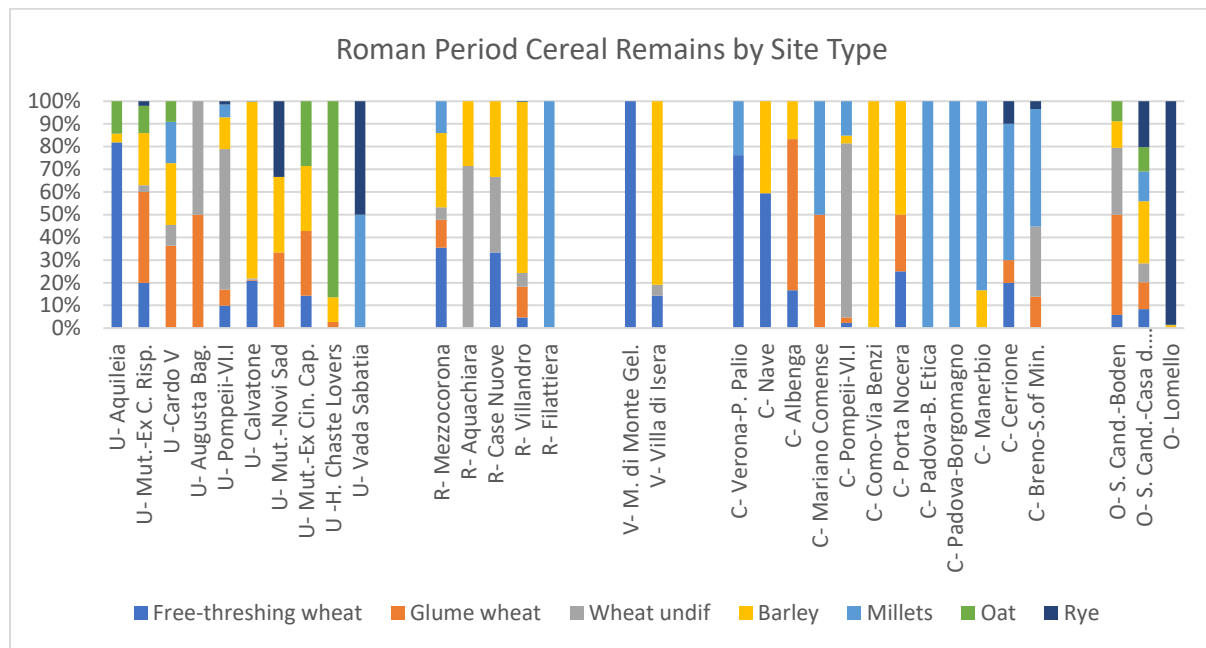


Figure 8-37 Fully quantified Roman period cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, V=Villa, C= Ceremonial, O=Other.

Though forming less of the assemblage for the urban category overall, when looking at assemblages by individual sites, glume wheat has a notable presence at the majority of urban sites. This is masked by a cache of 1,082 barley grains from Calvatone (Site 117). The dominance of millets at rural sites is skewed by a cache of 55,002 millets at Filattiera-Sorano (Site 128). Additional caches also include 6,551 barley grains at the rural site of Villandro (Site 196). Due to the prevalence of cereal caches in this period, it is best to supplement the fully quantified analysis with the results of the presence/absence analysis. Still, one interesting pattern that may be observed is the prevalence of millets at ceremonial sites; millets are present at eight out of 12 and comprise a notable portion of the cereal assemblage at most of these.

Late Roman period

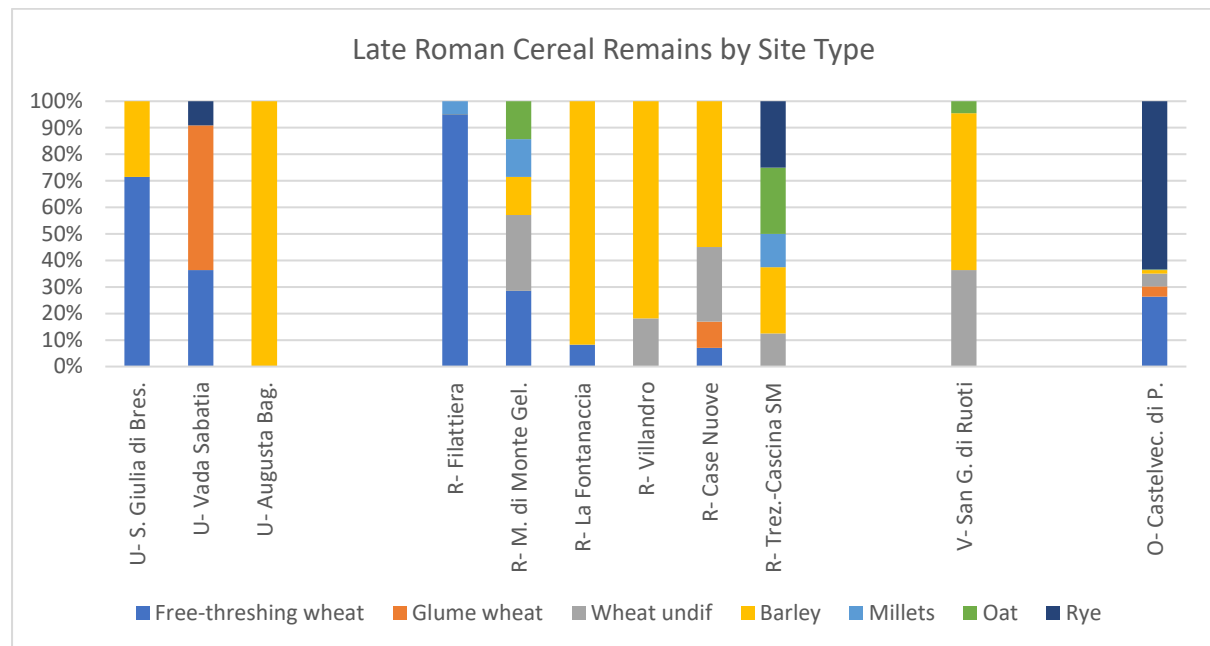


Figure 8-38 Fully quantified Late Roman cereal remains by site type. Individual sites are ordered by most common cereal type. U= Urban, R= Rural, V=Villa, O=Other.

Due to the paucity of Late Roman period assemblages with fully quantified cereal remains, few patterns may be observed in the dataset.

8.3.3 Fruits/Nuts

8.3.3.1 Fruit/Nuts: Regional variation

Pre-Roman period

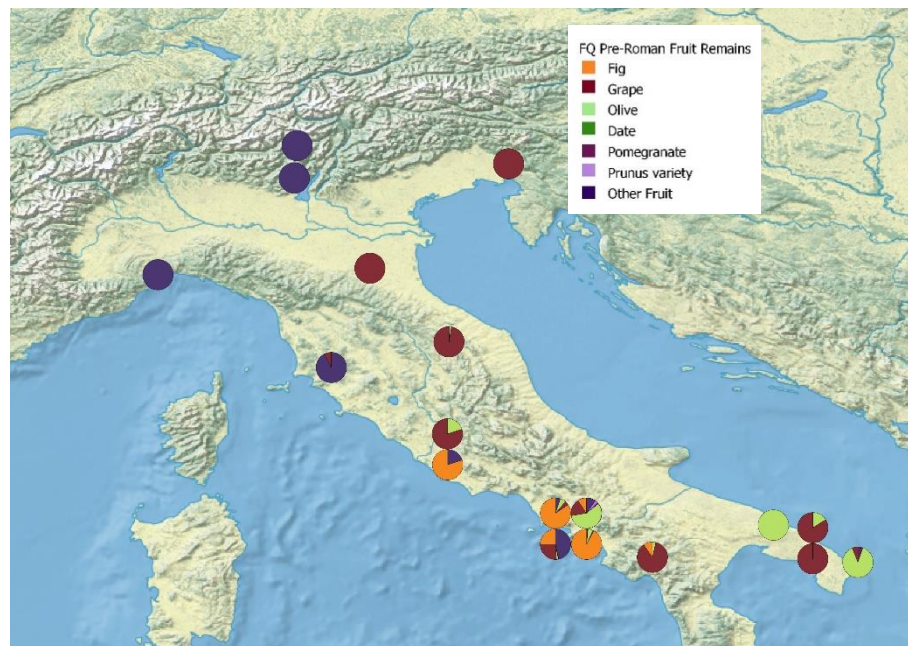


Figure 8-39 Fully quantified Pre-Roman fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

In the Pre-Roman period, grape appears to be the dominant fruit in all regions. All of the fruit assemblages from the North are limited in size and consist of one fruit type, and thus are not well suited to comparing the abundance of fruit species. Central and southern Italy, however, have more varied assemblages, in which fruits including fig and varieties of *Prunus* can be observed. The distribution of olive is limited to the South, with the exception of one site in central Italy.

Chapter 8 Results: Italy

Roman period

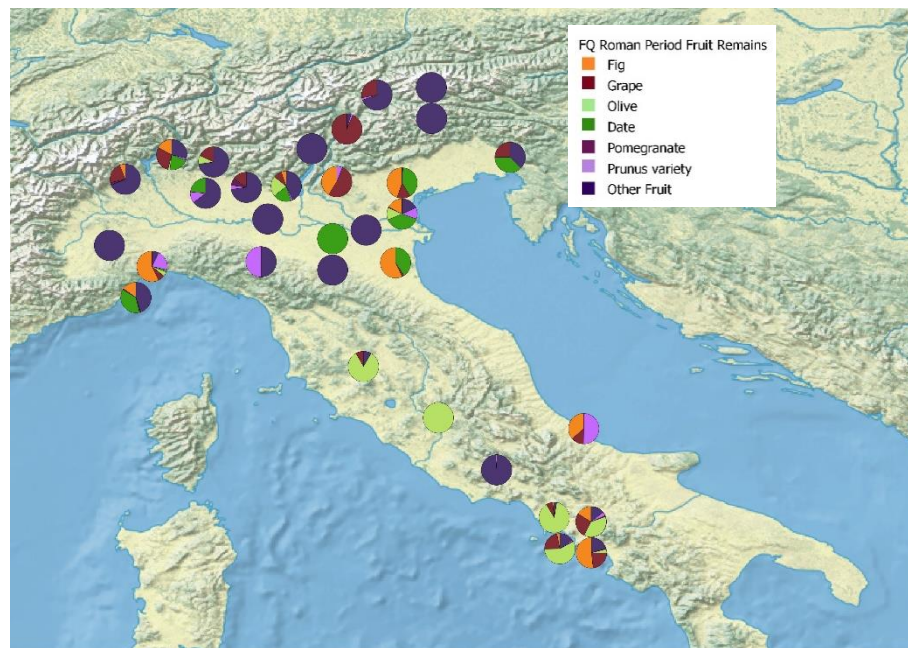


Figure 8-40 Fully quantified Roman period fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

Olive remains are markedly more abundant in central and southern Italy than in the North in the Roman Period. There also may be a rise in exotic fruits in this period, with date appearing for the first time at northern sites, and an apparent increase in abundance of *Prunus* varieties.

Late Roman period

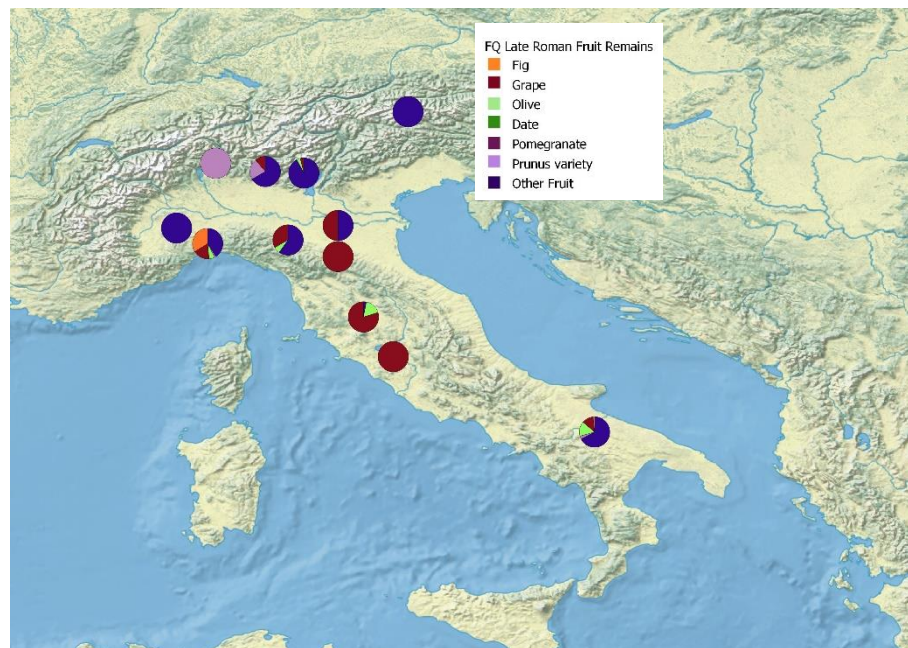


Figure 8-41 Fully quantified Late Roman fruit/nut remains, displayed according to spatial distribution of assemblages at the site level.

The lack of fully quantified southern sites in the Late Roman period may mask certain patterns somewhat. There appears to be a decrease in olive, for example, though it cannot be said whether this is due to the general lack of fully quantified, Late Roman sites in the South, where olive has been abundant previously, or because of a shift in practices. In general, however, there does appear to be a decrease in sites with notable abundance of fig, and complete absence of date in this period. This may be due to site types: the prevalence of rural sites over other site types in this period may explain the decrease in more exotic fruit varieties, such as fig, *Prunus* fruits and date.

8.3.3.2 Fruit/Nuts: Variation by site type

Pre-Roman period

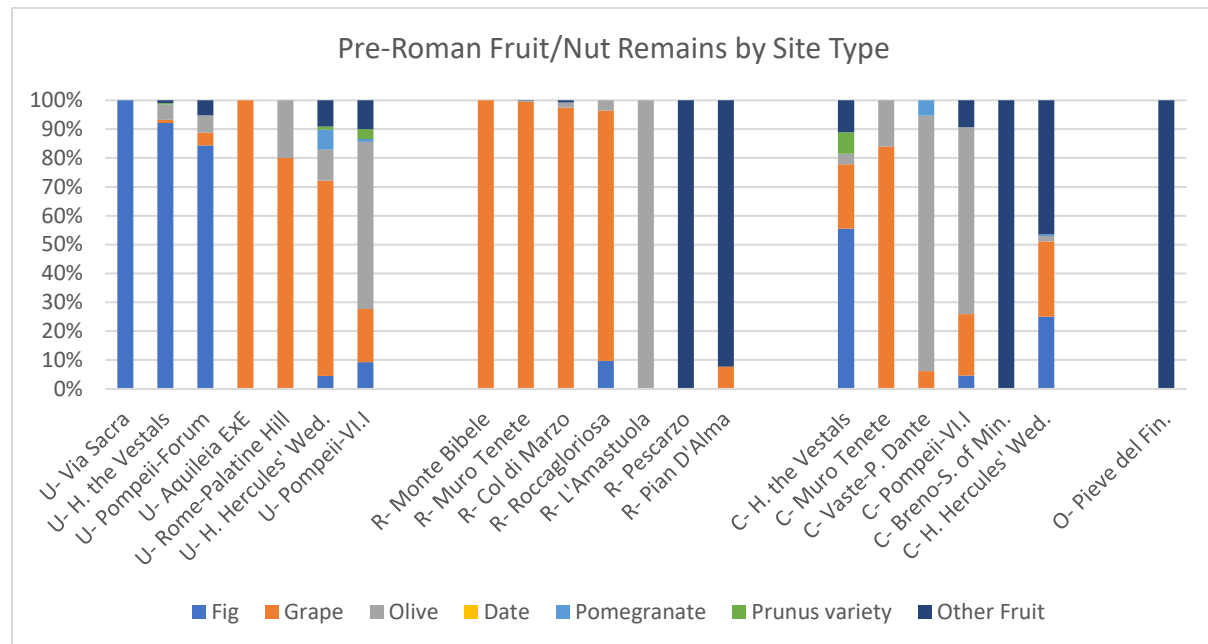


Figure 8-42 Fully quantified Pre-Roman fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, C= Ceremonial, O=Other.

A number of caches skew the Pre-Roman fruit analysis; in removing a cache of 5,178 grape seeds from the rural site of Muro Tenete (Site 152), as well as a cache of 2,136 fig seeds from the House of the Vestals at Pompeii (Site 137), certain patterns become clearer. A greater abundance of olive at both rural and, especially, urban sites may be observed, though grape remains dominant at rural sites, as well as at ceremonial sites by a finer margin. Similarly, *Prunus* fruits have an increased- albeit still limited- visibility at urban sites, which could be reflective of the plant's status as a luxury item.

Roman period

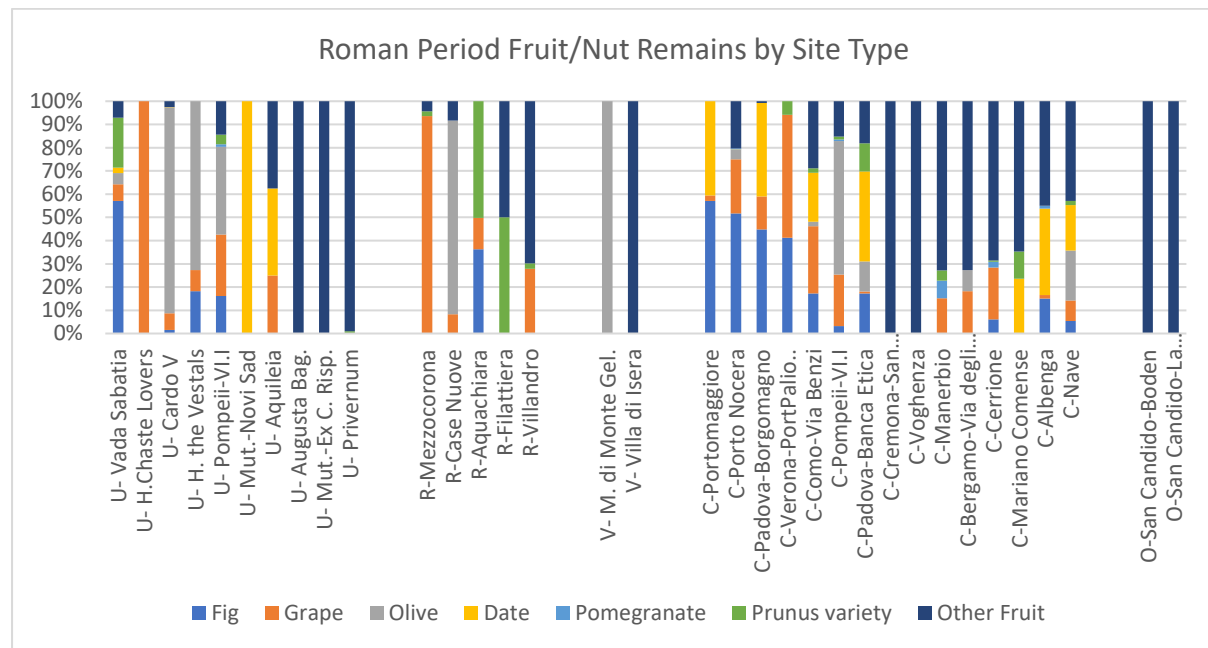


Figure 8-43 Fully quantified Roman period fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, V= Villa, C= Ceremonial, O=Other.

The Roman period sees some interesting developments, such as an increase in *Prunus* varieties at rural sites, as well as the appearance of date at ceremonial and, to a lesser degree, at urban sites. Similar to the Pre-Roman period, olive remains dominant at urban sites, while grape is the most abundant species at rural sites. Fruits included in the 'other fruits' category become especially prominent at villa, ceremonial and other sites in this period as well.

Late Roman period

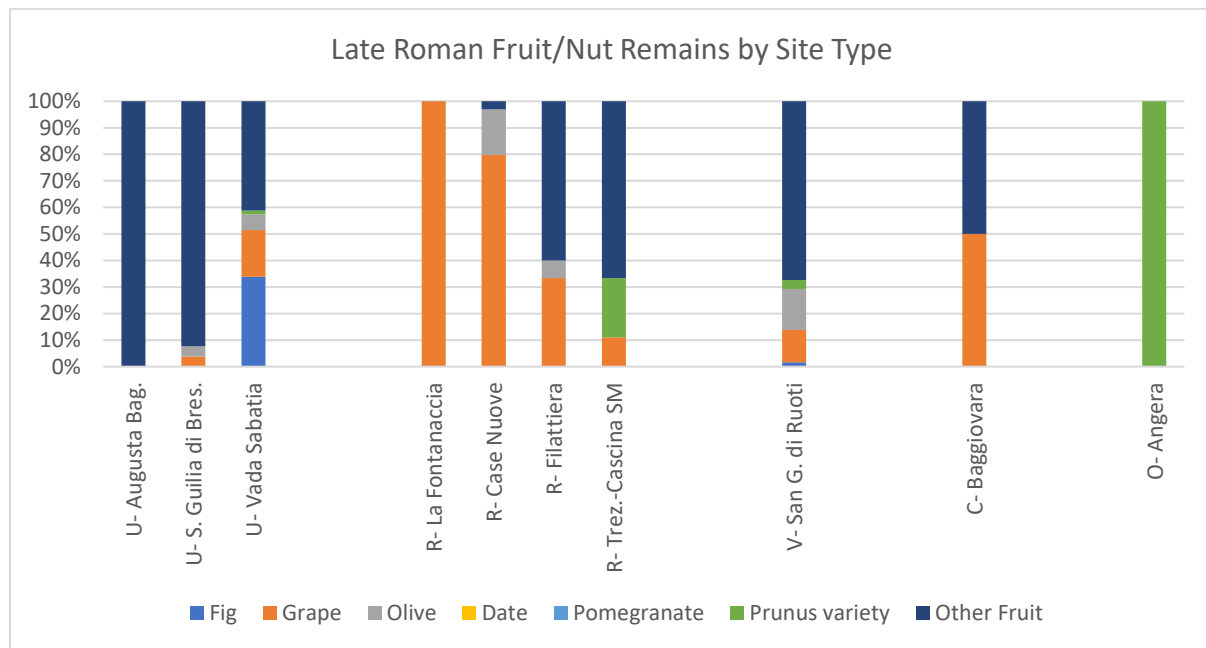


Figure 8-44 Fully quantified Late Roman fruit/nut remains by site type. Individual sites are ordered by most common fruit type. U= Urban, R= Rural, V= Villa, C= Ceremonial, O=Other.

The low number of sites in each category in the Late Roman period, is, of course, limiting, though it is possible to discern some patterns. Grape continues to be the most dominant fruit at rural sites. While ‘other fruits’ are most abundant at urban sites, olive, grape, fig, and *Prunus* are present in lower amounts.

8.3.4 Pulses

8.3.4.1 Pulses: Regional variation

As for the Eastern dataset, regional variation in the fully quantified pulse assemblages will be summarised below.

The Pre-Roman period assemblages exhibit a considerable degree of homogeneity, with only two sites producing an assemblage in which *Vicia faba* is not one of the most abundant pulses. In addition to *Vicia faba*, *Pisum sativum* and *Vicia ervilia* form significant proportions of a number of assemblages in south and central Italy, though the latter appears to show a stronger association with the South, where it comprises a significant proportion of more assemblages (> 50%). *Lens culinaris* is less visible in the Pre-Roman assemblages, and is only dominant at one site in the South (in Apulia).

Pulse assemblages appear to diversify to some degree in the Roman period, though in the North, many assemblages are still dominated by *Vicia faba* (~65% of northern sites). *Lens culinaris* appears

to increase somewhat in the Roman period throughout the peninsula, and is among the most prevalent pulses in 25% of assemblages.

The Late Roman assemblages exhibit an apparent decrease in diversity, with *Cicer arietinum* and *Vicia ervilia* being absent all together. *Vicia faba* continues to be dominant in the North, and *Vicia sativa* is found only in this region, where it is dominant at one site and present in lesser proportions at two. In addition to *Vicia faba*, *Lens culinaris* is prominent at a number of sites in the North and central Italy, and is dominant at ~36% of sites total.

8.3.4.2 Pulses: Variation by site type

Pre-Roman period

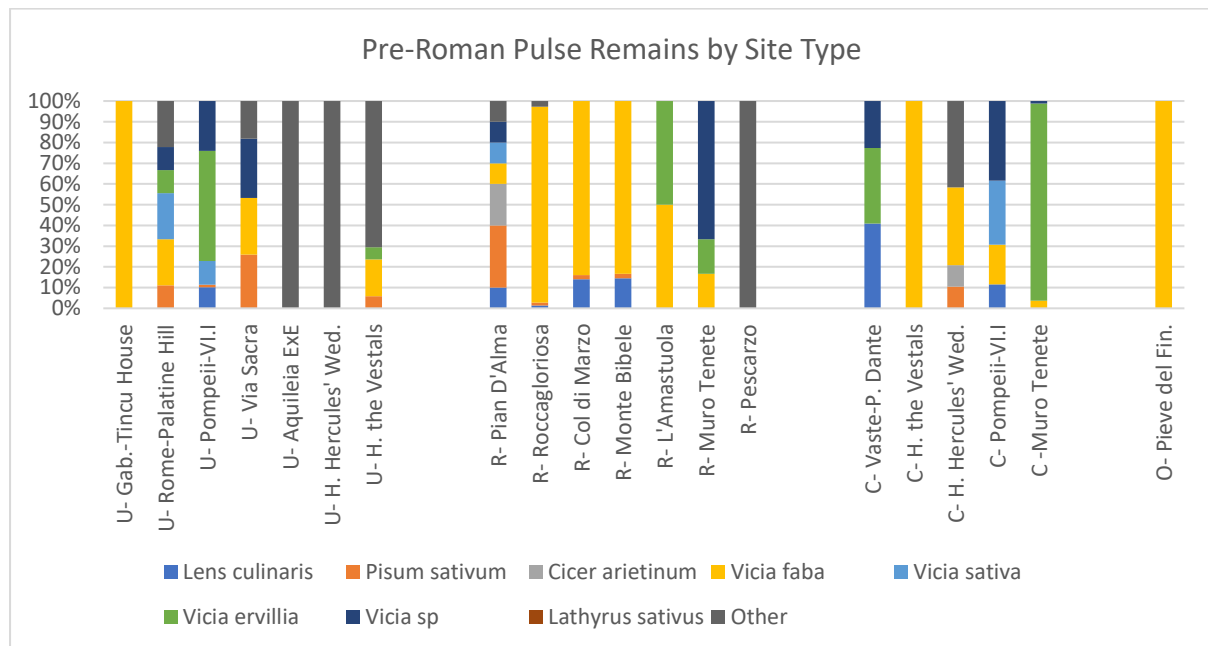


Figure 8-45 Fully quantified Pre-Roman pulse remains by site type. Individual sites are ordered by most common pulse type.

U= Urban, R= Rural, C= Ceremonial, O=Other.

In the Pre-Roman period, *Vicia faba* is by far the most abundant at rural sites, while urban and ceremonial sites have more varied assemblages. *Vicia ervilia* is the most abundant pulse at ceremonial sites, as well as at Urban sites, though only marginally at the latter. *Pisum sativum* and *Lens culinaris* have a presence at all sites, though the species is somewhat more abundant at rural sites, while *Vicia sativa* is present at urban and at ceremonial sites but is absent from rural assemblages.

Roman period

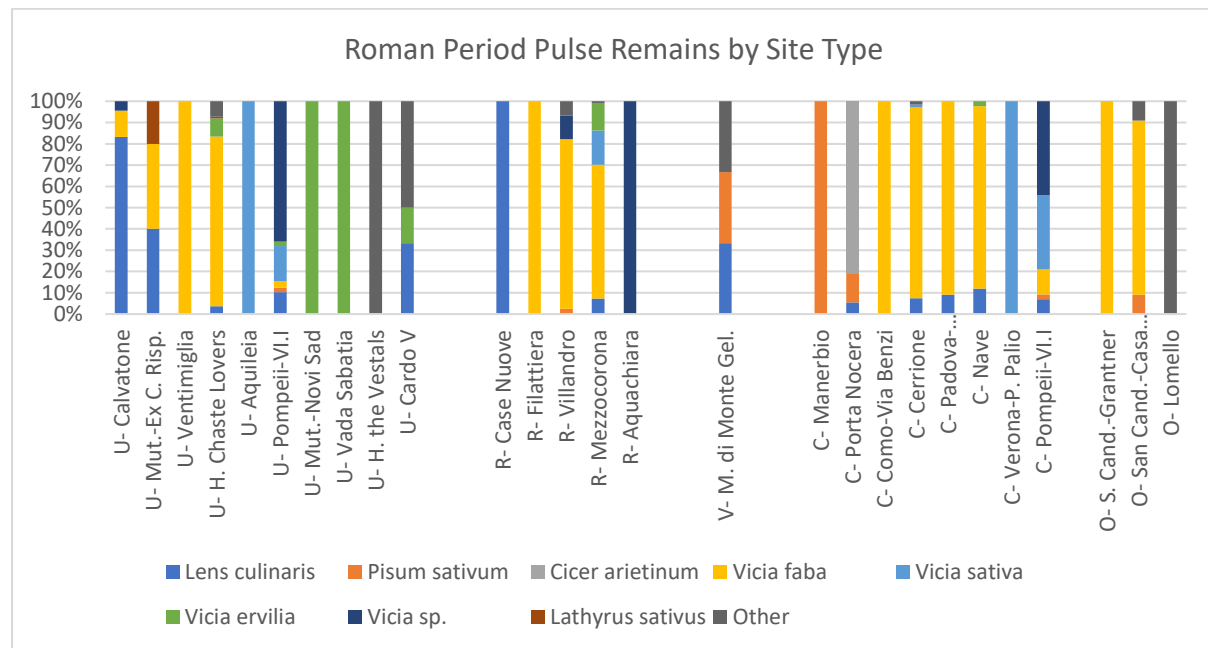


Figure 8-46 Fully quantified Roman period pulse remains by site type. Individual sites are ordered by most common pulse type. U= Urban, R= Rural, V=Villa, C= Ceremonial, O=Other.

The overall prominence of *Vicia faba* continues in the Roman period, though this is more varied at urban sites, and the pulse is virtually absent from the single fully quantified villa site from this period. *Lens culinaris*, as well as *Vicia ervilia* has a notable presence at urban sites.

Late Roman period

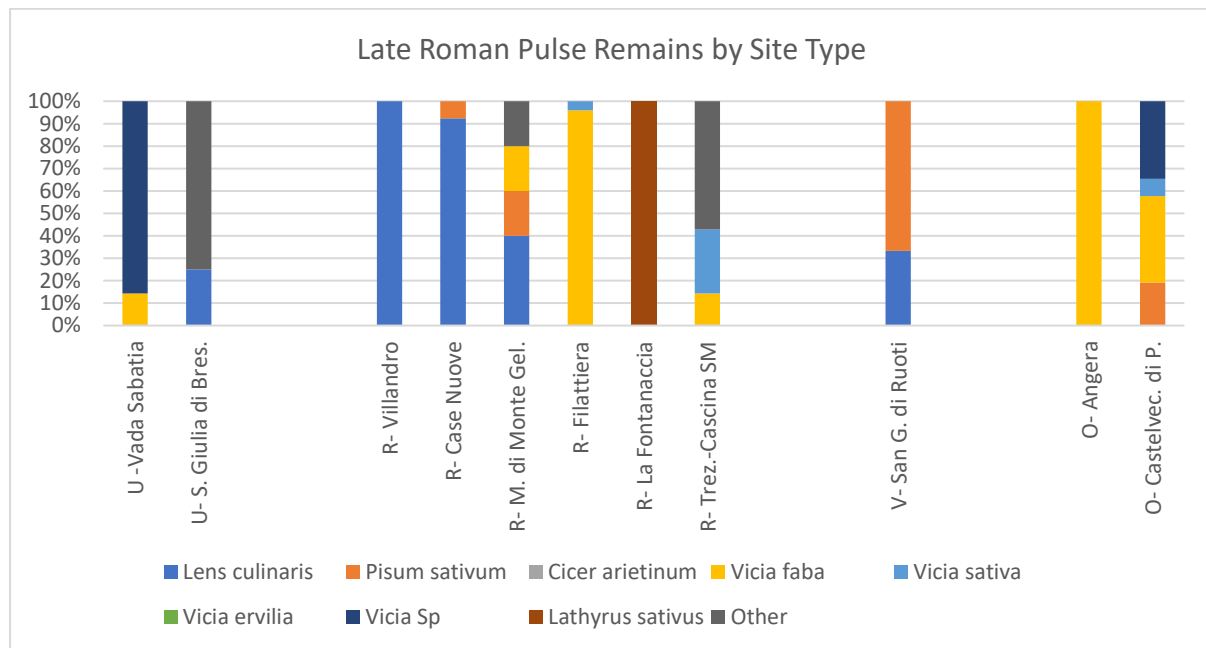


Figure 8-47 Fully quantified Late Roman pulse remains by site type. Individual sites are ordered by most common pulse type.

U= Urban, R= Rural, V=Villa, O=Other.

Analysis of Late Roman period pulses is made somewhat problematic due to the limited amount of sites, together with a number of caches that skew the data. It is possible that the distribution of *Lens culinaris* (lentil) favours rural sites, where it can be observed in greater proportions.

8.3.5 Nuts

Due to the scarcity of nuts in the dataset, particularly when considering only fully quantified assemblages, it was decided that nuts would only be examined in terms of presence/absence.

8.3.6 Densities

It was possible to calculate densities for samples from 23 out of the 100 sites total. In general, values are low, which offers little aid in detecting economic specialisation. There are, however, a few exceptions.

Multiple samples from drainage systems and cesspits produced significant values for fig, though due to the large number of seeds in a single fig, this is difficult to interpret. Furthermore, such deposits are more reflective of consumption than economic specialisation (see sample from cesspit at the House of the Vestals in Pompeii; see also samples from drains in the Pompeii Forum (Sites 137 and 167). The sample from the manger at the House of Chaste Lovers in Pompeii (Site 132) produced

significant values, though this is due to the in-situ preservation of its contents following the eruption of Mt. Vesuvius.

The rural site of Aquachiara (Site 102) produced significant values for both fig and *Prunus domestica* in a sample from the farmstead (6.4 and 7.8 items per litre respectively). Due to the site type, this may be one of the only samples that actually represents agricultural production (see also Sumsample 1 and 2 from the rural site of Villandro (Site 196), which contain sizable concentrations of: barley, free-threshing wheat, glume wheat, rye, broad bean, walnut, as well as elder).

Despite these exceptions (among a few others), it generally seems that, like in the East, the utility of analysis based on densities is rather limited for the Italian dataset.

8.3.7 Crop-processing analysis

As for the East, crop-processing analysis was performed on the Italian dataset. Unfortunately, there were only seven records that produced a sufficient amount of chaff and cereal grains (i.e. more than 10 items representative of a particular cereal type, consisting of a combination of chaff and caryopses).

Table 8-7 Results of crop-processing analysis. Values produced per cereal are based on the chaff to grain ratios as indicated in Tables 5.3 and 5.4. 'X' indicates the interpretation of the assemblage.

Period	Site	Site type	Values Produced per cereal			Interpretation		
			Free-threshing wheat	Barley	Glume wheat	Grain product	Crop processing by-product	Indet.
Pre-Roman	152	Rural			0.56	X		
Pre-Roman	134	Urban			6.5		X	
Pre-Roman	154	Urban	0.18		3.0	X		
Pre-Roman	193	Urban			8.99		X	
Roman	153	Urban	0.4	0.13	2.95	X	X	X
Roman	196	Rural			0.92			X
Late Roman	152	Rural			0.67			X

Four (~57%) of the records suitable for crop-processing analysis are dated to the Pre-Roman period; three of the records are classified as urban, and one is from a rural site. Of these records, two of the assemblages were interpreted as crop-processing by-products, and both were from urban contexts (site 193 is located in Rome, while site 134 is in Pompeii). The other two records, one of which is from a rural site, produced assemblages consisting of grain products.

Of the two Roman period records, only one featured deposits that were able to be interpreted. This urban site (Site 153) produced a barley assemblage reflective of a grain product, while the glume wheat assemblage reflects crop-processing activities. The Late Roman period record that was able to be subject to crop-processing analysis produced indeterminate results.

Interestingly, all deposits interpreted as crop-processing by-products consist of glume wheats, and all are from urban sites.

8.3.8 Conclusions

In considering the Italian dataset, certain overarching trends may be discerned. The dominance of *Triticum dicoccum* over other glume wheats throughout the Italian peninsula in all periods is notable, though glume wheats, in general, appear to decrease over time. Barley remains the most frequent cereal in all periods, though not necessarily the most abundant at all site types.

In terms of fruit remains, there is an evident increase in fruit diversity in the Roman period and then a subsequent decrease in diversity in the Late Roman period. It is also possible to discern that the more diverse and exotic fruits are often associated with urban and ceremonial sites. Also notable is the frequency of grape remains overall, and the abundance of olive remains in the southern half of the Italian peninsula, the Late Roman period exclusive. Other trends include the prevalence of *Vicia faba* among the pulses, as well as the association of cereal chaff with urban sites in all periods.

It should also be noted that there are a number of cases in which the two-tiered analysis was able to highlight complexities in the data and in the manner of deposition that may have otherwise been missed. For example, in the Late Roman period, cereal remains are less abundant at urban sites than at rural sites, despite occurring at the same frequencies at both site types. This suggests that cereals tend to appear in greater quantities at rural sites, though this pattern requires verification with an expanded dataset. Further discrepancies include differences in cereals remains in the Pre-Roman period, as barley just surpasses glume wheats as the most frequently occurring at urban sites, though glume wheat is the most abundant, dominating a greater number of assemblages.

Chapter 9. The East: Discussion

9.1 Introduction/Taphonomy

Prior to interpreting the patterns in the archaeobotanical remains from the Roman East, it is important to recognise a few patterns that affect the assemblage. Most of the deposits are characterised by low densities, indicating that the majority of the assemblages were built up over time rather than preserved in a single carbonisation event. As a result, much of the material is hard to classify taphonomically, and can often be described as ‘background noise,’ or, depending on composition, possible dung fuel (Murphy et al. 2013 on ‘background noise,’ see Miller 1991; Charles 1998 on dung fuel in the archaeobotanical record). The latter is supported by the relatively high frequency of fodder crops among the weed seeds in all periods and would seem to highlight the role of dung fuel in the formation processes affecting the archaeobotanical record.

Additionally, it may be important to note that due to the uneven regional distribution of sites, some patterns discussed below may be most applicable to the Levant, which produced significantly more datasets than the other Middle Eastern regions examined.

9.2 Climate change and environment

The paucity of archaeobotanical material from the region does not allow for significant comment on debates of climate and climate change during this period. Perhaps with more intensive archaeobotanical sampling of securely dated contexts it may become possible, though the effects of taphonomy will always be problematic. However, a limited number of points on the matter may be made at this time. Firstly, it is important to bear in mind that, beyond serving as indicators for past climate change, archaeobotanical as well as archaeological remains highlight the ability of past societies to overcome climatic constraints (Horden and Purcell 2000; Rosen and Rosen 2001; Kouki 2013). This can be seen not only in the remains of hydraulic systems and irrigation channels, which would have better allowed for the cultivation of crops in marginalised environments, but also in the distribution patterns characterising the archaeobotanical remains (see Kamash 2012 on hydraulic structures; see below on archaeobotanical remains). The spread of crop cultivation into harsher environments, such as is well attested in the Negev, exemplifies this phenomenon, as does the shifting dispersal of certain crop types (see Erickson-Gini 2012; see below on shifts in dispersal of particular crops).

However, there are certain correlations with the picture painted by the palaeoenvironmental data that merit consideration. The expansion of fruit cultivation, or at least the relative abundance of fruit

remains, coincides with suggested warmer and wetter periods in the region (see McCormick 2012; see also Harper and McCormick 2018). This can be seen in Figures 7-30 through 7-33, wherein fruit overcomes cereals as the most abundant plant type beginning in the Pre-Roman period and increasing overtime, particularly in the Levant (in the Early Pre-Roman period, fruit is the most abundant plant type at 17.6% of sites while cereals are most abundant at 61.8% of sites, but by the Roman period, fruit is most abundant at 42.9% and cereals at 39.3% of sites). It is also possible that under these more favourable conditions, the cultivation of fruits was able to spread to areas that previously were not suitable. The distribution of fruits such as olive and *Prunus* varieties, for example, increase outside of the Levant and coastal areas in the Roman period. However, the increase and expansion of fruits also coincides with the presence of the Roman army in the region. Increased fruit cultivation may have been facilitated by their construction of large hydraulic structures in the area, as well as by choices made by local farmers in response to increased aggregate demand fuelled by growth in both population and urbanisation (see Bar 2004 and below for more on increased populations; see Hanson 2016 on urban growth). In the most likely scenario, the expansion of fruit cultivation was motivated by some combination of all the above factors.

Interestingly, the resurgence of glume wheat in the Late Roman period coincides nicely with proposed periods of drought in the region (see McCormick 2012; Izdebski et al. 2016 among others). Cultivating glume wheat, which requires less water to thrive than free-threshing wheat, would have been more feasible if water was scarce, and would have been a practical decision on the part of the ancient farmers. This was certainly known to farmers in antiquity, as is confirmed by ancient sources including Pliny (see *HN* 18.19). As such, if wheat was the preferred cereal for human consumption, this would have allowed populations to adhere to cultural preference, while conforming to new and temporary environmental constraints.

However, Decker (2009) also links glume wheats, emmer in particular, to the military in antiquity, due to not only its ability to tolerate a wider range of ecological conditions, but also to its potential for higher yields than free-threshing counterparts (Decker 2009: 100-101).

The degree to which shifts in climatic conditions impacted cultivation practices is difficult to assess, but it would stand to reason that if ancient populations were capable of expanding agriculture into marginalised landscapes by the Late Roman period, then they were capable of adjusting to challenges such as decreased rainfall with a considerable amount of adaptability and dynamism. Thus, it is difficult to say whether the risk-reducing measures were employed in response to changed climatic conditions, or in response to increased population pressures, or even to the continued presence of a new political-economic entity, the Roman Empire.

9.3 Risk reduction in agricultural systems

As previously discussed, the region saw significant population increase by the Late Roman period. According to Bar (2004), this period of expansion was well under way during the Roman period, whence populations would have already risen to unprecedented levels. The additional pressures this would cause in terms of food and plant resources would necessarily require adjustments and reorganisation of agricultural resources in order to cope with increased demand. One way this was achieved was to expand into previously marginalised areas (for agricultural expansion in the Negev, for example, see Anvi et al. 2009; Erickson-Gini 2012: 53). As populations moved into these harsher environments, agricultural practices would have to be adjusted, with measures taken to ensure that the populations could be sustained. Such measures would have included the implementation of new water management strategies, as well as the inclusion of risk reducing practices into agricultural regimes.¹⁶

As mentioned, the increased irrigation throughout the regions may be linked to the spread of fruits apparent in the data. Not only do fruits appear to be increasing in quantity overtime, it is also possible to detect the expansion of fruit cultivation into new areas. The widespread distribution and abundance of barley in all periods and regions would certainly have contributed greatly to reducing risk in agricultural regimes. Not only is the crop able to be used for animal fodder as well as for possible human consumption, but it also tolerates harsher conditions better than free-threshing wheat species (see Zohary et al. 2012: 57 on ability of barley to adapt to extreme conditions). In this way, barley would have served as a fall-back that would have been able to sustain populations in cases of drought and, when wheat was able to be grown, would have been used as animal feed. Notably, though literature often refers to wheat as the dominate cereal by the Early Roman period, this is not widely apparent in the data, with barley continuing to be the most common cereal in all periods (see Decker 2009: 104 on predominance of wheat; though see also Gal. *Alim. Fact.* 1.11 for indication that certain populations ate barley meal rather than bread despite the availability of wheat).

There may, however, be taphonomic factors affecting the preservation of certain cereals in the data. Free-threshing wheats are more likely to be consumed after being ground into flour, which would

¹⁶ Large hydraulic structures, such as irrigation systems, do increase in much of the region, as is made evident by Kamash (2012). Many of these served to supply urban centres, but also had branch lines to rural areas, where they provided water for agricultural purposes as well (see Kamash 2012: 72 for further details).

render them less likely to be preserved by accidental charring during food preparation. Furthermore, the frequent use of barley as a fodder may have led the cereal to be burnt (and thus preserved) more commonly in dung fuel.

Still, patterns observable in the geographical distribution of glume wheats and millets may also be linked to risk reduction, affirming that ancient farmers were in fact taking such measures (see 7.3.2.1). Like glume wheats, millet is considered to be an exceptionally drought-resistant cereal (see Zohary et al. 2012: 69, 71 on ability of millets to withstand intense heat, poor soils, and limited rainy seasons). The distribution of both glume wheats and millet favours the northern and eastern portion of the study area during all periods with the exception of the Late Roman period (Figs. 7-39 through 7-42). These areas have harsher environments and are less suited to the cultivation of free-threshing wheat species. This implies the conscious implementation of risk reducing strategies in the region in the face of environmental constraints.

Marston and Miller (2014) consider the ratio of *Hordeum*, a drought-resistant cereal, to free-threshing wheats, which are less tolerant to droughts, as a means by which to gauge the amount of risk reduction incorporated into past farming strategies (Marston 2011; applied in Marston and Miller 2014). In reference to the site of Gordion, Turkey, the authors find that the Roman period has the lowest *Hordeum* to free-threshing wheat ratio, which indicates more risk in agricultural strategies than during the other periods. When the same ratio is applied to the entire region for this study, similar results are achieved: The Roman period is characterised by the lowest ratio, and thus the highest risk agricultural regime, followed by the Pre-Roman, the Early Pre-Roman, and finally, the Late Roman period, which produced the highest ratio and thus the implementation of the most risk-reducing agricultural practices. It is interesting that this particularly high Late Roman ratio correlates with the proposed periods of drought in the region. This may further indicate that, when made necessary by environmental constraints, risk-reducing measures were taken (and additionally, that they were necessary in the Late Roman period, whether it be because of increasingly dry conditions or because of increased demand on the land due to population pressures).

9.4 Agricultural regimes

Mixed or integrated farming is an additional method of risk reduction in crop cultivation. Decker 2009 proposes a model combining a mixed regime with a dependency on certain cash crops (such as olive) in defining agricultural patterns in the Late Roman East (see also Butcher 2003). This model suggests that crops such as orchard and vines were intensely cultivated, while cereals were less dominant, and were worked in wherever opportune. The mixed composition of the deposits

together with the apparent increase in fruits over time would seem to support this model, and the increase in irrigation as proposed by archaeological remains supports the intensified cultivation of cash crops.

9.4.1 Specialisation

As has been noted, the ability of olive to tolerate harsh environments renders it particularly suited to the more arid regions in the study area. This was certainly not lost on ancient farmers, as is attested, not only by the widespread archaeological evidence of press remains, but also by historical sources (e.g. *Geoponica* 2.8.3). The archaeological survey data of press remains would suggest that olives and the olive oil industry was an important pillar in the regional economy in the Roman and, especially, Late Roman periods (Lewit 2007; Tchalenko 1953 among others). This correlates with the archaeobotanical macrodata, which shows widespread distribution and increased abundance of olive remains throughout the region (7.3.3). The prominence of olive in the later two periods, after beginning to increase in the Pre-Roman period, points to some degree of specialisation in the region, and generally supports Decker's (2009) proposed reliance on a cash crop, which likely was often olive throughout much of the region.

The increased specialisation in olive cultivation is made particularly apparent when examining the percentage of fully quantified datasets that produced greater than 10 olive remains. Fig. 9-1 indicates that, though there is a slight decrease in the Roman period, the percentages appear to be relatively similar until a sudden surge in the Late Roman period, when the percentage is nearly two-fold that of all other periods here considered.

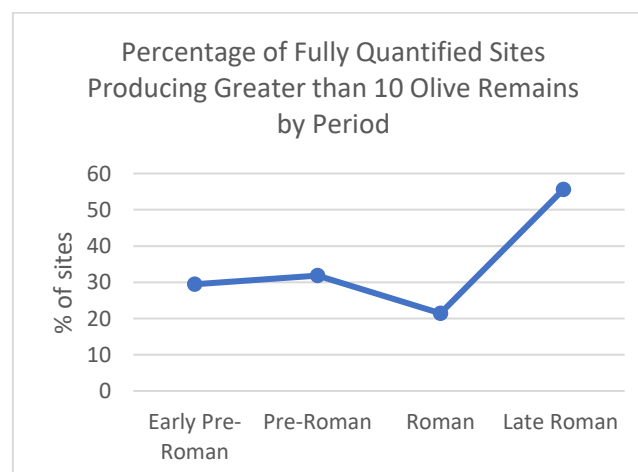


Figure 9-1 Percentage of fully quantified sites producing greater than 10 olive remains.

This picture is further supported by the high *Olea* values observable in pollen data from locations throughout the region, including the Judean hills, the Dead Sea, Lake Huleh, the Sea of Galilee, the Golan Heights, as well as from certain parts of Jordan (see Izdebski 2016 Fig. 4 for reworked integrated pollen diagram). It is interesting to note that the high *Olea* values that characterise Roman-Late Antique pollen diagrams from the region dramatically decline during subsequent periods, emphasising that the pattern is a phenomenon associated with Antiquity and the periods prior to Islamic occupation.

High densities of crop remains in archaeobotanical samples may be one method used to assess specialisation. However, the exceptionally low densities together with the failure to report sample size in the majority of reports in the region are unfortunately limiting. Densities were able to be calculated for 10 sites, in addition to Hippos-Sussita and Jerash (see supplementary data for densities of samples in secondary dataset; Appendix C for Hippos-Sussita data; 6.1 for Jerash data). Some of the values were obtained from 'sumsamples' (often by period), and for those that were not sumsampled, densities were calculated for each sample. Very few sites yielded significant results, with as few as five sites producing values over seven items per litre (Sites 15, 31, 32, 64 and 97).¹⁷ A sample (13006) from Zeugma (Site 97) produced a density of 107 for free-threshing wheats in the Roman period; however, this two-litre sample produced exceptionally high quantities as it was from an in-situ destruction layer. Similarly, samples from the Late Roman dump at Hippos-Sussita (Site 32) produced an average density of 27.3 items per litre. However, the dump samples are almost entirely comprised of olive and charcoal, and clearly represent fuel burnt in the bathhouse that is situated adjacently.¹⁸ As such, though it may appear that no crop processing was carried out at a scale resulting in high densities, it is also worth considering that while such measures prove fruitful indicators in other regions, archaeobotanical datasets from the East simply may not be suited to such an approach due to characteristic low densities.

Nevertheless, the collective dataset does seem to point to an increase in olive specialisation in the region, though the situation is less clear with other crops, such as cereals. In examining wild/weed seeds, it immediately becomes apparent that there are more weed seeds of higher frequencies in

¹⁷ The value of seven items per litre was chosen as the threshold of what may be considered significant concentrations of a particular crop type. Though ideally this value would be higher, it was selected in light of the low concentrations observed throughout the dataset.

¹⁸ The exceptional densities of wild/weed taxa in the samples from Late Roman period Gordion (referred to as the 'Pit House' phase by the authors) are also notable, and, as two of the three samples come from hearths, appear to represent dung fuel.

the Early Pre-Roman period than in the later periods. *Galium* sp. (37.21% of sites) and *Lolium* sp. (34.88% of sites), followed by taxa including *Bromus* sp., *Polygonum*, and *Silene* (all at 25.58%) are particularly frequent in the Early Pre-Roman period. Such plants are commonly identified as agricultural weed seeds or viewed in association with fallow fields. A possible interpretation of the high frequencies of weed seeds during the Early Pre-Roman period is that they reflect the importance of large-scale, specialised cereal cultivation (as well as the use of dung fuel), which would then appear to decrease in the subsequent period as the prominence of fruits, especially olive, increases (though this may apply to the Levant more so than to other regions).

9.4.2 Intensification

A shift toward the cultivation of fruit would have required intensive techniques, including capital investment in irrigation systems, throughout much of the region (see Kamash 2012 on intensification of irrigation techniques in the region during the Roman, and particularly, Late Roman periods). Thus, in assessing evidence of intensification in the region, plants associated with water become particularly useful. Though weed seeds are significantly more abundant and appear at higher frequencies during the Early Pre-Roman period, hydrophilic plants such as *Juncus* sp. and the sedges of the Cyperaceae family comprise a significantly smaller percentage of the total weed seeds for the period. During the Early Pre-Roman period, such seeds account for 1% of all weed seeds, while during the Pre-Roman, Roman and Late Roman period they account for 8.65%, 1.9% and 7.97% respectively. The low value for the Roman period is notable, however there are a number of confounding variables that may be affecting this figure.

Weed seeds occur at an exceptionally low abundance during the Roman period, significantly lower than during most other periods including the Late Roman period, despite the lesser number of sites (there is more than 20,000 less weed seeds for the Roman period than for the Early Pre-Roman period, for example). Due to the uneven distribution of the dataset, it is possible that the percentage distribution of the hydrophilic *Juncus* sp. and Cyperaceae plants are not able to provide a reliable measure of moisture in the environment, or, more specifically, of the shifts in irrigation practices and intensification. However, the significantly lower figure produced for the Early Pre-Roman period may indicate that, unlike during some of the later periods, irrigation was less common in the agricultural systems of this time.

Though risk reducing strategies do appear to have been variably employed in agricultural regimes in the region, risks were also taken in order to conform to cultural preference. The appearance of free-threshing wheats in particularly hot, arid parts of the region is attested not only by their ubiquity

amongst the archaeobotanical remains, but also in historical sources such as the Nessana papyri (see Decker 2009: 104 for discussion). Their very presence speaks to the willingness of ancient farmers to put more effort into cultivating crops that were not particularly well suited to the ecological setting, and points to the use of intensive farming methods in order to do so.

Manuring is another practice associated with intensive farming regimes (Jones 2005; Bogaard et al. 2013). Forming a better understanding of manuring practices may allow closer examination of specific agricultural practices. Though the practice is well attested in ancient literature, archaeobotanical evidence of manuring has proved limited in the Roman East (see Kron 2015: 162 for discussion of the extensive evidence of manuring in literary sources; see Lodwick et al. 2020 for isotopic evidence of shifts in manuring practices in Iron Age to Roman Britain; note also the archaeological remains of dovecotes throughout the region [Zissu 2005, Ramsay and Tepper 2010], as ancient authors including Plin., *HN* 17.6, attest to the utility of pigeon dung as fertiliser). Ideally it would be possible to examine the chronological distribution of seeds associated with fertile/high quality soils, however such an endeavour was made largely impossible by the limited number of identifications made on the species level in the dataset. Still, efforts were made to track the frequency of a number of species associated with high fertility soils: the distribution of *Chenopodium album*, for example, was examined, but the species appears only in the Roman and Late Roman period datasets. Though, as the frequency values of 2.63% of sites in the Roman period and 4.35% of sites in the Late Roman period are too low to be the basis of any arguments, the appearance of *Chenopodium album* in only the later two periods may be significant in itself.

In order to test this further, the author looked to an additional weed commonly associated with soils of higher nutrient levels: *Atriplex* sp. The plant occurs at 2.33% and 2.94% of sites during the Early Pre-Roman and Pre-Roman periods, and, though absent from the Roman period dataset, the frequency of *Atriplex* sp. then increases to 4.35% of sites in the Late Roman period. Though the frequencies are markedly low and thus the results are similarly inconclusive to those produced in the examination of *Chenopodium album*, a possible correlation may be seen in the peak of both *Chenopodium album* and *Atriplex* sp. in the Late Roman period.

However, it is interesting to note that the (albeit limited) evidence for increased soil quality in the later periods coincides with the apparent increase in horticulture and fruit production in the region, as the strong association between manuring and horticulture has been widely observed and can be seen in the texts of the ancient agronomists (van der Veen 2008: 103; Cato, *Agr.* 48.2; Plin., *HN* 17.39, 17.46). Increased olive production in the region may have necessitated more manuring as well, as is also attested in the ancient literature (Cato, *Agr.*, 5.8, 10.1, 10.29; Plin., *HN* 17.30). In this

way, the shifts in agricultural patterns and crop choices correlate well with the trends observed in the weed seed assemblage, and broadly support a picture in which increased manuring may have improved soil quality, facilitating improved crop yields and a rise in horticulture/fruit cultivation.

Still, though such efforts lead to interesting suggestions regarding the possibility of increased soil quality, more work with an expanded dataset is needed in order to better understand manuring practices in the Roman East.

9.4.2.1 Convertible Husbandry

Intensified agricultural systems also often involve the integration of animal husbandry (Bogaard et al. 2013). As livestock produces the dung, which can be used in manuring to nurture soil as well as burnt as fuel, it may be useful to examine grazing practices in the region.

In their study of land use at Gordion, Marston and Miller (2014) use the ratios of wild seeds to cereals to gauge the degree of grazing versus foddering, with higher values indicating a preference for grazing on nearby pastures. The applicability of this method, of course, depends on the majority of archaeobotanical remains deriving from the use of dung fuel, which, though perhaps less suitable for datasets from other regions, does indeed appear to be the case for the Near East. This is supported not only by decades of scholarship on the matter, but also by taphonomic analyses carried out for this work, which indicate that dung fuel is one of the top three deposit types identified in the Eastern dataset, with at least 20% of all records containing samples interpreted as deriving from dung/the use of dung fuel (Fig. 11-1). Many other dung fuel deposits have likely been masked by poor preservation and a prohibitive lack of detail in archaeobotanical reports (see Appendix B on site taphonomy; see Miller 1991: 154 for assertion that charred assemblages from the Near East are predominantly comprised of fuel; see also Miller and Smart 1984 on dung fuel).

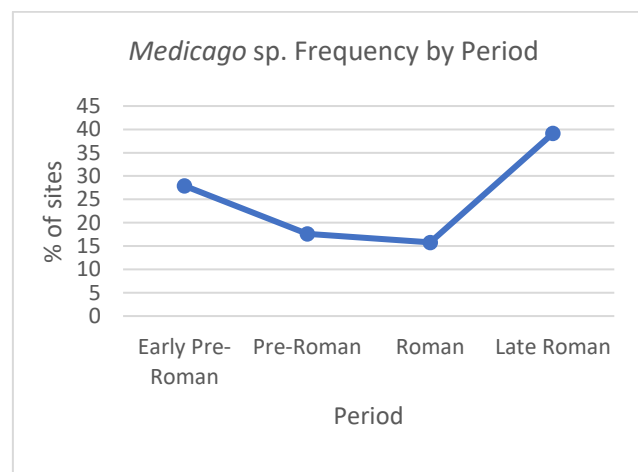
Although the small sample size (i.e. number of sites) in the Late Roman period means that any interpretation must be treated with caution, the wild seed:cereal ratios produced may be indicative of a significant increase in grazing during this period (Table 9-1). Though the figure of 9.79 far exceeds that produced for other periods and thus should be taken with a fair degree of scepticism, the increased grazing of livestock may be indicative of an increase in convertible husbandry. It is notable that the relative abundance of wild/weed species in the Late Roman period supports the validity of these ratios, with wild/weed seeds being the most common type of remain (as opposed to cereals, fruits, pulses etc.) at just over 44% of sites.

Table 9-1 Ratio of wild/seed seeds to cereals.

Period	Wild seed: Cereal ratio
Early Pre-Roman	0.27
Pre-Roman	0.10
Roman	0.67
Late Roman	9.79

The integration of convertible husbandry has been suggested as an alternative to a system relying solely on crop rotation (see Kron 2000 for extensive overview of ancient literary evidence in support of convertible husbandry; see below on crop rotation). In such a system, crop fields are allowed to rest, or fallow, for several years. This aids in preventing soil degradation and allows nutrients (such as nitrogen or phosphate) to be replenished, thus making the soil suitable for arable farming once more. During fallow years, the fields serve as pasture lands, allowing for fertilisation of the soil by manure.

Medicago sp. is thought to be particularly suited to ley-farming as well as to the dry conditions that prevailed throughout much of the region, and ancient sources attest to its use (see Vergil's *Georgics* 214-215; *Geoponica* 3.2.4; see Plin., *HN* 18.46 on ability of tree-medick in particular to grow when planted in conditions lacking in moisture). In an effort to detect increased ley lands, which may have been used for grazing, the chronological distribution of *Medicago* sp. was examined.¹⁹ Though *Medicago* is among the most frequent wild/weed seeds found in all periods, it shows a significant increase -more than twofold- in the Late Roman period.

Figure 9-2 Frequencies of *Medicago* sp. by period.

¹⁹ Note: The general lack of species level identifications for the *Medicago* genus prohibited more detailed examination.

The pasture legume *Biserrula*, though its presence is minimal, occurs only in the Roman and Late Roman periods, at frequencies of 2.63% and 4.35% respectively. *Biserrula* is known for being persistent in the face of drought conditions, and thus may have been particularly suited to the expansion of agriculture into marginalised environments beginning in the Roman and (continuing/increasing) in the Late Roman period, as well as to the periods of drought that have been suggested for the Late Roman period (see McCormick et al. 2012; Izdebski et al. 2016).

9.4.2.2 Crop Rotation

Pulse remains may also be able to shed light on crop husbandry patterns, pointing to shifts in the Roman and Late Roman period, when they decrease in overall abundance as pulse caches disappear. Though this may in part reflect cultural shifts and changes in settlement patterns that resulted in a decrease in centralised food stores (see 9.5), this may also have occurred at the same time as changes in crop husbandry strategies.

It is possible that the decrease in large quantities of pulses indicates a shift in cultivation practices, with ley-farming/convertible husbandry increasing relative to crop-rotation with pulses. This implies that the large caches of pulses from the early periods are evidence that farmers were producing regular pulse crops in rotation with cereals. In such a model, shifts to ley-farming then lead to the decrease of these large caches as the sowing of pulse crops becomes less regular, and even in the case of cultivated leys, pulses may have been utilised in green manuring or grazed upon by livestock. Given that even in regular crop rotation soil becomes depleted in nutrients after some time, such a shift would have allowed for nutrients to be reintroduced during periods of fallow.²⁰

In order to examine crop rotation more closely, the abundance of free-threshing wheats and pulses were examined together in Figure 9-3. Interestingly, there does indeed seem to be a positive correlation between the distribution of the two types of plant remains, especially in the Early Pre-Roman period, when more sites producing both large free-threshing wheat and pulse assemblages can be observed (see Lepetz and Zech-Matterne 2018: 46 on association of this correlation with crop rotation). These patterns not only support that crop rotation was practiced throughout the study period, they also conform well with the idea that the practice was more commonly employed in the earlier periods, possibly before ley-farming/convertible husbandry rose in prevalence.

²⁰ Of course, that is not to say that ley-farming was suddenly adopted throughout the entire region. Both crop rotation and ley-farming would have been employed.

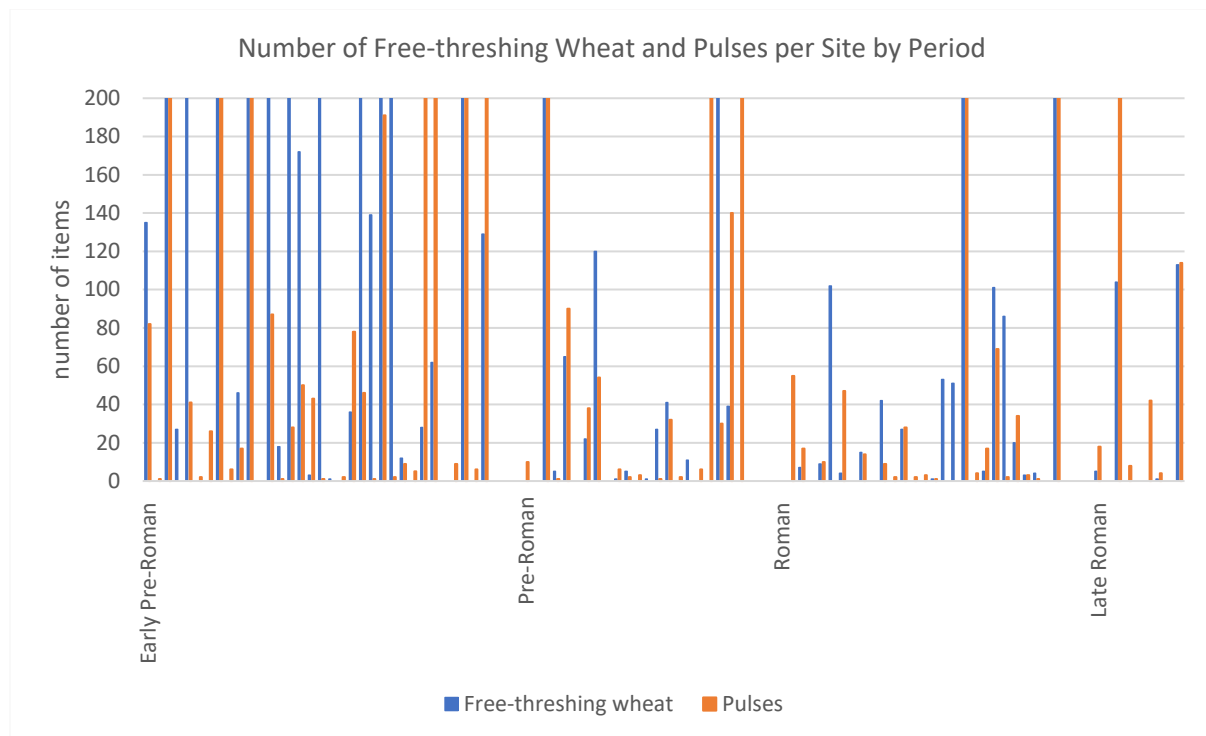


Figure 9-3 Number of free-threshing wheat and pulses per site by period.

9.7 Dietary preferences and socio-cultural trends

Now that crop husbandry practices have been considered, plant consumption and dietary patterns may be examined more closely.

Previously, archaeobotanists have used luxury items such as exotic species and flavourings in order to shed light on social access and culture change (Bakels and Jacomet 2003; Livarda and van der Veen 2008; Livarda 2011; Lodwick 2014). Unfortunately, solely charred assemblages do not lend themselves to such an exercise, as such items are rarely preserved in the archaeobotanical record. Additionally, though exotic foodstuffs may be more easily tracked in the western Roman empire, many such items already grew throughout the East and thus cannot be considered luxury items in the same way. Still, there are some observable trends in the data that allow for discussion of differential consumption patterns.

The range of flavourings present in the Early Pre-Roman assemblage demonstrates that, unlike in other regions where many of the flavourings have been considered to be Roman introductions, flavourings were common in the region long before Roman occupation (see Livarda and van der Veen 2008; see also above for further references). The Early Pre-Roman assemblage produced nine different flavourings, including *Carum carvi* (caraway), *Coriandrum sativum* (coriander), *Mentha* sp. (mints), *Cuminum cyminum* (cumin), *Foeniculum vulgare* (fennel), *Laurus nobilis* (bay), *Nigella sativa*

(black cumin), *Petroselinum crispum* (parsley), as well as *Trigonella foenum-graecum* (fenugreek), though the latter is also known to be a common fodder plant as described by the Roman agronomists (e.g. Columella, *Rust.* 2.7). Though the later three periods lack the array of flavourings present in the Early Pre-Roman dataset, their absence is best attributed to preservation (or a lack there of), as it is unlikely that such plants simply disappeared from the plant repertoire following the Early Pre-Roman period.

Another interesting pattern can be seen when examining the distribution of large caches. Firstly, the decline in caches may be reflective of changes in the socio-political organisation and settlement types in the region. In the earlier periods, settlements such as the large, fortified, iron age sites, for example, often appear to have operated with a system based on redistribution of foodstuffs by a centralised power. At Horbat Rosh Zayit for example, storage caches of cereals (*Triticum parvicoccum*) as well as pulses (*Vicia faba* and *Vicia narbonensis*) were kept in a fortified storage/administrative building of sorts and are presumably not of private ownership or intended for private use (Site 33; Kislev and Melamed 2000). Similarly, the storerooms at the Early Pre-Roman fortress site of Ayanis contained extremely large caches of barley and millet (Site 9: data from Solmaz and Oybak Dönmez 2013). This form of settlement was not as prevalent by the Roman period, however, when food was instead more commonly distributed in markets.

There are also certain implications that can be gleaned when examining particular species, such as of pulses. *Lathyrus sativus* (grass pea/chickling vetch), for example, is found stored in large quantities at Early Pre-Roman Ashkelon as well as at the Pre-Roman site of Tille Höyük (Sites 7 and 91; Weiss, Kislev and Mahler-Slasky 2011; Nesbitt 2002). Though it is possible that the assemblages represent fodder stores rather than foodstuffs intended for human consumption, the purity of the caches suggests otherwise. If the caches represent a crop that was intended for use as feed, it is highly unlikely that such efforts would have been put into separating the pulse from weed seeds and other contaminants.

By the Roman period, however, *Lathyrus sativus* is found at only one urban site: Tell Hadidi (three items; see Site 80). Though the nature of the context in which the remains were found is unclear, there is no indication of intent for human consumption, as the rest of the assemblages are comprised of mainly wild species, as well as barley and barley rachis (with the ratio of rachis to grain just over one, so definitely not purified crop). This apparent decrease in *Lathyrus sativus* consumption may have been influenced by cultural preference, as, with the coming of Roman soldiers into the region, other pulses were viewed as favourable. In the same vein, chickpea is more frequent at ceremonial and urban sites than other site types, though the fully quantified dataset

reveals that even at these sites, chickpeas are never as abundant as most other pulses. Though these patterns may indicate that the chickpea carried more prestige than other pulses, such an idea would be better explored with the incorporation of additional datasets.

The patterns observable in the nut remains also may speak to shifting dietary preferences in the region. *Juglans regia*, or walnut, is absent from the archaeobotanical record until the Pre-Roman period, when it is found at only one site. Walnut then increases in frequency in the Roman period, though the nut continues to appear in low quantities (four items total, though there are also nutshell remains from Site 97 that were interpreted as representing roughly two items). The prosperous Late Roman period sees an increase in the frequency as well as in the abundance of walnut, highlighting the rising popularity of the nut. Notably, all *Juglans regia* remains occur at urban, as well as one military, sites, speaking to the elevated degree of prestige associated with this species in particular. The frequency of almond exhibits similar patterns, with a marked rise in prevalence in the later periods, though *Pistacia* sp. becomes less common. Previously, scholars have pointed to the association of *Pistacia atlantica* in particular with the Persian diet, highlighting the possible influence of Persian consumption habits in the region (Sancisi-Weerdenburg 1995; see Challinor and de Moulines 2005: 418 in connection to macroremains from Zeugma). If *Pistacia* can be viewed in such a way, then the decline of the nut in the region may point to shifts in influencing dietary cultures, as Persian consumption patterns are replaced by other dietary preferences.

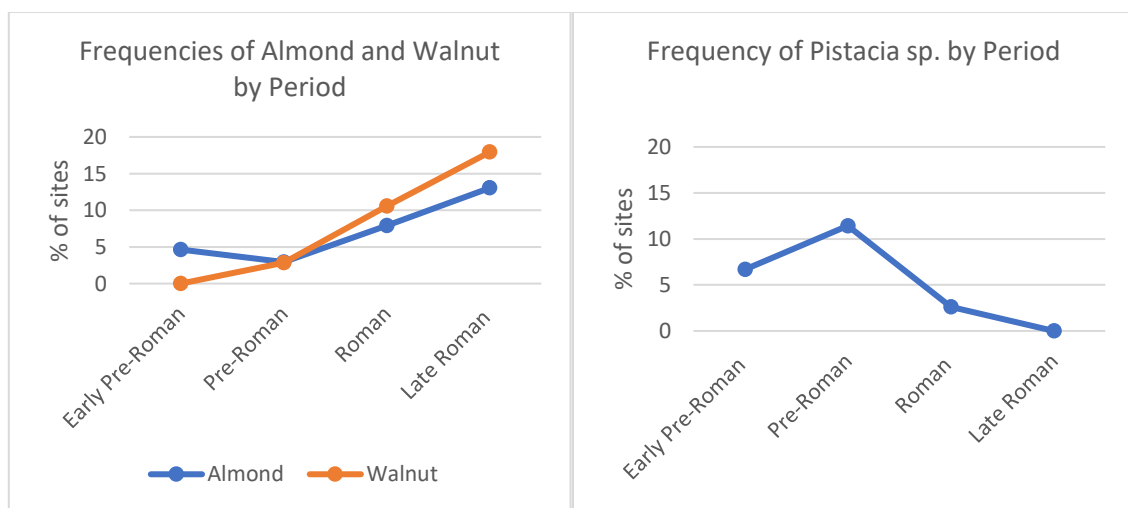


Figure 9-4 (a) Increasing frequencies of almond and walnut by period, as compared with (b) declining frequency of *Pistacia* sp. by period.

Pinus pinea, first appears in the East in the Roman period, occurring at 2.63% of sites (at Site 15, Caesarea, only), and then increases somewhat into the Late Roman period, when it was found at 4.35% of sites, though this percentage is also comprised of remains from Caesarea. The limited

distribution of *Pinus pinea* in the East may indicate that the nut was not an especially important component of diet in the region, or it may have been prepared in a way that does not commonly lend itself to preservation (i.e. ground as in pesto, or uncooked).

Beyond nuts, it is also interesting to note the increase in diversity of fruit remains that characterises the Roman period assemblage, as some of the less common fruits such as *Prunus* sp. and *Phoenix dactylifera* (date) increase in frequency (Fig. 9-5; see Fig. 7-18). This may be owed to some combination of moist conditions, growth in irrigation systems, intensive agricultural methods, and new horticultural techniques throughout the region, which allowed for the production of increased amounts of a greater variety of fruits. Moreover, an increased demand in urban markets and from the Roman military would have encouraged efforts to grow such products as well as to increase their distribution via expanded imperial trade networks. The rise in horticulture and fruit cultivation is certainly supported in the works of the ancient agronomists, with Columella even stating that though previous generations had been negligent, horticulture was, at the time he was writing, a popular pursuit (Columella, *Rust.* 10.1; see also 10.3, in which Columella indicates that demand for produce was higher than it had been previously). Though Columella may have been focused on Italy while making such a statement, the evidence suggest that it applies to the Near East as well.

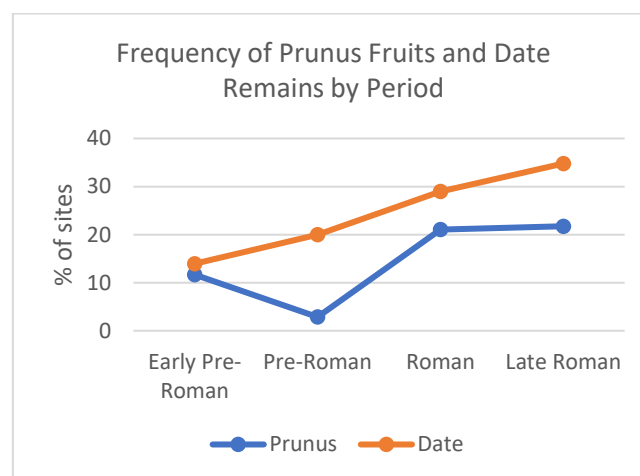


Figure 9-5 Percentage of sites with *Prunus* fruits and date remains by period.

The patterns observable in olive remains (i.e. the increase over the course of the study period) predominantly pertain to the Levant, where the majority of olive assemblages were recovered. This, however, is likely due to environmental factors rather than dietary preference. In reference to Anatolia, for example, the general lack of Roman and Late Roman sites located closer to the coast in areas suitable to oleiculture is more likely to account for the paucity of olive remains than an actual lack of olive and olive oil consumption (see Theophr., *Caus. Pl.* 6.2.4 for ancient authors' belief that olive grows only in areas in close proximity of the coast, which is later repeated by Pliny *HN* 15.1).

The dataset also contains a number of rare species and new introductions. Though previously thought to have been unknown in the region until after the medieval period, *Sorghum* first appears in the Late Roman period in a 'military' context at En Boqeq, near the Dead Sea (Site 24; see Zohary et al. 2012: 73 on absence of *Sorghum* in the Roman period). The grain is known to be drought tolerant and can thrive in hot, arid environments, which may have made it particularly attractive in the region, especially during the periods of drought that may have occurred during this period (Zohary et al. 2012: 72).

Lathyrus clymenum (Spanish vetchling) is commonly associated with the Greek island of Santorini, where the pulse is an important dietary component even in modern times. Archaeobotanical finds of *Lathyrus clymenum* in the East have previously been interpreted as Aegean imports, though the wild forms of the pulse that grow throughout the Mediterranean may cast doubt and complicate this assertion (Kislev et al. 1993 on Aegean influence in the Bronze Age Levant; pulse also found in late Iron Age (here, Early Pre-Roman) levels at Tel el-Burak; see Zohary et al. 2012: 97 on wild/weed varieties).

Hyphaene thebaica, or the doum palm, represents a rare find of a plant that may be rather unique to Eastern (and North African) consumption patterns. The doum palm grows in hot and dry environments, such as in North Africa, the Arabian Peninsula, and parts of the Levant. There is little evidence to suggest that the Romans took to the plant as they seem to have the date palm, for, unlike in the case of the date, there is limited evidence attesting to the regular import of the doum palm into Italy or the Western provinces. Two notable exceptions include the single mesocarp found in a 1st century BC layer at the harbour of Neapolis in Italy, and an amphora inscribed with reference to the fruit at Carlisle in Britain (see Allevato et al. 2015 on Neapolis; Tomlin 1992 on amphora from Carlisle). Pliny does make reference to the doum palm, indicating that the juice and fruit are palatable and sweet, but once dried, the fruit becomes so hard that it cannot be eaten without days of soaking (HN 13.18). However, the main aim of the passage seems to be to praise the wood, which is said to be held in high esteem by the Persians, further supporting the association of the plant with the East (and North Africa). Still, even in the Eastern dataset, the plant is rare, and is represented by only one find in the Cave of the Pool in the Judean Desert (Site 17), which may indicate that the plant was not especially favoured as a food source in the Near East either.

Rice is a notable find in the dataset. In Italy, rice seems to have been an Eastern import, although Zohary et al. (2012) indicate that rice was grown in the Po valley in Roman times. Pliny highlights rice as the cereal of choice in India (HN 18.13), and in describing various foreign cereals, makes reference to rice, which he stipulates is an import from the East (HN 18.20). In the Near East/West Asia,

however, rice would have been somewhat more common. Though the more arid environs throughout the region would not have been suitable for cultivation, rice would certainly have been cultivatable in certain portions of the study area, i.e. in Mesopotamia (see also Feliks 1983 on rice cultivation in Roman period Israel, though evidence of this is virtually absent from the dataset). Indeed, one of two sites with rice remains in the dataset, Susa, is located nearby to this fertile region, and is even referenced as producing the grain in the ancient literature (Site 68; see Diod. Sic. 29.13 on the general Eumenes feeding his soldiers with rice upon arrival in Susa, as, though lacking in other grains, rice was readily available). Notably, the rice remains are found in the form of a cache, demonstrating the importance of the grain at the site.

9.5 City/Hinterland relationships in agricultural systems

In addition to providing insight into crop husbandry practices, further implications may be gleaned from the comparatively large amount of high frequency weed seeds from the Early Pre-Roman period (see Table 7-6 on weed seed frequencies). It is possible that, during the earlier periods of this study, crop-processing activities were more widespread, and were not confined to or associated with particular site types. Large sites such as Tilly Höyük (Site 91) produced assemblages with markedly high proportions of wild/weed taxa (39.5% in sample 6, for example). Such samples were interpreted as representing the by-products from fine sieving, which were then saved as fodder (Nesbitt 2016: 371). The same site, among others, yielded large caches of rather pure crops that have been interpreted as stores. This would seem to indicate that centralised food stores were kept for urban populations who processed their own food on, or near to, site. This may differ from the Roman and Late Roman period, when exceptionally large urban populations had to depend on the greater *territorium* (and beyond) in order to procure sufficient foodstuffs.

The relationship between cities and their hinterlands in the region may be further explored in tracking other types of archaeobotanical macroremains. The dispersal of olive remains, for example, supports the existence of a high degree of connectedness among cities and their hinterlands in the region during the Roman and Late Roman periods. The close association of olive remains with urban sites in the Roman and Late Roman period, despite many of the known press remains being located in rural contexts, would seem to suggest that the by-products of olive oil production were being transported from their place of processing to urban contexts. Though this may often be attributed to the consumption of table olives, assemblages from a number of urban sites in the dataset confirm the use of pomace as a fuel source (see Petra ez-Zantur [Site 57] and Hippos-Sussita [Site 32], for example). Similarly, the vast majority of chaff remains occur in urban contexts. Though it is possible

that some crops were cultivated in urban environments, it is unlikely that cereals were grown, and arable agriculture was practiced, on such a small scale. It is more likely that urban gardens were able to yield limited amounts of fruits, vegetables, and herbs as opposed to cereals. As such, it would stand to reason that, like olive remains, chaff remains were transported from production locations in the countryside and surrounding areas into urban centres as well.

Though chaff remains were also commonly found in urban contexts in the earlier periods, the strong association of larger olive assemblages with urban contexts is a Roman period development (7.3.3.2). The implications of this are twofold: not only does this point to the status of said materials as marketable commodities in their own right, but it also suggests that the Roman period saw particularly close links between city and hinterland, with established networks capable of regularly transporting such commodities to the growing urban centres (see 11.4.3 on economic value and uses of chaff).

Similar observations have been made for particular sites, such as Petra and the surrounding countryside/hinterland, but the distribution of agricultural by-products at urban sites throughout the entire region would seem to suggest that such cases are not isolated instances (see Bouchaud et al. 2013 on Petra). The existence of close city-hinterland relations, and the high degree of connectedness suggested by the macroremains implies the existence of economic structures facilitated by the establishment of a dominating Roman presence in the region, as well as by the subsequent period of peace that ensued. In this way, Roman impact on local economies, and the utility of agricultural by-products as a proxy for connectivity, is made clear.

9.6 Fuel and sustainability

Though the use of nitrogen fixing pulses, and practices such as ley-farming and crop rotation represent sustainable agricultural practices, the data can contribute to further discussion of sustainability in the region. Agricultural systems are not limited to the farming practices employed and the harvests intended for consumption, but also include the aforementioned agricultural by-products produced in crop-processing activities. Such products have been known to be used as fuel: for example, the crushed olive stones that result from olive oil production, commonly referred to as pomace, is able to be dried and formed into cakes, which burn at higher temperatures and produce less smoke than other fuel sources (Warnock 2007; Rowan 2015; Braadbaart et al. 2016). Such products may be described as biomass and represent a sustainable fuel source used throughout history (see Rowan 2018).

The rise in populations in the Roman and Late Roman periods, particularly in urban centres, would have placed increased pressures on surrounding environments in order to meet increased demands, not only for foodstuffs, but also for fuel supply.²¹ Considering the landcover throughout the East, much of which is not especially heavily forested, it is a reasonable supposition that wood charcoal would have been in shorter supply than in other parts of the Roman Empire. Thus, populations would have had to look for other sustainable options in order to fuel their fires, which explains the transport of by-products such as olive stones and cereal chaff.

Dung is also known to have been a common fuel source, and the use of agricultural by-products in fuel provision goes hand in hand with this practice. Though it is possible that agricultural by-products were burnt as fuel outright, as appears to have been the case in the bathhouse at Hippos-Sussita where the fuel is comprised of almost purely olive and wood, it is also possible that such products often made their way into the archaeobotanical record in a less direct manner (see 6.2 on composition of Hippos-Sussita samples). In addition to necessitating greater supplies of foodstuffs and fuel sources, increased human populations likely relied on increased livestock in, or near, urban areas. Consequentially, a larger number of animals would require an increased amount of fodder/feed. Thus, agricultural by-products may also have been transported to urban contexts as fodder, and then burnt in the form of dung fuel, only after having passed through the digestive track of animals.

In this way, it seems plausible that the decrease in wild species after the Early Pre-Roman period, and increase in by-products, is representative of shifts in fodder regimes. However, such shifts would go against the increased grazing and implementation of convertible husbandry as implied by the higher ratio of wild seeds to cereals discussed above (9.4.2.1). This incongruity may speak in favour of an alternative solution: the decrease in wild species may instead be reflective of a decline in dung fuel use, and a shift toward using by-products as fuel instead.

In order to examine patterns in dung fuel use more closely, the author tracked the chronological distribution of *Prosopis* sp., which has previously been considered a dung fuel indicator (see Charles 1998). Though the plant occurs at low frequencies in general, it is notable that it peaks in the Early Pre-Roman period, occurring at 6.98% of sites. *Prosopis* sp. is conspicuously absent from the Pre-Roman and Late Roman datasets, though it does occur at 5.26% of Roman period sites,

²¹ Janssen et al. (2017) produce estimates of necessary fuel supply for Roman Sagalassos, and, though the study focuses only on wood fuel, the authors conclude that already at this time, the extremely high demand for fuel would have necessitated intensive use of the surrounding woodland cover.

demonstrating that, though the use of dung fuel may have declined, the practice of course did not disappear altogether.

While the dung itself is often not recorded and is prone to fragmentation, charred dung remains can be observed in the dataset (Table 9-2). Though frequencies are expectedly low, it is interesting to note that not only is the highest frequency observed in the Early Pre-Roman dataset, but also that the only period which produced no dung remains is the Late Roman period. The absence of dung remains during the Late Roman period correlates with the surge in large olive assemblages and possible specialised olive cultivation, as demonstrated above (Figure 9-1). Such patterns do indeed appear to support a movement away from the use of dung fuel in the region in favour of agricultural by-products as fuel.

Table 9-2 Frequency of dung remains per period.

Period	% of sites
Early Pre-Roman	6.98
Pre-Roman	2.86
Roman	5.26
Late Roman	0

This apparent decline in dung fuel use may be attributed to a heightened need of dung for manuring, as increased demand necessitated a greater output of food. Additionally, the apparent rise in horticultural activity reflected in the increase in fruit remains would have required larger amounts of dung to be diverted for this purpose as well. In any case, the remains represent the use of sustainable fuel resources in the face of increased demands and population pressures in urban centres.

9.8 Conclusions

In general, the picture painted by the archaeobotanical remains supports a model of ancient Roman agriculture in the East that combines the integration of different crop types, with a focus on intensive cultivation of particular crops, such as olive. There is evidence that points to ley-farming, or convertible husbandry, which may have been practiced increasingly overtime. Risk reducing strategies were employed, though to varying degrees in different periods, with the Roman period seeing less of these strategies than the subsequent Late Roman period. This shift was likely a

conscious decision on the part of the farms in response to increased population pressures, and, perhaps, periods of drought throughout the region.

There appears to have been a high degree of connectivity between cities and their agricultural hinterlands, with established networks that operated in the regular exchange of agricultural by-products. Such links appear to have supported a complex, sustainable fuel system that was able to support enlarged urban centres regardless of limitations to environmental resources. In terms of dietary practices, though less easily traced than in other regions of the Roman empire, consumption patterns do appear to have been impacted, to some degree, by imperial presence.

Finally, it should also be noted that the impact of the foundation and growth of Constantinople during the Late Roman period would have greatly affected regional production, as increased demand necessitated shifts in supply chains in order to provide for the city. Though such a topic is undoubtedly important to bear in mind, it requires more extensive study, outside the scope of this thesis, which is primarily concerned with the Roman era.

Chapter 10. Italy: Discussion

10.1 Agricultural regimes

As for the Eastern Empire, scholars have suggested that mixed farming was the prevalent mode of cultivation in Italy as well (White 1970; Kron 2000; Marzano 2020 among others). Archaeological remains serve to corroborate such a model, with remains such as that uncovered at Pompeii, for example, pointing to the intercultivation of various plant types (Jashemski 1979: 209-210 on the cultivation of tress [likely fruits] in the vineyard uncovered at Pompeii; see also Pracchia 2000 for archaeological evidence near Rome). Indeed, the macrodata largely support the use of polyculture, as assemblages appear to be of a generally mixed composition, often containing cereals, fruits/nuts, as well as plants from other categories such as pulses and/or weed species.

10.1.1 Intensification

As previously discussed, scholars such as Kron (2000) have long argued for Roman mixed farming as being characterised by a high degree of intensification. One method of intensifying agricultural regimes is by means of irrigation and capital investment in water management systems. There is no shortage of evidence that the Romans carried out large scale manipulation of the hydrological resources in Italy, as is well attested in both textual and archaeological evidence (Wilson 2009; Keenan-Jones 2013). However, while in the East this consisted mainly of irrigation systems, in Italy large-scale drainage projects and fluvial manipulation were also carried out. Thus, tracking the Cyperaceae species as indicators of soil moisture may be less useful in assessing intensification via irrigation, because some intensive measures (i.e. irrigation) in Italy may have led to increased Cyperaceae but others (e.g. drainage) may have decreased hydrophilic plants. Furthermore, the centuriation system would have created plots of land bordered by drainage ditches and canals. While this may have caused hydrophilic plants to be clustered in certain locations, this may not be visible in a general decrease in such species overall. In this way, a detailed study that tracks the distribution of such plants in the archaeobotanical record for a given site or area may be useful, though, presently such detailed records do not exist.

An autecological study of weed seeds, however, was undertaken by the author, as the Italian dataset contained more species level identifications than the data from the East.²² This approach was taken

²² It should be noted that in examining weed seed frequencies, it was determined best to remove the circa 30 ceremonial sites from the North in the Roman period, as such assemblages are highly

in an effort to shed light on agricultural regimes. The most frequent weed seeds were considered, taking into account the autecological values assigned in Pignatti et al. (2005), and, with the goal of tracking intensive practices such as manuring and crop rotation with pulses, soil fertility as reflected by nitrogen values (N) was studied by grouping weed seeds accordingly and tracking their distribution by period and region.

Of course, the crop processing that has been performed prior to the deposition of archaeobotanical assemblages causes certain biases in the data and affects the seeds that may or may not be represented. That is, if processing took place in rural settings, and the samples in question were taken from urban contexts, then it is likely that they contain material that has already been through the various stages of crop processing, and thus, as the larger weed seeds included in the crop would have already been removed, only small weed seeds would be preserved. However, as attempts to employ techniques for detecting crop-processing stages were unsuccessful, the stages of crop processing represented and the biases affecting the data remain unclear (see van der Veen and Jones 2006 on said techniques). As such, care was taken to ensure that the weed seeds used to track soil quality are of a variety of sizes, so that any biases resulting from an overrepresentation of particular crop-processing stages have been avoided as much as possible.

In terms of the results, wild/weed species that thrive in more nutritious soils increased in average frequencies (i.e. presence at a percentage of sites) during the Roman period, then decreased again in the Late Roman period (Fig. 10-1).²³ This pattern has a number of implications: with the expansion of agriculture in the Roman period, the increased soil nutrient value may indicate that farmers were taking measures, such as manuring, crop-rotation, and/or nitrogen-fixing pulse cultivation, in order to replenish nutrients and achieve optimal yields. The subsequent decline during the Late Roman period may be influenced by the lower number of seeds for this phase, or may show a break from previous patterns due to the socio-political climate of the time: that is, political turmoil and the wave of invasions that plagued Italy in the Late Roman period may have affected the normal operations of many farms. Furthermore, increased climatic variability and flooding during the 3rd century may also have taken a toll (see 10.5 for discussion of environmental changes).

curated and generally exclude wild/weed varieties, which would result in an underestimation of the prevalence of such plants.

²³ Though weed seed frequencies are generally low, such an approach has not been used for Roman Italy previously and is thus worthwhile to include.

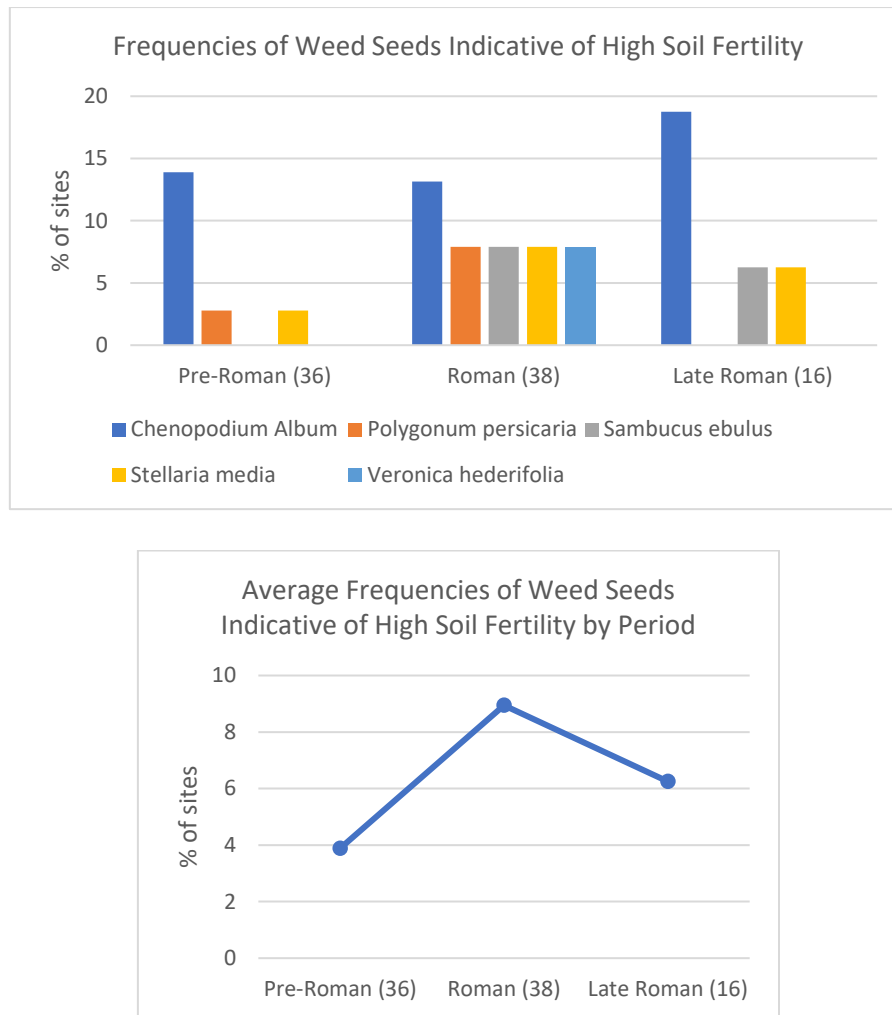


Figure 10-1 (a) Frequency of weed seeds indicative of high soil fertility and (b) Average frequency of weed seeds indicative of high soil fertility by period.

Interestingly, wild/weed seeds indicative of low soil quality show little change in frequencies during the Roman period, and even increase in average frequency if possible forage crops are disregarded (Fig. 10-2). This would seem to point to a significant level of diversity in farming practices employed throughout the peninsula, with nutritionally depleted soil indicating the continuation of extensive regimes, while, at the same time, other farmers were taking intensive measures to replenish the nutrients in the soils. It should also be noted that a number of the plants associated with lower soil qualities, such as *Vicia* sp. and *Medicago* sp., are also fodder plants and are suited to fallow fields (for further discussion of fodder plants in the dataset, see 11.2.3 Fodder). Therefore, these species may be reflective of fodder cultivation, possibly in rotation with arable crops, or as cultivated ley-

farming in a convertible husbandry-based regime (see Bowes et al. 2017 on archaeological and especially pollen evidence for such a system in southern Tuscany).²⁴

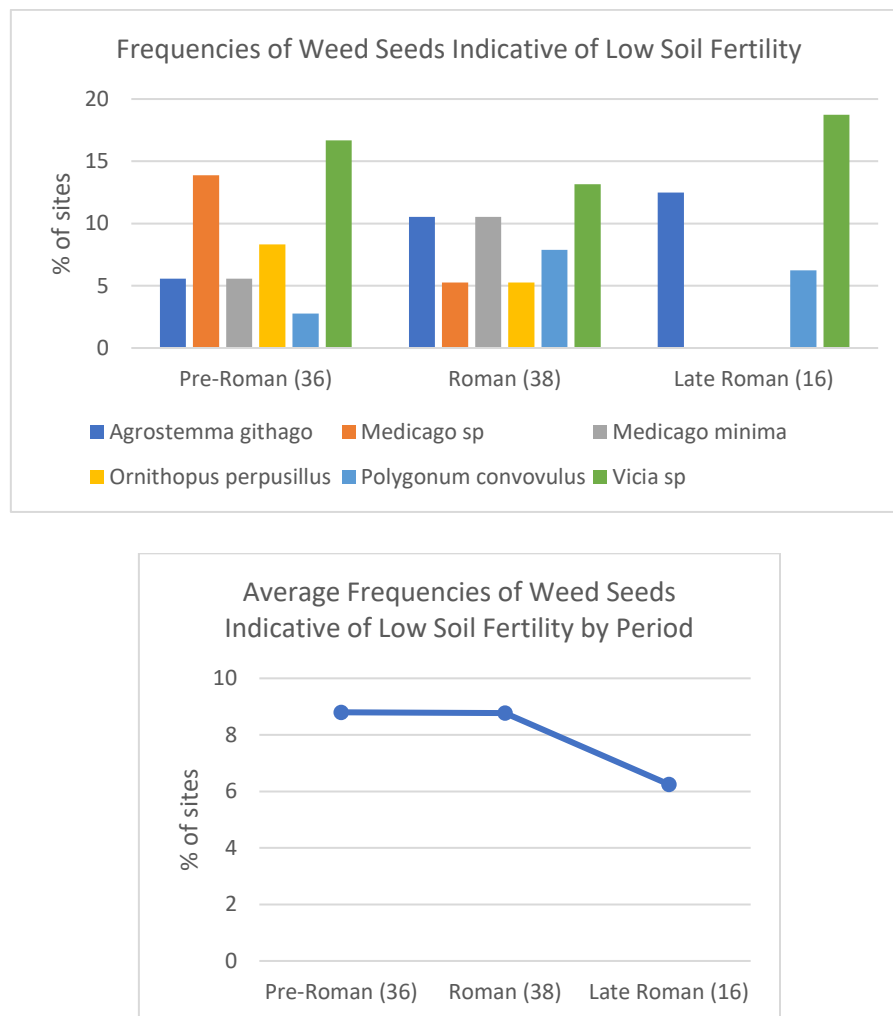


Figure 10-2 (a) Frequency of weed seeds indicative of low soil fertility and (b) Average frequency of weed seeds indicative of low soil fertility by period.

In this way, autecology-based analysis does support the agricultural intensification championed by Geoffrey Kron, but the results also indicate that intensive systems were not necessarily universally employed. In general, such a diversity undermines the very debates surrounding Roman agriculture that place intensive and extensive agriculture in stark opposition, pointing instead to an agricultural

²⁴ Note: In analysing the Eastern dataset, the ratio of wild seeds to cereal was used to assess the grazing/foddering practices in the hopes of better understanding the use of convertible husbandry in the region (see Marston and Miller 2014 on use of said ratio). This method, however, was not employed for the Italian dataset due to certain taphonomic considerations: such a ratio depends on the fact that the wild seeds/cereals are derived from dung, likely burnt as fuel. However, though this seems to be appropriate interpretation for many Eastern assemblages, such an interpretation for the Italian data is questionable (see discussion of fuel below).

system characterised by a variety of techniques, including both intensive and extensive, as well as the possibility of ley-farming, coinciding with each other.

Autecological analyses were also able to shed light on certain regional variations characterising agricultural practices throughout the Italian peninsula (Figs. 10-3 and 10-4 below). The chronological distribution of weed seeds indicative of high soil quality show interesting patterns in Northern Italy in particular, with a complete absence during the Pre-Roman period giving way to a notable increase in the Roman period, when the North produced the highest values of any region for high fertility seeds. In contrast, central Italy shows a marked decline in weed seeds associated with high fertility soils, which peak in the Pre-Roman period, and by the Late Roman period, are completely absent. The implications of these patterns highlight the differential trajectories of agricultural development in each of the regions, with an apparent introduction of intensive measures in the North from the Roman period, while in the centre of the peninsula intensive practices associated with cereal production seem to decrease in the Roman and Late Roman period.

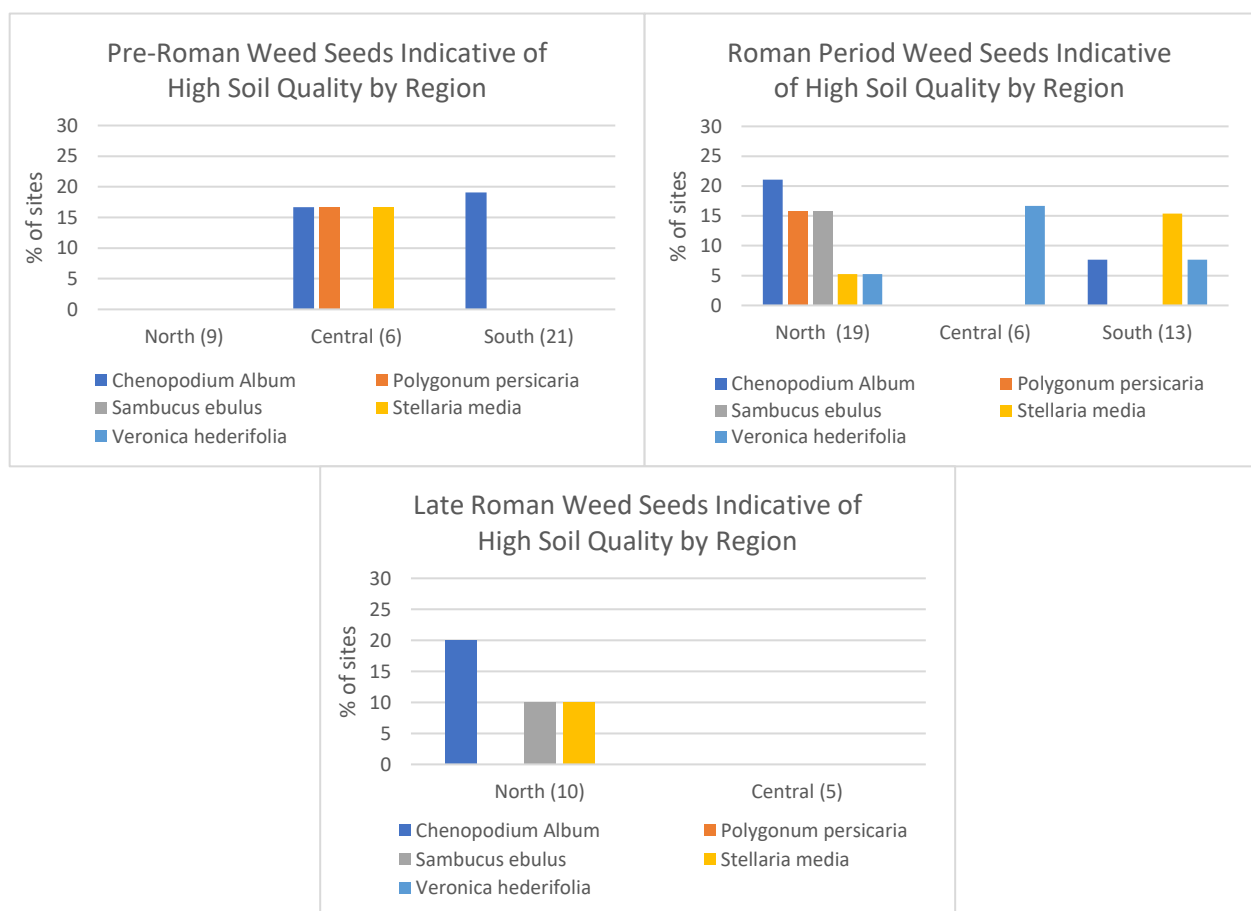


Figure 10-3 Regional distribution of weed seeds indicative of high-quality soils for the Pre-Roman, Roman, and Late Roman periods.

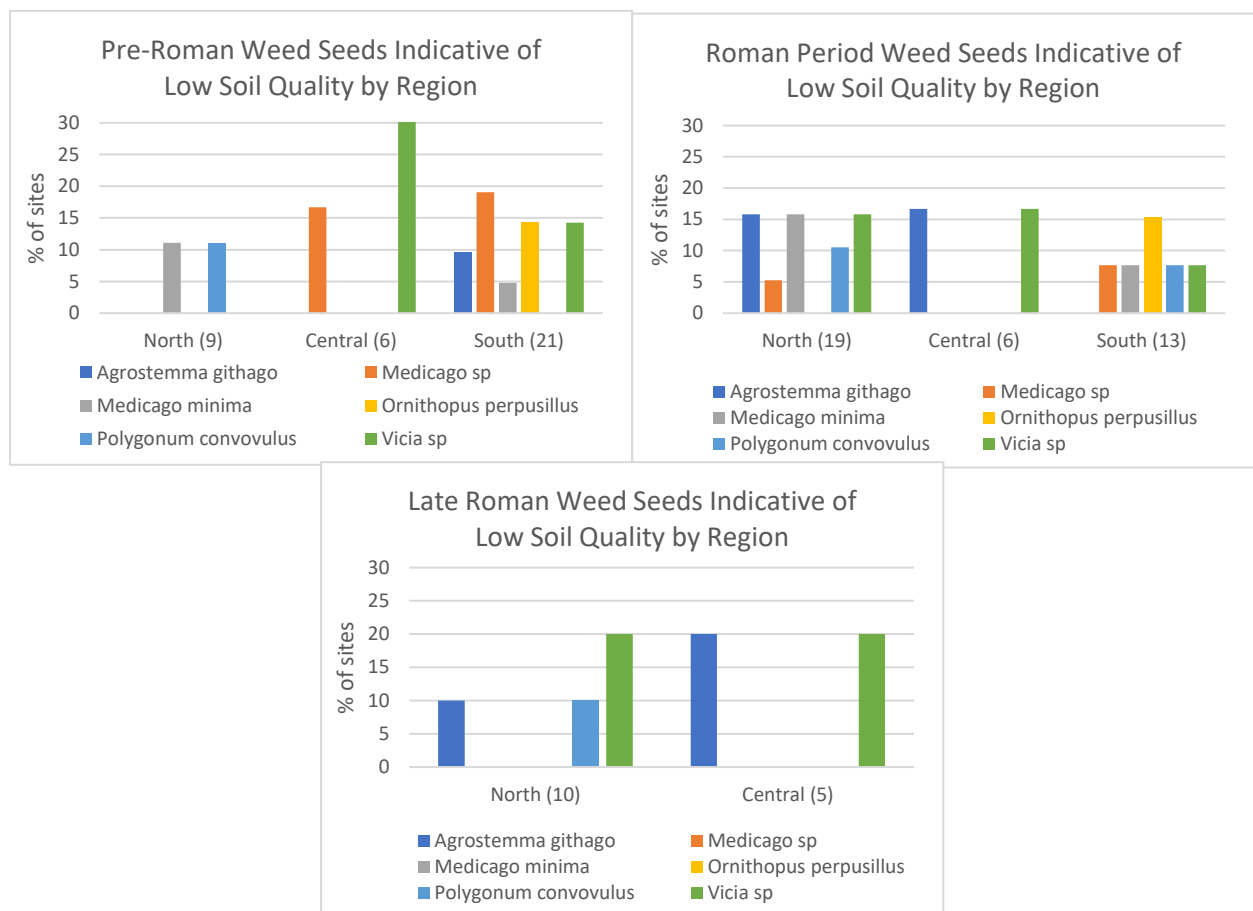


Figure 10-4 Regional distribution of weed seeds indicative of low-quality soil for the Pre-Roman, Roman, and Late Roman periods.

Though the Late Roman period is lacking in sites from southern Italy, the South produced more weeds associated with low fertility soils than high fertility soils in the Pre-Roman and Roman period datasets. This suggests that intensive cereal cultivation was less prevalent in the region than in the north of Italy, where intensive and extensive measures can be detected by autecological analysis, particularly in the Roman period.

In order to investigate the differential application of agricultural techniques and intensive measures further, the implementation of crop-rotation was assessed by examining the correlation between large free-threshing wheat and large pulse assemblages (see Lepetz and Zech-Matterne 2018: 46 on this method). The underlying assumption in such an endeavour is that a positive correlation between large cereal and large pulse crops may be indicative of the rotation of cereals and pulses, with large nitrogen-fixing pulse crops being produced in between cereals such as free-threshing wheats, which require more fertile, nutrient-rich soils. In considering Figure 10-5 (below), it seems that, though crop rotation appears to have been practiced to some degree in all periods, the strongest correlation between large pulse and free-threshing wheat deposits can be observed in the Late Roman period dataset.

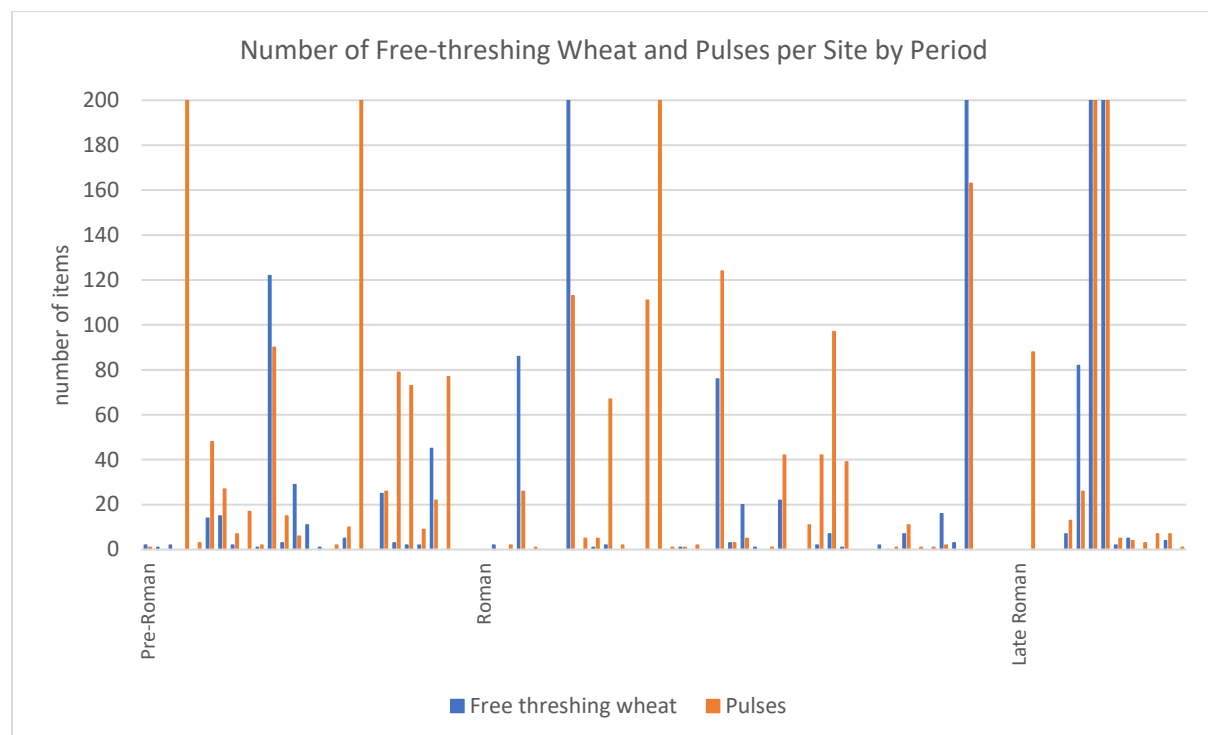


Figure 10-5 Number of free-threshing wheat and pulse remains per site by period.

Though this suggests that rotation may have been most prominent in the Late Roman period, the autecological analysis points to a peak in the implementation of intensive practices during the Roman period. Thus, other intensive practices, such as ley-farming/convertible husbandry and manuring may have risen in prevalence during the Roman period, accounting for the apparent increase in soil fertility in certain areas (i.e. the north).

On the other hand, the increasing prevalence of crop-rotation in the Late Roman period is further supported by analysing the percentage of sites with more than 20 free-threshing wheats that also produced more than 20 pulses for each period, as the percentage peaks in the Late Roman period at 100% (Table 10-1).

Table 10-1 Percentage of sites with 20 or more free-threshing wheats that also produced 20 or more pulses.

Period	Percentage of sites
Pre-Roman	75%
Roman	83.33%
Late Roman	100%

However, it should be noted that this is based on only three Late Roman sites that produced more than 20 free-threshing wheat remains, and the percentages for the other two periods are based on similarly low figures (four sites in the Pre-Roman period, and six sites in the Roman period).

Additionally, if the correlation between large free-threshing wheat and pulse crops and crop rotation is accepted, then the results indicate that the practice was prevalent in all periods here considered.

10.1.2 Specialisation

Though ideally specialisation could be examined by calculating the densities of the samples with recorded sample size, this exercise did not yield any conclusive results for the Italian datasets. Not only were no patterns observable, but few sites produced densities high enough to be significant. Though there were a small number of samples with densities over seven items of a specific plant per litre, they are typically the result of either sumsampling or types of caches, such as the preserved fodder in the manger at the House of Chaste Lovers in Pompeii (Site 132) or caches for food storage, rather than agricultural specialisation. This can be interpreted in different ways. It may indicate that farmers were not specialising in cereals, vine, or any particular crops at a large scale, but were instead practicing polycropping/intercultivation, with very mixed agricultural regimes. However, though there may be a degree of truth in this, it is unlikely that nowhere in Italy, in none of the periods considered here, were farmers producing enough of a particular crop to exceed a value of seven items per litre. Thus, the other conclusion is that densities are not suitable indicators of specialisation for the Italian dataset, which must be highly affected by taphonomic biases.

Cereals

Cereal frequencies decrease notably from the Pre-Roman to the Roman period so that most species are present at a lower percentage of total sites, with free-threshing wheats, glume wheats and barley reduced by about 30% and remaining relatively low during the Late Roman period. When looking at the fully quantified data, however, cereals are by far the most abundant during the Roman period due to a number (three) of caches. Though there are only 11 sites with cereal remains in the fully quantified dataset for the Late Roman period, a cache can be observed. These shifts in cereal visibility may be reflective of changes in cereal supply during the Imperial period, with a rise in large-scale cereal importation, decline in subsistence-based production, as well as increased centralisation of the cereal distribution system within certain areas of Italy (see Kessler and Temin 2007 on institutional influence in cereal trade under the Roman empire; Erdkamp 2005).

This may also explain why the frequencies of minor cereals reflect a decline in diversity in central Italy during the Roman period, an area which would have required the movement of massive amounts of grain to feed the population (Fig. 8-12). Furthermore, if large quantities of cereals were being imported into the region, such as to feed the sizable populations of the city of Rome,

increased market competition would have caused local farmers in central Italy to have less incentive to cultivate cereals; they would instead be able to better their capital gain by producing goods less suited to long distance transport, such as flowers, fruits, and other perishable items (Morley 1996).

The dataset from northern Italy, however, is characterised by a continued diversity throughout the entire study period. This may be reflective of a situation in which the North was subject to more specialised cereal production, cultivating more of its own cereals, while in southern and central Italy, though certainly there was some cereal cultivation, there was also a larger dependence on outsourcing. Much of central Italy was characterised by a high degree of urbanisation, with Rome occupying the core, and a densely settled countryside, which was less conducive to large scale cereal cultivation (Goodchild 2013; Marzano 2013). Though certainly not applicable to the entire region, portions of southern Italy, particularly parts of Campania and the Vesuvian region, have been described as comprising a sort of ‘wine district’ that relied on outside sources for the provision of staples including cereals (see DeSimone 2017: 48; see also Strabo 5.4.3 on the pre-eminence of the wine, but also the grain, from the region around Capua).²⁵ De Simone attributes this to the higher profit that could be gained from wine production as opposed to cereals, which would yield less capital gain than other cash crops (see De Simone 2017). Much of the north of Italy, however, was characterised by a low degree of urbanisation paired with highly fertile soils (see Maiuro 2017 for detailed discussion; De Ligt 2017). The area was particularly suited to cereal production, and even today is known as the cereal production hub of Italy. Additionally, Bosi et al. (2020) attribute the considerable presence of some of the minor cereals such as rye and oat to influence from Germanic and Celtic populations, and if cereal cultivation was widespread throughout the region, there would have been ample opportunity to accommodate different cultural preferences.

Furthermore, it is interesting to note certain correlations between this picture and the results of the arable weed seed analysis: while the increase in weed seeds associated with nutrient rich soils attest to the introduction of intensive practices as well as to the continued importance of cereal-based agriculture in the north of Italy, the decline in such weed seeds in central Italy supports a movement away from cereal cultivation, towards the production of other more profitable crop types destined for the markets of the nearby city of Rome.

²⁵ Note: Though cereal production would have been prominent in other areas of southern Italy, such as Apulia in particular, there is a dearth of sites from the area in this dataset. Perhaps with further archaeobotanical sampling, these smaller regional variations within different parts of Italy will be able to be detected.

Grape

Grape is the most frequent fruit remain in all periods, particularly when the nuts species that largely comprise the 'other fruit' category are discounted, which highlights the continued importance of the fruit throughout the Italian peninsula. Though among the most frequent and abundant remains for all site types during every period here considered, the dominance of grape is especially apparent at rural sites, where processing for wine production would have occurred (8.33), though in the Roman period this is less clear due to new *Prunus* fruits and the relatively low number of rural sites. In general, the archaeobotanical evidence lacks verification of any decline in viticulture and the wine industry and does not support arguments for a crisis in Italian viticulture due to competition from the provinces. In order to verify this, the percentage of sites with greater than 10 grape remains in their fully quantified datasets was calculated for each period (Fig. 10-6). The results highlight that, apart from some very small fluctuations, there does not appear to be any significant change in the frequency of relatively large grape assemblages during the time periods here considered. The negligible nature of the fluctuations that can be observed in the grape assemblages can be further emphasised in comparing them with the notable shifts affecting olive remains, as is displayed in Figure 10-7. Though studies such as Marzano (2013) have already brought this proposed crisis into question, archaeobotanical macroremains have not previously contributed to the debate due to a lack of large-scale data synthesis in the region.

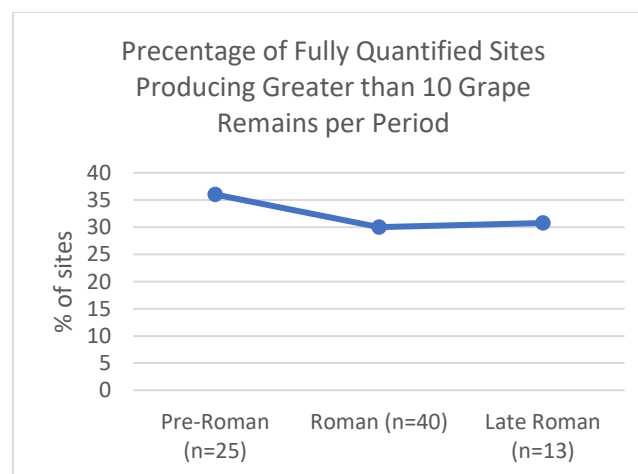


Figure 10-6 Percentage of fully quantified sites that produced greater than 10 grape remains per period.

Olive

Olive continues to be a ubiquitous crop throughout the period under study, however there is an apparent decrease in olive frequencies during the Roman period. Though the fully quantified dataset does seem to indicate that olive grows in prevalence in central and southern Italy during the Roman period, this is only relative to other fruits in the assemblages, and the actual counts, apart from the Cardo Sewer data (Site 118), do not appear to show an increase. In fact, sites with larger olive assemblages appear to decrease over time if raw numbers are considered (and the outlying Cardo Sewer assemblage is discounted).

In order to examine this pattern more closely, the percentage of sites producing more than 10 olive remains was calculated for each period (Fig. 10-7). The results of this exercise emphasise the reduction in large olive assemblages, which decrease by 13% (roughly half) between the Pre-Roman and Roman periods.

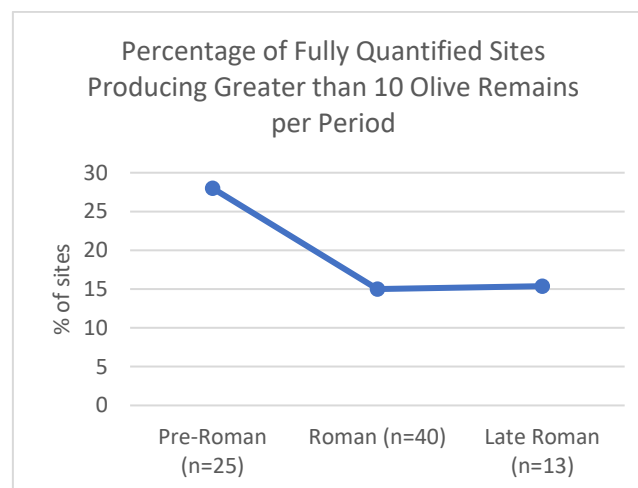


Figure 10-7 Percentage of fully quantified sites producing more than 10 olive remains per period.

Thus, the data suggest that throughout Italy as a whole, specialisation in large-scale olive cultivation and oil production may have contracted, possibly in the face of competition from big production centres such as those in Baetica and North Africa (see Remesal Rodríguez 1998 on prominence of Baetica; Mattingly 1988a, 1988b). This of course, is a separate discussion from the wine industry, which, as studies such as Marzano (2013) have demonstrated, likely continued to thrive, and does not negate that in certain areas, such as the hinterland of Rome where demand was massive, the olive oil industry may have continued unaffected. Furthermore, though the works of the Roman agronomists seem to suggest that wine production carried a certain prestige, and thus attracted wealthy landowners regardless of economic profit, olive oil does not seem to have been viewed in quite the same manner; the discussion of the varying qualities of olive oil does not quite compare

with the many vintages of prestigious wine (see Purcell 1985). This would seem to support that, with an increase of large-scale importation from the provinces, there may have been less motivation to invest primarily in large-scale oleiculture at large estates, and that farms and landowners instead may have cultivated a more limited quantity of olive in mixed agricultural regimes characterised by a significant degree of intercultivation.

Despite the possibility that large-scale olive cultivation may have decreased in popularity during the Imperial period, olive consumption does seem to spread geographically over the course of the study period. During the Pre-Roman period, it appears only in the southern half of the peninsula, throughout much of which the climate is better suited to oleiculture, before spreading north in the Roman period, likely by trade (see Figs. 8-13; 8-39 and 8-39 for full-quantified data). Thus the importance of olives in the Roman diet is apparent, and the influence of Roman consumption habits can be seen to increase even in the northern areas, where, at least initially, Pre-Roman practices may have been of continued importance (see above/below on other fruits spreading to the North during the Roman period; cf. Bosi et al. 2020; see also works such as Maiuro 2017 who highlights the importance of Pre-Roman cultural influence in the North, in this case on settlement patterns, though here as applied to diet).

10.2 Diet and social access

As mentioned, olive is not the only plant that expanded geographically during the Roman period. During the Pre-Roman period, the only fruits represented in the North are grape and ‘other fruits’, which actually consists of walnut and hazelnut (Fig. 8-17).²⁶ Meanwhile in central and southern Italy the assemblages feature fruits such as fig, olive, *Prunus* fruits, and pomegranate. Subsequently, in the Roman period, all of these fruits, as well as date, appear in the northern dataset (Fig. 8-17). Though the northern dataset does contain a large number of ceremonial sites during this period, the new fruit species are also found in urban and, to a lesser extent, rural contexts, and thus it is not biases caused by the uneven distribution of ceremonial sites that are responsible for this increased diversity. That said, the fact that these more exotic fruits show a stronger association with ceremonial and urban sites does speak to their status as more luxurious foodstuffs (Fig. 8-18). Thus, the fruit remains indicate that the Roman period is certainly the most diverse in terms of fruit

²⁶ Note: there is one example of a more diverse example from the site Forcello, however, the remains are preserved by waterlogging rather than carbonisation, and thus, in the interest of consistency, no wider conclusions may be drawn from this evidence (see Appendix G for waterlogged assemblages)

consumption, with date only occurring in this period and *Prunus* fruits peaking, as the prominence of luxury fruits increases in the North.

The association of the Roman period with increased fruit diversity was also observed in the East, and has been highlighted elsewhere in the Roman Empire (see 9.7 for the East; see recent work by Bosi et al. 2020 on northern Italy; van der Veen et al. 2008 on Britain; Livarda 2011 on northwestern Europe). Notably, other plant foods appear to diversify in the Roman period dataset as well.

Flavourings in particular, though present as minor occurrences, are the most visible during the Roman period (see Fig. 8-6; see below for qualitative discussion of flavourings). Bosi et al. (2020) have recently pointed to the peak of complexity in plant-based diet in the north of Italy as occurring during the Roman period, and, in general, the dataset presented here supports a wider, pan-Italian application of this observation.

Though the north of Italy appears to develop in dietary complexity later than the other regions, there is some evidence that plant consumption in the South diversified first. This can be seen in the fruit remains, for example, as during the Pre-Roman period *Prunus* fruits and pomegranate appear only in the southern Italian dataset, rendering it more diverse than the other regions (see Figs. 8-16 on fruit and 8-21 on pulses, both of which highlight the diversity of the Southern dataset from the beginning of the study period, as well as the later diversification in the North). This may reflect the influence of Greek culinary culture in the South, where Greek colonies had been established for hundreds of years.

There are also patterns observable in the distribution of nuts, which speak to the varying levels of prestige that may have been associated with the different species. Walnut and hazelnut are the most prevalent nuts and are present in all site types (8.2.5). Though occurring at a slightly lower frequency during the Pre-Roman period, walnut becomes the most frequent nut during the Roman and, especially, the Late Roman period (Fig. 10-8).

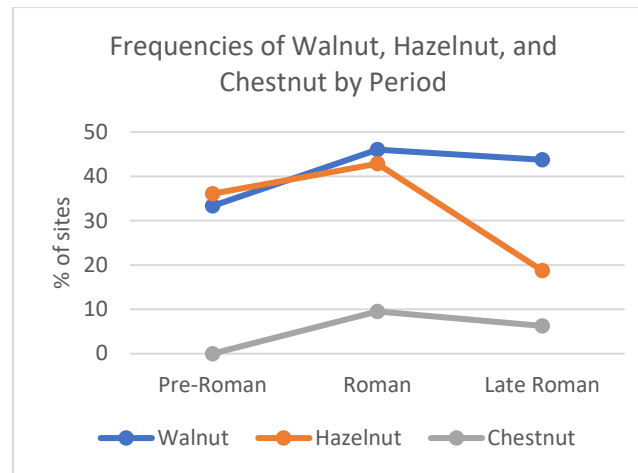


Figure 10-8 Percentage of sites producing walnut, hazelnut, and chestnut by period. Compare most frequent nuts, walnut and hazelnut, with chestnut, which is among the least frequent.

However, the distributions of pine nuts and almond in particular are, with one exception (Col di Marzo during the Pre-Roman period, Site 125), limited to urban and ceremonial contexts during the Pre-Roman and Roman periods, and are absent from the Late Roman period dataset altogether. This would seem to indicate differential status of the nut species, with walnut being the most commonplace, while almond and pine nut were luxuries.

Such a ranking in the cultural preferences for nuts is supported in the textual evidence, particularly in Pliny's *Natural History*, which contains in depth discussion of the different nut types (see book 15). It is firstly notable that throughout the whole of the work, Pliny often uses walnut and hazelnut as a reference for sizing other objects, implying that they were widely known and commonplace, as is also made apparent in the archaeobotanical dataset. Walnut is used as a size comparison for the white truffle (Plin., *HN* 19.12), the wild cucumber (Plin., *HN* 20.3), and a precious stone called *belus* (Plin., *HN* 37.55). The size of the hazelnut was used to describe the proper amount of honey and almond in remedies (Plin., *HN* 22.73, 23.75), as well as the size of the fruit of the *Mandragora* plants (25.94) and the precious stones opal (37.21) and *adamas* (31.15).

Meanwhile the impression that almond was more of a rarity is supported in Pliny's questioning of whether almond was yet in Italy during the time of Cato, implying that the nut was perceived as a relatively new introduction and thus may have been more of a luxury item than more common species (Plin., *HN* 15.24). Pliny also compares almonds to walnuts, remarking that the former is superior in flavour and taste, which serves to further emphasise the higher degree of prestige that the nut seems to have carried (Plin., *HN* 15.24).

However, in describing the chestnut, Pliny wonders at why Nature would bestow such a formidable shell to an 'object of so little value' (Plin., *HN* 15.25). This evidence that the chestnut was not an

especially coveted plant food in Italy under Roman occupation correlates well not only with the relative scarcity of the nut in the dataset (Fig. 10-8), but also with previous studies that, integrating anthracological and palynological evidence, claim that the chestnut tree was more valued for its timber, and only really began to gain in popularity from the 5-6th century AD (Di Pasquale et al. 2010: 871; see Squatriti 2013, Rottoli 2014 on the association of chestnut with medieval dietary patterns in Italy; see also Buonincontri et al. 2015 on the spread of chestnut in Italy in the Middle Ages, particularly as a source of timber rather than as an important component of diet).

Among the pulses, it is notable that only six records for all periods (four Pre-Roman and two Roman) feature *Cicer arietinum*, or chickpea. Bosi et al. (2020) suggest this pulse was not an important component of diet in the Roman North, but rather was more important in ceremonial contexts. The data for the whole of the Italian peninsula would appear to support this conclusion, as only one of the six total chickpea finds occurs outside of a ceremonial context. Furthermore, virtually all of the sites that produce chickpea remains are located in the South (though there is one in central Italy), where the warmer climate is better suited to their cultivation. This speaks to the regionalism that continued to characterise the Roman diet, even throughout the Imperial period.

Though the markedly low chickpea frequencies appear to indicate that chickpea really was not an important component of the Roman diet, considering their presence in ancient literature, it seems likely that the pulse was at times eaten in such a way that it is less commonly preserved, and thus may also be underrepresented in the archaeobotanical record (Plin., *HN* 18.32; 22.72 for use in remedies; though referenced as a snack food and item for after dinner consumption alongside luxurious foods including pear, apple, almond, sesame cakes, and cheese in Ath. 14.643, 14.649, which may support the idea that chickpea was not a dietary staple).

Among the cereals, barley is the most frequent in all periods (Fig. 8-11). However, as barley is an exceptionally versatile cereal and was used as a fodder crop as well as for human consumption, particularly in times of famine, it is difficult to ascertain any further details of its (human) consumption based on the archaeobotanical data. However, a known trend that has previously been linked with cultural preferences toward cereal consumption is observable in the distribution of glume wheats. The decrease in frequency of glume wheats overtime (Fig. 8-11) has oft been suggested as beginning before and continuing through the Roman period, as cultural preferences shifted away from glume wheats toward free-threshing wheats (van der Veen 2018: 55; Heinrich 2019: 104). This pattern is clearly observable in the data, with the frequency of glume wheats decreasing by approximately half from the Pre-Roman to the Roman period, and then slightly more in the Late Roman period. In this way, the dataset presented here agrees with a general shift away

from glume wheats overtime, and utilises the largest body of data from Italy yet considered to confirm this phenomenon.

Millet has a considerable presence among the cereals and is generally present in greater abundances than the other minor cereals (Figs. 8-35 and 8-36). In the fully quantified datasets for the Pre-Roman and Roman periods, there appears to be an association between millets and certain site types – namely ceremonial and urban sites, though they are indeed present as rural sites as well.²⁷ A potential link between ceremonial contexts and millets has been observed previously by Rottoli and Castiglioni (2011), and the data presented here support this trend (see Murphy 2016 for discussion of cultural attitudes toward millets and ritual association). Though isotopic studies have used the distribution of C4 to support that the consumption of millet may be associated with the lower echelons of society, it is difficult to assess the social distribution of millet in the dataset presented here. Millets are present at virtually all site types during the Pre-Roman and Roman periods, and the presence of the cereal at urban sites may be indicative of consumption by urban dwellers of varying social standings, as well as of its use as fodder (see Murphy 2016: 73-74 for useful discussion of isotopic evidence; see Killgrove and Tykot 2013: 36 on link between socio-economic status and millet consumption). The distribution of millets during the Late Roman period, however, does mark a departure from previous patterns, as the cereal occurs at only rural sites. Though it is tempting to interpret this pattern as reflecting differential consumption according to social standing, it is difficult to maintain such a claim with any certainty, as there are more than twice the number of rural sites than any other site type in the Late Roman dataset.

There are also some less common plant remains that should be included in the discussion of diet. Though aromatic plants and flavourings are rarely preserved by carbonisation, a few sites have yielded said remains. Though presumably such plants would have been fairly widespread, it is interesting that flavourings are only present during the Roman period and are limited to villa and urban sites, both of which are more prestigious site types (see assemblage from the urban site of Privernum, [Site 172], where flavourings were uncovered at a luxurious *domus*; see also remains from the villa Oplontis, Site 157). This would seem to indicate that, to some degree, the ability to add more flavourings to meals was still a luxury in Roman Italy, though the preservation biases that affect such plant types prevent such a statement from being asserted with any certainty. Still, it is notable that flavourings (and vegetables) are only present at urban sites in the mineralised and generally ‘uncharred’ assemblages, and only at one ceremonial site and one villa site in the

²⁷ Note: The Late Roman dataset exhibits a departure from these patterns, with millets present only in rural contexts, though rural sites are the most common site type during this period.

waterlogged data, all of which would seem to support an association with some degree of prestige (see Appendix G for uncharred plant food assemblages).

Additional luxury foodstuffs visible in the archaeobotanical record include newly introduced exotics such as the date (*Phoenix dactylifera*), which does not appear in the data until the Roman period, and then is absent again in the Late Roman dataset (Fig. 8-16). In the second book of his *Rerum Rusticarum*, Varro references the date palms of Syria, which he indicates can grow in Judea but not in Italy, in order to exemplify that different plants and animals are suited to certain regions and environments (2.1.27-28). Pliny, too, described the date palm as being particular to Syria, further highlighting the nature of the date as an imported, exotic foodstuff (Plin., *HN* 13.10). Still, Pliny describes a detailed ranking of the many different date varieties cultivated throughout the ancient world, which bespeaks the high regard in which dates were held (Plin., *HN* 13.9). The distribution of date among particular site types further reflects the prestige associated with the fruit, as in the Roman period dataset, date is found at only ceremonial and urban sites, at circa 55% and 26% of these site types respectively.

In addition to the date, the jujube (*Ziziphus jujuba*) represents another exotic plant food. Pliny indicates that the jujube was a very recent introduction to Italy during the 1st century AD, and associates it with the Near East and North Africa throughout his writing (Plin., *HN* 15.14, 21.27). This is reflected in the data, with the plant's first appearance occurring in the Roman period. Like date, Jujube is absent from the Late Roman dataset, and even in the Roman period, the distribution of the plant is limited to only two ceremonial contexts (Albenga [Site 98] and in Padova [Site 158] though note one additional waterlogged find at the urban site of Vada Sabatia [Site 188]).

Possible *Prunus mahaleb* remains are also an interesting component of the dataset. Though able to grow throughout Italy, there is a lack of references to the fruit in classical literature. The fruit is bitter in taste and not commonly eaten, however the seeds are used to produce the spice mahleb, which is used in the modern cuisines of Turkey, Armenia, Greece, Egypt and other countries throughout the Middle East. Unfortunately, due to the challenges in detecting such a use archaeobotanically, as well as the lack of literary evidence, whether the plant was used for such purposes in antiquity is not clear at this point.

10.3 City/Hinterland roles and relationships

The distribution of chaff, which occurs primarily at urban sites has a number of implications. By the Roman period, cereal processing is largely thought to have occurred outside of cities, in the

agricultural hinterlands (Robinson 1999, 2002; Murphy et al. 2013). Considering the limited space for processing activities in the growing urban centres of Roman Italy, this idea seems reasonable, and, due to the relatively small size of the chaff assemblages, there is little evidence in the Italian dataset to suggest otherwise (see Murphy et al. 2013 on Pompeii in support of this).

Still, with the distribution of chaff in mind, efforts were made to test this further. In order to track crop-processing activities, the ratios of chaff to grain were considered for each of the sites with a sufficient number of remains (see van der Veen and Jones 2006). However, with few significant values, the results were largely inconclusive (8.3.7). There are two urban sites in the Pre-Roman period (Sites 134 and 193) and one in the Roman period (153) that produce ratios that favour crop-processing activity, but even in these instances, the ratios of chaff to grain are all below four. Furthermore, all of the values that suggest crop-processing activities were obtained for glume wheats. As glume wheats can be stored hulled and then dehusked for processing at a later date, and as all of the assemblages are rather small, even these instances appear to be indicative of occasional cereal processing at the household level, rather than large-scale crop-processing activities taking place in urban contexts.

Thus, particularly in the case of the chaff from free-threshing wheats, the lack of evidence for crop-processing activities together with the association of chaff at urban contexts points to its transport from rural processing points to urban centres, for various uses such as for fodder or fuel (see 11.4.3 on chaff for further elaboration on such uses). This highlights the considerable degree of connectivity between cities and their hinterlands, and further exemplifies the ability of ancient peoples to turn crop-processing by-products into useful commodities and renewable resources, as has been observed with the use of pomace fuel in Pompeii as well as throughout the East.

The distribution of chaff remains has one additional implication that should be noted. As mentioned, Murphy et al. (2013) interpret the absence of cereal chaff at Pompeii *Insula* VI.1 as indicating that cereal processing was not taking place inside the city, a phenomenon which they consider to be 'an index of Romanised urbanisation' (Murphy et al. 2013: 415). However, though perhaps not present at a scale suggestive of crop processing, the distribution of chaff at predominantly urban sites in all periods here considered complicates such an interpretation, as such occurrences are not necessarily indicative of either cereal processing *or* a lack of urbanisation. As such, care should be taken in interpreting the distribution of chaff remains, as the distribution may not always be such a clear indicator of said index, particularly in light of the transportation of chaff away from their processing points, as highlighted above.

10.4 Fuel

Fuel is, of course, a highly important commodity, and should be considered in any discussion of agricultural economies, with Roman Italy being no exception. The considerable fuel economy that existed in Italy throughout the period under study has been highlighted in the work of Robyn Veal, who shows wood fuel travelling notable distances, such as, for example, from Samnium forests to Pompeii (see Veal 2012, see also Veal 2017 on supply to Rome). Wood/charcoal was certainly the dominant fuel source in Italy, and scholars have maintained that even during the period of peak consumption, Italy would have been able to produce far more wood for fuel than was needed by its population (Grove and Rackham 2001: 173-174).

Notably, alternative fuel sources are not so visible in the Italian dataset. Robyn Veal (2012, 2017) does note an increase in fruit tree charcoal at Pompeii from the 1st c. BC, which can likely be traced to the increasing importance of arboriculture in Italy from the early imperial period. Though a survey of charcoal remains was outside the scope of this thesis, the growth of arboriculture may be reflected in the increase in certain fruit remains such as *Prunus* fruit varieties, as exhibited in Figs. 8-15 and 8-16. In this way, such a trend may reflect an increase in the use of certain by-products, resultant from pruning, as a fuel source, though, unfortunately, this was not able to be examined in detail via the macroremains.

Certainly, the by-products of olive oil production were made into pomace for fuel, as is evidenced by data from Pompeii and Herculaneum, though, aside from these isolated instances, pomace is not widely observable in the Italian dataset. It is true that such a by-product would have had to be disposed of in some manner, lest it damage valuable land due to its toxic properties (see Rowan 2019: 111-112 for discussion). However, the visibility of such remains is limited in the archaeobotanical record at this time, and thus, despite convincing arguments for the widespread use of pomace fuel as posited by Rowan (2019) with regard to Rome, the lack of evidence renders the prominence of this fuel source throughout the greater peninsula unclear.

Though undoubtedly a prominent fuel source in antiquity and up to modern times, the use of dung fuel in Roman Italy has received little attention. Though dung fuel has certainly been observed during the Roman period, particularly in more arid environments such as in Egypt and the East, the scale of its use in Roman Italy is less known (see 9.6 on East; Marston and Miller 2014 for example from Roman Gordion). Unlike in the Eastern dataset, where charred dung remains have at least a minimal presence, charred dung is virtually absent from the data for Italy. That said, dung fuel is often not preserved in the archaeological record and can be difficult to identify using archaeobotanical macroremains; its absence in the dataset does not indicate that it was not used.

The presence of weed seeds and wild species in carbonised assemblages are commonly associated with the use of dung fuel (Miller and Smart 1984; Charles 1998). However, in the Italian dataset, weed species exhibit rather low frequencies, especially when compared to other regions of the Roman Empire, which may be linked to a less frequent use of dung fuel (see Table 8-6 for Italian weed seeds; for comparison, see Table 7-6 for weed seeds from the East). That is not to say that that dung fuel was never used in the Italian peninsula: at the Houses of Hercules Wedding in Pompeii (Site 136), for example, samples taken from a hearth contain wild species and pulses, which may be reflective of digested fodder and thus dung fuel, though, be that as it may, it could still have been a less common fuel choice.

It is interesting to note that, though there is ample discussion of the use of dung for the purposes of manuring in ancient literature, references to dung fuel are lacking (see detailed discussions in Columella *Rust* 2. 16; Plin., *HN* 17. 8). There is mention of dung fuel in Livy's *History of Rome*, in which Livy remarks on the lack of timber in Axylon (Anatolia), stating that the local peoples use dung fuel in the place of wood (38.18.3-5).²⁸ The use of dung fuel in this passage appears to be a consequence of the scarceness of wood, and thus suggests that dung was viewed as a less desirable fuel source. This is also supported by the author's use of this practice as a way to demonstrate the otherness of these peoples and the marginalisation of the land that they inhabit. The very mention of the use of dung fuel indicates that the practice was remarkable to Livy in some way, possibly suggesting that the author does not view it as a common practice. This would seem to suggest that dung was indeed not an especially common, or at least a very desirable, fuel source in Italy or in Cisalpine Gaul, where Livy was born, at least during the 1st century BC to the 1st century AD.

Though efforts were made to detect dung fuel based on the flowering times of the most common weed seeds in the datasets, the results were largely inconclusive: species with flowering times that specifically do not coincide with cereal harvests (such as in January, February, or March) are minimal, and most of the weeds that do flower in the winter continue to flower into the spring months (see Charles 1998 for this method; Appendix E for Italian weed seed flowering times). As such, though it is possible that these weeds flowered in the winter months and thus may be dung fuel indicators, this cannot be determined with any certainty. Regardless, even the possible winter flowering weed seeds in the assemblage are a minority, and, in this way, the unsuccessful

²⁸ Livy 38 .18. 3-5: 'Then the army entered a tract of country called Axylon. It derives its name from the character of the soil; not only does it bear nothing in the shape of timber, but not even brambles or thorn bushes grow here, or anything which can serve for fuel. The inhabitants use cow-dung instead of wood.' (Yardley 2018)

examination of dung fuel might actually confirm that dung was not a very common fuel source in Roman Italy.

There may, however, have been certain regional trends in fuel use within the Italian peninsula. The North, for example, is less suited to oleiculture than the south of Italy, and the archaeobotanical data indicate that olive was a less important crop in the region. Thus, it seems likely that pomace fuel was less commonly used in the region, and, due to the ample wood supply and low urbanisation rates, demand for alternative fuel sources was probably low anyway (see Maiuro 2017 for discussion of low urbanisation rates in northern Italy). The weed seed data may offer support to this hypothesis, as weed seed frequencies are lower for the North than other parts of Italy, despite the fertile land in the region and its suitability for arable agriculture. Such a pattern may indicate that the use of dung fuel was even less common in the North than in other parts of the peninsula, which correlates well with a lower demand for alternative fuel sources in the region. In this way, the use of alternative fuel sources seems to have been more of a matter of convenience than a necessity.

10.5 Environmental/Climate Change

The Roman imperial period in Italy is viewed as having a high degree of climatic stability, leading to expansion of agricultural activity into marginalised areas, following by instability, flooding, and a cooling of temperatures during the Late Roman period (see McCormick et al. 2012 for details).

In efforts to detect the effects of the proposed period of Late Roman climatic instability, and episodes of flooding in particular, the chronological distribution of the plant hydrophilic Cyperaceae was examined. When Cyperaceae were viewed as a percentage of the entire weed seed assemblages (as was done for the Eastern dataset), the results appear of little significance due to the extremely low values produced for all periods (under 3%). However, when the frequencies for the individual Cyperaceae species present during each period were examined, the patterns appear to indicate a simultaneous increase in the frequency of hydrophilic plants over time and reduction in the number of species represented. These results may tentatively point to shifts in environmental conditions in two ways.

Firstly, the decrease in diversity, with five Cyperaceae species represented in the Pre-Roman period decreasing to only two in the Late Roman period, reflects the patterns that were observed in Bosi et al. (2019). In said study, a decline in the diversity of both spontaneous and cultivated plant taxa was interpreted as indicating homogenisation in the face of adverse climatic conditions (see Bosi et al. 2019). Moreover, the correlation between the results presented in said study and those presented

here is particularly strong due to the distribution of the Cyperaceae, which during the Roman and Late Roman periods, occur carbonised only in the North.

Looking beyond the Cyperaceae present in the data, it is notable that more of the most frequent weed seeds in the Italian dataset are absent from the Late Roman period than any other period.²⁹ This could be due to taphonomy and the fact that the dataset is comprised of fewer sites than the earlier two periods, or this may be further evidence of decreased ecological diversity as observed in the vicinity of the ancient settlement of Mutina in northern Italy (Bosi et al. 2019: 21).

The second potential implication is based on the increased frequencies observed over time: though highly hypothetical until tested on a larger dataset, it is possible that the increase in hydrophilic plants reflect the climatic shifts that have been described as characterising the Late Roman period, with flooding episodes augmenting the wet environments that these plants thrive in.

Still, with such a limited Late Roman dataset, it is extremely difficult to offer significant remarks on climate change. However, one additional pattern that may *possibly* be interpreted as being related to such shifts is exhibited in the distribution of rye. The data support an increase in the frequency of rye over time, especially in the North. Bosi et al. (2020) attribute this to an influx of foreigners from northeastern Europe, where it was valued due to its ability to grow in cold conditions and low-quality soils (Bosi et al. 2020: 12; see Plin., *HN* 18, 40.1 on association of rye with peoples from Alpine region). While this is certainly plausible, it is also conceivable that the frost-resistant qualities of rye may have made the grain particularly attractive during this proposed period of cooling, particularly in regions already characterised by cooler climatic conditions than the central and southern parts of the peninsula. Furthermore, such interpretations are not mutually exclusive: the cultural preferences of certain populations may have become increasingly attractive due to the climatic conditions at the time.

10.6 Roman prosperity - Late Roman decline

Recent scholarship has used archaeobotanical evidence to contribute to discussions of Late Roman decline, often pointing to decreased plant/plant food diversity as evidence of lowered standards of living and the instability that characterised the political and economic spheres during this period (see Sadori and Susanna 2005 on La Fontanaccia, Site 129, for example).

²⁹ Out of the topmost frequent weed seeds for each period and region, of which there are 32 in total, 27 are represented during the Pre-Roman period, 29 during the Roman period, and 19 in the Late Roman period.

Though it is important to bear in mind that the Late Roman period has significantly fewer sites than the other two periods, the dataset correlates well with this picture of decline in a number of ways. The Late Roman period shows a general decrease in fruit diversity, with the disappearance of pomegranate, lack of date, and a decrease in fig. There is also an observable absence of rare plant types such as flavourings and vegetables, which may indicate that hardship rendered dietary embellishment less feasible during this period, though the preservation of such items in the dataset is exceptionally rare in all periods.

Nut diversity appears to decrease at all site types in the Late Roman period, with walnut comprising 72% of the fully quantified assemblage. Such a pattern offers support to both the decline in plant food diversity, as well as the disappearance of the nut species that may have been associated with an element of prestige. Chickpea represents an additional potential prestige item that is absent from Late Roman dataset, though the status of the pulse needs further clarification.

However, a few biases that may affect the data are important to bear in mind. Unlike the earlier two periods, rural sites are the most common site type during the Late Roman period, comprising almost half of the total sites. It should also be noted that movement away from cremation during the later Empire may have contributed to decline in charred ceremonial assemblages, where many prestige items were typically found. Thus, at this point, though the dataset does appear to support Late Roman decline in not only dietary complexity, but also in plant diversity in general, any conclusions made here must remain tentative. It is the hope of the author that the picture will be clarified with the further archaeobotanical sample of Late Roman sites.

10.7 Conclusions

There appears to have been a considerable variety of agriculture systems in operation throughout the Italian peninsula during the study period. Intensive agricultural strategies do appear to have been variously employed, however the weed seed evidence suggests that there was no universal shift, with intensive and extensive methods continuing to be practiced concurrently.

The development of regional variations in agricultural practices can be detected, with the north of Italy seeing an increase in the introduction of intensive measures from the Roman period, while data from central and southern Italy appear to show a movement away from intensive cereal-based agriculture.

The continued importance of grape remains in all periods shows no indication of crisis in Italian wine production, supporting claims that the Italian wine industry continued to thrive despite increased

provincial competition. Specialisation in large-scale oleiculture, on the other hand, may have declined in the Roman period, though that is not to say that olive did not continue to be omni-important/widely cultivated.

The Roman period appears to mark a peak in dietary diversity, with the introduction of new fruits and even the presence of less commonly preserved plant types, such as flavourings. This diversity then declines in the Late Roman period, when the more luxurious foodstuffs disappear from the archaeobotanical record, which may point to a decline in the standard of living in the face of unstable conditions, both climatically and politically.

There are also indications of differential social access to, and preferences for, certain plant types, particularly with regard to nut varieties, with some, such as walnut and hazelnut becoming more widespread, while pine nut and almond may have carried a greater degree of prestige.

A high degree of variation is observable regionally (and likely within each region, though a more detailed study would be needed to assess this) in terms of both the uptake of new foods, such as fruit remains, which appear later in the North, as well as in cereals, with a continued diversity of cereal remains characterising the north throughout the study period. There may also be regional variations in fuel choices, though alternative fuel choices may have been less prevalent throughout the peninsula as a whole.

Finally, it is worth noting that, though a number of these trends, such as the decrease in glume wheats over time and the association between the Roman period and increased fruit diversity, have been previously suggested, it is significant that these trends are visible in the dataset, as such a large dataset has never before been examined for the whole of the Italian peninsula.

Chapter 11. A Comparison Between Italy and the Near East

As the results for both Italy and the East have now been examined and the implications explored, this chapter seeks to compare the agricultural economy and plant consumption in the two regions in order to shed light on the different ways in which the effects of imperial presence were (or were not) made manifest.

11.1 Taphonomy and formation processes

Before comparing the results of the analysis of the Eastern and Italian datasets, the differences in the taphonomies and biases affecting the material should be taken into consideration. To this end, it is important to consider the types of deposits that comprise each of the datasets (Figs. 11-1 and 11-2 below; see Appendix B for details of categorisation).

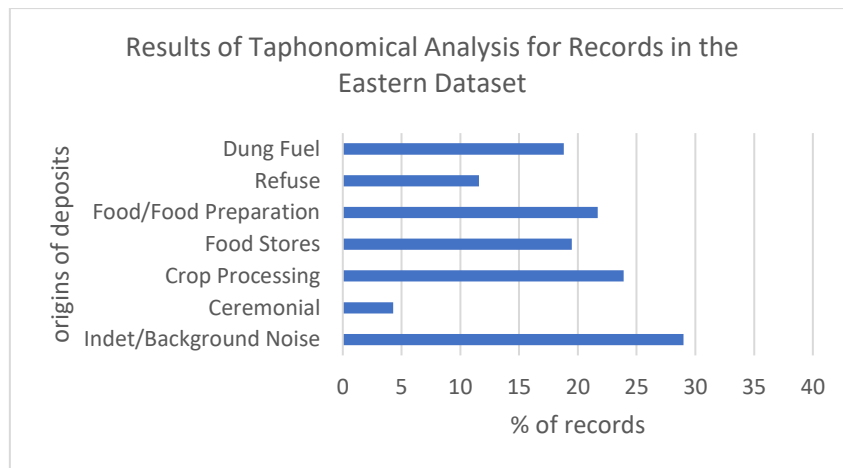


Figure 11-1 Categorisation of records in the eastern dataset according to results of taphonomical analysis. Note: figure produced for 'Indet/Background noise' includes only records with no interpretable samples.

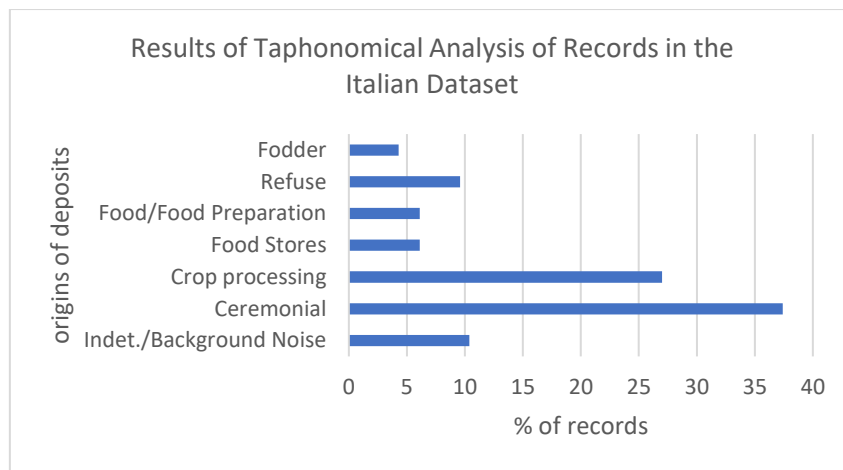


Figure 11-2 Categorisation of records in the Italian dataset according to the results of taphonomical analysis. Note: figure produced for 'Indet./Background noise' includes only records with no interpretable samples.

Crop processing appears to have played a significant role in the formation of the datasets in both regions. Such deposits are the most commonly represented type of assemblage in the East and are second only to ceremonial sites in Italy. As has been previously highlighted, the uneven distribution of ceremonial sites is abundantly clear, contributing over 35% of records in Italy, though less than 5% in the East. Measures were taken to avoid the skewing of the data that this may cause, particularly with regard to weed seed analysis. Food stores and remains representative of food/food preparation are more common in the Eastern dataset, though many low-density assemblages in the Italian dataset were interpreted as 'background noise,' which is often formed by accidentally deposited plant foods (typically during food preparation or consumption) that gradually build up over time (see Appendix B for detailed interpretation of Italian records). Dung fuel does not appear to be a major contributor to the Italian dataset. Eight sites may have fodder material, though most of these were preserved in the eruption of Vesuvius (see assemblages from Site 132, 157). In the East, 28.8% of records contained no samples able to be interpreted by the author, whereas in Italy only 10.4% were completely indeterminate. The lack of interpretation for these records was typically caused by vague archaeobotanical reports, lacking in quantification, sample size, and contextual information.

As has been noted, many of the samples have been reported using 'sumsampling,' which typically prohibits detailed interpretation of the remains (see 7.1.5.3 on this technique). As such, the percentage of sites producing samples able to be placed in the categories in Figures 11-1 and 11-2 above appears relatively low, and likely underestimates the importance of the various activities in the formation processes of the archaeobotanical record for each respective region. This can be seen in the case of dung fuel in the East, for example: while the collective weed seed assemblages show a considerable representation of fodder/forage plants that were likely charred in dung fuel use, only about 20% of sites yielded individual samples that were able to be firmly identified as dung fuel

based on context (such as a hearth, tabun or oven) or composition. However, many of the samples contained material that likely derived from dung fuel, but as it is mixed in with other types of deposits, dung fuel use cannot be isolated and identified. Due to data quality issues such as this, much of the analysis below was only able to be performed at a coarse level.

Another factor to bear in mind when comparing the Eastern and Italian datasets is the uneven distribution of sites within each region. In the East, the vast majority of records are from sites located in the Levant (circa 70% in total, and more in certain periods), and because of this, regional analysis within the East is somewhat less fruitful than in Italy. Though certainly the Italian dataset is not evenly dispersed throughout the peninsula, with the north producing more records than the other regions, the distribution is not as skewed in comparison to the Eastern dataset.

11.2 Agricultural regimes

11.2.1 Risk reduction

One aspect of agricultural regimes that was touched upon is that of risk reduction. Agricultural risk management strategies have previously been studied by Marston (2011), who defines risk as ‘variance in annual production,’ and risk management as, essentially, the methods used to manage and mitigate the effects of said variation, such as diversification and intensification in agricultural regimes.

Though the chronological distribution of Cyperaceae in the East was tracked in order to examine intensification via irrigation in the region, such an exercise is less suited to the Italian dataset due to environmental differences (i.e. the region is simply not arid enough for such a lens of analysis to be effective) (see 10.1.1 Intensification). Still, while in the East the distribution of hydrophilic plants suggests an increase in irrigation after the Early Pre-Roman period, there is ample archaeological evidence in Italy of increased manipulation of water resources under Roman occupation, whether this be in the construction of hydraulic structures such as aqueducts, or in largescale drainage projects, such as in the Pontine marshes (Wilson 2009; Keenan-Jones 2013). Thus, in both regions, the investments of capital and labour in such projects can be viewed as a method of reducing risk in agricultural regimes, as well as of intensification, which will be discussed in more detail below.³⁰

³⁰ Though there is ample work to be done in examining the effects of irrigation on archaeobotanical assemblages throughout the Roman empire, such an analysis is outside the scope of this thesis.

11.2.2 Intensification

In both regions, the data point to an increase in intensive cultivation practices following Roman occupation, though it seems that such techniques may have been most prominent somewhat later in the East, where intensive techniques appear to be especially visible in the Late Roman period dataset.

In Italy, autecological analysis suggests an overall increase in soil quality in the Roman period, indicating the introduction of additional intensive measures into agricultural regimes (Figs. 10-1). Indicators of high soil quality then decrease somewhat in the Late Roman period, which may be due to the interruption of normal cultivation practices during this period of turmoil.

Unfortunately, autecological analysis was not possible for the Eastern dataset, due to a paucity of species level identifications, as well as a lack of Ellenberg-type indicator values for the region (see Pignatti et al. 2005 for indicator values for Italy, Böhling et al. 2002 for the Aegean). However, the author was able to look at shifts in soil quality by coarser methods, in examining the distribution of plants widely accepted to be associated with soils of high nutrient content, such as *Chenopodium album* and *Atriplex* sp. Notably, both *Chenopodium album* and *Atriplex* sp. occur at the highest percentage of sites during the Late Roman period, despite the generally higher frequencies that characterise the wild/weed seed assemblages from the earlier periods.

Thus, in both regions, there appears to be evidence suggesting an increase in the implementation of intensive measures to improve soil quality, introduced following, or during, the Roman period. It should be noted, however, that these results do not indicate a universal process of intensification: in Italy, for example, this can be seen in the autecological analysis, which shows that weed seeds associated with low soil quality also peak during the Roman period. As such, the analysis for Italy serves to highlight an increase in not only intensive cultivation practices, but also in the diversification of agricultural regimes; rather than indicating a one directional shift toward – or away from – intensive cultivation techniques, the archaeobotanical evidence instead points to an expansion in practices. Such results serve to demonstrate that intensive and extensive agriculture should not be viewed as mutually exclusive, and that varied agricultural practices likely characterised all regions of the Roman empire.

11.2.2.1 Crop Rotation

The intensification observable in the dataset may have been carried out by a variety of methods; one intensive technique that was examined more closely is crop rotation. In order to track said practice, the author examined the distribution of large assemblages of fully quantified pulses and free-threshing wheats, which require more nutrient rich soil than other cereals.

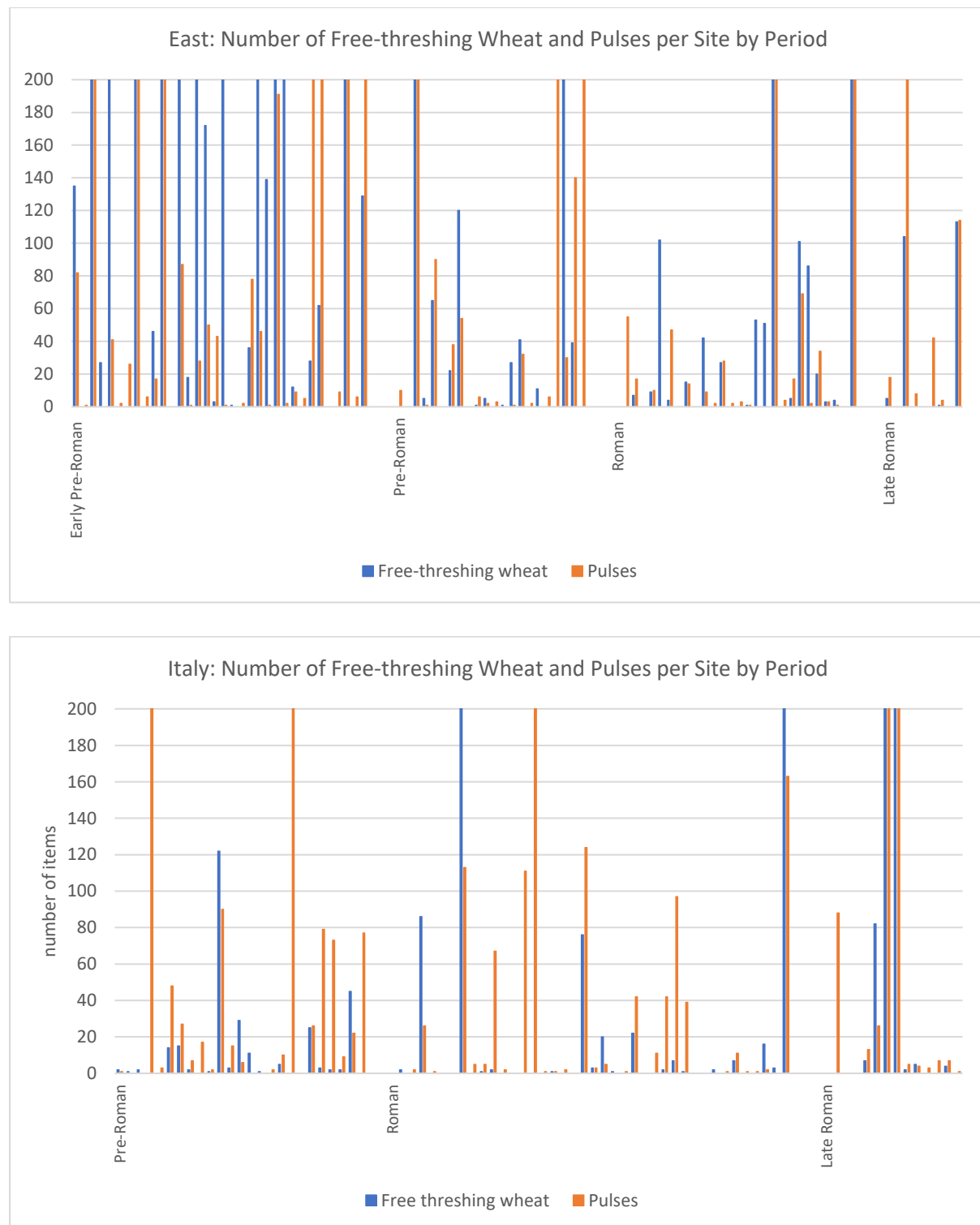


Figure 11-3 Number of free-threshing wheat and pulses per site by period in (a) Eastern dataset and (b) Italian dataset.

In comparing the results for Italy and the East, it seems that large, correlating free-threshing wheat and pulse assemblages peaked in prevalence (or at least in visibility) in different periods in each region: while in the East, crop rotation is most visible in the Early Pre-Roman period, in Italy it is most easily detected in the Late Roman period.

In order to further confirm this pattern, the percentage of all fully quantified datasets that produced more than 20 of both pulses and free-threshing wheats was considered for each phase in both Italy and the East (Table 11-1). The results support those demonstrated above, with the Early Pre-Roman period producing the largest percentage of sites in the East, while in Italy, a marked increase can be seen in the Late Roman period.

Table 11-1 Percentage of fully quantified sites with greater than 20 pulses and free-threshing wheats.

Period	Italy	East
Early Pre-Roman	-	44.12%
Pre-Roman	12%	31.82%
Roman	12.50%	14.29%
Late Roman	23.08%	22.22%

Though always prevalent, the possible increase in crop rotation with wheat and pulses in Late Roman Italy may point to an increasing need to push land to produce as much crop as possible in light of increased political and economic instability. With ongoing interruptions to the normal operation of the agricultural economy, farmers may have been under increased pressure to leave no land uncultivated. Furthermore, reforms under Diocletian in the late 3rd- early 4th century AD rendered Italy no longer exempt from direct taxation and put greater pressure on landlords to extract taxes from their tenants (Marzano 2020: 440 for brief overview). At this time, tenant farmers (*coloni*) were also increasingly tied to their land, and, with pressure from their landlords for rent in kind requiring regular crop output, they may have been forced to cultivate the same portions of land more continuously (see Kehoe 2013: 44 on this shift in policy). Thus, it is possible that this diminished their ability to leave large portions of land fallow, encouraging other methods of improving soil quality -- i.e. crop rotation.

In the Early Pre-Roman East, on the other hand, regular crops in rotation may have been necessary in order to produce surplus to fill stores, which sustained large, centralised settlements rather than the urban markets of the later periods. These storage caches are observable in the archaeobotanical record, and their visibility has contributed to the patterns observed in Figure 11-3 above.

11.2.2.2 Ley-farming/Convertible Husbandry

Additional methods of intensification include the incorporation of ley-farming/convertible husbandry into agricultural systems. Further to the discussion above, ley-farming is essentially a long crop rotation, though rather than sowing regular crops (of pulses, for example) in between cereals, the land is left to fallow for a longer period of time. Leys may also be cultivated, and often are

utilised for fodder crops. In a convertible husbandry-based system, animals are left to graze on leys/fallow lands (see Kron 2000).

In an effort to detect these practices, the author looked to the frequencies of plants that are well-suited to pastures and to ley-farming. *Medicago* sp., for example, is known to thrive in such systems, and the distribution of the plant in the East shows a growth in its prevalence, with the frequency of *Medicago* sp. increasing more than twofold in the Late Roman period (Fig. 11-4). Tracking the distribution of the plant in the Italian dataset, however, is somewhat more complicated: though the East is rather lacking in *Medicago* identified to the species level, there were a larger number of specific *Medicago* species reported in the Italian dataset. As such, the average for all (Italian) *Medicago* species present was calculated in order to produce a comparable value for each of the periods.

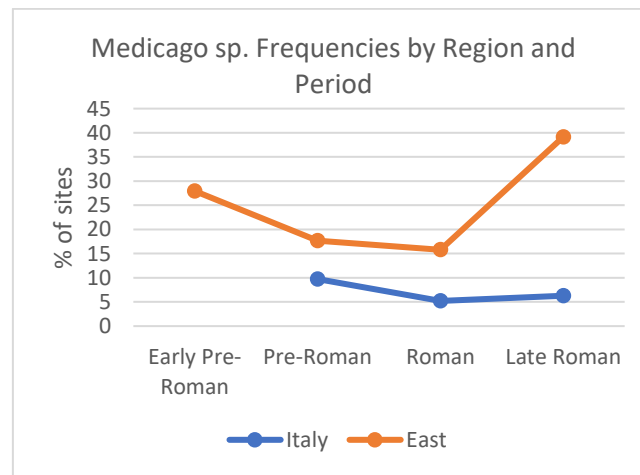


Figure 11-4 Percentage of sites with *Medicago* sp. by region and period. Note: the values for Italy are the average of all *Medicago* species present.

The results show that *Medicago* sp. is found considerably more frequently in the Eastern dataset, particularly in the Late Roman period. In order to explore this pattern further, the author looked to the pasture crop *Biserrula* sp., which is known to be well suited to intensive farming systems with pasture crop-rotation, as well as to extended periods of ley. *Biserrula* is not present in the Italian dataset, which could be due to an actual paucity of the plant or taphonomical considerations such as low rates of dung fuel use. It may also be that the drought-resistant properties of *Biserrula* make the plant particularly suited to the arid environs of the East, but less necessary in parts of Italy. In the East, however, *Biserrula* is absent during the Early Pre-Roman and Pre-Roman periods, but appears at 2.63% and 4.35% during the Roman and Late Roman periods respectively. Though the frequencies are low, the increased visibility of *Biserrula* in the Eastern dataset correlates with the increase in

Medicago sp., and may seem to support an increase in pasturing and, more generally, intensification in the East.

Furthermore, the ratio of wild/weed seeds to cereals in the Eastern dataset, which points to a possible increase in grazing relative to foddering in the Late Roman period, also suggests an increase in pasturing/convertible husbandry-based regimes (see 9.4.2.1 Convertible Husbandry). Such a measure, however, is not applicable to the Italian dataset due to taphonomical differences (i.e. the significantly lower rate of dung fuel use, as is suggested in the section on fuel below) (see Marston and Miller 2014 on wild/weed seeds to cereal ratios).

However, there are a number of limitations to this approach that should be recognised: firstly, it is important to acknowledge that the mere presence of *Medicago* sp. (and/or *Biserrula*) cannot, as a rule, be taken to indicate ley-farming or convertible husbandry; certainly, more archaeobotanical (and contextual) indicators would be needed to support the verity of such an interpretation. Secondly, the results produced for Italy do not agree with the ancient literature, nor previous scholarship that has highlighted evidence of ley-farming/convertible husbandry-based regimes, and it seems unlikely that such systems were as rare as the distribution of *Medicago* sp. would suggest (see Bowes et al. 2017 on southern Tuscany in Late Republican/Early Imperial periods; Kron 2000 on convertible husbandry).

Thus, though, in general, it appears that pasture crops are more visible in the Eastern dataset, it is important to bear in mind that this is likely due to issues of taphonomy (see 11.4.1 Dungon dung fuel). Furthermore, it should be noted that, rather than indicating a lack of pasturing and convertible husbandry-based regimes, which are widely attested in ancient literary sources, it seems likely that the absence of archaeobotanical evidence for such a system can be traced to issues of preservation, as well as to the general challenge of specifically identifying such a practice in the archaeobotanical record.

11.2.3 Fodder

Another aspect of the agricultural economy that should be touched upon is foraging and fodder regimes. Fodder consists of plants that are harvested and then fed to animals, in contrast with pasture plants that are fed on directly by the animals themselves while grazing. Fodder can be difficult to detect in the archaeobotanical record for multiple reasons:

- As fodder and grazed material can consist of the same species, it is difficult to discern between the two in the archaeobotanical record.

- Some common fodder plants, such as barley, wheat varieties, as well as pulses including *Vicia faba*, *Lens culinaris*, and *Cicer arietinum*, to name a few, were also commonly consumed by humans, which complicates efforts at discerning for whom, or what, such plant foods were intended (see, for example, Jones 1998).
- The fodder plants that are wild species are problematic because defining between foddering material and wild/weed inclusions is not always possible.
- Almost anything in the archaeobotanical record can be fodder; in addition to cultivated fodder plants and wild species, animals may also be fed various fruits, as well as agricultural by-products (the importance of agricultural residues in the feeding of livestock, for example, is highlighted by Foxhall (1998)).

The Italian dataset features two sites (the House of Chaste Lovers in Pompeii [Site 132] and Oplontis [Site 157]) that produced definite fodder stores, which were preserved in the eruption of Vesuvius (see Ciaraldi 2007; Ricciardi and Aprile 1998). These assemblages allow for a rare opportunity to examine fodder plants in detail. However, the wide range of plants represented only serves to further emphasise how varied such material can be, and the high wild species content highlights the difficulties in identifying foddering material in the archaeobotanical record. The assemblage found in the manger at the House of Chaste Lovers in Pompeii, for example, contains a wide range of species, with the most abundant being *Vicia faba*, *Poa pratensis*, *Lolium perenne*, *Galium aparine*, and *Polygonum convolvulus*. Unfortunately, none of these species can be used as fodder indicators more widely, as they each pose certain challenges: *Vicia faba*, for example, cannot be used to track fodder due to its popularity as a food for human consumption, while the wild species *Polygonum convolvulus* is a common weed of cereal fields, and thus, in other datasets, may be attributed to crop processing.

Thus, efforts were made by the author to examine plants that are specifically known to be forage and fodder crops, such as *Medicago sativa*, which is widely praised by the Roman agronomists for its utility as fodder (see Columella *Rust.* 2.7). Unfortunately, *Medicago sativa* cannot be used as an indicator, as a limited number of Eastern sites and only one site in Italy (San Giovanni di Ruoti) produced remains, though whether this is due to its absence in the archaeobotanical record, or a lack of species level identifications is unclear. Similarly, fenugreek (*Trigonella foenum-graecum*), though championed as a top fodder crop by the ancient agronomists, is conspicuously absent from most of the dataset, occurring only at 4.44% of sites in the Early Pre-Roman East, and absent from the Italian assemblages altogether. *Trigonella* sp., however, is present and, in this way, the lack of fenugreek may also be due to a lack of species level identification in the dataset (see Columella, *Rust.* 2.7; Cato, *Agr.* 27.1).

As such, the author elected to track the distribution of additional crops that were A) emphasised as being the best fodder materials by the ancient agronomists and B) less prominent in human diet (i.e. not tracking barley or lentil, as these crops are particularly challenging to interpret). Medick (included here as *Medicago* sp., but also more specifically as *Medicago sativa*) and fenugreek are included; though due to the limitations described above, the latter has been included in the analysis only in its more general form, as *Trigonella* sp. In addition to *Medicago* and *Trigonella*, Cato recommends sowing plants including clover (*Trifolium* sp.) and bitter vetch (*Vicia ervilia*), while Columella (*Rust* 2.7) adds chickling vetch (*Lathyrus sativus*) to the aforementioned recommendations by Cato (*Agr.* 27.1). *Melilotus* is also included in the analysis as a common fodder/forage crop, not consumed by humans.

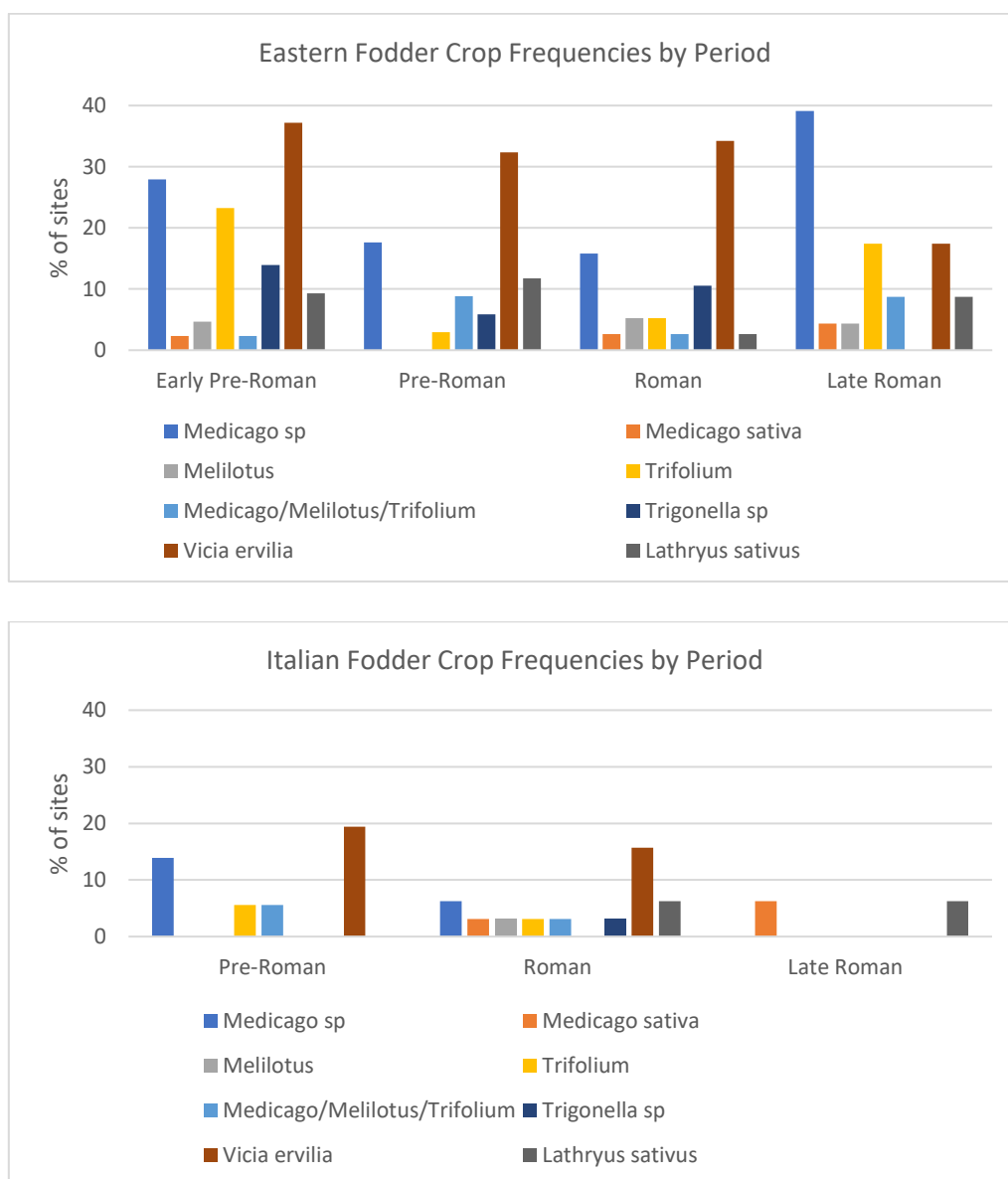


Figure 11-5 Frequencies of selected fodder crops in the (a) Eastern and (b) Italian datasets by period.

In examining the distribution of fodder plants in both Italy and the East, it is immediately clear that the frequencies are significantly lower overall for Italy than for the Eastern dataset. This is likely due, at least in part, to taphonomical differences: dung appears to have been a less common fuel source in Italy (11.4.1 Dung), and thus the forage and fodder plants consumed by animals are far less commonly preserved. As such, the Italian dataset may be less suited to the analysis of fodder crops, as such remains are more likely to be preserved by chance than derived directly from consumption.

11.2.4 Specialisation

Neither Italy nor the East produced a wealth of datasets that allowed specialisation to be tracked by densities, which would seem to indicate that specialised crop production was not prominent in either region. As discussed in the previous chapters, few sites produced samples with densities over seven items per litre. This is likely, at least in part, due to the high percentage of sites for which sample size was not indicated in the archaeobotanical reports. In this way, efforts at assessing densities have shed light on the lack of standardisation in archaeobotanical studies in Italy and the East relative to other regions (such as the UK) where such a method has been more successfully employed (van der Veen and Jones 2006; Lodwick 2017). As such, it appears that such a measure may not be entirely useful for assessing specialisation in either region considered here, though it is hoped that in the future, the publishing of further detailed archaeobotanical reports for the region may remedy this situation.

In addition to these issues, it is also possible that specialisation was not dominant in the regions considered here as farmers looked to polycropping/mixed agricultural regimes (see Decker 2009 chapter 7 on movement away from specialisation and crop monoculture towards mixed farming in the Late Antique East). Additionally, the 'limited specialisation' model, as suggested by Decker for the East, may be another attractive possibility. Such a system is characterised by a reliance on cash crops (such as the olive in parts of the East), but with other products mixed in where possible in order to reduce risk and optimise agricultural output (Decker 2009: 207). With this in mind, it is worth looking at some of the most important cash crops in order to examine cultivation patterns more closely.

Olive

In order to measure specialisation, the percentage of sites with fully quantified datasets that produced more than 10 olive remains was considered for both Italy and the East. In displaying the results for each of the regions together, the differing trajectories can be detected.

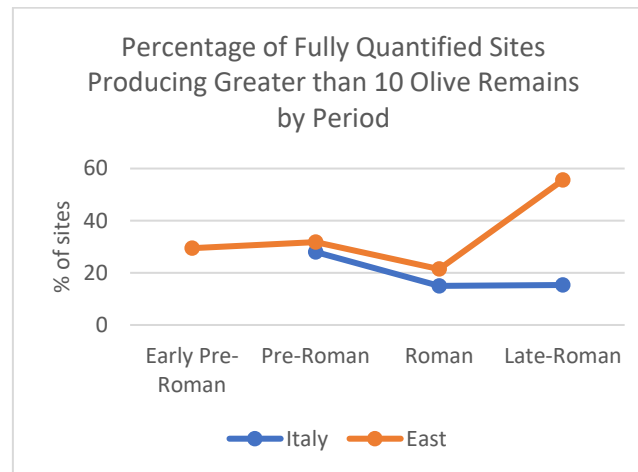


Figure 11-6 Percentage of fully quantified sites producing greater than 10 olive remains by period for both Italy and the East.

It is immediately clear that the percentage of sites with relatively large olive assemblages decreases in Italy and increases in the East over the course of the study period. This implies certain differences in the organisation of the olive and olive oil industry in each of the regions. While in Italy, the author has suggested that specialised, large-scale olive oil production becomes less prominent, in the East, olive cultivation and oil production appear to have experienced a surge in the Late Roman period.

As previously discussed, in the East, Late Roman population pressures led to the expansion of settlements into marginalised areas such as the Syrian limestone massif (and the Negev). Though Italy may also have seen settlements expand into marginalised lands over the course of the Roman period, the nature of the environments differed: while in the East populations spread to increasingly arid environments, in Italy the draining of swamps and marshlands allowed for expansion into areas less suitable for olive cultivation (Keenan-Jones 2013). The arid environments in the East would have been less hospitable to many crop-types, but the xerophytic olive is able to thrive in such conditions. In this way, olive oil production would, necessarily, have been a highly important cash crop in these areas as the occupying peoples strove to cope with environmental constraints on agricultural systems.

Meanwhile, in Italy, while in some regions (i.e. the North) the climate is less suited to oleiculture, in other areas farmers would have been able to cultivate a wider variety of plants, and thus would have

had the option to produce other profitable crop-types (including fresh fruit or vegetables) in a market that was increasingly saturated with olive oil from the provinces (see Kron 2017 on benefit of producing non-staple goods, and outsourcing for less expensive staples such as cereals). Such an opportunity may have been particularly attractive for smaller farms looking to make a profit without a large-scale operation on a vast estate. Even in the south of Italy, scholarship (e.g. De Simone 2017) has pointed to the possibility that in specific areas such as the Vesuvian plain wine production was more important than olive oil production (De Simone 2017: 40). This has previously been corroborated by the lower rates of olive pollen in the palynological record, and now receives further support in the archaeobotanical macrodata presented here (see Russo Ermolli et al. 2014 for palynological analysis).

In this way, one can see the high degree of connectivity between the agricultural economies of the different provinces, which, at least with regard to large-scale olive specialisation, appear to shift in a way that is almost complementary, according to comparative advantage. Such an analysis highlights that -though already clear and fairly instinctual- the functioning of regional economies throughout the Roman world is best considered relative to each other rather than in isolation.

Grape

In contrast to the olive remains, the distribution of grape assemblages appears to remain relatively consistent in all periods in Italy, demonstrating the continued importance of the plant. There appears to be more relatively large grape assemblages than olive in the data from all periods, though in the Pre-Roman period the figures are relatively similar for each of the plants. Such a pattern goes against previous arguments for a 1st century AD decline in the Italian wine industry due to competition from the provinces, and instead supports the continued importance of viticulture throughout the Roman imperial period (see Rostovtzeff 1957 on the decline of the Italian wine industry in the 1st century AD; for opposing viewpoints, see Purcell 1985, Tchernia 1986, Van Limbergen et al. 2017 on continued flourishing; Marzano 2007: 113-120 on archaeological evidence of grape cultivation).

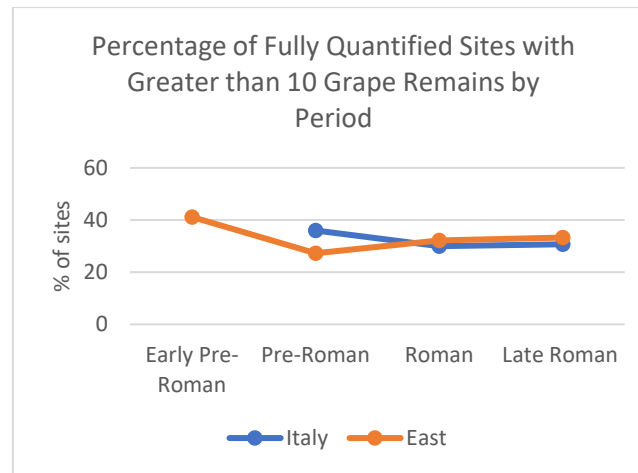


Figure 11-7 Percentage of fully quantified sites with more than 10 grape remains by period.

Similarly, in the East, the proportion of sites with larger grape assemblages appears to remain relatively stable throughout the study period. Although, while in Italy, grape is the most common fruit in all periods, in the East olive is more frequent in two of the four periods considered (Pre-Roman and Late Roman). Thus, particularly in the Late Roman period, olive may appear to have been a more important cash crop than grape. However, it should be noted that grape remains may be less commonly preserved than olive, as, not only is the olive stone markedly denser and more prone to surviving carbonisation, olive oil pressing residue was also a frequently utilised fuel source, and thus subject to regular charring (for more on pomace, see 6.3; 9.6 and 11.4.2 below).

In general, it is likely that the demand for wine was consistently so high in both regions, that viticulture was always an important and worthwhile venture, especially given its suitability for polyculture. Despite increased wine production throughout the Roman provinces, both regions had large urban centres and growing populations that needed providing for, and the archaeobotanical evidence does not show any indication of significant impact from provincial competition.

Cereals

There generally appears to be a reduction in the specialisation of large-scale cereal production in much of Italy, likely as intercultivation rose in prominence. This can be seen in the notable decline in cereal frequencies in the Roman period, possibly due to importation of grain from the provinces (see 10.1.2 Specialisation. There are, however, regional variations in this pattern, as it seems cereal production may have been a more important part of agricultural regimes in the north of Italy than in other regions. This can be seen in the continued cereal diversity and rise in arable weed seeds

indicative of intensive cultivation practices, which suggests that cereal-based agriculture may have continued in importance.³¹

It seems that there may also have been a movement away from largescale cereal production in the East. The particularly high frequencies observed for arable weed seeds in the Early Pre-Roman East may highlight the importance of arable agriculture during this period; arable weed frequencies then decline in the later periods, possibly due to a shift in agriculture regimes, with other crops such as fruits, rising in prevalence (see Table 7-6 on weed seed frequencies; see Figs. 7-31 through 7-34 for increase of fruit dominated sites).

As has been previously observed, this may also speak to a system based on polycropping, with an increased focus on horticulture as well as on cash crops such as vine and olive, and cereals being worked in where possible. Such a pattern is supported by the Late Roman Syro-Roman lawbook, which, as Decker (2009: 162) points out, estimates that 1 *iugerum* of olive trees, 5 *iugera* of vineyard, and 20 *iugera* of arable land may be equally taxed. These figures suggest that arable agriculture was a much less profitable venture, which would have discouraged the independent small farmers of the Late Antique East from specialising in cereal production, encouraging a polyculture-based regime as described above instead.

11.3 Dietary patterns

Both regions support the association between Roman occupation and increased diversity in fruits, as has been observed in other parts of the Roman world, though in Italy this is made manifest by new introductions, while in the East, less common fruit types, such as *Phoenix dactylifera* (date) and *Prunus* sp., increase in prevalence. This diversity then continues into the Late Roman period in the East, though in the Italian dataset, a reduction in fruit diversity can be observed (for further discussion of this contrasting pattern, see 11.6 The Impact of climatic instability and disparate Late Roman trajectories Late Roman period).

In considering the distribution of specific fruit types, it is interesting that pomegranate is most frequently encountered in the earliest period in both regions, though in the East this is Early Pre-Roman and in Italy, Pre-Roman. In the East during the Roman and Late Rome periods, pomegranate becomes restricted to occurring only at urban sites, despite previously being found at rural sites as

³¹ Note: Bosi et al. 2020 indicate a decrease in minor cereals (such as *Panicum miliaceum*) in the Imperial period for the north of Italy as well, and, though decrease they may, the region still exhibits relative diversity when compared to the southern and central Italian datasets.

well. In Italy, pomegranate only ever occurs at ceremonial, urban and villa sites, despite ample references to the fruit in the ancient literature (Columella, *De Arboribus* 23; Cato, *Agr.* 7.3, 51.1; Plin., *HN* 17.26 and, for medicinal uses, *HN* 24.47, 23.62.123, 20.52 among others). *Prunus* fruits, on the other hand become present at a greater range of sites in both regions during the Roman period, which may show shifts in cultural preferences toward particular fruits as others decline in popularity. This pattern may also be linked to shifts in cultivation methods, as horticulture becomes more prevalent and irrigation increases in both regions, the drought tolerant qualities of pomegranate may have become less important (see Kamash 2012 on irrigation in the East; Keenan-Jones 2013 on Italy).

Despite becoming more common overtime in the East, *Prunus* fruits generally occur at higher frequencies in the Italian dataset. Ancient literary sources give high praise to *prunus* fruits (e.g. *Prunus domestica* or common plum; *Prunus avium* or sweet cherry), and their popularity can be seen in Pliny's description of the peach as the most expensive fruit to ever be sold (*HN* 15.11; see *HN* 15.12 on plums; 15.30 on the different varieties of cherries). Such a demand would have encouraged increased production of *Prunus* fruits in Italy, whereas in the East, *Prunus* fruits may have been more familiar, and less a component of haute cuisine. Certainly, ancient literary references demonstrate that (at least some) *Prunus* fruits were widespread in the East long before being introduced to Italy: Pliny, for example, states that L. Licinius Lucullus brought the cherry to Rome from the Black Sea region, and also refers to the peach as the 'Persian apple' (*HN* 15.30 on the cherry, 15.11 on the peach).

Unlike the *Prunus* fruits, date, however, is more common in the Eastern than the Italian dataset. In Italy, dates would have been imported luxury foods, and are only present in the Roman period at ceremonial and urban sites. In the East, date, which grows particularly well in the warmer parts of the region, is present at most site types in all periods, and is actually most prevalent at rural sites in the Roman period (Zohary et al. 2012: 131). In this way, it appears that many of the fruits that were considered luxury foods in Italy and the Western Roman empire would have been more common components of diet in the East.

Still, the (albeit somewhat smaller) increase observable in the frequencies of *Prunus* fruits in the Eastern dataset may indicate that neither Italy nor the Near East was immune to the influence of emerging dietary preferences in the other, thus demonstrating the interconnectedness of regional dietary patterns throughout the Roman world.

Despite the increased prevalence of horticulture and fruits in both regions, cereals would have remained fundamental to diet throughout the study period. In terms of the various cereal types,

barley and free-threshing wheats appear to be dominant in both Italy and the East, though glume wheats occur at the same percentage of sites as free-threshing wheats in Pre-Roman Italy (Figs. 7-12, 8-11). Though free-threshing wheats were the cereal of preference, it is difficult to say whether much of the barley was intended for human or animal consumption. In any case, barley would have been a safeguard against famine during times of drought or in the case of an unsuccessful cereal crop.

The remains from both regions support a movement away from glume wheats, except for in times of drought or instability, when the durability and storability of glume wheats would have become more desirable (Figs. 7-12, 8-11). This pattern demonstrates the wilful prioritisation of cultural preference in cereal choices, even in regions where free-threshing wheats are more difficult to cultivate (i.e. the arid areas in the East), unless extenuating circumstances necessitate otherwise.

As previously mentioned, minor cereals were more important in marginalised landscapes of both regions (e.g. the 'Greater Middle East,' which is more arid than -say- the coastal Levant; the less temperate parts of northern Italy), which highlights that the incorporation of these cereals may have been motivated more often by necessity than dietary preference. Notably, the minor cereals are more common in the Italian dataset than in the East in all periods here considered, which points to a higher degree of diversification in cereal cultivation in Italy, and generally suggests that minor cereals were a less important component of diet throughout much of the East (compare Figs. 7-12 and 8-11).

In considering the distribution of the minor cereals more closely, it is interesting that rye disappears from the archaeobotanical record in the East following the Pre-Roman period despite the cereal's ability to withstand conditions of drought, such as is thought to have occurred during the Late Roman period in the region (McCormick et al. 2012; Izdebski et al. 2016). Such a phenomenon may point to a general resistance to the cereal, even in times of hardship, because of cultural preferences in the East. Meanwhile, the opposite trend can be seen in Italy, with an increase in rye overtime. This increase may be influenced by multiple factors, including both the cooling of temperatures proposed for the Late Roman period, which rye would have been able to withstand, as well as the aforementioned cultural influence of the Celtic peoples in the Alpine North (see Plin., *HN* 18.40; see discussion in 10.5). In this way, it may be possible to see the cultural influence of different populations in two datasets, with the peoples of Italy being more amenable to rye despite both regions seeing conditions in which the cereal may have offered benefits. This suggests that reactions to climate/environmental changes were impacted by local cultures and cuisines, highlighting the primacy granted to the latter phenomena.

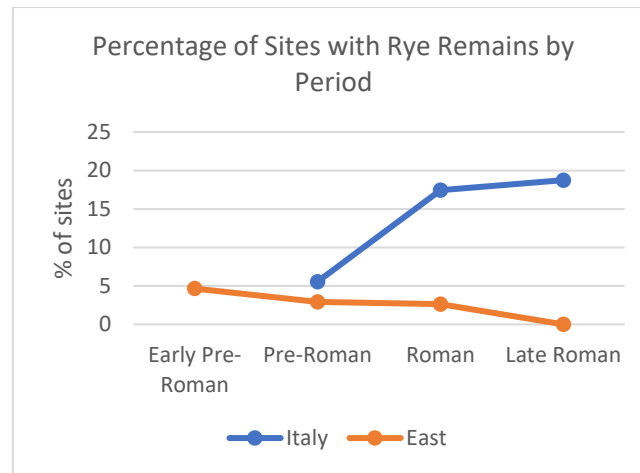


Figure 11-8 Percentage of sites with rye remains by period.

Notably, however, sorghum, which is tolerant of very warm and arid conditions, first appears in the dataset in the Late Roman East (Zohary et al. 2012: 72). This may show some willingness to adapt cereal consumption in times of environmental/climatic strain, though perhaps not in the case of rye specifically.

In general, though the range of pulses found in each region is the same, pulses occur at higher frequencies in the East in all periods. *Lens culinaris*, *Vicia ervilia*, *Cicer arietinum*, and *Lathyrus sativus* are all more frequent in the East throughout the whole of the study period, speaking to the importance of the pulse in agricultural regimes as well as in dietary patterns. The only type of pulse that deviates from this pattern is *Vicia faba*. *Vicia faba*, or broad bean/fava bean, is the most common type of pulse in Italy in all periods, though in the East it occurs only at a small percentage of sites. This may indicate that *Vicia faba* was a more important part of diet in Italy than in the East.

Chickpea is surprisingly scarce in both datasets. It is unclear if this is due to preparation methods that did not commonly lead to preservation by carbonisation, or if the pulse simply was not actually an important component of diet in either region. It is, however, interesting to note that Pliny indicates that the chickpea can be detrimental to soil health unless steeped before sowing, stating that the pulse 'is apt to scorch the ground' (Plin., *HN* 18.32). Furthermore, *Vicia faba* is actually more efficient at nitrogen fixing than the chickpea, though it is unclear whether ancient authors were aware of this.³² With this in mind, it is possible that chickpea is less widespread because it was a less beneficial crop choice than other pulses, and thus the cultivation of chickpeas may not have been motivated by agricultural considerations, but rather by dietary preference alone. If this is true, then the ability to cultivate chickpea over other pulses would have depended on a certain level of security

³² <https://grdc.com.au/resources-and-publications/all-publications/factsheets/2013/07/grdc-fs-nfixation-chickpeas>.

and prosperity, an idea which is supported by the pulse's absence from the dataset of Late Roman Italy. Indeed, Bakels and Jacomet (2003) categorise the chickpea as a luxury food in central Europe, imported for the comfort of the Roman officers stationed in the region. However, according to the new results here presented, it may be that, rather than being useful as a sort of indicator of 'Romanness,' the chickpea may have been relatively rare – and possibly prestigious- in the rest of the Empire as well, Italy included.

Though many plants were brought westward to Italy by the Roman period, some seem to have continued to remain relative rarities after introduction. *Pistacia*, for example, is described by Pliny as a nut that is particular to Syria (Plin., *HN* 13.10). Pliny credits L. Vitellius, the governor of Syria and the father of the short-lived emperor Vitellius, as introducing the plant to Italy in the 30s AD, which suggests that during the Roman imperial period, the nut likely remained rather exotic in Italy, as is attested by dearth of the nut in the archaeobotanical record (Plin., *HN* 15.24).³³ *Pistacia* seems to be somewhat more common in the East, and was even stored in a cache at Tel el-Mazar during the Early Pre-Roman period, demonstrating the dietary importance of the nut. *Pistacia* does, however, appear to decrease in frequency after the Pre-Roman period, and is missing from the Late Roman dataset altogether. It is possible that this trend signifies a movement away from previous culinary practices (such as those influenced by Persian consumption patterns). However, as the nut never occurred at markedly high frequencies, this pattern may benefit from further consideration when more data becomes available.

Unlike *Pistacia*, *Prunus dulcis* (almond) and *Juglans regia* (walnut) increase over time in the East. Both of these nuts were valued in Roman Italy, as is attested by the dominance of walnut, which is the most common type of nut from the Roman period onward, and, in the case of almond, by its distribution at only prestigious site types, as well as the praise afforded to the flavour of the almond by Pliny (*HN* 15.24). In this way, the nut assemblages in Italy and the East seem to develop correspondingly, at least in reference to these particular species, suggesting a link in shifting dietary preferences among the provinces.

While flavourings are scarce in the Italian dataset, occurring only at prestigious site types and only during the Roman period, finds of caches of flavourings in the East in the Early Pre-Roman period indicate that such plants were considered to be important and necessary dietary components (see, for example, 2524 *Nigella sativa* seeds from a domestic context in a Hellenistic destruction layer at

³³ There are, however, two occurrences of *Pistacia lentiscus* in the dataset, both of which are from Pre-Roman period sites in Puglia (Sites 99 and 152). However, this species, known at the mastic, was not a food plant, but rather was used for other purposes, often medicinal.

Site 8; see also the large stores of flavourings including coriander, parsley, and caraway at Early Pre-Roman site 9). In this way, the Eastern assemblage points to a highly diversified diet long before Roman occupation, which, at least in terms of flavourings and condiments, has not been observed for other provinces (see Livarda and van der Veen 2008 for comparison).

The East had a long history of urbanism prior to the rise of the Roman Empire (emphasised in Ball 2016: 173). This may speak to a link between urbanisation and the accompanying rise in urban markets and increases in dietary diversity rather than an association between 'Roman culture/Romanisation' and heightened dietary diversity as has previously been suggested for other provinces (see Wiethold 2003 for 'Romanisation'; Livarda and van der Veen 2008: s207 for similar association of new condiments and expansion of urbanism in northwest Europe during the medieval period). In the West, the apparent link between the rise in dietary diversity and the spread of Roman occupation may actually, at least in part, be a factor of increased urbanisation, as well as increased economic connectivity via urban markets. That is not to say that rural populations were not capable of growing and utilising flavourings and varied crop types, but certainly the operation of regular food supply networks and markets would have facilitated access to greater variety and the adoption of new plant foods (see Plin., *HN* 19.53 on rural peoples using poppy, cumin and parsley to season their bread).

The mark of Roman Imperial occupation on dietary patterns in the East is made most apparent in the increase in horticulture/arboriculture, which appears to have occurred in both regions, gaining in momentum during the Imperial period. Otherwise, the transmission of new plant foods from east to west is detectable, but there is a general lack of evidence of movement in the other direction, though that does not rule out western influence on dietary preferences and preparation methods, or the possibility that such plant foods simply have yet to be recovered. Still, this does highlight the significant influence of Asian/West Asian foodways on Roman dietary patterns, and suggests that, though often overlooked in previous scholarship, in studying Roman food culture, it is highly important to look East as well.

11.4 Regional fuel economies

11.4.1 Dung

The most obvious way of tracking dung fuel use in the archaeobotanical record is via the charred dung remains themselves. For the eastern dataset, this endeavour produced results that highlight the greater frequency of dung fuel in the archaeobotanical record for the Early Pre-Roman period (9.6 Fuel and sustainability, Table 9-2). Notably, there is no intact charred animal dung in the Italian

dataset in any period, which, though perhaps prohibiting fruitful interregional comparison, may be telling in itself. As previously discussed, the dung fuel indicator *Prosopis* sp., which peaks in the Early Pre-Roman period in the East, is also absent from the Italian dataset, and efforts to utilise weed seeds flowering times to track dung fuel in Italy was of limited success (10.4; Appendix E; Charles 1998).

The author also examined seed assemblages from contexts where dung fuel may have been used, such as hearths, ovens, tanurs and tabuns, in the hopes that, in the absence of preserved dung itself, the distribution of wild/weed assemblages suggestive of dung fuel use may be better assessed. The distribution of samples from pyrotechnic features is unfortunately uneven; out of 35 total samples from such contexts, 31 are from the East and five are from Italy. None of the Italian samples appear suggestive of dung fuel use. Of the Eastern samples, 15 can be interpreted as indicating dung fuel (48.4%), and an additional five (16.1%) - more tentatively - *may* be reflective of dung fuel. Thus, in contrast to the Italian data, the majority of pyrotechnic features (64.5%) in the Eastern dataset produced material that suggest the burning of dung fuel.

The varying trends in weed seed assemblages in the datasets, however, may be useful in discussing differential dung fuel use in each of the regions. As the aim is to examine dung fuel use, which would be made manifest in the archaeobotanical record by more concentrated/sizable weed seed assemblages as opposed to the occasional wild/weed seed, the author elected to look to abundance rather than frequency, and to examine the average size of wild/weed seed assemblages in the fully quantified datasets of both regions under consideration (Table 11-2). The results show the wild/weed seed assemblages in the East are – on average- significantly larger than those in the Italian dataset. As the most likely way that such remains would be charred and preserved in the archaeobotanical record is via the burning of dung as fuel, such an analysis suggests that dung fuel use was far more common in the East than in Italy.

Table 11-2 Average Number of wild/weed seeds per site for Italy and the East.

Region	Average No.
Italy	64
East	755

It is also interesting that Cyperaceae and other hydrophilic plants form such a lower percentage of total weeds per period in Italy than in the East, despite the periods of drought and the more arid climate that characterises large portions of the latter. Thus, it is possible that the greater importance of hydrophilic plants in the Eastern dataset may actually be attributed to dung fuel use as well; the grazing of livestock near irrigation channels and water sources may have caused more of these seeds

to be burnt as dung fuel, whereas in Italy such seeds were not being charred, and thus preserved, as commonly in the use of dung fuel.

Furthermore, it should be noted that the wild/weed seed assemblages that do appear to be reflective of animal waste in the Italian dataset are preserved by mineralisation rather than carbonisation, which suggests the dung was left uncharred, and perhaps utilised as fertilizer, rather than gathered and used as fuel (see Rattighieri et al. 2013 for assemblages from two rural sites in Tuscany that produced mineralised assemblages containing common fodder/forage plants, such as *Trifolium* sp., *Medicago* sp., among many others).

In this way, the paucity of evidence of dung fuel use in Italy, together with the limited, though informative, textual evidence previously discussed (10.4) points to the possibility of regional preferences in not just food/dietary choices, but also in fuel choices. These preferences may be influenced not only by local environments and access to fuel materials, but also by varying cultural attitudes toward fuel.

11.4.2 Pomace

At the same time that wild species possibly indicating dung fuel fall in the East, olive increases in prevalence, particularly in the Levant (see Fig. 9-1 for increase in large olive assemblages; see increase from Fig. 7-47 to Fig. 7-49). Increased olive oil production in the region, visible in the dataset particularly during the Late Roman period, would also have yielded higher amounts of the by-product pomace. Though pomace can be used as fertilizer in olive groves, it is not suitable for wider use in arable crop fields due to toxically high pH. levels. Ancient authors were certainly aware of the harm that such material could cause for crops (see Cato, *Agr.* 37.1). Pomace may also be used as fodder, but must be limited in quantity and mixed with other fodder materials/crops, as the olive stones are not so easily digested (see Rowan 2019: 110 for more detailed discussion of properties of pomace). Thus, the main utility of pomace in the region would have been as fuel. With populations rising in cities, the transport of pomace into urban centres would solve two problems, both finding a way to dispose of the by-product material as well as meeting increased fuel demands.

Urban centres, however, would not have been the only populations who required increased fuel sources in the Late Roman period, for during this time, rural settlements such as villages and farmsteads saw a great expansion throughout much of the East as well (see Lewit 2007: 120 for overview). In addition to increased demand for fuel, local populations would have had to use every means possible to intensify crop cultivation and maximise agricultural output in order to sustain new

population levels; this may have prompted farmers to utilise animal dung for manuring at an increased rate rather than as a source of fuel (see 9.6 for more detailed examination of fuel use in the East).

Notably, though large-scale trade in olive oil produced in the East is made apparent by the scale of production, which would have exceeded subsistence levels, there is a marked lack of amphora evidence in the archaeological record (see Waliszewski 2014; Lewit 2007 for evidence of scale of oil production exceeding local consumption). This, however, may be reflective of the regional fuel economy rather than the olive oil industry itself. That is, if pomace fuel was increasingly necessary to sustain the everyday lives of local populations (particularly those inhabiting more arid regions lacking in forest cover), there may have been less available to devote to kilns and ceramic production, requiring local producers to look to other more perishable vessels (skins, for example) for the transport of goods such as olive oil (see Peña 1998 on the use of skins to transport olive oil from processing point to port in 4th century AD North Africa).

Though in other arid environments, such as North Africa, the use of pomace fuel in amphora production appears to have been key to the industry, olive oil production in the East was organised in a very different way: While in North Africa the olive industry appears to have been characterised by the large-scale processing points often located on the estates of wealthy ‘absentee landlords’ who were able to mobilise massive amounts of resources, in the East, independent farmers and landowners lived locally and were directly involved in production (Lewit 2007: 133-135). Thus, the readily available pomace would have been particularly important to sustain their livelihood, especially if, as suggested, dung was needed to maximise agricultural output in the marginal environments they often inhabited.

In this way it appears that agricultural by-products such as pomace may have become a more prominent fuel source relative to dung fuel in the East during the Roman and Late Roman periods. This pattern is not, however, seen in the archaeobotanical evidence from Italy: though there are certainly examples of pomace use, it does not appear to be as widespread, and perhaps was not as integral to fuel supply. This -admittedly controversial- suggestion is contra Rowan (2019), for example, who argues that pomace was an important fuel source for the city of Rome; though the arguments are convincingly rendered, material evidence has yet to be uncovered (see Fig. 10-7 on decline in large olive assemblages).

One factor that may have influenced the use of pomace fuel in antiquity is the timing and severity of the rainy seasons that would have begun around the time that olives were being pressed in both regions considered here. Table 11-3 and 11-4 below show the average number of days with rain per

month for each region, which, though modern, may be taken as a rough indication of average rainfall patterns in antiquity, except in exceptional circumstances such as the Late Roman periods of drought or flooding that may have plagued the Eastern provinces and Italy respectively.³⁴

Table 11-3 Average number of days with rain per month for the East.³⁵

Place	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Limestone Massif	13.6	13.1	13	11.2	8.2	4.5	5.1	5.6	3.4	7.3	8.6	13
Golan Heights	12.6	11.7	9.5	4.7	1.7	0.2	0	0	0.2	4	6.7	10.9
Galilee	11.5	10.9	8.6	9.7	1.1	0	0	0	0.2	3.4	6.1	10.3
Negev	6.2	5.5	4.5	1.6	0.6	0.1	0	0	0.1	1.2	2.8	5
Petra	4.9	4.1	4	2.1	1.6	0.5	0.2	0.2	0.3	1.3	2	3.5

Table 11-4 Average number of days with rain per month for Italy.

Place	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Tuscany	13.2	12	13	13.4	11.6	9.7	6	7.8	9	11.6	14.1	13
Rome	14.2	12.8	13.5	13.6	10.1	8.3	4.5	6.4	8.9	12	14.9	14.3
Campania	13.9	13.1	13.6	12.5	9.5	7.8	4.8	6.3	8.1	11	13.6	14.1
Puglia	13.8	12.9	12.6	10.3	7.3	4.9	2.9	4	6.7	9.9	11.8	13.7

Table 11-5 Average number of days with rain per month for areas considered.

Region	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
East	9.76	9.06	7.92	5.86	2.64	1.06	1.06	1.16	0.84	3.44	5.24	8.54
Italy	13.78	12.7	13.18	12.45	9.63	7.68	4.55	6.13	8.13	11.13	13.6	13.78

Though, in both regions, the timing of the rainy season may have caused issues for the drying of pomace fuel in outdoor settings, it appears that the East would have been less affected, for, not only do the areas here examined experience over 60% less rainy days in November and nearly 40% less in December, but they are also in close proximity to (very arid) regions of desert, so that, even if pomace was not able to be dried locally, it may have been in other areas in the general vicinity.³⁶ The rainfall patterns also indicate that the period of increased rain fall seems to be more severe earlier in

³⁴ Note: Northern Italy and Anatolia were excluded from this analysis as the dataset contains less evidence of large-scale olive cultivation in these regions.

³⁵ Rainfall data sourced from <http://www.fao.org/aquastat/en/climate-info-tool/>.

³⁶ Note: the movement of pomace in a regional fuel trade has already been suggested by its transport from rural processing sites for use in urban centres, as discussed in previous chapters (9.5 City/Hinterland relationships in agricultural systems 10.3 City/Hinterland roles and relationshipson links between cities and hinterlands.

Italy, coinciding even with the beginning of olive harvesting in the autumn (Columella, *Rust.* 22.52 indicates that olive harvesting begins in November and continues through December).

This does not, however, mean that pomace would have been wasted and left to decay in Italy; Rowan (2015), for example, looks to ethnographic studies, suggesting that pomace could be stored and preserved submerged in water during the winter months, and then dried in the spring (Rowan 2015: 466). Though interesting, such a practice is unable to be explored further due to a lack of archaeological evidence, such as in the form of securely identified pits for storing pomace, or auxiliary agricultural buildings in which pomace may have been laid out and dried in settings largely protected from the elements. While pits and multifunctional agricultural buildings have certainly been excavated, there is no evidence of their use for such purposes at this time. Additionally, despite the best efforts of the author, no historical references to such practices have been identified in the ancient literature.

Still, in general, the temporary storing of olive oil pressing residue seems highly feasible, and, in this way, pomace may have been made a seasonally available resource throughout much of Italy, while in the East, pomace may have been a more important source throughout the year.

11.4.3 Chaff

The strong association of cereal chaff with urban contexts characterises the distribution of the by-product in both Italy and the East. This correlation is notable, and serves to further emphasise the transportation of such a material as a commodity for intended uses in cities. Though initially the idea of chaff being transported to urban areas for foddering purposes may seem the most attractive explanation for the distribution of the material, Columella points out that chaff is not actually an optimal foddering material, prompting the author to explore alternative explanations (Columella, *Rust.* 6.3.3 states ‘we are not looking after our cattle so well if we feed them on chaff...’ though he does recognise that the by-product is ‘universal, and in some districts the only, resource’).

Though other by-products (most often, olive oil pressing residue) have received due attention in terms of their utility as a fuel source and a commodity in their own right, chaff has been the subject of less scrutiny. There has been some recognition of the use of chaff as fuel, and its utility in arid environments in particular has been highlighted (see van der Veen 1999; see also Foxhall 1998: 36, though the focus is mostly on other uses; van der Veen 2007: 937). In recent decades, scholars have also been exploring the utility of chaff as a sustainable fuel source for modern use, highlighting the potential of the material. Kiš et al. (2017) highlight the calorific value of *Triticum spelta* chaff

specifically, demonstrating the potential of the material as a source of bio-energy. Brlek et al. (2012) also examine the utility of spelt chaff, though after the hulls have been transformed to fuel pellets, a process that was also focused upon as applies to wheat chaff by Weiß and Glasner (2018).

Indeed, it is important not to discount the use of chaff as a viable fuel source, and to consider such usage when encountering chaff remains in the archaeobotanical record rather than assuming it to be fodder material which then ends up being carbonised in the burning of dung fuel. Chaff is certainly useful as tinder, and ancient sources attest to this: Plutarch, for example, references chaff while offering romantic advice, comparing the excitement of new love with the burning of chaff or hare's fur, which catches fire readily but 'goes out rather quickly' unless further fuel sources are introduced to maintain the flame (Plut., *Conjug.* 4).

Further, in reference to its use as tinder, Columella advises farmers to burn piles of chaff in between rows of vines in order to ward off the damage caused by fog and mildew (Columella, *De Arboribus* 13). Additional use of chaff as fuel is highlighted by Pliny, who references the burning of chaff in metalworking, describing the ability of gold in particular to withstand the effects of fire made with live coal, though it becomes red with heat when exposed to a fire made with chaff (Plin., *HN* 33.19; see also *HN* 33.30; chaff is referenced in connection to the working of gold by a number of other ancient authors, including Strabo 3.2.8 and Macrobius, *Sat.* 7.16.23).

There are also notable references attesting to the transport of chaff from processing points to other locations for various uses, as is apparent in the archaeobotanical record (see also van der Veen 1999 on importation of chaff for use at 'consumer sites'). The by-product seems to have been transported considerable distances; though not the focus of the passage, Cicero references the accidental capsizing of a barge full of chaff (Cic., *Parad.* 20). The casual use of this example in making a point about the severity and significance of a helmsman's transgressions speaks to the commonality of the large-scale transport of chaff away from processing points. Additionally, the fact that Cicero mentions the chaff but not the loss of any other goods, would seem to support that chaff was transported as a commodity in itself, rather than just as a useful packaging material in the movement and storage of foodstuffs and other more fragile items (for use of chaff in storage, see Plin., *HN* 15.18 for use in keeping fruit, 19.24 for storing garlic).

Unfortunately, the lack of detailed archaeobotanical reporting has largely prohibited contextual analysis that may aid in the interpretation of chaff finds in the dataset. Still, the utility of chaff as a fuel source, particularly in the more arid environs of the Near East, should be emphasised.

11.5 City-Hinterland relations

As has been demonstrated above, shifts in agricultural production, such as the surge in the olive industry in the East following the Roman period, are reflected in trends in fuel choices, demonstrating the interconnectedness of urban and rural sites and regional agricultural systems in general.

This interconnectedness is particularly apparent in the East. In the Early Pre-Roman dataset, assemblages characterised by a high proportion of wild/weed seeds and food stores observable at urban sites would seem to indicate that at least some stages of crop-processing activities were taking place in, or in the vicinity of, the settlements themselves rather than in the surrounding countryside (9.5). In the later periods, however, the larger urban populations would have necessarily looked to the surrounding *territorium* for the provision of foodstuffs, which would then have been sold in urban markets. Still, during the later periods, the association of chaff remains as well as sizeable olive assemblages with urban contexts, the latter being a pattern arising in the Roman period dataset, attests to the transport of commodified agricultural by-products for use in urban centres.

Though olive remains/pomace may have been a less common fuel source in Italy, which makes the transport of such a by-product to urban centres for use as fuel less easily detected, the distribution of chaff remains in the region shows similar patterns to those observed in the East: that is, despite little to no evidence for crop processing at urban sites, the chaff that is observable in the dataset occurs primarily in urban contexts (11.4.2; 10.3 on chaff in urban contexts).

This points to the operation of regular trade networks between cities and the countryside, in a system characterised by a high degree of connectivity in both Italy and the East. As such, it would appear that this close city-hinterland relationship is not particular to either respective region, but rather was a common facet of the ancient economy (though of course in less urbanised regions, this relationship may have taken on a different character).

11.6 The Impact of climatic instability and disparate Late Roman trajectories

It does appear to be possible to detect climatic shifts and events in the archaeobotanical record to some extent in both Italy and the East. The proposed period of Late Roman environmental instability appears to have impacted both datasets, though the two regions were differentially affected: in the East, the Late Roman period saw periods of drought, while in Italy, climatic instability manifested

itself in periods of flooding and a cooling of temperatures (see McCormick 2012; discussed in greater detail in 9.2, 10.5).

The Eastern dataset produced the highest barley to free-threshing wheat ratio in the Late Roman period, despite cultural preferences for free-threshing wheats, indicating that populations may have been taking more risk reducing measures in their agricultural strategies than in other periods (9.3 Risk reduction in agricultural systems; see Marston and Miller 2014 for use of this ratio).

Furthermore, though the previous periods saw a gradual decline in glume wheat frequencies, the slight increase in drought resistant glume wheats during the Late Roman period may point to further efforts at coping with the harsh climatic conditions. Meanwhile in Italy, the proposed cooling of temperatures and increased flooding is made manifest in the increase in Cyperaceae frequencies as well as in the cereal Rye, especially in the North (10.5 Environmental/Climate Change).

What may be more interesting, however, is the differing impact of these climatic shifts in the historical narrative. In each region the Late Roman period was a time of change: while the East saw expansion and prosperity, Italy experienced a period marked by political strife, invasions, and general socio-economic instability (see Harper 2017 on Italy; Bar 2004 on expansion in the East). In addition to the climatic shifts that have been proposed for each respective region, these disparate histories are also visible in the archaeobotanical remains.

In Italy, the data show a marked decline in the diversity of fruits, with more exotic varieties such as date and pomegranate disappearing from the dataset altogether. Similarly, other possible prestige items such as pine nut, almond and even chickpea are absent in this period as well. These items, together with the lack of flavourings and vegetable remains may point to a simplification of diet.

In the East, however, dietary diversity appears to continue, despite possible periods of drought. Fruit remains continue to be diverse, the olive oil industry appears to have experienced a surge in productivity, and archaeological evidence highlights the significant growth of both urban and rural populations, with rural settlements expanding greatly, and bringing previously marginalised landscapes into cultivation (4.2; 4.3; Bar 2004, Gawlikowski 1997, Tate 1997).

Additionally, the chronological distribution of food caches in each of the regions show interesting contrasts, which may be connected to the general conditions/welfare experienced at the time. There is a marked decrease in caches observable in the East, from 34.29% in the Early Pre-Roman period to 0 in the Late Roman dataset. In Italy, caches appear to increase over time, with 15.38% of sites in the

Late Roman period dataset, up from 8.33% of sites in the Roman period, producing caches.³⁷ As such, it seems possible that there is a connection between societal stability and the tendency for populations to keep food caches, a proposition that is supported by Marston (2011), which describes food storage as a method of agricultural risk reduction (Marston 2011: 193). In times of peace and prosperity, there may simply be less need to store large quantities of food, as markets, networks of exchange and the general regional economies are able to operate smoothly and regularly, whereas in times of turmoil, such as in Italy during the Late Roman period, people tend to store more food due to unsure access and the increased risk of disruption to regular economic functioning and food supply chains.

Interestingly, the percentage of (fully quantified) sites with caches is greater in the East in all periods (apart from the Late Roman period) than the highest percentage observed in any period for Italy. This may point to greater food insecurity in the East, perhaps due to the harsher environments and more arid landscapes that characterise some areas in the region, as well as the challenges associated with living on the edge of the empire. This is supported by the distribution of sites with caches remains: 54% of sites are located in the Greater Middle East, which is the most easterly region and is home to harsher environments than coastal areas, such as in the Levant. Furthermore, when looking at the Roman period specifically, 50% (three sites) are in the Greater Middle East and 50% (three sites) are in the Levant, however, of the three sites located in the Levant, two had military garrisons to provide for and the other is located in the harsh environs of the Negev desert.

Thus, though the challenges of changing climates can be seen in the data from both Italy and the East, so can the concurrent historical context and the general conditions experienced by societies in each of the regions. In this way, the differences in trajectories really serve to highlight the interconnectedness of the historical narrative and agricultural regimes, and how deeply socio-political conditions affected the greater agricultural sector and daily life. Furthermore, the results presented here also point to the preponderance of the effects of peace and prosperity over climatic instability, with the former determining the ability of a society to cope with the latter.

³⁷ Note: the figure for the Roman period was calculated without the many ceremonial sites particular to this period, as any apparent cache in such a site type does not represent food stores and is thus irrelevant to this discussion.

Chapter 12. Conclusion

This thesis features the first meta-analysis of carbonised archaeobotanical assemblages from Roman period sites in both Italy and the Near East.

While other areas of the Roman empire, particularly central and northwestern Europe, have received far more attention in terms of large-scale archaeobotanical studies, the Near East has hitherto remained a research gap, which this study has now addressed.

Additionally, this thesis not only marks the first archaeobotanical meta-analysis for the entire Italian peninsula, it also provides context for previous and future research on 'Roman' dietary patterns. Previous conceptions of the plant component of the Roman diet have not been based on a broad understanding of the material evidence, but rather have looked to ancient literary sources as well as evidence from individual archaeobotanical datasets or more limited regional syntheses, which may or may not be representative of consumption patterns more widely.

Though analysis was predominately based on secondary data, the primary data from Jerash and Hippos-Sussita serve to demonstrate patterns exhibited in the greater regional dataset, such as the importance of oleiculture, as well as the use of agricultural by-products as an alternative fuel source in the region.

In using a two-tiered approach to data analysis, the author was able to include both presence/absence and fully quantified datasets. This allowed for the inclusion of as much data as possible, which was particularly useful, as data are, admittedly, more limited than in other regions where archaeobotanical meta-analysis has previously been undertaken (cf. van der Veen et al. 2007, for example). However, despite this limitation, large-scale data synthesis was still able to produce interesting results for previously under-studied regions, demonstrating that such an endeavour is worthwhile.

12.1 Agricultural patterns and cultivation strategies

In both Italy and the East, agricultural patterns reflect trends in demography. Both regions experienced demographic growth and population increases during the study period, though in Italy, this occurred rapidly in the 1st century BC, and then more steadily over the course of the Roman period (1st-2nd centuries AD), while in the East, this peaked in the Late Roman period (4.2.2.2 on Late Roman settlement expansion in the East; Bar 2004; see De Ligt 2012 for Italy, though see also 4.3.4 on debate surrounding demographic growth in Republican to Imperial period Italy). Notably, these periods of growth saw agricultural intensification and expansion into previously marginalised

environments in both regions (9.4.2, 10.1.1). Though this is most visible in the hydraulic manipulations associated with Roman occupation (e.g. aqueducts in the East, while in Italy this also includes largescale drainage projects), this phenomenon can also be seen in the archaeobotanical remains suggestive of an increase in intensive cultivation practices.

The rise in horticultural activity is apparent in the Roman period in both Italy and the Near East, and this certainly would have required the application of intensive techniques including manuring and increased irrigation (see Figs. 7-18 and 8-16 for increase in frequencies of fruits such as fig [*Ficus carica*], date [*Phoenix dactylifera*], and *Prunus* fruits in the East and Italy respectively). The increased prevalence of horticulture is mentioned in the ancient literature with respect to Italy, but this pattern also seems to apply to the provinces, as is evidenced here in the East, and previously in other parts of the Roman world (Columella, *Rust.* 10.1, 10.3; Van der Veen et al. 2008; Livarda 2011).

However, while the dataset does suggest some measure of intensification, weed seed analysis also highlights that intensification should be viewed in the context of a diverse agricultural system in which both intensive and extensive practices were employed simultaneously (10.1.1; see Kron 2000, 2012 on intensive farming methods).

Though specialised agricultural production proved difficult to track in the dataset, results gleaned from examining the distribution of certain cash crops, olive in particular, reflect the connectivity and interdependence in the Roman world; this clearly extended to the agricultural economy, with specific localities taking on their own role in the greater Imperial economy, such as according to comparative advantage. Such a system can be seen in the distribution of relatively large olive assemblages, which show a marked increase in the East in the Late Roman period, while, in Italy, a reduction over the course of the study period can be observed (11.2.4; see Neumann et al. 2007, 2010 for pollen evidence suggesting peak levels of *Olea* in the Roman and Late Roman East; see Bowes et al. 2017 for palynological evidence from Tuscany suggestive of rather limited olive cultivation relative to grape).

The importance of viticulture as reflected by grape remains, however, does not seem to be similarly affected (10.1.2). While archaeobotanical evidence has not previously contributed to debates surrounding the proposed/alleged decline in the Italian wine industry in the 1st century AD, the results here presented show little evidence that Italian viticulture was affected by provincial competition, and instead suggest that grape continued to be important in Italy (see Rostovtzeff 1957 for early work suggesting a decline in the Italian wine industry; for opposition, see Purcell 1985, Tchernia 1986, Van Limbergen et al. 2017).

The archaeobotanical data also suggests that certain measures were taken during times of hardship: an increase in crop-rotation and caches, for example, can be associated with periods of increased instability, as is observed in Italy in the Late Roman period, and a decrease with times of imperial prosperity, as in the East during the Roman and Late Roman periods (see sections 9.4.2.2; 10.1.1; 11.2.2.1).

12.2 Diet

The remains of plant foods suggest an intricate interplay between dietary regionalism and imperial trends. The increase in horticultural production and fruit diversity during the Roman period can be observed in both regions, though in the East the archaeobotanical record continues to be rich in fruit remains into the Late Roman period, while in Italy a decline in diversity may be observed (see 11.6 on disparate Late Roman trajectories; see also Bosi et al. 2020 for peak diversity in Roman period northern Italy). In both regions, the archaeobotanical remains indicate the prioritisation of cultural preference in cereal choices, though less-desired minor cereals were incorporated when necessary (e.g. when motivated by environmental constraints or instability). Free-threshing wheats do appear to be the preferred cereal type, and are present even in regions where they would have been more difficult to cultivate (Fig. 7-39 through 7-41). Barley, however, is the most frequently encountered cereal in all regions, likely due to the versatility of the cereal, which would have been instrumental for risk management purposes (Figs. 7-12 and 8-11). Minor cereals are more common in marginalised landscapes of both regions; in Italy, this includes areas with cooler climates in the North, while in the East, this can be seen in the northern and eastern portions of the study area, the latter of which would have included particularly arid environments (see 4.1, Fig. 4.2).

This study also utilises the largest dataset to offer confirmation of the previously proposed decline in the popularity of glume wheats over the course of the study period in both regions, though a slight resurgence – possibly due to shifting climatic conditions – is observable in the East during the Late Roman period (see 12.4 below on glume wheat resurgence; for decline of glume wheats, see Figs. 7-12 and 8-11; Nesbitt and Samuel 1996; van der Veen 2018: 55; Heinrich 2019: 104). The results also reflect observable trends in the cultural preference for certain nut types, which has never before been explored to such an extent. Interestingly, the data from both Italy and the Near East show correlating increases in particular nut species (i.e. walnut and almond), which may be evidence of interregional trends in tastes and dietary preferences throughout the Roman Empire.

However, though some patterns can be observed in both regions, others are regionally distinctive. For example, exotic plants that were classed as luxury items in Italy were not necessarily considered

as such in the East, where food plants such as *Prunus* fruits and dates (*Phoenix dactylifera*) had long been widely distributed. Thus, some of the foods that appear to have been components of *haute cuisine* in Roman Italy, would have been more commonplace in the East, making such dietary trends less appealing (or at least less applicable) in the region.

Observations such as this highlight the relative nature of classifications such as 'luxury' and 'exotic,' and demonstrate a fundamental difference between this study and previous archaeobotanical meta-analyses focusing on the western Roman provinces.

Similarly, despite the fact that the spread of food plants from east to west is apparent, the dataset is largely lacking in evidence suggesting transfer of new species in the other direction. However, it is possible that less easily detected elements of diet, such as preparation methods, were subject to greater influence in the East. In any case, the influence that the East had on dietary patterns in Italy, and the contribution of the region to the 'Roman diet' should not be underestimated.

The increases in dietary diversity apparent in both regions in the Roman period are also notable. However, the dataset indicates that plant consumption in the East, which had a long history of urbanisation, was diversified long before Roman occupation (see 9.7 for wide array of flavourings preserved in the Early Pre-Roman dataset, for example). As such, while previously viewed in light of Roman presence, the link between urbanisation and dietary diversity should not be discounted (see Wiethold 2003 on association of diversification with Roman influence).

12.3 Fuel choices

There is some evidence for alternative fuel sources in the Italian dataset, but in general less evidence was uncovered for Italy than the East.

In the East, assemblages deriving from dung fuel appear to decrease over the course of the study period, while evidence of the use of agricultural by-products as fuel increases (9.6). Such a pattern correlates well with both the boom in the olive industry, which would have produced increased amounts of the by-product pomace, as well as with the rise in intensive measures and horticultural production, which would have required increased amounts of dung for manuring (see 12.1 above on olive assemblages; Tchalenko 1953 for impressive scale of olive oil production in the region; Lewit 2007 on Late Antique intensification of commercial production; Waliszewski 2014 on rising quantities in Roman and Byzantine period in particular).

In contrast, in Italy, dung fuel does not seem to have been particularly prevalent and may even have been viewed as less desirable (10.4). Pomace, on the other hand, would certainly have been an

available fuel source, though it may have been less integral to fuel procurement strategies in the region, which is more heavily forested than much of the Near East. It has also been suggested that the availability of pomace fuel in Italy may have been more affected by seasonality (11.4.2).

Thus, the regional differences in fuel usage are likely influenced by a number of factors, including environmental setting and necessity, but also by variation in cultural preferences and attitudes toward fuel choices, an idea which has received little attention in previous scholarship.

12.4 Environmental conditions and impact on crop choices

The dataset does show some indication of the periods of environmental instability that have been proposed for both regions, though in Italy this is thought to have consisted of episodic flooding and a cooling of temperatures, as opposed to periods of drought in parts of the Near East (McCormick et al. 2012).

In Italy, the effects of said climatic instability may be made manifest in the increased frequencies of hydrophilic Cyperaceae plants and rye (*Secale cereale*) in the Late Roman period (10.5). In the East, the high barley to free-threshing wheat ratio suggests that populations may have been more mindful of risk reduction/employing more risk reducing measures than in previous periods (9.3; Marston and Miller 2014 on this use of ratio analysis). The increase in the frequency of glume wheats in the Late Roman period, despite the longstanding downward trajectory, may also suggest that certain measures were deemed necessary in order to ensure the provision of sufficient cereal crop in the face of unstable climatic conditions (Fig. 7-12).

Nevertheless, the important take away is the apparent ability of ancient peoples to adapt to changing environmental conditions and climatic instability during times of relative prosperity, as in the East during the Late Roman period, which was prosperous despite possible climate fluctuations (see 11.6). However, in times of political turmoil and economic instability, as in Late Roman Italy, climatic instability has a more crippling effect and previous prioritisation of cultural preferences for particular plant types – exotic and luxury foods in particular- may necessarily be abandoned.

12.5 Research gaps and limitations of data

In both Italy and the Near East, data quality proved problematic. Firstly, it should be stated that archaeobotanists should endeavour to publish their data, so that access is not limited to a select few (Costello et al. 2013; Lodwick 2019a, 2019b). If datasets are exceptionally small or limited in terms of

productivity, a centralised data-sharing system would be beneficial, particularly for countries that do not have an accessible corpus of grey literature.

Though perhaps more of a discipline-wide issue not unique to the study areas in question, the considerable variations in data quality also highlight a general need for more detailed and rigorous reporting methods with some measure of standardisation, so as to better facilitate inter-site, as well as interregional, comparison. Ideally, archaeobotanical reports would include fully quantified data as opposed to indications of species present, so that the heterogeneity characterising archaeobotanical assemblages may be further illuminated. The Hippos-Sussita case study emphasises the need for standardisation in quantification methods even when fully quantified data are reported, with particular reference to methods utilised for olive oil pressing residue.

Many reports indicated archaeobotanical remains in more general terms, failing to include the scientific names for plant species or reporting to only the genus level. However, species level identifications should be indicated when possible. This would be particularly helpful with regards to wild/weed seeds so that their utility may be maximised. It should also be noted that, too often, archaeobotanical reports indicate results using only a data table, while providing little in the way of contextual details. In separating archaeobotanical remains from the contexts in which they were uncovered, some of the meaning and interpretative power is inevitably lost.

Other issues include the uneven distribution of records; the Late Roman period is under-represented in both Italy and the East, as are certain regions, most of eastern Italy and the Anatolian peninsula in particular. It should also be noted that the quantity of remains and sample densities were typically low, which hindered efforts to include detailed statistical analyses. Such a limitation may, at times, be attributed to small sample size, but low densities is also an observable characteristic of charred assemblages in both regions that may not be ameliorated by larger sample size.

12.6 Future research

Most importantly, there needs to be more archaeobotanical sampling at archaeological sites in both regions, particularly in the underrepresented portions of the study area. Sampling should be undertaken in line with a systematic sampling strategy whenever possible. It is the hope of the author that, with further sampling and additional datasets, the patterns detected in this thesis may be further explored and refined. This may also be achieved by looking to additional unpublished material, which would aid in creating an expanded dataset. As mentioned, limitations in the dataset prohibited more detailed statistical analysis (e.g. correspondence analysis). However, with an expanded dataset, such pattern searching techniques may be made possible in the future.

It would be interesting to do more detailed intraregional analysis when more data are available, with a greater focus on topographical and ecological variation. For example, placing sites into zonal categories (i.e. plains, mountainous terrain, coastal regions, etc.) may serve to illuminate patterns that were otherwise masked. Such an exercise has the potential to provide further insight into the relationship between crop choices and environmental setting, as well as into the specialised regional roles that various regions fulfilled within their wider economy.

Increased refinement of the chronological resolution would also be beneficial, enabling a closer examination of pivotal moments in processes of change, with the hope of assessing key causal factors, as well as how swift or gradual observable shifts may have been. In the East, this may aid in shedding further light on the effects of imperial integration on agricultural regimes; the study conducted by Friedman (2013) at Khirbet Faynan, for example, suggests a reorganisation and centralisation of agricultural systems under Roman imperial administration, though to what extent this occurred throughout the greater region remains unclear. In Italy, greater chronological resolution may enable archaeobotanical evidence to make a greater contribution to debates surrounding events such as the agrarian crisis, as well as the transition between the republican and imperial periods (see 4.3.3 on the agrarian crisis).

It would also be useful to integrate other types of evidence: while the basics of dietary patterns in both regions may show many similarities by this time period, differences in preparation methods, for example, are difficult to detect archaeobotanically, and, in this way, the integration of ceramics may be instrumental. Such an exercise may shed light on the adaption of new culinary practices from other regions or cultures that may not be detectable by means of plant remains alone. Similarly, combining the archaeobotanical evidence with zooarchaeological evidence would allow for a fuller picture of consumption patterns to be formed, and may shed further light on the role of animal husbandry in ancient agricultural regimes.

12.7 Concluding remarks

This study demonstrates that Roman imperial occupation did not cause homogenisation of consumption patterns, but rather that local choices and environmental factors remained highly important in defining ancient foodways. That is not to say, however, that Roman imperial presence had no effect on consumption, for there does appear to be certain interregional markers that may be associated with the Roman period: the rise in horticultural production and fruit diversity, for example, is not unique to the Italian peninsula, but rather can be observed in the East, as well as in other parts of the Roman world (van der Veen et al. 2008; Livarda 2011; Peña-Chocarro et al. 2017).

Still, a considerable degree of regionalism continued to characterise not only diet and agricultural practices, but also fuel choices. Such an observation confirms the difficulty in defining 'Roman' consumption patterns, which not only varied regionally, but were also subject to a variety of cultural influences, as can be seen in the adoption of food plants from the Near East. This alone negates notions of unilateral processes of exchange accounting only for the dissemination of Roman dietary patterns to provincial populations, and points to the considerable influence that Near-Eastern consumption habits would have had in Italy (and vice versa).

The results of this study highlight that socio-economic stress, as seen in Italy in the Late Roman period, appears to hinder the dynamic ability of ancient peoples to adapt to environmental conditions. Finally, it should be noted that though the importance of cultural preference in dietary patterns is widely recognised, the role of cultural preference in fuel choices has received less scrutiny, which is perhaps an oversight now brought to light.

This study marks the largest body of archaeobotanical evidence that has been collated to date, for both Italy and the Roman Near East. It will aid in providing context to future archaeobotanical and archaeological research in both regions.

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Appendices

Appendix A Site Catalogue

Table A1 Catalogue of sites producing charred archaeobotanical remain in the Near East and Italy.

Site ID No.	Site Name	Region	Subregion	Site type	Period(s)	Reference	Year of publication
1	Abi'or Cave	East	Levant	Rural	Roman	Kislev	1992
2	Abu Qubur	East	GME	Other	Roman	van Zeist	1991
3	Aila	East	Levant	Urban	Pre-Roman, Roman, Late Roman	Ramsay and Parker	2016, pers. comm.
4	Ain Dara	East	Levant	Urban	Early Pre-Roman	Crawford	1999
5	Amorium	East	Anatolia	Urban	Pre-Roman	Giorgi	1993
6	Araq el-Emir	East	Levant	Rural	Early Pre-Roman, Pre-Roman, Roman, Late Roman	McCreery	1983
7	Ashkelon	East	Levant	Urban	Early Pre-Roman	Weiss et al.	2011
8	Asvan Kale	East	GME	Rural	Pre-Roman, Roman	Nesbitt et al.	2017
9	Ayanis	East	GME	Other	Early Pre-Roman	Solmaz and Oybak Donmez	2013
10	Bastam	East	GME	Urban	Early Pre-Roman	Hopf and Willerding	1988
11	Bir Madhkur (Military)	East	Levant	Military	Roman	Ramsay and Smith	2013
12	Bir Madhkur (Rural)	East	Levant	Rural	Roman, Late Roman	Ramsay and Smith	2013
13	Bosra	East	Levant	Urban	Pre-Roman, Roman	Wilcox	2003
14	Çadir Höyük	East	Anatolia	Urban	Pre-Roman	Chernodd and Harnischfeger	1996
15	Caesarea	East	Levant	Urban	Roman, Late Roman	Ramsay	2008
16	Caesarea Inner Harbour	East	Levant	Urban	Late Roman	J. Giorgi	1999

Appendix A: Site catalogue

17	Cave of the Pool	East	Levant	Rural	Roman	Zaitscheck	1962
18	Cave of the Spear	East	Levant	Rural	Roman	Simchoni and Kislev	2009
19	Cave of the Treasure	East	Levant	Rural	Roman	Zaitschek	1980
20	Cave V/49	East	Levant	Rural	Pre-Roman	Melamed	2002
21	City of David	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Liphschitz and Wasiel	1992
22	Dascyleum	East	Anatolia	Urban	Early Pre-Roman, Pre-Roman	Oybak Donmez et al.	2016
23	Deir Alla	East	Levant	Urban	Early Pre-Roman	Neef	1989
24	Dhiban	East	Levant	Urban	Early Pre-Roman, Roman	Farahani	2018?
25	Düzen Tepe	East	Anatolia	Other	Pre-Roman	Vanhaverbeke et al	2010
26	El-Lejjun	East	Levant	Military	Late Roman	Crawford	2006
24	En Boqeq	East	Levant	Military	Late Roman	Liphschitz and Waisel	1993
28	En Gedi (Military)	East	Levant	Military	Roman	Melamed and Kislev	2005
29	En Gedi (Rural)	East	Levant	Rural	Roman	Melamed and Kislev	2005; 2007
30	Gordion	East	Anatolia	Urban	Roman	Marston and Miller	2014
31	Gordion 2	East	Anatolia	Urban	Early Pre-Roman, Pre-Roman	Miller	2010
32	Hippos-Sussita	East	Levant	Urban	Pre-Roman, Roman, Late Roman		unpublished
33	Horvat Rosh Zayit	East	Levant	Other	Early Pre-Roman	Kislev and Melamed	2000
34	Horvat Mesad (Military)	East	Levant	Military	Roman	Liphschitz	2012

Appendix A: Site catalogue

35	Horvat Mesad (Roadside Station)	East	Levant	Other	Pre-Roman	Liphschitz	2012
36	Sumaqa (Ceremonial 1)	East	Levant	Ceremonial	Late Roman	Liphschitz	1999
37	Sumaqa (Ceremonial 2)	East	Levant	Ceremonial	Late Roman	Liphschitz	1999
38	Sumaqa (Rural)	East	Levant	Rural	Late Roman	Liphschitz	1999
39	Humayma (Military)	East	Levant	Military	Roman	Ramsay	2013
40	Humayma (Roadside Station)	East	Levant	Other	Roman	Ramsay	2013
41	Huqoq	East	Levant	Rural	Late Roman	Ramsay et al.	2015
42	Jebel Khalid	East	GME	Urban	Pre-Roman	Fairbairn; Amr-Al Azm	2003; 2005
43	Jerash	East	Levant	Urban	Pre-Roman, Roman		unpublished
44	Jiyeh/Porphyreon	East	Levant	Urban	Early Pre-Roman, Pre-Roman, Roman, Late Roman	Badura et al.	2016
45	Kaman Kalehöyük	East	Anatolia	SiedSo	Early Pre-Roman	Fairbain	2002, 2003, 2004
46	Kerkenes	East	Anatolia	Urban	Early Pre-Roman	Marston and Branting `	2016
47	Khirbet Qumran	East	Levant	Rural	Roman	Kislev and Marmorstein	2003
48	Khirbet er-Rasm	East	Levant	Rural	Pre-Roman	Weiss	2011
49	Khirbet et-Tannur	East	Levant	Ceremonial	Roman	Wetterstrom	2013
50	Kilise Tepe	East	Anatolia	Rural	Early Pre-Roman, Late Roman	Bending and Colledge	2007
51	Kuşakli	East	Anatolia	Urban	Early Pre-Roman	Pasternak	1998
52	Madâ'in Sâlih	East	GME	Urban	Pre-Roman, Late Roman	Bouchaud	2008
53	Nahal Yattir	East	Levant	Rural	Roman	Kislev	1986
54	Nimrud	East	GME	Rural	Pre-Roman	Helbaek	1966
55	Patnos	East	GME	Urban	Early Pre-Roman	Oybak Dönmez	2003

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56	Pella	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Wilcox	1992
57	Petra- ez-Zantur	East	Levant	Urban	Pre-Roman, Roman, Late Roman	Bouchaud et al.	2016
58	Petra- Pool and Garden Complex	East	Levant	Urban	Pre-Roman, Roman	Ramsay and Bedal	2015
59	Qal' eh Ismail Aga	East	GME	Other	Early Pre-Roman	Costantini and Biansini	1984
60	Qasr Al-Buleida	East	Levant	Military	Late Roman	Ariotti	2009
61	Qumran Cave 24	East	Levant	Rural	Roman	Liphschitz and Bonani	2001
62	Sagalassos-LE	East	Anatolia	Urban	Late Roman	Poblome et al.	2015
63	Sagalassos	East	Anatolia	Urban	Roman, Late Roman	Fuller et al.	2012
64	Si	East	Levant	Other	Pre-Roman, Roman	Wilcox	2003
65	Sidon	East	Levant	Urban	Early Pre-Roman	Riehl and Kümmel	2005
66	Sos Höyük	East	GME	Rural	Early Pre-Roman	Logford et al	2009
67	Susa-Ville Royale II (Ceremonial)	East	GME	Ceremonial	Early Pre-Roman	Miller	1981
68	Susa-Ville Royale II (Urban)	East	GME	Urban	Roman	Miller	1981
69	Tall al-'Umayri	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Ramsay and Mueller	2016
70	Tall Zirā'a	East	Levant	Rural	Early Pre-Roman, Pre-Roman, Roman, Late Roman	Olsvig-Whittaker	2017
71	Tel Beer Sheba	East	Levant	Urban	Early Pre-Roman	Liphschitz and Waisel	1973
72	Tel Halaf	East	GME	Urban	Early Pre-Roman	Riehl and Kümmel	2005
73	Tel 'Ira	East	Levant	Urban	Early Pre-Roman	Liphschitz	1999
74	Tell Afis	East	Levant	Urban	Early Pre-Roman	Watcher-Sarkady	1998

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75	Tell Beth-Shean	East	Levant	Urban	Early Pre-Roman	Simchoni and Kislev	2008
76	Tell el-Burak	East	Levant	Rural	Early Pre-Roman	Orendi and Deckers	2018
77	Tell el-Hesi	East	Levant	Urban	Pre-Roman	Stewart	1989
78	Tell es-Safi	East	Levant	Urban	Early Pre-Roman	Mahler-Slasky and Kislev	2012
79	Tell es-Sa'ldiyeh	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Pritchard	1985
80	Tell Hadidi	East	GME	Other	Roman	van Zeist and Bakker-Heeres	1985
81	Tell Halif (Rural)	East	Levant	Rural	Late Roman	Laustrop and Seger	1990
82	Tell Halif (Urban)	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Laustrop and Seger	1990
83	Tell Hesban	East	Levant	Urban	Early Pre-Roman, Pre-Roman, Roman	Gilliand	1986
84	Tell el-Mazar (Other)	East	Levant	Other	Early Pre-Roman	Neef	2012
85	Tell el-Mazar (Other 2)	East	Levant	Other	Pre-Roman	Neef	2012
86	Tell Mishrifeh	East	Levant	Urban	Early Pre-Roman	Riehl and Kümmel	2005
87	Tell Sheikh Hamad (Ceremonial)	East	GME	Ceremonial	Roman	van Zeist	2008
88	Tell Sheikh Hamad (Urban)	East	GME	Urban	Early Pre-Roman, Roman	van Zeist	2008
89	Tel Michal (Military)	East	Levant	Military	Pre-Roman, Roman	Liphschitz and Wasiel	1989
90	Tel Michal (Rural)	East	Levant	Rural	Early Pre-Roman	Liphschitz and Wasiel	1989
91	Tille Höyük	East	GME	Urban	Early Pre-Roman, Pre-Roman	Nesbitt	2016
92	Timnah	East	Levant	Urban	Early Pre-Roman, Pre-Roman	Kislev et al.	2006

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93	Tushan	East	GME	Urban	Early Pre-Roman	Rosenzweig	2016
94	Yoncatepe (Ceremonial)	East	GME	Ceremonial	Early Pre-Roman	Donmex and Belli	2007
95	Yoncatepe (Other)	East	GME	Other	Early Pre-Roman	Donmex and Belli	2007
96	Yotvata	East	GME	Military	Late Roman	Ramsay	2015
97	Zeugma	East	GME	Urban	Roman	Challinor and Moulins	2005
98	Albenga	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
99	Alezio	Italy	South	Ceremonial	Pre-Roman	Colaiani	2008
100	Angera (Ceremonial)	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
101	Angera (Other)	Italy	North	Other	Late Roman	Rottoli	1995
102	Aquachiara	Italy	Central	Rural	Roman	Shelton	2009
103	Aquileia	Italy	North	Urban	Roman	Castelletti	1972
104	Aquileia Ex Essiccato	Italy	North	Urban	Pre-Roman	Maselli Scotti and Rottoli	2007
105	Arsago Seprio	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
106	Augusta Bagiennorum	Italy	North	Urban	Roman, Late Roman	Caramiello et al.	2013
107	Baggiovara (Ceremonial)	Italy	North	Ceremonial	Late Roman	Rinaldi et al.	2011
108	Baggiovara (Ceremonial 2)	Italy	North	Ceremonial	Late Roman	Rinaldi et al.	2011
109	Baggiovara (Rural)	Italy	North	Rural	Roman	Rinaldi et al.	2011
110	Bergamo-via degli Orti	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
111	Blera-Le Pozze	Italy	Central	Rural	Pre-Roman	Costantini and Giorgi	1987
112	Bologna-Fiera Internazionale	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011

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113	Bologna-Nuova Stazione AV	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
114	Botromagno	Italy	South	Rural	Pre-Roman	Lentjes	2016
115	Breno-Sanctuary of Minerva	Italy	North	Ceremonial	Pre-Roman	Castiglioni and Rottoli	2010
116	Bresica-Capitolium	Italy	North	Urban	Pre-Roman	Castelletti	1987
117	Calvatone	Italy	North	Urban	Roman	Rottoli	1996
118	Cardo V Sewer	Italy	South	Urban	Roman	Rowan	2017
119	Casalecchio di Reno	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
120	Case Nuove	Italy	Central	Rural	Roman, Late Roman	Mercuri, Rattigheri, and Rinaldi	2013
121	Casteldebole	Italy	North	Villa	Roman	Bandini Mazzanti et al	1995
122	Castelvechio di Peveragno	Italy	North	Other	Late Roman	Motella de Carlo	1995
123	Cavallino	Italy	South	Urban	Pre-Roman	Fiorentino and Colaanni	2005
124	Cerrione	Italy	North	Ceremonial	Roman	Castiglioni et al.; Rottoli and Castiglioni	2011b; 2011
125	Col di Marzo	Italy	Central		Pre-Roman	Morales Mateo, J.	pers. comm. (
126	Como-via Benzi	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
127	Cremona-San Lorenzo	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
128	Filattieria-Sorano	Italy	Central	Rural	Late Roman	Rottoli and Negri	1998
129	La Fontanaccia	Italy	Central	Rural	Late Roman	Sadori and Susanna	2005

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130	Forcello	Italy	North	Urban	Pre-Roman	Castelletti and Rottoli	1986
131	House of Amaranthus at Pompeii	Italy	South	Ceremonial	Pre-Roman	Robinson	2002
132	House of Chaste Lovers at Pompeii	Italy	South	Urban	Roman	Ciaraldi	2007
133	House of Hercules' Wedding at Pompeii (Ceremonial)	Italy	South	Ceremonial	Pre-Roman	Ciaraldi	2007
134	House of Hercules' Wedding at Pompeii (Urban)	Italy	South	Urban	Pre-Roman	Ciaraldi	2007
135	House of the Postumii at Pompeii	Italy	South	Ceremonial	Roman	Robinson	2002
136	House of the Vestals (Ceremonial)	Italy	South	Ceremonial	Pre-Roman	Ciaraldi	2007
137	House of the Vestals (Urban)	Italy	South	Urban	Pre-Roman, Roman	Ciaraldi	2007
138	L'Amastuola	Italy	South	Rural	Pre-Roman	Lentjes	2016
139	Levate	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
140	Lomello	Italy	North	Other	Roman	Castelletti	1975
141	Lovere-via Martinoli	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
142	Manerbio	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
143	Mariano Comense- Via T. Grossi	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
144	Mezzocorona	Italy	North	Rural	Roman	Castiglioni and Rottoli	1994
145	Modena-Ferrovia Modena Sassuolo	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011

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146	Mola di Monte Gelato (Rural)	Italy	Central	Rural	Late Roman	Girogi	1997
147	Mola di Monte Gelato (Villa)	Italy	Central	Villa	Roman	Giorgi	1997
148	Montebelluna	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
149	Monte Bibele	Italy	North	Rural	Pre-Roman	Accorsi et al.	1984
150	Monte Papalucio	Italy	South	Ceremonial	Pre-Roman	Lentjes	2016
151	Muro Tenete (Ceremonial)	Italy	South	Ceremonial	Pre-Roman	Lentjes	2016
152	Muro Tenete (Rural)	Italy	South	Rural	Pre-Roman	Lentjes	2016
153	Mutina-Ex Cassa Risparmio	Italy	North	Urban	Roman	Rinaldi et al.; Bosi et al.	2013; 2017
154	Mutina-Ex Cinema Capitol	Italy	North	Urban	Pre-Roman, Roman	Bosi et al.	2015
155	Mutina-Novì Sad	Italy	North	Urban	Roman	Bosi et al.	2015, 2017
156	Nave	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
157	Oplontis	Italy	South	Villa	Roman	Ricciardi and Aprile	1988
158	Padova-Banca Etica	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
159	Padova-Borgomagno	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
160	Palike	Italy	South	Ceremonial	Pre-Roman	Castiglioni	2008
161	Parma-Piazza Garibaldi	Italy	North	Ceremonial	Pre-Roman	Bosi et al.	2011
162	Pescarzo	Italy	North	Rural	Pre-Roman	Castiglioni et al.	1999a
163	Piadena-San Paola Ripa d'Oglio	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
164	Pian d'Alma	Italy	Central	rural	Pre-Roman	Mariotti Lipi et al.	2002
165	Pieve del Finale	Italy	North	Other	Pre-Roman	Arroba and Murialdo	1996

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166	Pomarico Vecchio	Italy	South	Urban	Pre-Roman	Caramiello and Siniscalco	1998
167	Pompeii-Forum	Italy	South	Urban	Pre-Roman, Roman	Rowan	2014
168	Pompeii-VI.1 (Ceremonial)	Italy	South	Ceremonial	Pre-Roman, Roman	Murphy et al.	2013
169	Pomp-VI.1 (Urban)	Italy	South	Urban	Pre-Roman, Roman	Murphy et al.	2013
170	Porta Nocera at Pompeii	Italy	South	Ceremonial	Roman	Matterne and Derremaux	2008
171	Portomaggiore- Gambulaga	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
172	Privernum	Italy	Central	Urban	Roman	Sadori, Giardini, and Susanna	2010
173	Roccagloriosa	Italy	South	Rural	Pre-Roman	Costantini and Fitt; Lentjes	1990; 2016
174	Rome-Palatine Hill	Italy	Central	Urban	Pre-Roman	Motta	2002
175	Russi	Italy	North	Villa	Roman	Bandini Mazzanti et al.	2001
176	San Gruilia di Bresica	Italy	North	Urban	Late Roman	Castiglioni et al.	1999b
177	San Candido-Boden	Italy	North	Other	Roman	Castiglioni	2005
178	San Candido-Grantner	Italy	North	Other	Roman	Castiglioni	2005
179	San Candido-La Casa dell'Organista	Italy	North	Other	Roman	Castiglioni	2005
180	Settefinestre	Italy	Central	Villa	Roman, Late Roman	Jones	1985
181	San Giovanni di Ruoti	Italy	South	Villa	Roman, Late Roman	Costantini; Monckton	1983; 2003
182	Spilamberto	Italy	North	Rural	Roman	Marchesini and Marvelli	2002
183	Tempio di Venere at Pompeii	Italy	South	Ceremonial	Roman	Fiorentino and Marinò	2008
184	Tincu House- Gabii	Italy	Central	Urban	Pre-Roman	Motta	2016

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185	Torre di Satriano (Ceremonial)	Italy	South	Ceremonial	Pre-Roman	Novellis	2008, 2009
186	Torre di Satriano (Other)	Italy	South	Other	Pre-Roman	Novellis	2008, 2009
187	Trezzo-Cascina S. Martino	Italy	North	Rural	Late Roman	Castiglioni and Rottoli	2012
188	Vada Sabatia	Italy	North	Urban	Roman, Late Roman	Arobba et al.	2013a
189	Vaste-Piazza Dante	Italy	South	Ceremonial	Pre-Roman	Mastronuzzi et al.	2013
190	Ventimiglia	Italy	North	Urban	Roman	Arroba et al.	2005
191	Verdello	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
192	Verona-Porto Palio e Spianà	Italy	North	Ceremonial	Roman	Rottoli and Castiglioni	2011
193	Via Sacra- Rome	Italy	Central	Urban	Pre-Roman	Girogi	1988
194	Villabassa	Italy	North	Rural	Late Roman	Banzi et al.	2009
195	Villa di Isera	Italy	North	Villa	Roman	Castiglioni et al.	2011a
196	Villandro	Italy	North	Rural	Roman, Late Roman	Nisbet	2006-2007
197	Voghenza	Italy	North	Ceremonial	Roman	Forlani and Bandini Mazzanti	1984

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Table B1 Categorisation Indicators utilised for taphonomic analyses.

Classification	Context indicators	Density indicators	Plant Indicators	Other characteristics
Ceremonial	Burials, shrines, temples	Med-High, but often concentrated, small deposits	Food plants such as fruits and cereals, ornamental plants. Often includes more rare/exotic items	Often carbonised (i.e. 'burnt offerings') and confined by context
Crop processing	Can be near obvious processing facilities, such as presses for olive oil or wine production.	Medium-High	By-products, such as cereal chaff, grape pip and pedicel, olive stones, arable weed seeds harvested with cereals.	For cereals, high ratios of chaff to cereal. In the case of olive, stones are often highly fragmented.
Food preparation	Kitchens, ovens, hearths	Typically low, resultant of accidental deposition	Food plants, particularly those that need to be prepared/cooked in fire	
Refuse	Drains, sewers, latrines, sometimes pits	Various	Often inedible or indigestible portions of foodplants, such as olive stones, grape pips, and fig seeds.	Can be found alongside other refuse, such as broken vessels and animal bones. Can be preserved in human waste, often mineralised
Food stores	Can be in storage container such as amphora or other vessel	Very high densities	Storable food items such as cereals or pulses	Assemblages exhibit high degree of uniformity, consisting of mostly one plant type.
Fodder/Dung	Structures associated with animal husbandry, stables, mangers	Various, can be Medium-High	Forage plants, such as legumes <i>Medicago</i> , <i>Melilotus</i> , <i>Trifolium</i> , <i>Vicia</i> sp., <i>Lathyrus</i> sp., some grasses, barley, and various wild species.	
Dung Fuel	Hearths, tabun, ovens, industrial contexts requiring fuel.	Medium-High	Wild/weed species eaten by animals, indicating dung fuel. <i>Prosopis</i> sp. in the East.	Can be found alongside remains of charcoal. Preserved dung may indicate dung fuel.
Background noise	Contexts vary	Low densities, assemblages build up overtime rather than in single event	Any	Does not meet criteria for other classifications

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Table B2 Results of Taphonomical Analyses for the East. H.P.= handpicked. Samples are presumed to be bulk samples unless indicated otherwise. Due to sumsampling and presence/absence reporting, numerous interpretations are necessarily tentative. Assemblages labelled as 'Other' are predominantly pomace fuel.

Record	Site Type	Period	No. of Samples	Dung fuel	Fodder	Indet/ Background noise	Crop processing	Ceremonial	Storage	Food/ Food Prep.	Refuse	Other
Abi'or Cave	Rural	Roman	1				X		X	X		
Abu Qubur	Other	Roman	11						X			
Aila	Urban	Pre-Roman	1				X					
Aila	Urban	Late Roman	1				X					
Aila	Urban	Roman	1				X					
Ain Dara	Urban	Early Pre-Roman	34	X			X					
Amorium	Urban	Late Roman	1			X						
Araq el-Emir	Rural	Early Pre-Roman	1 H.P.			X						
Araq el-Emir	Rural	Pre-Roman	1 H.P.			X						
Araq el-Emir	Rural	Late Roman	1 H.P.			X						
Araq el-Emir	Rural	Roman	1 H.P.			X						
Ashkelon	Urban	Early Pre-Roman	14		X		X		X		X	
Asvan Kale	Rural	Pre-Roman	26		X		X		X	X		
Asvan Kale	Rural	Roman	2				X					
Ayanis	Other	Early Pre-Roman	73	X					X			
Bastam	Urban	Early Pre-Roman	81	X					X			
Bir Madhkur (Military)	Military	Roman	1				X					

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Bir Madhkur (Rural)	Rural	Late Roman	2		X		X			X		
Bir Madhkur (Rural)	Rural	Roman	1				X			X		
Bosra	Urban	Pre-Roman	4				X					
Bosra	Urban	Roman	5				X					
Çadir Höyük	Urban	Pre-Roman	5				X					
Caesarea	Urban	Late Roman	2	X								
Caesarea	Urban	Roman	1	X								
Caesarea Inner Harbour	Urban	Late Roman	1								X	
Cave of the Pool	Rural	Roman	1 H.P.						X	X		
Cave of the Spear	Rural	Roman	2							X		
Cave of the Treasure	Rural	Roman	1 H.P.							X		
Cave V/49	Rural	Pre-Roman	1 H.P.							X		
City of David	Urban	Early Pre-Roman	19									
City of David	Urban	Pre-Roman	7									
Dascyleum	Urban	Early Pre-Roman	1			X						
Dascyleum	Urban	Pre-Roman	3			X						
Deir Alla	Urban	Early Pre-Roman	6						X			
Dhiban	Urban	Early Pre-Roman	1				X					
Dhiban	Urban	Roman	1				X					
Düzen Tepe	Other	Pre-Roman	1			X						

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El-Lejjun	Military	Late Roman	1	X			X					
En Boqeq	Military	Late Roman	1				X					
En Gedi (Military)	Military	Roman	1 H.P.									
En Gedi (Rural)	Rural	Roman	1						X			
Gordion	Urban	Roman	1	X			X					
Gordion 2	Urban	Early Pre-Roman	35	X		X			X	X		
Gordion 2	Urban	Pre-Roman	89	X		X			X	X		
Hippos-Sussita	Urban	Pre-Roman	9								X	
Hippos-Sussita	Urban	Late Roman	28	X							X	X
Hippos-Sussita	Urban	Roman	11								X	X
Horvat Rosh Zayit	Other	Early Pre-Roman	4						X			
Horvat Mesad (Military)	Military	Roman	1 H.P.			X						
Horvat Mesad (Roadside station)	Other	Pre-Roman	3 H.P.			X						
Sumaqa (Cerem. 1)	Cerem.	Late Roman	5					X				
Sumaqa (Cerem. 2)	Cerem.	Late Roman	8					X				
Sumaqa (Rural)	Rural	Late Roman	2			X						
Humayma (Military)	Military	Roman	3				X		X			
Humayma (Roadside station)	Other	Roman	1				X					
Huqoq	Rural	Late Roman	1			X						
Jebel Khalid	Urban	Pre-Roman	2	X								

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Jerash	Urban	Pre-Roman	6	X						X		
Jerash	Urban	Roman	3							X		
Jiyeh/Porphyreon	Urban	Early Pre-Roman	2 H.P, 6 bulk			X						
Jiyeh/Porphyreon	Urban	Pre-Roman	5 H.P, 36 bulk			X						
Jiyeh/Porphyreon	Urban	Late Roman	3 H.P., 8 bulk			X						
Jiyeh/Porphyreon	Urban	Roman	1 H.P., 12 bulk								X	
Kaman Kalehöyük	Other	Early Pre-Roman	2	X								
Kerkenes	Urban	Early Pre-Roman	71	X								
Khirbet Qumran	Rural	Roman	1 H.P.						X	X		
Khirbet er-Rasm	Rural	Pre-Roman	38									
Khirbet et-Tannur	Cerem.	Roman	6 H.P.					X				
Kilise Tepe	Rural	Late Roman	1			X						
Kilise Tepe	Rural	Early Pre-Roman	3			X						
Kuşakli	Urban	Early Pre-Roman	1	X			X					
Madâ'in Sâlih	Urban	Pre-Roman	1			X						
Madâ'in Sâlih	Urban	Late Roman	1				X					
Nahal Yattir	Rural	Roman	1						X			
Nimrud	Rural	Pre-Roman	1	X					X			
Patnos	Urban	Early Pre-Roman	8						X			

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Pella	Urban	Early Pre-Roman	16							X		
Pella	Urban	Pre-Roman	2							X		
Petra- ez-Zantur	Urban	Pre-Roman	4	X			X			X	X	X
Petra- ez-Zantur	Urban	Late Roman	2				X			X	X	X
Petra- ez-Zantur	Urban	Roman	1									X
Petra- Pool and Garden Complex	Urban	Pre-Roman	1							X	X	
Petra- Pool and Garden Complex	Urban	Roman	2	X						X	X	
Qal' eh Ismail Aga	Other	Early Pre-Roman	10			X						
Qasr Al-Buleida	Military	Late Roman	2							X	X	
Qumran Cave 24	Rural	Pre-Roman	1 H.P.			X						
Qumran Cave 24	Rural	Roman	1 H.P.			X						
Sagalassos-LE	Urban	Late Roman	1							X		
Sagalassos	Urban	Late Roman	1			X						
Sagalassos	Urban	Roman	1			X						
Si	Other	Pre-Roman	6							X	X	
Si	Other	Roman	30							X	X	
Sidon	Urban	Early Pre-Roman	1				X					
Sos Höyük	Rural	Early Pre-Roman	1			X						
Susa-Ville Royale II (Cerem.)	Cerem.	Early Pre-Roman	8					X				

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Susa-Ville Royale II (Urban)	Urban	Roman	3						X	X		
Tall al-'Umayri	Urban	Early Pre-Roman	1							X		
Tall al-'Umayri	Urban	Pre-Roman	2			X						
Tall Zira'a	Rural	Late Roman	1			X						
Tall Zira'a	Rural	Roman	1			X						
Tall Zira'a	Rural	Pre-Roman	1			X						
Tall Zira'a	Rural	Early Pre-Roman	1			X						
Tel Beer Sheba	Urban	Early Pre-Roman	1			X						
Tel Beer Sheba	Urban	Pre-Roman	1 H.P.			X						
Tel Halaf	Urban	Early Pre-Roman	1	X			X					
Tel 'Ira	Urban	Early Pre-Roman	1 H.P.			X						
Tell Afis	Urban	Early Pre-Roman	40				X			X	X	
Tell Beth-Shean	Urban	Early Pre-Roman	4	X					X			X
Tell el-Burak	Rural	Early Pre-Roman	1				X					
Tell el-Hesi	Urban	Pre-Roman	21						X	X	X	
Tell es-Safi	Urban	Early Pre-Roman	3 H.P., 1 bulk				X					
Tell es-Sa'Idiyeh	Urban	Early Pre-Roman	11							X		
Tell es-Sa'Idiyeh	Urban	Pre-Roman	4							X		

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Tell Hadidi	Other	Roman	4	X								
Tell Halif (Rural)	Rural	Late Roman	1			X						
Tell Halif (Urban)	Urban	Early Pre-Roman	1			X						
Tell Halif (Urban)	Urban	Pre-Roman	1			X						
Tell Hesban	Urban	Early Pre-Roman	6			X						
Tell Hesban	Urban	Pre-Roman	7	X								
Tell Hesban	Urban	Roman	12									
Tel el-Mazar (Other)	Other	Early Pre-Roman	6						X	X		
Tel el-Mazar (Other 2)	Other	Pre-Roman	13						X	X		
Tell Mishrifeh	Urban	Early Pre-Roman	2	X			X					
Tell Sheikh Hamad (Cerem.)	Cerem.	Roman	2					X				
Tell Sheikh Hamad	Urban	Early Pre-Roman	29	X			X		X			
Tell Sheikh Hamad	Urban	Roman	2			X						
Tel Michal	Military	Pre-Roman	1 H.P.			X						
Tel Michal	Military	Roman	1 H.P.			X						
Tel Michal (Rural)	Rural	Early Pre-Roman	1 H.P.			X						
Tille Höyük	Urban	Early Pre-Roman	15				X		X			
Tille Höyük	Urban	Pre-Roman	2						X			
Timnah	Urban	Early Pre-Roman	9									X

Appendix B: Taphonomy categorisation protocol and classifications of records

Timnah	Urban	Pre-Roman	2									
Tushan	Urban	Early Pre-Roman	1	X								
Yoncatepe (Cerem.)	Cerem.	Early Pre-Roman	1					X				
Yoncatepe	Other	Early Pre-Roman	11						X			
Yotvata	Military	Late Roman	4 H.P., 4 bulk	X								
Zeugma	Urban	Roman	80						X	X	X	

Appendix B: Taphonomy categorisation protocol and classifications of records

Table B3 Results of taphonomical analysis for records from Italy. Due to sumsampling and presence/absence reporting, numerous interpretations are necessarily tentative. Some overlap between very low-density food remains from domestic contexts and 'background noise' should be noted.

Record	Site Type	Period	No. of Samples	Fodder	Indet/ Background noise	Crop processing	Ceremonial	Storage	Food/ Food prep.	Refuse	Other
Albenga	Cerem.	Roman	2				X				
Alezio	Cerem.	Pre-Roman	5				X				
Angera (Ceremonial)	Cerem.	Roman	1				X				
Angera (Other)	Other	Late Roman	4			X					
Aquachiara	Rural	Roman	4			X					
Aquileia	Urban	Roman	2			X					
Aquileia-Ex Essiccato	Urban	Pre-Roman	1			X					
Arsago Seprio	Cerem.	Roman	2				X				
Augusta Bagiennorum	Urban	Late Roman	5		X						
Augusta Bagiennorum	Urban	Roman	6		X						
Baggiovara (Cerem. 1)	Cerem.	Late Roman	3				X				
Baggiovara (Cerem. 2)	Cerem.	Late Roman	3				X				
Baggiovara (Rural)	Rural	Roman	2		X						
Bergamo-via degli Orti	Cerem.	Roman	1				X				
Blera-Le Pozze	Rural	Pre-Roman	1		X						
Bolonga-Fiera Internazionale	Cerem.	Roman	1				X				
Bologna-Nuova Stazione AV	Cerem.	Roman	1				X				

Appendix B: Taphonomy categorisation protocol and classifications of records

Botromagno	Rural	Pre-Roman	1			X					
Breno-Sanctuary of Minerva	Cerem.	Pre-Roman	4				X				
Breno-Sanctuary of Minerva	Cerem.	Roman	2				X				
Bresica-Capitolium	Urban	Pre-Roman	1			X					
Calvatone	Urban	Roman	1			X		X			
Cardo V Sewer	Urban	Roman	22							X	
Casalecchio di Reno	Cerem.	Roman	1				X				
Case Nuove	Rural	Late Roman	2			X					
Case Nuove	Rural	Roman	2			X					
Casteldebole	Villa	Roman	1							X	
Castelvecchio di Peveragno	Other	Late Roman	19		X	X					
Cavallino	Urban	Pre-Roman	1			X			X		
Cerrione	Cerem.	Roman	2				X				
Col di Marzo	Rural	Pre-Roman	252			X					
Como-via Benzi	Cerem.	Roman	1				X				
Cremona-San Lorenzo	Cerem.	Roman	1				X				
Filattiera	Rural	Late Roman	15			X		X			
Filattiera	Rural	Roman	4			X		X			
La Fontannacia	Rural	Late Roman	12			X		X			
Forcello	Urban	Pre-Roman	1						X		
House of Amarantus	Cerem.	Pre-Roman	2				X				

Appendix B: Taphonomy categorisation protocol and classifications of records

House of Amarantus	Cerem.	Roman	2				X				
iHouse of Chaste Lovers	Urban	Roman	1	X							
House of Hercules' Wedding (Cerem.)	Cerem.	Pre- Roman	3				X				
House of Hercules' Wedding (Urban)	Urban	Pre- Roman	41	X						X	
House of the Postumi	Cerem.	Roman	2				X				
House of the Vestals (Cerem.)	Cerem.	Pre- Roman	4				X				
House of the Vestals (Urban)	Urban	Pre- Roman	53	X						X	
House of the Vestals (Urban)	Urban	Roman	3							X	
L'Amastuola	Rural	Pre- Roman	1			X					
Levate	Cerem.	Roman	1				X				
Lomello	Other	Roman	1	X		X		X			
Lovere-via Martinoli	Cerem.	Roman	1				X				
Manerbio	Cerem.	Roman	2				X				
Mariano Comense-via T. Grossi	Cerem.	Roman	1				X				
Mezzocorona	Rural	Roman	22			X					
Modena-Ferrovia Modena Sassuolo	Cerem.	Roman	1				X				
Mola di Monte Gelato (Rural)	Rural	Late Roman	6			X					
Mola di Monte Gelato (Villa)	Villa	Roman	6		X						
Montebelluna	Cerem.	Roman	1				X				
Monte Bibele	Rural	Pre- Roman	4						X		
Monte Papalucio	Cerem.	Pre- Roman	1				X				

Appendix B: Taphonomy categorisation protocol and classifications of records

Muro Tenente (Ceremonial)	Cerem.	Pre-Roman	7				X				
Muro Tenente (Rural)	Rural	Pre-Roman	14			X					
Mutina- Ex Cassa Risparmio	Urban	Roman	1		X						
Mutina-Ex Cinema Capitol	Urban	Pre-Roman	2			X			X		
Mutina-Ex Cinema Capitol	Urban	Roman	2		X				X		
Mutina- Novi Sad	Urban	Roman	4		X						
Nave	Cerem.	Roman	1				X				
Oplontis	Villa	Roman	1	X							
Padova-Banca Etica	Cerem.	Roman	1				X				
Padova-Borgomagno	Cerem.	Roman	1				X				
Palike	Cerem.	Pre-Roman	2				X				
Palike	Cerem.	Roman	1		X						
iParma-Piazza Garibaldi	Cerem.	Pre-Roman	2				X				
Pescarzo	Rural	Pre-Roman	1		X				X		
Piadena- San Paola Ripa d'Oglio	Cerem.	Roman	1				X				
Pian D'Alma	rural	Pre-Roman	1		X						
Pieve del Finale	Other	Pre-Roman	3					X			
Pomarico Vecchio	Urban	Pre-Roman	1		X						
Pompeii-Forum	Urban	Pre-Roman	2							X	X
Pompeii-Forum	Urban	Roman	1							X	X

Appendix B: Taphonomy categorisation protocol and classifications of records

Pompeii-VI.I (Cerem.)	Cerem.	Pre-Roman	1				X				
Pompeii-VI.I (Cerem.)	Cerem.	Roman	1				X				
Pompeii-VI.I (Urban)	Urban	Pre-Roman	1		X						
Pompeii-VI.I (Urban)	Urban	Roman	1		X						
Porta Nocera	Cerem.	Roman	2				X				
Portomaggiore-Gambulaga	Cerem.	Roman	13				X				
Privernum	Urban	Roman	4								X
Roccagloriosa	Rural	Pre-Roman	7			X					
Rome-Palatine Hill	Urban	Pre-Roman	1			X					
Russi	Villa	Roman	1						X		
Santa Giulia di Bresica	Urban	Late Roman	1						X		
San Candido-Boden	Other	Roman	1			X			X		
San Candido-Grantner	Other	Roman	3		X						
San Candido-La Casa dell'Organista	Other	Roman	2			X					
Settefinestre	Villa	Late Roman	4		X						
Settefinestre	Villa	Roman	8		X						
San Giovanni di Ruoti	Villa	Late Roman	13			X					
San Giovanni di Ruoti	Villa	Roman	2			X					
Spilamberto	Rural	Roman	1		X						
Tempio di Venere	Cerem.	Roman	1				X			X	
Tincu House- Gabii	Urban	Pre-Roman	16		X						
Tore di Satriano	Other	Pre-Roman	3		X						

Appendix B: Taphonomy categorisation protocol and classifications of records

Tore di Satriano	Cerem.	Pre-Roman	1				X				
Trezzo-Cascina San Martino	Rural	Late Roman	6			X				X	
Vada Sabatia	Urban	Late Roman	2							X	X
Vada Sabatia	Urban	Roman	3							X	X
Vaste-Piazza Dante	Cerem.	Pre-Roman	7				X				
Ventimiglia	Urban	Roman	3		X						
Verdello	Cerem.	Roman	1				X				
Verona-Porto Palio e Spianà	Cerem.	Roman	1				X				
Via Sacra	Urban	Pre-Roman	7	X		X					
Villabassa	Rural	Late Roman	1		X						
Villa di Isera	Villa	Roman	3		X						
Villandro	Rural	Late Roman	1	X		X					
Villandro	Rural	Roman	2	X		X		X			
Voghenza	Cerem.	Roman	2				X				

Appendix C Archaeobotanical data from Hippos-Sussita

Table C1 Raw data for samples taken from Hippos-Sussita during the 2017 field season.

Sample number	1	2	3	4	5	6	7	8	9	10	11	12	13
Locus	2877	2877	2880	2880	2880	2880	2880	2880	2880	2875	2875	2880	2877
Area	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I
Sample size	8L	10L	10L	10 L	10 L	10 L	10 L	9 L	10 L	10 L	10 L	8 L	10 L
Period/Date	5-8 AD	5-8 AD	LR	LR	LR	LR	LR	LR	LR	Indet.	Indet.	LR	5-8 AD
% sorted (1mm/ 0.3 mm)	100	100	25/25	25/25	25/25	25/25	25/12.5	25/12.5	25/25	50/25	100/25	25/25	100
Cereals													
cf. <i>Triticum dicoccum</i>					1								
<i>Triticum</i> sp.													
cf. <i>Triticum</i> sp.													
Cereal indet.													
Chaff													
<i>Triticum monococcum</i> / <i>dicoccum</i> (spikelet base)													
Cereal indet. (culm node)					1								
Cereal indet. (awn)										1			
Pulses													
cf. <i>Lens culinaris</i>						1							
<i>Vicia/Lathyrus/Pisum</i>					1								
Large pulse indet.													
Fruit/Nut													
<i>Ficus carica</i>	1									2			
cf. <i>Ficus carica</i>	1												2
<i>Vitis vinifera</i>	1												2
<i>Vitis vinifera</i> , mi.	3												

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Olea europaea</i>	{3}	{2}	23 {47}	22 {65}	15 {60}	8 {41}	20 {64}	6 {46}	6 {31}	{6}	{3}	24 {84}	{28}
Fruit skin/flesh indet.		x			x								
Fruit stone indet.													
Wild/Weed													
cf. Chenopodiaceae													
Caryophyllaceae										1			
cf. <i>Vicia/Lathyrus</i>		1								1			
<i>Medicago/Trifolium</i>	1	2											
cf. Small legume indet.											2		
Small legume indet.										2			
Fabaceae										1			
Boraginaceae, uncharred													
Asteraceae					1								
Cyperaceae													1
Poaceae										1			2
Seed indet.											1		
Other													
Charred lump indet.		x											
cf. Dung					x								

Appendix C: Archaeobotanical data from Hippos-Sussita

Sample number	14	15	16	17	18	19	20	21	22	23	24	25	29
Locus	2877	2877	2880	8007	8007	8007	8007	8007	8003	8003	8003	8003	8003
Area	SWL I	SWL I	SWL I	HLC	HLC	HLC	HLC	HLC	HLC	HLC	HLC	HLC	HLC
Sample size	10 L	8 L	10 L	8 L	8 L	8 L	10 L	10 L	10 L	10 L	8 L	8 L	10 L
Period/Date	5-8 AD	5-8 AD	LR	1 st BC	1 st BC	1 st BC	1 st BC	1 st BC	Early 3 rd AD	Early 3 rd AD	Early 3 rd AD	Early 3 rd AD	Early 3 rd AD
% sorted (1mm/ 0.3 mm)	100	100	25/25	100	100	100	100	100	100	100	100	100	100
Cereals													
cf. <i>Triticum dicoccum</i>													
<i>Triticum</i> sp.				1							1		
cf. <i>Triticum</i> sp.		1											
Cereal indet.	1												
Chaff													
<i>Triticum monococcum</i> / <i>dicoccum</i> (spikelet base)													
Cereal indet. (culm node)													
Cereal indet. (awn)													
Pulses													
cf. <i>Lens culinaris</i>													
<i>Vicia/Lathyrus/Pisum</i>													
Large pulse indet													
Fruit/Nut													
<i>Ficus carica</i>		3			4					9	2		2
cf. <i>Ficus carica</i>										3	1	1	2
<i>Vitis vinifera</i>			1							1			
<i>Vitis vinifera</i> , mi.													
<i>Olea europaea</i>	{8}		13 {70}	1 {5}	1 frag	2 {1}	{1}		2 {4}	{1}	{4}	{1}	{1}
Fruit skin/flesh indet.													
Fruit stone indet.													

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	14	15	16	17	18	19	20	21	22	23	24	25	29
Wild/Weed													
cf. Chenopodiaceae													1
Caryophyllaceae	1												
cf. <i>Vicia/Lathyrus</i>													
<i>Medicago/Trifolium</i>	1												
cf. Small legume indet.													
Small legume indet.													
Fabaceae													
Boraginaceae, uncharred													
Asteraceae													
Cyperaceae													
Poaceae													
Seed indet.	2				1				1		2		2
Other													
Charred lump indet.		X						X					
cf. Dung													
Bud		1											

Appendix C: Archaeobotanical data from Hippos-Sussita

Sample number	30	31	32	33	34	35	36	37	38	39
Locus	2882	2882	2881	2881	2883	2885	8019	2901	2875	2901
Area	SWL I	SWL I	SWL I	SWL I	SWL I	SWL I	HLC	SWL I	SWL I	SWL I
Sample size	7 L	10 L	8 L	7 L	8 L	10 L	10 L	8 L	10 L	10 L
Period/Date	LR	LR	LR	LR	LR	LR	1 st AD	5-8 AD	Indet.	5-8 AD
% sorted (1mm/ 0.3 mm)	25/25	25/25	25/25	25/25	50/25	100	100	25/25	25/25	100
Cereals										
<i>cf. Triticum dicoccum</i>										
<i>Triticum</i> sp.										
<i>cf. Triticum</i> sp.						1	1			
Cereal indet.							1			
Chaff										
<i>Triticum monococcum/</i> <i>dicoccum</i> (spikelet base)							1			
Cereal indet. (culm node)										
Cereal indet. (awn)										
Pulses										
<i>cf. Lens culinaris</i>										
<i>Vicia/Lathyrus/Pisum</i>										
Large pulse indet.							1			
Fruit/Nut										
<i>Ficus carica</i>							1			
<i>cf. Ficus carica</i>	X								1	
<i>Vitis vinifera</i>				1			1			
<i>Vitis vinifera</i> , mi.										
<i>Olea europaea</i>	10 {60}	2 {69}	22{52}	10{37}	1 {6}	8 {33}		9 {29}	1 {11}	1 {7}
Fruit skin indet.										
Fruit stone indet.										X

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	30	31	32	33	34	35	36	37	38	39
Fruit flesh indet.										
Wild/Weed										
cf. Chenopodiaceae										
Caryophyllaceae										
cf. <i>Vicia/Lathyrus</i>										
<i>Medicago/Trifolium</i>						1				
cf. Small legume indet.										
Small legume indet.										
Fabaceae										
Boraginaceae, uncharred										X
Asteraceae										
Cyperaceae										
Poaceae										
Seed indet.	1						1		2	4
Other										
Charred lump indet.							2			
cf. Dung										
Bud										

Appendix C: Archaeobotanical data from Hippos-Sussita

Table C2 Raw data for samples taken from Hippos-Sussita during the 2018 field season.

Sample number	1	2	3	5	6	7	8	9	10	11	12	13	14
Locus	2927	2774	2927	2929	2927	2774	2834	2927	2940	2940	2798	2797	2936
Area	SWL I	DMW		SWL I	SWL I	DMW	SWL I	SWL I	SWL I	SWL I	DME	DME	SWL I
Sample size	10 L	10 L	10 L	8 L	10 L	6 L	8 L	10 L	10 L	10 L	5 L	6 L	10 L
Period/Date	5-6 AD	1 BC-1 AD	5-6 AD	Umayyad	5-6 AD	1 BC	c. 5 AD	5-6 AD	4-5 AD	4-5 AD	1 BC	1 AD	Byz/Um
% sorted (1 mm/ 0.3 mm)	100	100	100	100	100	100	100	100	50/25	50/50	100	100	100
Cereals													
<i>Hordeum</i> sp. (hulled)													
<i>Hordeum</i> sp.													
cf. <i>Hordeum</i> sp.													
<i>Triticum durum/aestivum</i>													
<i>Triticum</i> sp. (free-threshing)													
<i>Triticum</i> sp.													
cf. <i>Triticum</i> sp.	1											1	
<i>Secale cereale</i>													
Cereal indet.													
cf. Cereal indet.													
Cereal chaff													
<i>Hordeum</i> sp. (rachis)													
<i>Triticum monococcum/dicoccum</i> (spikelet base)													
<i>Triticum</i> sp. (free-threshing cf. hexaploid rachis)													
<i>Triticum</i> sp. (free-threshing rachis)													

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	1	2	3	5	6	7	8	9	10	11	12	13	14
<i>Triticum</i> sp. (hexaploid rachis)													
<i>Triticum</i> sp. (cf. tetraploid rachis)													
cf. <i>Triticum</i> sp. (rachis)													
Cereal indet. (rachis)													
Cereal indet. (awn)													
Pulses													
<i>Lens culinaris</i>													
cf. <i>Lens culinaris</i>			1									1	
<i>Vicia faba</i>													
<i>Vicia</i> cf. <i>faba</i>													
<i>Vicia</i> cf. <i>ervilia</i>													
cf. <i>Vicia</i> sp.													
Large pulse indet.			1				2						
cf. Large pulse indet.													
Fruit/Nut													
<i>Ficus carica</i>					1								
cf. <i>Ficus carica</i>													
<i>Vitis vinifera</i>												1	
<i>Vitis vinifera</i> , mineralised													
<i>Olea europaea</i>	1 {6}		3 {6}	{1}	{7}	{1}	1 {2}	{5}	{17}	{12}	{1}	{1}	{7}
<i>Olea europaea</i> , mineralised	1												
nutshell indet.													
Other cultivated													
cf. <i>Linum usitatissimum</i> type												1	

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	1	2	3	5	6	7	8	9	10	11	12	13	14
<i>Linum</i> sp.													
cf. <i>Linum</i> sp.													
Wild/Weed													
Chenopodiaceae													
<i>Stellaria media</i>													
Caryophyllaceae													
<i>Rumex</i> sp.													
cf. <i>Rumex</i> sp.													
<i>Rumex/Carex</i>													
<i>Malva sylvestris</i>													
<i>Malva</i> sp.													
cf. <i>Malva</i> sp.													
<i>Raphanus raphanistrum</i>													
<i>Vicia/Lathyrus</i>													
cf. <i>Vicia/Lathyrus</i>													
<i>Medicago/Trifolium</i>							1					1	
cf. <i>Medicago/Trifolium</i>													
Apiaceae													
<i>Galium</i> sp.													
<i>Onopordum</i> sp.													
Asteraceae						1							
Cyperaceae													
Poaceae													
Small Poaceae indet.												9	
Large Poaceae indet.		1											
Seed indet.			1										
Seed indet, mineralised													
Other													

Appendix C: Archaeobotanical data from Hippos-Sussita

Bread/dung													

Appendix C: Archaeobotanical data from Hippos-Sussita

Sample number	15	16	17	18	19	20	21	22	23	24	25	26	27
Locus	2951	2940	2952	3808	2927	2947	3810	2933	3819	2947	3184	2356	2947
Area	SWL I	SWL I	SWL I	DME	SWL I	SWL I	DME	SWL I	DME	SWL I	DME	North Dump	SWL I
Sample size	10 L	10 L	10 L	8 L	10 L	8 L	7 L	10 L	8 L	8 L	10 L	10 L	8 L
Period/Date	Indet.	4-5 AD	Indet.	1 BC	5-6 AD	5-6 AD	1 BC	Indet.	LR/Byz	4-5 AD	5-6 AD	Hel-Byz	4-5 AD
% sorted (1 mm/ 0.3 mm)	50/25	100	100	100	100	100/50	100	100	50/25	25/12.5	100	100	25/12.5
Cereals													
<i>Hordeum</i> sp. (hulled)													
<i>Hordeum</i> sp.								1					
cf. <i>Hordeum</i> sp.													
<i>Triticum durum/aestivum</i>													
<i>Triticum</i> sp. (free-threshing)													
<i>Triticum</i> sp.								2					
cf. <i>Triticum</i> sp.													
<i>Secale cereale</i>													
Cereal indet.								1					
cf. Cereal indet.													
Cereal chaff													
<i>Hordeum</i> sp. (rachis)								1					
<i>Triticum monococcum/dicoccum</i> (spikelet base)								1					
<i>Triticum</i> sp. (free-threshing cf. hexaploid rachis)								11					
<i>Triticum</i> sp. (free-threshing rachis)								17					
<i>Triticum</i> sp. (cf. free-threshing rachis)													

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	15	16	17	18	19	20	21	22	23	24	25	26	27
<i>Triticum</i> sp. (hexaploid rachis)													
<i>Triticum</i> sp. (cf. tetraploid rachis)													
cf. <i>Triticum</i> sp. (rachis)								6					
Cereal indet. (rachis)								4					
Cereal indet. (awn)													
Pulses													
<i>Lens culinaris</i>													
cf. <i>Lens culinaris</i>													
<i>Vicia faba</i>													
<i>Vicia</i> cf. <i>faba</i>								1					
<i>Vicia</i> cf. <i>ervilia</i>													
cf. <i>Vicia</i> sp.													
Large pulse indet.													
cf. Large pulse indet.		1											
Fruit/Nut													
<i>Ficus carica</i>							1	27					
cf. <i>Ficus carica</i>													
<i>Vitis vinifera</i>								9					
<i>Vitis vinifera</i> , mineralised											1		
<i>Olea europaea</i>	1 {4}		1{7}	{1}	3 {8}	7 {25}	{1}	2 {3}	23 {109}	7 {24}	1 {3}	{4}	10 {5}
<i>Olea europaea</i> , mineralised									1				
nutshell indet.					1								
Other cultivated													
cf. <i>Linum usitatissimum</i> type													
<i>Linum</i> sp.													

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	15	16	17	18	19	20	21	22	23	24	25	26	27
cf. <i>Linum</i> sp.													
Wild/Weed													
Chenopodiaceae													
<i>Stellaria media</i>													
Caryophyllaceae													
<i>Rumex</i> sp.													
cf. <i>Rumex</i> sp.													
<i>Rumex/Carex</i>													
<i>Malva sylvestris</i>													
<i>Malva</i> sp.													
cf. <i>Malva</i> sp.													
<i>Raphanus raphanistrum</i>													
<i>Vicia/Lathyrus</i>								8					
cf. <i>Vicia/Lathyrus</i>								1	2			1	
<i>Medicago/Trifolium</i>													
cf. <i>Medicago/Trifolium</i>													
Apiaceae													
<i>Galium</i> sp.													
<i>Onopordum</i> sp.													
Asteraceae													
Cyperaceae								1					
Poaceae													
Small Poaceae indet.													
Large Poaceae indet.													
Seed indet.									1				
Seed indet, mineralised											1		
Other													
Bread/dung										1			

Appendix C: Archaeobotanical data from Hippos-Sussita

Sample number	28	29	30	31	32	33	34
Locus	2356	2960	2356	2977	2980	2980	2980
Area	North Dump	SWL I	North Dump	SWL I	SWL I	SWL I	SWL I
Sample size	10 L	10 L	10 L	10 L	10 L	10 L	10 L
Period/Date	Hel-Byz	Byz/Um	Hel-Byz	Byzantine	Roman	Roman	Roman
% sorted (1 mm/ 0.3 mm)	100	100	100	100	50/50	100/50	100
Cereals							
<i>Hordeum</i> sp. (hulled)							
<i>Hordeum</i> sp.				1			
cf. <i>Hordeum</i> sp.							
<i>Triticum durum/aestivum</i>							
<i>Triticum</i> sp. (free-threshing)	1						
<i>Triticum</i> sp.							
cf. <i>Triticum</i> sp.							
<i>Secale cereale</i>							
Cereal indet.							
cf. Cereal indet.							
Cereal chaff							
<i>Hordeum</i> sp. (rachis)							
<i>Triticum monococcum/dicoccum</i> (spikelet base)							
<i>Triticum</i> sp. (free-threshing cf. hexaploid rachis)							
<i>Triticum</i> sp. (free-threshing rachis)							
<i>Triticum</i> sp. (cf. free-threshing rachis)							
<i>Triticum</i> sp. (hexaploid rachis)							

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	28	29	30	31	32	33	34
<i>Triticum</i> sp. (cf. tetraploid rachis)							
cf. <i>Triticum</i> sp. (rachis)							
Cereal indet. (rachis)							
Cereal indet. (awn)							
Pulses							
<i>Lens culinaris</i>							
cf. <i>Lens culinaris</i>							
<i>Vicia faba</i>							
<i>Vicia</i> cf. <i>faba</i>							
<i>Vicia</i> cf. <i>ervilia</i>							
cf. <i>Vicia</i> sp.							
Large pulse indet.		1					
cf. Large pulse indet.							
Fruit/Nut							
<i>Ficus carica</i>	1			2	2		
cf. <i>Ficus carica</i>	2			1			1
<i>Vitis vinifera</i>				1			
<i>Vitis vinifera</i> , mineralised							
<i>Olea europaea</i>	{1}	1 frag	1 {4}	1 {5}	6 {17}	3 {18}	4 {36}
<i>Olea europaea</i> , mineralised							
nutshell indet.							
Other cultivated							
cf. <i>Linum usitatissimum</i> type							
<i>Linum</i> sp.							
cf. <i>Linum</i> sp.							
Wild/Weed							
Chenopodiaceae							

Appendix C: Archaeobotanical data from Hippos-Sussita

(Sample cont.)	28	29	30	31	32	33	34
<i>Stellaria media</i>							
Caryophyllaceae	1						
<i>Rumex</i> sp.							
cf. <i>Rumex</i> sp.							
<i>Rumex/Carex</i>							
<i>Malva sylvestris</i>							
<i>Malva</i> sp.							
cf. <i>Malva</i> sp.							
<i>Raphanus raphanistrum</i>							
<i>Vicia/Lathyrus</i>							
cf. <i>Vicia/Lathyrus</i>							
<i>Medicago/Trifolium</i>							
cf. <i>Medicago/Trifolium</i>				2			
Apiaceae							
<i>Galium</i> sp.							
<i>Onopordum</i> sp.							
Asteraceae							
Cyperaceae							
Poaceae							
Small Poaceae indet.							
Large Poaceae indet.							
Seed indet.			1	1			
Seed indet, mineralised							
Other							
Bread/dung							

Appendix D Indicator values used in autecological analysis

Table I1 Ecological indicator values for the most frequent weed seeds in the Italian dataset. After Pignatti et al. 2005.

Taxa	L (Light)	T (Temperature)	C (Continentality)	U (Moisture)	R (Reaction)	N (Nutrient)	S (Salt)
<i>Agrostemma githago</i>	7	X	X	X	4	3	0
<i>Atriplex</i>	6-11	5-12	4-8	1-6	0-7	1-9	0-3
<i>Bromus</i> sp.	5-11	5-11	4-8	2-8	4-8	0-6	0
<i>Bromus secalinus</i>	6	X	6	X	X	X	0
<i>Carex</i> sp.	2-11	1-8	0-7	2-10	0-9	0-8	0
<i>Chenopodium</i> sp.	7-8	5-9	4-7	2-6	4-8	2-9 (most 5-9)	0
<i>Chenopodium album</i>	7	7	5	4	5	7	0
<i>Cupressus sempervirens</i>	7	7	6	3	X	3	0
<i>Euphorbia helioscopia</i>	9	7	5	3	5	6	0
<i>Fumaria</i> sp.	7-8	7-9	4-6	2-4	5	2-6	0
<i>Galium</i> sp.	2-11	2-10	3-6	1-8	1-7	1-5	0
<i>Galium aparine</i>	6	X	5	4	5	5	0
<i>Lolium</i> sp.	7-8	5-8	4-5	3-5	4-8	2-7	0
<i>Medicago</i>	7-12	5-11	3-7	1-4	4-9	1-7 (most 1-3)	0-2
<i>Medicago minima</i>	11	7	5	3	8	1	0
<i>Ornithopus perpusillus</i>	7	5	4	2	2	3	0
<i>Phalaris</i> sp.	7	6-8	X	3-5	6	4-6	0
<i>Polygonum</i> sp.	6-11	2-10	4-7	1-11	3-7	1-8	0-2
<i>Polygonum aviculare</i>	7	7	5	3	6	1	0
<i>Polygonum convolvulus</i>	8	7	4	4	5	3	0
<i>Polygonum persicaria</i>	6	5	5	3	7	7	0
<i>Quercus</i> sp.	2-7	6-10	3-6	3-6	3-7	2-6	0
<i>Rumex</i> sp.	4-9	2-11	3-9	2-10	1-8	1-9	0

Appendix D: Indicator values used in autecological analysis

<i>Sambucus ebulus</i>	8	6	5	5	8	7	0
<i>Sherardia arvensis</i>	8	6	5	5	8	5	0
<i>Stellaria media</i>	6	X	X	4	7	8	0
<i>Veronica hederifolia</i>	6	6	5	5	3	7	0
<i>Vicia</i> sp.	4-11	4-11	3-6	2-5	3-8	1-5	0

Appendix E Flowering times of weed seeds in the Italian dataset

Table J1 Flowering times of top most frequently occurring weed seeds in the Italian dataset. X= flowering month.

Taxa	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Common Name
<i>Agrostemma githago</i>					X	X							Common corncockle
<i>Atriplex</i> sp.					X	X	X	X	X	X			Saltbush/Orache
<i>Bromus</i> sp.			X	X	X	X	X	X					Brome grasses
<i>Bromus secalinus</i>					X	X							Rye brome
<i>Carex</i> sp.		X	X	X	X	X	X	X	X				Sedge
<i>Chenopodium</i> sp.					X	X	X	X	X	X	X	X	Goosefoot
<i>Chenopodium album</i>						X	X	X	X				White goosefoot
<i>Euphorbia helioscopia</i>	X	X	X	X	X							X	Sun spurge
<i>Fumaria</i> sp.	X	X	X	X	X	X	X	X	X	X		X	Fumitory
<i>Galium</i> sp.	X	X	X	X	X	X	X	X	X				Bedstraw
<i>Galium aparine</i>	X	X	X	X									Cleavers/Bedstraw
<i>Lolium</i> sp.				X	X	X	X	X					Ryegrass
<i>Lathyrus</i> sp.			X	X	X	X	X	X					Vetchlings
<i>Medicago</i> sp.			X	X	X	X	X	X					Medick
<i>Medicago minima</i>					X	X	X						Bur medick
<i>Melilotus/Medicago/Trifolium</i>	X	X	X	X	X	X	X	X	X	X	X	X	Sweet clover/Medick/Clover
<i>Ornithopus perpusillus</i>					X	X							Little white bird's foot
<i>Phalaris</i> sp.				X	X	X	X						Phalaris grasses
<i>Polygonum</i> sp.				X	X	X	X	X	X	X			Buckwheat/Knotweed
<i>Polygonum aviculare</i>						X	X	X	X	X			Yard knotweed
<i>Polygonum convolvulus</i>					X	X	X	X					Wild buckwheat/ Black-binweed
<i>Polygonum persicaria</i>							X	X	X	X			Spotted lady's thumb
<i>Quercus</i> sp.			X	X	X	X							Oak

Appendix E: Flowering times of weed seeds in the Italian dataset

<i>Rumex</i> sp.	X	X	X	X	X	X	X	X	X				Dock/Sorrel
<i>Sambucus ebulus</i>					X	X	X						Dwarf Elder
<i>Sherardia arvensis</i>			X	X	X	X	X						Field madder
<i>Stellaria media</i>	X	X	X	X	X	X	X	X	X	X	X	X	Common chickweed
<i>Veronica hederifolia</i>	X	X	X	X	X								Ivy leaved speedwell
<i>Vicia</i> sp.			X	X	X	X	X	X					Vetches

Appendix F Summary of uncharred data from the Near East

Table K1 Number of sites producing desiccated plant remains by period. Material from Sites 1, 17, 18, 20, and 47.

	Early Pre-Roman (0)	Pre-Roman (1)	Roman (4)	Late Roman (0)
Cereals and cereal chaff			2	
Barley			2	
Glume wheat			1	
Free-threshing wheat				
Pulses			2	
Flavourings			1	
Vegetables		1	1	
Other economic taxa			1	
Wild/Weed			2	
Fig			1	
Grape			1	
Olive			3	
Date			4	
Pomegranate			3	
<i>Prunus</i> fruits				
Other fruits			1	
Nuts			2	

Table K2 Number of sites producing waterlogged plant remains by period. Material from Site 16, and Ramsay (2010).

	Early Pre-Roman (0)	Pre-Roman (0)	Roman (0)	Late Roman Period (2)
Cereals and cereal chaff				1
Barley				1
Glume wheat				1
Free-threshing wheat				1
Pulses				1
Flavourings				
Vegetables				1
Other economic taxa				
Wild/Weed				2
Fig				2
Grape				2
Olive				2
Date				

Appendix F: Summary of uncharred data from the Near East

Pomegranate				1
<i>Prunus</i> fruits				1
Other fruits				1
Nuts				1

Table K3 Number of sites producing mineralised plant remains by period. Material from Sites 31, 32, 44, 45, 46, 76, 97, and Baeten et al. (2012).

	Early Pre-Roman (4)	Pre-Roman (2)	Roman (3)	Late Roman (1)
Cereals and cereal chaff			1	
Barley				
Glume wheat			1	
Free-threshing wheat				
Pulses				
Flavourings				
Vegetables				
Other economic taxa				
Wild/Weed	2	2		
Fig	2	1	2	1
Grape	1			
Olive				
Date				
Pomegranate				
<i>Prunus</i> fruits				
Other fruits				
Nuts				

Table K4 Number of sites producing generally 'uncharred' plant remains by period. Material from Sites 4, 6, 7, 19, 31, 32, 35, 45, 46, 64, 65, 72, 74, 86, and 97.

	Early Pre-Roman (9)	Pre-Roman (3)	Roman (3)	Late Roman (1)
Cereals and cereal chaff				
Barley	1		1	
Glume wheat			1	
Free-threshing wheat				
Pulses	1			1
Flavourings				
Vegetables				

Appendix F: Summary of uncharred data from the Near East

Other economic taxa	1	1		
Wild/Weed	9	1	1	
Fig	1	1	1	
Grape	2		1	
Olive			2	
Date		1	1	
Pomegranate			1	
<i>Prunus</i> fruits				
Other fruits			1	
Nuts			2	

Appendix G Summary of uncharred data from Italy

Table L1 Sites producing waterlogged plant remains by period. Material from Sites 111, 118, 154, 155, 163, 188, Arroba et al. (2013b), Bertacchi et al. (2008), Bosi et al. (2015), Lentjes (2016), and Ciaraldi (2007).

	Pre-Roman (5)	Roman (9)	Late Roman (4)
Cereals and Cereal Chaff	1	1	
Barley	1		
Glume wheat	1		
Free-threshing wheat	1		
Wheat, general		1	
Pulses	1	2	
Flavourings	1	4	
Vegetables	2	6	
Other economic taxa		1	1
Wild/Weed	4	9	4
Fig	3	5	2
Grape	4	9	3
Olive	2	4	1
Date			
Pomegranate			
<i>Prunus</i> fruits		6	1
Other fruits	4	9	2
Nuts	3	7	3

Table L2 Number of sites producing mineralised remains by period. Material from Sites 118, 133, 134, 136, 137, 167, 168, 169, 183, 187, 190, and Rattighieri et al. 2013.

	Pre-Roman (7)	Roman (8)	Late Roman (1)
Cereals and cereal chaff	5	4	1
Barley		1	
Pulses	2	3	
Glume wheat		1	
Free-threshing wheat			
Flavourings	3	1	
Vegetables	1	1	
Other economic taxa	4	1	
Wild/Weed	6	5	1
Fig	7	5	1
Grape	6	5	1
Olive	2	1	
Date	1	1	
Pomegranate	1	1	

Appendix G: Summary of uncharred data from Italy

<i>Prunus</i> fruits	1	2	1
Other fruits	6	3	
Nuts	1	2	

Table L3 Number of sites producing generally 'uncharred' remains by period. Material from Sites 103, 104, 107, 108, 109, 117, 120, 122, 153, 187, and Follieri 1975.

	Pre-Roman (1)	Roman (6)	Late Roman (6)
Cereals and cereal chaff	1		
Barley	1		
Glume wheat	1		
Free-threshing wheat	1		
Wheat, general	1		
Pulses		1	
Flavourings	1	1	1
Vegetables	1	1	1
Other Economic Taxa	1	1	1
Wild/Weed	1	4	6
Fig	1	1	2
Grape	1	2	4
Olive	1	1	1
Date			
Pomegranate		1	
<i>Prunus</i> fruits	1	1	2
Other Fruits	1	1	2
Nuts	1	2	2