



HAL
open science

Land management and food resources in Bronze Age central Greece. Insights from archaeobotanical assemblages from the sites of Agia Paraskevi, Kynos and Mitrou (Phthiotida)

Maria Ntinou, Angeliki Karathanou, Clémence Pagnoux, Soutana-Maria Valamoti

► To cite this version:

Maria Ntinou, Angeliki Karathanou, Clémence Pagnoux, Soutana-Maria Valamoti. Land management and food resources in Bronze Age central Greece. Insights from archaeobotanical assemblages from the sites of Agia Paraskevi, Kynos and Mitrou (Phthiotida). Soutana-Maria Valamoti; Anastasia Dimoula; Maria Ntinou. *Cooking with plants in ancient Europe and beyond. Interdisciplinary approaches to the archaeology of plant foods*, Sidestone Press, pp.71-91, 2022, 978-94-6427-033-4. hal-03985874

HAL Id: hal-03985874

<https://hal.science/hal-03985874v1>

Submitted on 19 Oct 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

COOKING WITH PLANTS IN ANCIENT EUROPE AND BEYOND

 **sidestone**press



This is a free offprint – as with all our publications the entire book is freely accessible on our website, and is available in print or as PDF e-book.

www.sidestone.com

COOKING WITH PLANTS IN ANCIENT EUROPE AND BEYOND

*Interdisciplinary approaches to
the archaeology of plant foods*

SOULTANA MARIA VALAMOTI, ANASTASIA DIMOULA AND MARIA NTINOU (EDS)

© 2022 Individual authors

Published by Sidestone Press, Leiden
www.sidestone.com

Lay-out & cover design: Sidestone Press

Photograph cover: Kostas Prokos

ISBN 978-94-6427-033-4 (softcover)

ISBN 978-94-6427-034-1 (hardcover)

ISBN 978-94-6427-035-8 (PDF e-book)



Contents

Cooking with plants in ancient Europe and beyond	9
Soultana Maria Valamoti, Anastasia Dimoula, Maria Ntinou	
1. Plant ingredients archived with <i>ArboDat</i> – evaluating regional food preferences and changes from crop remains, using the new archaeobotanical database for Greece	19
Soultana Maria Valamoti, Angela Kreuz, Chryssa Petridou, Angeliki Karathanou, Martha Kokkidou, Pavlos Lathiras, Stavroula Michou, Pelagia Paraskevopoulou, Hara Stylianakou	
2. Cooking with cereals in the Early Bronze Age kitchens of Archondiko Giannitson (northern Greece): an archaeobotanical investigation of phase IV (2135-2020 cal BC)	43
Soultana Maria Valamoti, Chryssa Petridou	
3. Early viticulture in Neolithic and Bronze Age Greece: looking for the best traditional morphometric method to distinguish wild and domestic grape pips	57
Vincent Bonhomme, Clémence Pagnoux, Laurent Bouby, Sarah Ivorra, Susan E. Allen, Soultana Maria Valamoti	
4. Land management and food resources in Bronze Age central Greece. Insights from archaeobotanical assemblages from the sites of Agia Paraskevi, Kynos and Mitrou (Phthiotida)	71
Maria Ntinou, Angeliki Karathanou, Clémence Pagnoux, Soultana-Maria Valamoti	
5. Staple grains in the later Bronze Age of the (southern) Aegean: archaeobotanical, textual and ethnographic insights	93
Paul Halstead, Amy Bogaard, Glynis Jones	
6. Early Chalcolithic plant economy at Aktopraklık Höyük in northwest Anatolia: preliminary findings	105
Ceren Kabukcu, Eleni Asouti, Emma Percival, Ellen Grice, Necmi Karul	
7. New bioarchaeological approaches to the study of plant food practices in the Eastern Mediterranean during the 2nd millennium BC	113
Janine Fries-Knoblach and Philipp W. Stockhammer	
8. The importance of flavoured food: a (cautious) consideration of spices and herbs in Indus Civilization (ca 3200-1500 BC) recipes	143
Jennifer Bates	

9. The first five millennia of plant food production in the central and western Balkans: archaeobotanical evidence from the Neolithic to the Bronze Age	155
Dragana Filipović, Djurdja Obradović, Anne de Vareilles	
10. Strategic drinking: the shelf-life and socio-political importance of Early Iron Age west-central European beer	175
Joshua Driscoll	
11. Cereals and cereal-based products from Tiel Medel, an Early Neolithic Swifterbant site in the Netherlands	187
Lucy Kubiak-Martens	
12. Cooked and raw. Fruits and seeds in the Iberian Palaeolithic	201
Ernestina Badal, Carmen M. Martínez Varea	
13. Trends and evolution of the plant-based diet in prehistoric Iberia: a view from archaeobotany	219
Leonor Peña-Chocarro, Guillem Pérez-Jordà	
14. Unearthing a new food culture: fruits in early modern Ireland	229
Meriel McClatchie, Susan Flavin, Ellen OCarroll	
15. Let nothing go hungry: the indigenous worldview of Andean food and feeding	239
Christine A. Hastorf	
16. Grinding and pounding in Early Neolithic southeastern Europe: culinary preferences and social dimensions of plantfood processing	249
Ismini Ninou, Nikos Efstratiou, Soutana-Maria Valamoti	
17. Grinding practices in prehistoric north and central Greece: evidence from the use-wear analysis	269
Danai Chondrou, Maria Bofill, Haris Procopiou, Roberto Vargiolu, Hassan Zahouani, Eleftheria Almasidou, Tasos Bekiaris, Ismini Ninou, Soutana Maria Valamoti	
18. The daily grind. Investigating the contexts of food grinding practices and tools in the Neolithic of southeastern Europe	297
Tasos Bekiaris, Danai Chondrou, Ismini Ninou, Soutana-Maria Valamoti	
19. Cooking on the rocks? An interdisciplinary approach on the use of burnt stone slabs from Neolithic Avgi, Kastoria	319
Tasos Bekiaris, Nikos Katsikaridis, Christos L. Stergiou, Georgia Stratouli	
20. Grinding systems as cultural markers at the turn of the 6th millennium BC in north-western continental Europe	335
Caroline Hamon	

21. Cooking in progress: evolution and diversity of cooking pottery in prehistoric northern Greece and Bulgaria	347
Anastasia Dimoula, Zoi Tsirtsoni, Paraskevi Yiouni, Alexander Chohadzhiev, Pascal Darcque, Maria Ivanova, Chaido Koukouli-Chryssanthaki, Sophia Koulidou, Krassimir Leshtakov, Petar Leshtakov, Konstantinos Filis, Dimitria Malamidou, Nikos Merousis, Aikaterini Papanthimou, Vanya Petrova, Evangelia Stefanit, Nadezhda Todorova, Katerina Tzanavari, Evangelia Voulgari, Soultana Maria Valamoti	
22. Plant boiling among the first pottery-making societies in the southern Levant: an insight from charred residues of pottery	391
Julien Vieugué, Monica Ramsey, Yosef Garfinkel	
23. Cooking in Bronze Age northern Greece: an investigation of thermal structures	407
Evanthia Papadopoulou, Sandra Prévost-Dermarkar, Anastasia Dimoula, Niki Chondrou, Soultana-Maria Valamoti	
24. Clay cooking ware and kitchen equipment in the ancient Greek household	431
Eleni Manakidou	
25. Preparing vegetables in ceramic pots over a hearth fire: using Minoan cookware to understand plant-based dishes in the ancient world	443
Jerolyn E. Morrison	
26. Glume wheats in modern Greece: lessons for antiquity	455
Paul Halstead	
27. Modern research and efforts for the organic restoration of prehistoric wheat in Greece	465
Kostas Koutis, Evangelos Korpetis, Parthenopi E. Ralli, †Nikolaos Stavropoulos	
28. Acorns as an alternative vital food resource today: an example from Kea Island, Greece	473
Marcie Mayer	
29. Food plants and commensality among early farmers in the Iberian Peninsula: connecting pioneering and modern kitchens	483
Anna B. Barberà, Sandra Lozano, Ferran Adrià, Ramon Buxó, Antoni Palomo	
30. “If you brew it, they will come”: experimental archaeology, ancient alcohol and US museums	493
Bettina Arnold	
Contributors	505

Land management and food resources in Bronze Age central Greece. Insights from archaeobotanical assemblages from the sites of Agia Paraskevi, Kynos and Mitrou (Phthiotida)

Maria Ntinou, Angeliki Karathanou,
Clémence Pagnoux, Soultana-Maria Valamoti

Abstract

This paper integrates analyses of charred wood and non-wood plant macroremains and morphometric analysis of grape pips (*Vitis vinifera*) aiming to provide insights into the vegetation, management of woodland resources, farming activities and dietary habits at three Bronze Age sites in Phthiotida, central Greece: Platania-Agia Paraskevi, Mitrou and Kynos. The sites span the entire Bronze Age (3200-1100 BC), a period of significant transformations in the social and economic realm. The evidence is based on remains retrieved by flotation from 396 soil samples. Wood charcoal analysis demonstrates a rich diversity of plant taxa with olive and deciduous oak commonly used at all periods and sites for fuel, alongside trees of the evergreen woodlands, especially *Arbutus*, therefore indicating the management of the lowlands and the meso-Mediterranean vegetation growing on the foothills near the settlements. Finds of olive and grapevine wood suggest management of both species while morphometric analyses of grape pips point towards an increase of domesticated grape pip morphotypes during the course of the Bronze Age and therefore to a systematic cultivation of the plant. Cereal staples included barley, einkorn, emmer and *T. timopheevii* wheat with free-threshing wheat and spelt wheat being poorly represented in the investigated finds; no millet was identified in the assemblages. A wide range of pulses, found in large quantities, most likely contributed significantly to the diet of humans and/or animals: lentils, bitter vetch and Celtic bean were grown as crops but the role of grass pea and chickpea is less straightforward. Fruit trees were also harvested, while the exploitation of various environmental niches, potentially not only for cultivation (i.e. grazing, building and basketry resources, etc), is also hinted by the available wild flora remains.

Keywords: *Bronze Age central Greece, archaeobotany, morphometric analysis, woodland management*

4.1 Introduction

Archaeobotanical research has the potential to offer precious insights about the interaction between human societies and the natural and cultural environment. Different lines of archaeobotanical research offer patches of information and when integrated, they become a powerful tool for comprehending past societies. For prehistoric Greece such an integration of archaeobotanical remains, bringing together palynological, anthracological and macroscopic plant remains (other than charcoal) are rare except for cases where specific plants are investigated such as the grapevine (e.g. Valamoti et al 2020) or the olive (Margaritis 2013; Valamoti et al 2018). One of the major axes of investigation within the ERC project PlantCult was the investigation of the long-term interaction between plants and people in prehistoric southeastern Europe. The area of Phthiotis lends itself to such an approach and we focus on the study of archaeobotanical assemblages from the three Bronze Age sites of Mitrou, Agia Paraskevi-Platania (hereafter Agia Paraskevi) and Kynos. The sites span the 3rd to 2nd mill BC that correspond to the Early, Middle and Late Bronze Age. We explore the management of natural vegetation and the cultivation of crops to fulfill the various needs of the human communities that inhabited our study region through the integration of anthracological and other macroscopic plant remains, including morphometric analysis of grape pips. This approach allows us to offer a more complete picture for the past, offering at the same time a diachronic perspective.

4.2 The natural setting

Phthiotis, our study area, is located in eastern central Greece, opposite the island of Euboea (Fig. 4.1a). The topography is highly varied. Along the north Euboean Gulf, the narrow coastal lowland fringe where the sites of Mitrou (12 m asl) and Kynos (10 m asl) are located, is succeeded by middle and high altitude (>1000 m asl) land, within a short distance from the coast. Further to the north in the broader area of the Maliakos Gulf where the coastal plain is bordered by the foothills of high mountain ranges to the north, south and west, lies the site of Agia Paraskevi (7 m asl) (Fig. 4.1 a). In this area, the Sperchios River exiting in the Maliakos Gulf has shaped the geography through depositional processes, resulting in the prolongation of the delta and the formation of a flat alluvial plain (Vouvalidis et al 2010, 65 and references therein).

The bioclimatic characteristics and the corresponding vegetation types in the study area are summarised in Fig. 4.1 b following Bohn et al (2002/2003). At present, much of the low and middle altitude areas are cultivated and therefore little remains of the natural vegetation. Thermo-Mediterranean sclerophyllous forests and xerophytic scrub characterise the narrow coastal zone along the north Euboean Gulf. Meso-Mediterranean evergreen woodlands

and scrub characterise the hilly land to the west of the coastal zone as well as the northern part of the study area from the coastline of the Maliakos Gulf to the foothills of the surrounding mountains. Evergreen woodlands are succeeded in altitude by meso/supra-Mediterranean and sub-Mediterranean thermophilous oak and mixed forests. Supra-Mediterranean fir forests consisting of dominant *Abies cephalonica* with *Pinus nigra* grow in the highest part of the mountains up to the tree line. *Platanus orientalis* alluvial forests and brackish water *Tamarix* scrub can be found in the area.

4.3 The sites

The Bronze Age on the southern and central Greek mainland (Helladic culture), is subdivided into three phases: the Early Bronze Age (EBA) or Early Helladic period (EH) (3200-2100 BC), the Middle Bronze Age (MBA) or Middle Helladic (MH) (2100-1700/1600 BC) and the Late Bronze Age (LBA) or Late Helladic (LH) (1700/1600-1100 BC). Archaeological research in the area of Phthiotis has provided evidence for long-term habitation already since the 4th mill BC testified by Final Neolithic finds in surface surveys and excavations, including the three sites that are presented in this study. The shift of habitation to central eastern mainland Greece during the 3rd mill BC, is documented in the flourishing of Early Bronze Age settlements (cf. Rutter 2001 and for the area under study, i.e. Phthiotida, see also Zahou 2009, 2019) of which Mitrou is a good example (Kramer-Hajos and O'Neill 2008; Van de Moortel and Zahou 2012; Van de Moortel et al 2018).

The sites of Mitrou and Kynos (Fig. 4.1), are located on the coastline of the North Euboean Gulf. The southernmost site, Mitrou, is a small tidal islet (3.6 ha) in the Bay of Atalante and the ancient settlement covers its entire surface (Van de Moortel and Zahou 2012, 1131, fig. 2; Karkanias and Van de Moortel 2014, 199, fig. 1). The islet is flat, rising gently to the north to about 12m asl. At low tide it is connected to the mainland and at high tide it is located only a hundred meters from the mainland coast. During the Bronze Age the site probably was part of the mainland, but still located close to the sea (Karkanias and Van de Moortel 2014, 199). Systematic excavations by the Mitrou Archaeological Project (2004-2008), revealed stratified sequences with more than 40 occupational phases with indoor floors and exterior surfaces, showing that the site was occupied without interruption from the Early Helladic IIB into the Late Protogeometric phase (ca 2400-900 BC) (Van de Moortel and Zahou 2012, 1132-1138; Karkanias and Van de Moortel 2014, 202). Abundant plant remains were recovered from fire destruction layers, pits, hearths, surfaces, floor deposits and fills from both internal and external spaces (Karathanou and Valamoti 2013; Karathanou 2019).

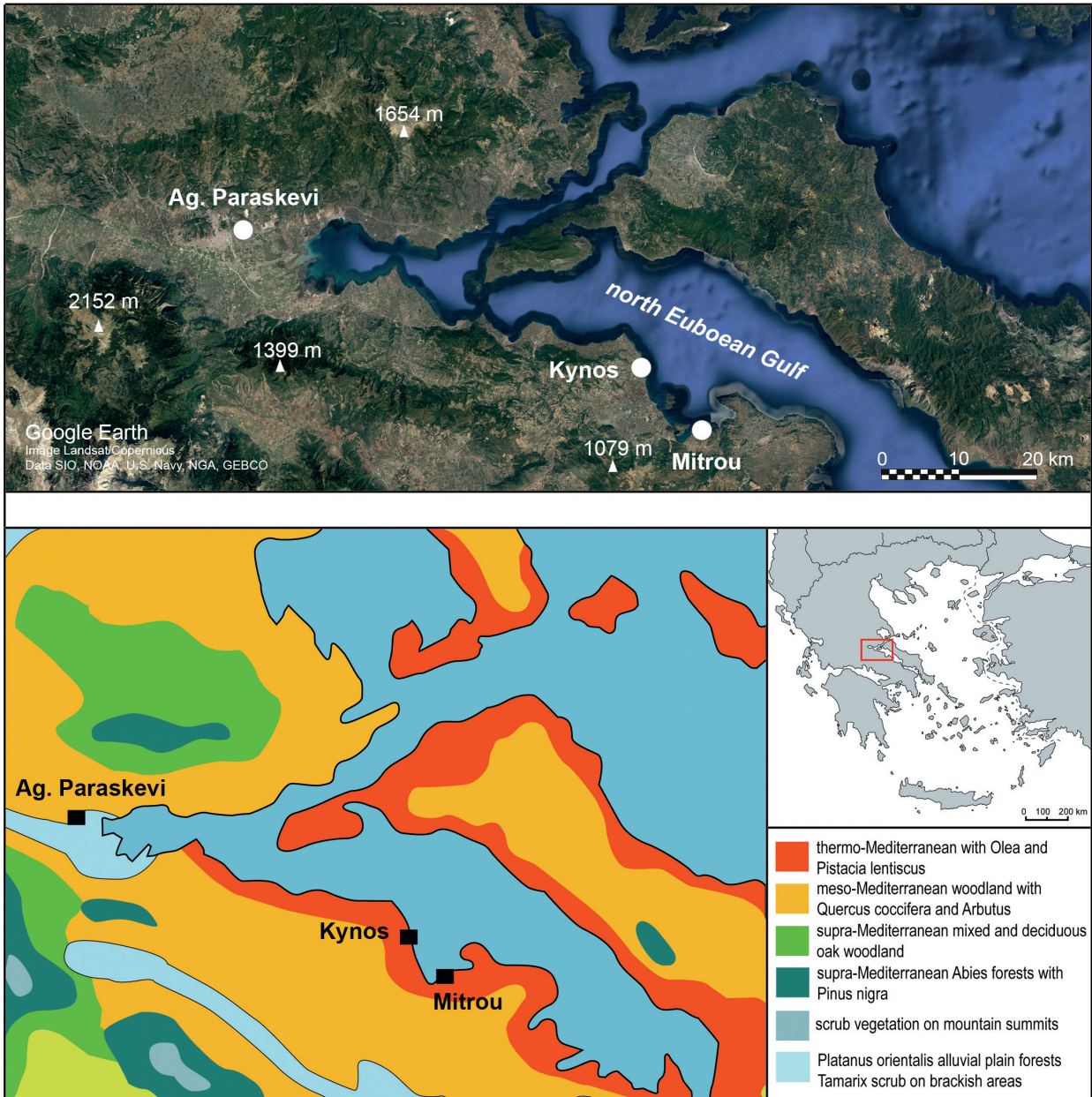


Fig. 4.1 a The location of the studied sites (Map data: Google, Image Data SIO, NOAA, U.S. Navy, NGA, GEBCO); b Bioclimatic zones and related vegetation types in the study area (after Bohn et al 2002/2003).

The site of Kynos is located on a coastal low mound northeast of the modern village Livanates overlooking the north Euboean Gulf (Fig. 4.1). The mound was formed by the debris of successive occupations starting in the Final Neolithic (4300-3200 BC) and lasting to the Early Byzantine period (5th-6th cAD). The material discussed here derives from successive architectural phases of the later part of the Late Bronze Age, mostly the Late Helladic IIIc. The structures were built with mudbrick walls on stone foundations. According to their size and

contents, the latter attesting to food preparation, storage and craft production (e.g. textiles, pottery), they were domestic units (Dakoronia 2010; Kounouklas 2011, 2015). Successive phases are distinguished by burnt destruction events which also provided excellent preservation of macrobotanical remains. Several crops were found stored in vessels and facilities (e.g. *pithoi* and clay bins) preserved *in situ*, and abundant plant remains from daily activities (crop processing, fuel spending, discarding) were recovered from the destruction layers on the floors and

the rebuilding fills above them (Karathanou and Valamoti 2013; Karathanou 2019; Kounouklas et al 2021).

The northernmost site of Agia Paraskevi (Fig. 4.1) is a low mound (7 m asl) overlooking the Sperchios River basin and the Maliakos Gulf (Papakonstantinou et al 2015). Multidisciplinary research coupled with ¹⁴C dating indicate that the area, which today is located 5.5 km from the present coastline, shifted from a marine palaeoenvironment (ca 5500 BC), to a coastal – lagoonal one (ca 3500 BC) and finally to a freshwater marshy environment (ca 2500 BC) (Vouvalidis et al 2010). Habitation at the site dates from the Late Neolithic to the Late Bronze Age and Historical times. Excavations at the center of the mound have revealed the architectural remains of a settlement of the Middle Helladic II period. Stone foundations of five apsidal buildings and parts of two more, some simultaneously used and others successively, were uncovered on either side of a street running along the N-S axis of the settlement and further separated by smaller streets/alleys. These domestic units usually comprised more than one parts/rooms and few reconstruction phases each, in cases distinguished by fire destruction debris. Pottery of a wide variety, abundant small finds and bioarchaeological materials including charred plant remains were contained in the deposits excavated both within the buildings and in the open spaces (Gkotsinas et al 2014; Papakonstantinou et al 2015; Papakonstantinou and Krapf 2020).

4.4 Materials and methods

A total of 396 sediment samples were collected from the three sites corresponding to 9506 litres of soil (Table 4.1). Though all prehistoric periods from the Early Bronze Age onwards are represented, most samples are dated to the Middle Bronze Age, followed by those of the Late Bronze Age. Sampling was systematic at Mitrou resulting in the representation of all excavated contexts. Systematic sampling was also applied during the first two excavation seasons at Agia Paraskevi, followed by sampling on a judgement basis in the following years. At Kynos, samples from the first campaign in the '80-90s were also collected in a less systematic way. Nevertheless, all undisturbed units were sampled systematically during the latest salvage excavation of an extensive clay construction that sealed the fire destruction layer of one of the settlement buildings at the site (Kounouklas et al 2021). Despite the discrepancy of sampling intensity among the three sites and in some cases within the same site, a wide variety of contexts are represented in the datasets: fills in open spaces and between floors, indoor destruction layers usually on top of floors, as well as more confined/specific features like vessels, bins, hearths, ovens, clay structures, pits, burials, etc.

Samples were processed by flotation, using a variant of the Ankara machine (French 1971) and by the wash-over

Cultural Period	Site	No of samples	Total volume (l)
EBA	Mitrou	18	468
EBA/MBA	Mitrou	5	88
MBA	Mitrou	48	3186
	Agia Paraskevi	149	1052
LBA	Mitrou	90	4041
	Kynos	72	285
LBA/Early Protogeometric	Mitrou	14	386
TOTAL		396	9506

Table 4.1 Number of soil samples and total volume processed per period at each site.

method in the case of the Kynos samples from the first campaign (Kenward et al 1980) due to their small volume. In all cases, the smallest mesh size used for the retrieval of floating material was 300 µm, while heavy residues were retained by a 1 mm plastic mesh.

4.4.1 Wood charcoal analysis

The study is based on the analysis of 202 flotation samples (3685 wood charcoal specimens in total) from the three Bronze Age settlements (Table 4.2). The material originates from fills and exterior areas, from burnt destruction layers in indoor contexts and from thermal structures. The provenance of the samples is shown in detail in Table 4.2. Wood charcoal macro-remains larger than 3 mm were examined for botanical identification at the ERC PlantCult project laboratory facilities (CIRI), with a Leica DM 2700M dark/bright field microscope with 50-500× magnification, and with the aid of the wood anatomy atlas of Schweingruber (1990) and the reference collection of the Departmental laboratory (LIRA). The analysis, presentation and interpretation of the wood charcoal macro-remains follow the main prerequisites of wood charcoal analysis (Chabal 1997; Asouti and Austin 2005; Kabukcu and Chabal 2021). The presence and ubiquity of the woody taxa in fills and burnt destruction layers is presented aiming to assess general aspects of access to and management of woody resources in different sites and periods. The qualitative and quantitative study of firewood remains from thermal structures that reflect short-term fuel uses is presented in a separate section. Quantification of the remains in long-term accumulation fills and dumping areas is based on fragment counts per taxon and the presentation of the data aims to tackle issues of firewood procurement strategies and woodland management diachronically. For the ease of discussing the taxonomically rich record, the woody taxa identified have been grouped in vegetation types according to their present-day distribution in bioclimatic zones (see Fig. 4.1). These are: a. Sclerophyllous Mediterranean woodland, b.

Table 4.2 The samples included in the wood-charcoal study and their provenance.

Cultural Period	EBA	EBA/MBA	MBA	LBA	MBA	LBA
Site	Mitrou			Agia Paraskevi		Kynos
Sample	no	no	no	no	no	no
fills	11		13	2	37	13
floors and burnt layers	7	5	8	12	62	25
thermal structures	2		4			1
Total no specimens analysed	990	221	1099	98	672	605

Deciduous Mediterranean woodland, c. Open woodland and scrub, d. Mediterranean mountain coniferous forests and e. Alluvial/riverine/brackish habitats. However, mixed formations at the interface of bioclimatic zones, growing under microclimatic conditions and influenced by human activity, should be considered as more realistic, especially in the areas close to the settlements.

4.4.2 Plant macro-remains other than wood

The results presented here rely on (a) 35 fully studied samples (Table 4.3), and, (b) 132 preliminarily studied samples (Table 4.4). As shown in Table 4.3, all fully studied samples come from the two Late Bronze Age sites, Mitrou and Kynos (first campaign of excavations). The 35 fully studied samples (Table 4.3) resulted from an initial number of 50 samples (33 from Mitrou and 17 from Kynos), some of which were amalgamated for the purposes of the analysis as they were from the same context and had almost the same archaeobotanical composition. The earlier periods are represented by a coarser-grained level of analysis and are only considered here in a qualitative way. The coarse level of analysis of the earlier samples involved (a) scanning of 66 samples and (b) sorting of 66 samples (Table 4.4); this procedure enabled the recording of species visible and an approximate estimation of the quantity in which the various species/genera were present in each sample. Scanning, as well as the sorting and identification that were applied to certain samples only, were performed with the aid of a stereomicroscope (X8-X40) with the contents of the coarse flot (>1mm) of each sample quickly being observed with the aid of a paint-brush; for the fine flots (1mm-300µm) only a smaller fraction of the sample was observed (cf. Valamoti 2004, 26). Scanning, sorting and identification were performed at the LIRA (AUTH) and the Ephoreia of Evritania and Phthiotida facilities. Identifications were aided by the LIRA modern seed reference collection and various seed atlases. Taxa nomenclature presented in the tables follows that of *Flora Europaea* (Tutin et al 1964-1993). Quantification was based on the selection of a specific part of the grain, chaff, seed or fruit only in order to avoid over-representation of an item broken into several pieces (see for example Valamoti 2004, 37). Ecological information for wild taxa were sought both in Greek sources (Gennadios 1914; Huxley and Taylor 1984;

Cultural Period	Site	No of fully studied samples (amalgamated)
LBA	Mitrou	21
	Kynos (first campaign samples)	14
Total		35

Table 4.3 Number of non-wood samples fully studied per cultural period and site.

Cultural Period	Site	No of scanned samples	No of sorted samples
EBA	Mitrou	18	
MBA	Mitrou	48	
	Agia Paraskevi		40
LBA	Kynos (recent campaign samples)		26
Total		66	66

Table 4.4 Number of non-wood samples preliminarily studied (scanned and sorted) per cultural period and site.

Kavvadas 1954-1964; Eleftherochorinos and Giannopolitis 2009; Papiomitoglou 2006) and sources including Greece within their study area (Tutin et al 1964-1980; Polunin 1969; Blamey and Grey-Wilson 2004).

4.4.3 Morphometric analysis

Morphometric analysis was performed on whole carbonized grape pips from the Middle Bronze Age settlement of Agia Paraskevi and Late Bronze Age Mitrou to explore past intra-specific diversity. This material has been fully published elsewhere (Pagnoux et al 2021) and is here presented in a summarised way. Samples of at least ten whole pips have been chosen and studied from the two sites in order to increase the reliability of the analyses with a total of 77 grape pips from Agia Paraskevi (Middle Bronze Age) and 89 from Mitrou (Late Bronze Age) represented in the analysis. The shapes of the seeds were described using outline analysis based on the Elliptic Fourier Transform technique (EFT), as developed and improved by previous studies (Terral et al 2010; Pagnoux et al 2015; for a complete description of the method, see Pagnoux et al 2021). The archaeological grape pips have been compared to a reference collection of modern grape

Cultural Period	EBA				MBA								LBA							
Site	Mitrou				Mitrou				Agia Paraskevi				Mitrou				Kynos			
Provenance	fills		destruction		fills		destruction		fills		destruction		fills		destruction		fills		destruction	
No samples studied	11		13		13		8		37		62		2		12		13		25	
Taxa	no	%	no	%	no	%	no	%	no	%	no	%	no	no	%	no	%	no	no	%
Evergreen Mediterranean woodland																				
<i>Olea europaea</i>	10	90.9	12	92.3	11	84.6	7	87.5	24	64.9	19	30.6	1	6	50.0	13	100	12	48.0	
<i>Arbutus</i> sp.	8	72.7	9	69.2	7	53.8	6	75.0	4	10.8	13	21.0	1	7	58.3	11	84.6	14	56.0	
<i>Quercus</i> sp. evergreen	7	63.6	6	46.2	6	46.2	4	50.0	3	8.1	5	8.1		3	25.0	13	100	9	36.0	
<i>Phillyrea/Rhamnus</i>	6	54.5	4	30.8	6	46.2	3	37.5	10	27.0	2	3.2		9	75.0	1	7.7	3	12.0	
<i>Pinus halepensis/P. brutia</i>																2	15.4	3	12.0	
<i>Pistacia lentiscus</i>							1	12.5			1	1.6				2	15.4	1	4.0	
Deciduous Mediterranean woodland																				
<i>Quercus</i> sp. deciduous	11	100.0	13	100.0	11	84.6	6	75.0	24	64.9	42	67.7		9	75.0	12	92.3	12	48.0	
<i>Fraxinus</i> sp.	2	18.2	4	30.8	2	15.4	1	12.5	6	16.2	10	16.1		1	8.3	1	7.7	1	4.0	
<i>Ostrya carpinifolia</i>	1	9.1												2	16.7					
<i>Carpinus</i> sp.			1	7.7					2	5.4										
Open woodland and scrub																				
<i>Pistacia terebinthus</i>	2	18.2	2	15.4					1	2.7				1	8.3	2	15.4	4	16.0	
<i>Pistacia</i> sp.	1	9.1							1	2.7						1	7.7			
<i>Acer</i> sp.									1	2.7										
Maloideae	4	36.4	2	15.4	1	7.7	2	25.0	4	10.8	7	11.3		2	16.7	10	76.9	11	44.0	
<i>Paliurus spina-christi</i>									1	2.7										
<i>Juniperus</i> sp.	3	27.3	3	23.1	4	30.8	3	37.5	2	5.4				3	25.0			1	4.0	
<i>Amygdalus</i> sp.	1	9.1							4	10.8	3	4.8								
<i>Prunus</i> sp.	1	9.1			2	15.4			2	5.4	1	1.6								
<i>Clematis</i> sp.			1	7.7												2	15.4			
Rosaceae																1	7.7			
Fabaceae	9	81.8	9	69.2	4	30.8	5	62.5	4	10.8	2	3.2		4	33.3	5	38.5	4	16.0	
<i>Erica</i> sp.	2	18.2	2	15.4	4	30.8	5	62.5	1	2.7	1	1.6		1	8.3	7	53.8	4	16.0	
Labiatae			3	23.1			1	12.5								1	7.7			
<i>Cistus</i> sp.			1	7.7												1	7.7	1	4.0	
Mountain forests																				
<i>Abies</i> sp.			1	7.7	1	7.7			12	32.4	6	9.7	1	6	50.0	3	23.1	5	20.0	
<i>Abies/Juniperus</i>									8	21.6						1	7.7			
<i>Castanea/Quercus</i>																5	38.5			
<i>Pinus nigra/Pinus sylvestris</i>	2	18.2	5	38.5	4	30.8	1	12.5	15	40.5	4	6.5		7	58.3	2	15.4			
Alluvial/Riverine/Brackish habitats																				
<i>Corylus/Alnus</i>											1	1.6								
<i>Celtis</i> sp.									1	2.7										
<i>Ulmus</i> sp.			1	7.7					2	5.4	1	1.6								
<i>Ulmus/Celtis</i>									2	5.4										
<i>Platanus orientalis</i>																		1	4.0	
<i>Populus/Salix</i>			1	7.7					3	8.1	3	4.8				1	7.7	3	12.0	
<i>Ficus carica</i>			3	23.1							1	1.6				1	7.7	1	4.0	
<i>Laurus nobilis</i>									1	2.7						1	7.7			
<i>Myrtus communis</i>			2	15.4												3	23.1	1	4.0	
<i>Vitex agnus-castus</i>			2	15.4					1	2.7	1	1.6				1	7.7			
cf. <i>Nerium oleander</i>																		1	4.0	
monocotyledon	1	9.1												1	8.3					
cf. <i>Chenopodiaceae</i>	1	9.1																		
<i>Tamarix</i> sp.									1	2.7	1	1.6								
Cultivated																				
<i>Vitis vinifera</i>			2	15.4					3	8.1								2	8.0	
cf. <i>Punica granatum</i>									1	2.7								1	4.0	

Table 4.5 Ubiquity of identified wood taxa in samples from fills and burnt destruction layers from indoor contexts at Mitrou, Agia Paraskevi and Kynos.

pips, which includes 281 modern cultivars and 82 wild individuals (see Pagnoux et al 2015; Bouby et al 2021). This set of reference aims to be as representative as possible of the modern-day wild and domesticated grapevine. Previous studies have shown that carbonization causes a distortion of the pips (Logothetis 1970, 1974; Smith and Jones 1990; Mangafa and Kotsakis 1996). However, recent investigation on the effect of carbonization revealed that despite deformation, experimentally charred pips are correctly classified in the group of origin when they are compared to uncarbonized material (Ucchesu et al 2016; Bouby et al 2018).

Carbonized archaeological grape pips from Agia Paraskevi and Mitrou are thus compared to the uncarbonized reference collection mentioned above through Linear Discriminant Analysis (LDA), in order to be assigned to a predefined group (wild/domesticated compartment). The results of this morphological analysis are used here in order to provide an additional line of investigation of the diachronic interaction between human societies and plants in the area under study during the Bronze Age.

4.5 Results and interpretation

4.5.1 Wood charcoal. The plant list: overview

The results of wood charcoal analysis at the three Bronze Age sites are presented in Table 4.5. For comparison purposes between assemblages of different contextual provenance, i.e. fills and burnt layers, and chrono-cultural attribution, i.e. successive phases intra-site, as well as among different sites, the ubiquity of the identified taxa is shown (Table 4.5). Samples from destruction layers in indoor contexts reflect the uses of wood in construction and/or crafts but also debris of other uses (i.e. firewood remains on floors). Samples from fills and dumping areas are mostly long-term accumulations of firewood remains that were deposited through repeated cleaning of thermal structures. Nevertheless, accumulation of burnt wood remains reflecting other uses, such as carpentry waste and/or burnt timber, cannot be excluded. In multi-period settlements such as the ones presented in this study, levelling fills between successive building phases would have incorporated domestic fuel waste and occasionally burnt construction materials.

The list of taxa per site is rich. Evergreen and deciduous broadleaved taxa are present as well as several conifers. Twelve taxa are present at all sites and periods, the most ubiquitous being *Olea europaea*, deciduous *Quercus* sp. and *Arbutus* sp. Evergreen *Quercus* sp., *Phillyrea/Rhamnus*, Fabaceae and *Erica* sp. are frequently present at Mitrou in all periods, but less so at Agia Paraskevi and Kynos. *Fraxinus* sp., Maloideae, *Juniperus* sp. and *Pistacia* sp. are ubiquitous at all sites followed by *Pinus nigra/P. sylvestris* and *Abies*

sp. *Populus/Salix* and *Vitis vinifera* are also frequently present at all sites. Several other taxa are variably present among different phases and sites (Table 4.5). Comparison between the data from fills and burnt layers at Mitrou does not indicate remarkable differences in the frequency of use of the different taxa either in the Early Bronze Age or in the Middle Bronze Age. Regarding the most ubiquitous taxa, the same frequency of use is attested in the fills and in the burnt indoor destruction layers. This is observed for both the taxa corresponding to trees such as *Abies*, *Pinus nigra/P. sylvestris*, *Quercus* sp. and *Olea europaea* as well as for bushy taxa such as Fabaceae and *Erica*. At Agia Paraskevi and Kynos the presence of the burnt remains of big trees such as *Abies* and *Pinus nigra/P. sylvestris* is more ubiquitous in the fills than in the burnt buildings. Nevertheless, at both sites, taxa of the understorey and scrub vegetation are more frequently present in the fills, probably reflecting their common use as kindling.

The variability of taxa observed through wood charcoal analysis may depend on contextual associations and origin of the samples and this aspect is investigated in the following sections.

4.5.2 Wood charcoal. Thermal structures

The results are presented in Table 4.6 showing that at all sites firewood use in hearths and ovens is characterised by a combination of tree and brushwood taxa. The hearth and ovens at Mitrou reflect the use of mostly *Olea europaea*, deciduous and evergreen *Quercus* and *Arbutus* alongside Fabaceae and *Erica*. The Early Bronze Age pit hearth at Mitrou is remarkable for a very high concentration of *Olea europaea* wood-remains. The hearth in the clay structure (NK145) of Phase 7 at Kynos presents a more varied taxonomic composition including several tree taxa in low frequency. Nevertheless, the main taxa used for fuel are again the above-mentioned Mediterranean evergreen trees, deciduous *Quercus* and the common brushwood taxa. Uncommon finds are *Populus/Salix* and *Vitis vinifera*, the latter probably having been used as kindling in the same manner as the brushwood mentioned above. The combination of *Populus/Salix* and *Vitis vinifera* in a hearth might also suggest the discard in the fire of useless/broken objects like baskets made of the flexible wood of willow or poplar alongside remains of their original content, grapevine bunches.

4.5.3 Wood charcoal. Fills and dumping areas: long-term accumulations of wood charcoal remains

Wood charcoal samples from fills and dumping areas originate from Early Bronze Age and Middle Bronze Age layers at Mitrou. Exterior areas (a street) are represented at Middle Bronze Age Agia Paraskevi while the material from a Late Helladic IIIC fill between phases 7 and 6 was

Cultural Period	EBA		MBA II				LBA	
Feature	pit hearth		oven 63		oven 63		NK 145	
N samples	2		3		1		1	
N taxa	8		9		12		13	
Taxa	n	%	n	%	n	%	n	%
Evergreen Mediterranean woodland								
<i>Olea europaea</i>	74	82.2	7	25.0	56	25.0	4	7.7
<i>Arbutus</i> sp.	4	4.4	3	10.7	24	10.7	5	9.6
<i>Quercus</i> sp. evergreen	2	2.2	2	7.1	19	8.5	2	3.8
<i>Phillyrea/Rhamnus</i>	1	1.1	1	3.6	10	4.5		
<i>Pinus halepensis/P. brutia</i>					1	0.4	2	3.8
Deciduous Mediterranean woodland								
<i>Quercus</i> sp. deciduous	6	6.7	5	17.9	70	31.3	16	30.8
Open woodland and scrub								
<i>Pistacia</i> sp.			1	3.6				
Labiatae					2	0.9		
Maloideae	1	1.1			9	4.0	1	1.9
<i>Juniperus</i> sp.	1	1.1	1	3.6	1	0.4		
Fabaceae	1	1.1	5	17.9	21	9.4	2	3.8
<i>Erica</i> sp.			3	10.7	9	4.0	4	7.7
Mountain conifer forests								
<i>Abies</i> sp.							2	3.8
<i>Castanea/Quercus</i>							1	1.9
<i>Pinus nigra/P. sylvestris</i>					2	0.9		
Alluvial/Riverine/Brackish habitats								
<i>Salix/Populus</i>							11	21.2
<i>Ulmus</i> sp.							1	1.9
Cultivated								
<i>Vitis vinifera</i>							1	1.9
Total fragments identified			28	100	224	100	52	100
<i>Quercus</i> sp.							3	
angiosperm			5		6		1	
Total no fragments analysed	90	100	33		230		56	

Table 4.6 Results of wood charcoal analysis of assemblages from thermal structures: taxonomic composition, absolute and % fragment counts.

studied at Kynos (Table 4.2). The results are presented in Table 4.7. The list of taxa is rich at all three sites and the types of vegetation managed by the settlements quite diverse. Regarding the dominant taxa, these are variable among sites and successive periods. Deciduous *Quercus* dominates (40%) in the Early Bronze Age assemblage at Mitrou but in the Middle Bronze Age period it decreases significantly (18%) and is replaced by *Arbutus* (29.5%). At Middle Bronze Age Agia Paraskevi deciduous *Quercus* dominates (40%). At Late Bronze Age Kynos three Mediterranean evergreen taxa are the most abundant in the following order, evergreen *Quercus* (27%), *Olea europaea* (17%) and *Arbutus* (14%). Also, deciduous

Quercus represents approximately 14% of the assemblage. Throughout the Bronze Age and at all different sites *Olea europaea* is the second most important firewood source (17-20%). Several other taxa are constantly present at all three sites in fluctuating frequency. *Phillyrea-Rhamnus*, *Fraxinus*, *Juniperus*, Maloideae and *Pistacia* were abundant alongside a variety of mixed evergreen/deciduous and understory/open woodland components. Brushwood vegetation including Fabaceae, Labiatae, *Cistus* sp. and *Erica* was abundant and regularly used at all sites and throughout the Bronze Age.

Cultural Period	EBA		MBA		MBA		LBA					
Site	Mitrou				Agia Paraskevi				Kynos			
N samples	11		13		37		13					
Taxa	no	%	no	%	No	%	no	%				
Evergreen Mediterranean woodland												
<i>Olea europaea</i>	109	17.5	102	20.8	80	19.8	56	17.0				
<i>Arbutus</i> sp.	49	7.9	145	29.5	9	2.2	46	14.0				
<i>Quercus</i> sp. evergreen	27	4.3	12	2.4	4	1.0	86	26.1				
<i>Phillyrea/Rhamnus</i>	12	1.9	48	9.8	11	2.7	1	0.3				
<i>Pinus halepensis</i> / <i>P. brutia</i>							4	1.2				
<i>Pistacia lentiscus</i>							3	0.9				
Deciduous Mediterranean woodland												
<i>Quercus</i> sp. deciduous	254	40.8	87	17.7	161	39.9	45	13.7				
<i>Fraxinus</i> sp.	3	0.5	2	0.4	17	4.2	1	0.3				
<i>Ostrya carpinifolia</i>	1	0.2										
<i>Carpinus</i> sp.					2	0.5						
Open woodland and scrub												
<i>Pistacia terebinthus</i>	3	0.5			1	0.2	2	0.6				
<i>Pistacia</i> sp.	4	0.6			1	0.2	1	0.3				
<i>Acer</i> sp.					3	0.7						
Maloideae	16	2.6	1	0.2	9	2.2	28	8.5				
<i>Paliurus spina-christi</i>					1	0.2						
<i>Juniperus</i> sp.	71	11.4	68	13.8	5	1.2						
<i>Amygdalus</i> sp.	1	0.2			5	1.2						
<i>Prunus</i> sp.	31	5.0	2	0.4	2	0.5						
<i>Clematis</i> sp.							8	2.4				
Rosaceae							1	0.3				
Fabaceae	32	5.1	13	2.6	4	1.0	8	2.4				
<i>Erica</i> sp.	2	0.3	5	1.0	1	0.2	15	4.6				
Labiatae							1	0.3				
<i>Cistus</i> sp.							1	0.3				

Cultural Period	EBA		MBA		MBA		LBA					
Site	Mitrou				Agia Paraskevi				Kynos			
N samples	11		13		37		13					
Taxa	no	%	no	%	No	%	no	%				
Mountain conifer forests												
<i>Abies</i> sp.			1	0.2	34	8.4	3	0.9				
<i>Abies/Juniperus</i>					10	2.5	1	0.3				
<i>Castanea/Quercus</i>							7	2.1				
<i>Pinus nigra</i> / <i>Pinus sylvestris</i>	5	0.8	5	1.0	24	5.9	3	0.9				
Alluvial/Riverine/Brackish habitats												
<i>Celtis</i> sp.					1	0.2						
<i>Ulmus</i> sp.					3	0.7						
<i>Ulmus/Celtis</i>					2	0.5						
<i>Populus/Salix</i>					4	1.0	1	0.3				
<i>Ficus carica</i>							1	0.3				
<i>Laurus nobilis</i>					1	0.2	1	0.3				
<i>Myrtus communis</i>							4	1.2				
<i>Vitex agnus-castus</i>					1	0.2	1	0.3				
monocotyledon	1	0.2										
cf. <i>Chenopodiaceae</i>	1	0.2										
<i>Tamarix</i> sp.					1	0.2						
Cultivated												
<i>Vitis vinifera</i>					3	0.7						
cf. <i>Punica granatum</i>					4	1.0						
Total fragments identified	622	100	491	100	404	100	329	100				
<i>Quercus</i> sp.	17		10		16		10					
angiosperm	14		23				8					
bark	3		3				5					
unidentifiable	1											
conifer			3									
Total no fragments analysed	657		530		420		352					

Table 4.7 Absolute and % fragment counts of wood taxa identified in fills and dumping areas.

4.5.4 Wood charcoal. Interpretation of the results and aspects of the management of the local vegetation during the Bronze Age

The dataset points to the management of diverse habitats. Sclerophyllous woodland with *Olea europaea*, *Arbutus* and evergreen *Quercus* would have expanded along the narrow coastal fringe and would have characterised the immediate surroundings of all three sites. Mixed woodlands with sclerophyllous and deciduous trees (namely deciduous oaks, *Fraxinus*, *Carpinus* sp., *Ostrya carpinifolia*, *Acer* sp.) would have grown on mid altitudes overlooking the coast. Sun-loving trees and shrubs represented by *Cistus*, *Erica*, Labiatae, Fabaceae, *Juniperus* sp., *Pistacia terebinthus* and Maloideae would have developed in woodland clearings or would have formed scrubland at the interface between woodlands and farmlands. The vegetation of wetlands, water channels and brackish water is represented at all three sites by taxa such as *Platanus orientalis*, *Salix/Populus*, *Corylus/Alnus*, *Ulmus* sp., *Celtis* sp., *Myrtus communis*, *Tamarix* sp., *Vitex agnus-*

castus and *Phragmites*. *Vitis vinifera* subsp. *sylvestris* could have been a climber in such riverine woodlands. Conifer woodlands with *Abies* and *Pinus nigra* would have covered the surrounding mountains. Although the management of these more distant resources is represented at all sites, the relative frequency of the representative taxa is higher at Middle Bronze Age Agia Paraskevi and Late Bronze Age Kynos compared to Early Bronze Age and Middle Bronze Age Mitrou.

Taking a closer look at the wood charcoal results from each settlement investigated in our paper, interesting aspects of the human-plant interaction in this part of mainland Greece are revealed. According to the archaeological evidence the Early Bronze Age II settlement at Mitrou was an important administrative center, like others of this period in mainland Greece (Van de Moortel and Zahou 2012, 1132). During the Early Bronze Age (Fig. 4.2), wood charcoal analysis at Mitrou indicates a balanced use of different vegetation types, especially the surrounding lowlands and foothills with olive,

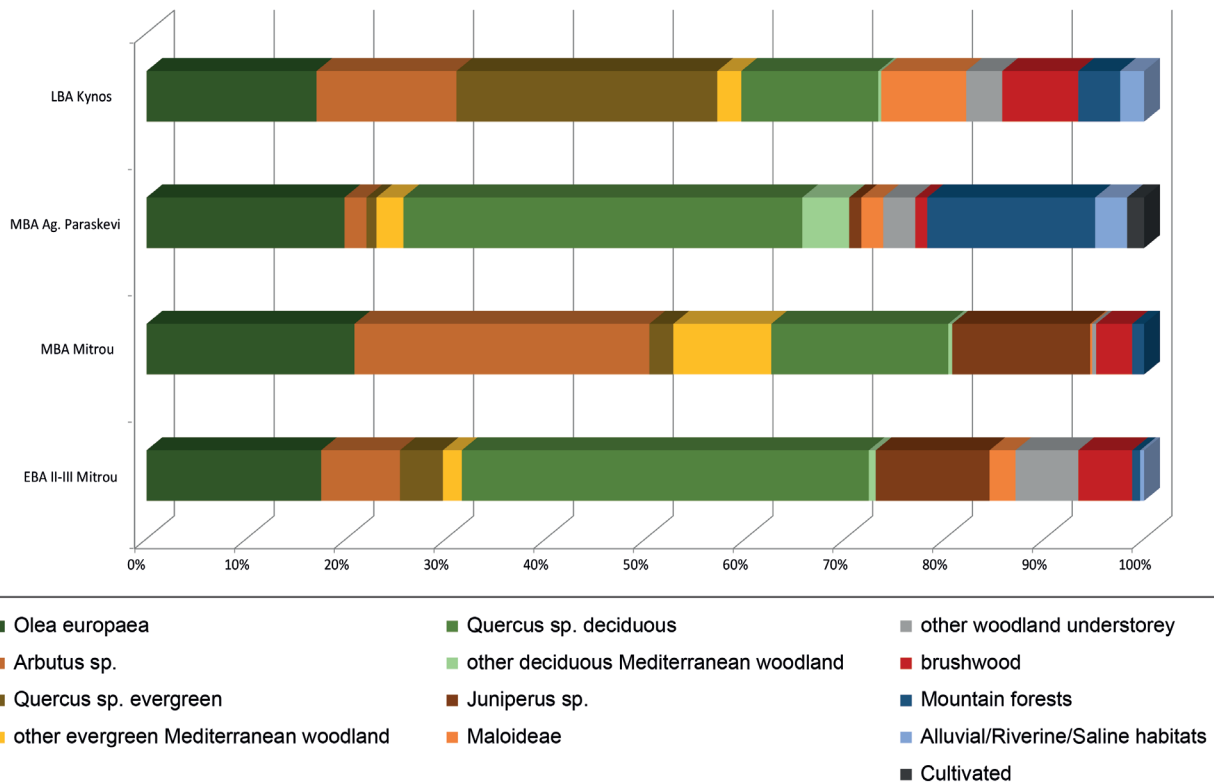


Fig. 4.2 Relative frequency of the most representative taxa and vegetation types in the three settlements in successive periods of the Bronze Age. Data based on the analysis of long-term accumulations of wood charcoal remains in fills and dumping areas.

sclerophyllous and deciduous woodlands. At Mitrou, the systematic use of olive wood both for fuel and construction timber suggests that already in the early 3rd mill BCE *Olea europaea* was an important feature of the local lowland vegetation. In the Middle Bronze Age, the wood charcoal results from Mitrou (Fig. 4.2) show the increase of *Arbutus*, *Juniperus* and brushwood at the expense of deciduous woodland. *Olea europaea* remained a stable source of firewood and timber. During this period, the previously flourishing Mitrou settlement had become a small village (Karkanas and Van de Moortel 2014, 202) and it may be suggested that the wood charcoal results reflect the expansion of maquis and scrub on abandoned farmland. Moreover, the reduced use of deciduous woodland resources may indicate concomitant shrinkage of the territory exploited by the settlement. Alternatively or in addition, one might argue that the observed reduction in deciduous woodland during the Middle Bronze Age at Mitrou and the expansion of maquis vegetation was the result of increasing human activity over time, during the course of the Early Bronze Age.

The Middle Bronze Age settlement of Agia Paraskevi was exploiting a diverse territory. Deciduous oak woodland, *Olea* and the coniferous forest of the nearby mountains

were the major sources for firewood and timber. Activities in nearby marshland and the alluvial plain are reflected in the variety of woody taxa that would have grown in such habitats and were brought to the settlement. Fir and black pine were used for the construction of the buildings. However, an additional reason for the management of the coniferous mountain woodland might have been the demand for timber in shipbuilding, a potential commodity in the trading networks of the settlement and the settlement's access to the wider territory and rights to appropriate its resources. The pottery study indicates local production but also trade with areas to the north and south, while the direct contact of the settlement with the sea was probably the main factor of growing trade relations with other regions (Papakonstantinou et al 2015, 992-993).

The Late Bronze Age settlements at Mitrou and Kynos flourished during the 12th c BC. A remarkable aspect of the period is the high frequency of evergreen oak and *Arbutus* and the presence of *Pinus halepensis* in the Bronze Age dataset (Fig. 4.2). These characteristics probably reflect the progressive substitution of deciduous oak and mixed woodlands by these evergreen pyrophytes. According to our wood charcoal data, the beginning of the dominance of evergreen oaks and the spread of Aleppo pines in the

Cultural period	EBA		MBA		LBA	
Site	Mitrou	Mitrou	Agia Paraskevi	Kynos	Mitrou	
No of samples studied	18	48	40	26	14	21
Level of analysis	preliminarily studied samples	preliminarily studied samples	preliminarily studied samples	preliminarily studied samples	fully studied samples	fully studied samples
<i>Triticum monococcum</i> (einkorn)	x	x	x	x	x	x
<i>T. dicoccum</i> (emmer)	x	x	x	x	x	x
<i>T. timopheevii</i>		? (em/tim)	x	x	x	x
<i>T. spelta</i> (spelt)						x
<i>T. aestivum/durum</i> (bread/macaroni)	x		x	x	x	x
<i>Hordeum vulgare</i> (barley)	x	x	x	x	x	x
<i>Cicer arietinum</i> (chick pea)				x	x	x
<i>Vicia ervilia</i> (bitter vetch)		x	x	x	x	x
<i>Vicia faba</i> var. <i>minor</i> (Celtic bean)		x	x	x	x	x
<i>Lens</i> sp. (lentil)	x	x	x	x	x	x
<i>Lathyrus sativus/cicera</i> (grass pea)	x	x	x	x	x	x
cf. <i>Pisum sativum</i> (pea)				x	x	
<i>Papaver somniferum</i> (opium poppy)			x	x	x	
<i>Linum usitatissimum</i> (flax)		x		x	x	x
<i>Pistacia</i> sp.			x			
<i>Olea europea</i> (olive)				x	x	
<i>Camelina</i> sp.				x		
cf. <i>Lallemantia</i> sp.				x	x	
<i>Myrtus communis</i> (myrtle)				x	x	
<i>Ficus carica</i> (fig)	x		x	x	x	x
cf. <i>Rubus</i> sp.			x			
<i>Pyrus/Malus</i> sp. (pear/apple)					x	
<i>Vitis vinifera</i> (grape pips and stalks)	x		x	x	x	x

Table 4.8 The presence of cereals, pulses, plants with oily seeds and fruit bearing species attested in preliminarily and fully studied assemblages at each site per cultural period. X indicates presence and the single question mark (?) identification in intermediate category.

coastal areas of eastern central Greece, may thus date to the 2nd mill BC. These characteristics would have been the result of long and repeated anthropogenic pressure on the vegetation coupled by a drying trend observed in the eastern Mediterranean after ca 4000 BC (Finné et al 2011, 2019; Weiberg et al 2019).

4.5.5 Plant macro-remains other than wood

Species presence, summarised for all sites per cultural period in Table 4.8, is based both on preliminary observations from scanned/sorted (Early Bronze Age Mitrou, Middle Bronze Age Mitrou and Agia Paraskevi, Late Bronze Age Kynos recent samples, see Table 4.4) and fully (Late Bronze Age Mitrou and first campaign Kynos samples, see Table 4.3 and Fig. 4.3) studied samples. Based on presence only, the following cereals have been identified at the three sites: *Triticum monococcum*

(einkorn), *T. dicoccum* (emmer), *T. timopheevii*¹, *T. spelta* (spelt), *T. aestivum/durum* (bread/macaroni or free-threshing wheat) and *Hordeum vulgare* (barley). Of those, einkorn, emmer, bread/macaroni wheat and barley are attested at all three sites throughout the Bronze Age. Spelt wheat is encountered only once at Late Bronze Age Mitrou as a single glume base (Table 4.8, Fig. 4.3), while *T. timopheevii* glume bases have securely been identified at Middle Bronze Age Agia Paraskevi and both Late Bronze Age sites, Kynos and Mitrou (Table 4.8, Fig. 4.3). A wide range of pulses have also been identified in the assemblages: *Lens* sp. (lentil) and *Lathyrus sativus/cicera* (grass pea) are present in all the periods at all sites, *Vicia ervilia* (bitter vetch) and *Vicia faba* var. *minor* (Celtic bean)

1 Until recently known as “new type” glume wheat (Jones et al 2000; Czajkowska et al 2020).

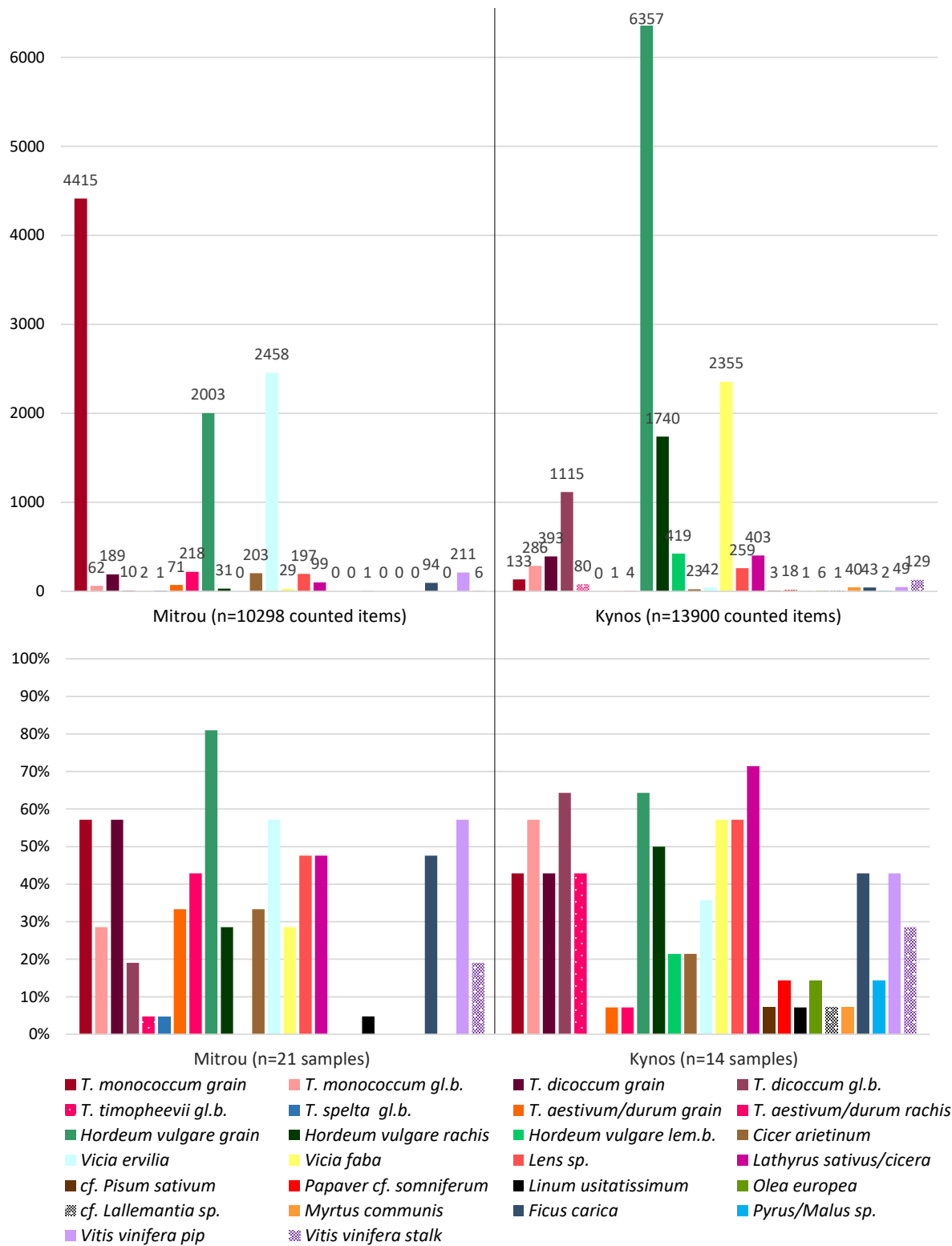


Fig. 4.3 Absolute seed/grain/chaff/etc numbers per species based on total numbers per site (top graph) and ubiquity of crop species present in the fully studied samples (bottom graph) from Late Bronze Age Mitrou (left) and Kynos (right).

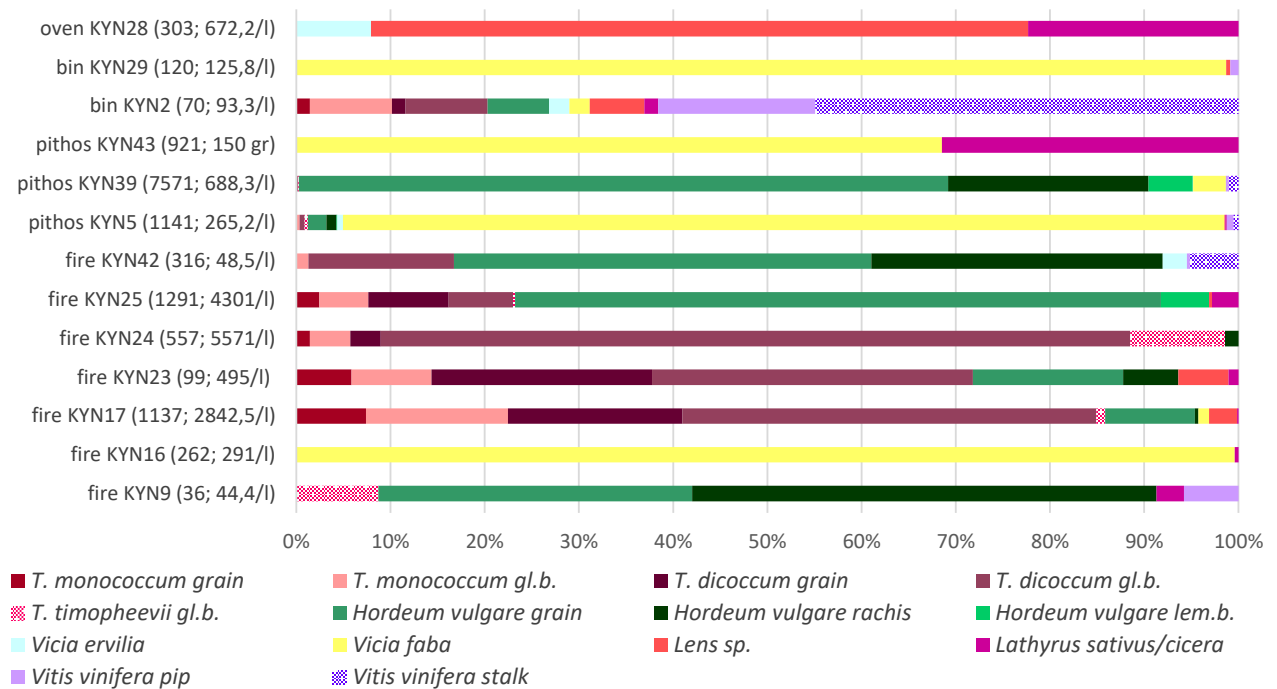


Fig 4.4 Chart showing the composition of each fully studied sample (with >20 counted crop/fruit items) from Kynos, expressing the relative proportions of all crop/fruit categories identified. Identification categories that never constituted more than 5% of the crop/fruit component at any sample were not included, namely *T. aestivum/durum* grain and rachis, *Cicer arietinum*, cf. *Pisum sativum*, *Ficus carica*, *Pyrus/Malus* sp., *Papaver somniferum*, *Linum usitatissimum*, *Olea europea*, cf. *Lallemantia* sp. and *Myrtus communis*. Intermediate/broad categories (e.g. *T. monococcum/dicoccum*, *Triticum* sp., *Vicia* sp./*Lathyrus* sp. etc) were also excluded. Total numbers of crop/fruit items and their density (items per litre of soil) per sample are given in parentheses.

are attested from the Middle Bronze Age onwards at all sites, while *Cicer arietinum* (chickpea) was identified only in the Late Bronze Age assemblages from both Kynos and Mitrou (Table 4.8, Fig. 4.3).

Contextual and quantitative data are available just for the two Late Bronze Age sites, Kynos and Mitrou (Karathanou in prep), and only these are further discussed here in terms of abundance and ubiquity (Fig. 4.3), as well as proportionate presence of crops/fruits in the different samples studied at each site (Fig. 4.4 and Fig. 4.5).

At Kynos the combination of extensive fire destruction episodes and judgment sampling yielded rather few albeit very rich (crop/fruit/wild totals per sample ranging between 67 and 11591 items) and dense samples (ranging between 88 and 20706 items per litre), mainly representing pure crop caches of barley grain and Celtic bean seeds either stored in clay vessels (*pithoi*) and bins (Fig. 4.4, samples KYN5, KYN29, KYN39) or found spilled in on-floor fire destruction debris (Fig. 4.4, sample KYN16). The above mentioned crops (barley and Celtic bean) were also found mixed with other crops at this site: Celtic bean has been found mixed with grass pea in another *pithos* sample (Fig. 4.4, sample KYN43), and barley grain has been found mixed with glume-wheat

chaff and wild/weed seeds, and to a lesser extent pulses on various on-floor fire destruction samples (Fig. 4.4, KYN25 and KYN17 from the same floor context, and KYN9) and in a bin (Fig. 4.4, sample KYN2). In other samples, barley grain and chaff, were also mixed with rich glume wheat chaff concentrations and pulses (Fig. 4.4, samples KYN9 and KYN42). Emmer prevails over einkorn and *T. timopheevii* in most of these glume-wheat admixtures when absolute numbers are taken into consideration (Fig. 4.3 and in Fig. 4.4, samples KYN17, KYN25, KYN42), the exception being samples KYN9 where *T. timopheevii*, represented by chaff, is the only glume wheat present, and KYN2 where only einkorn and emmer are present in equal proportions (Fig. 4.4). Emmer also predominates in an emmer-einkorn spikelet concentration as indicated by the chaff to grain ratios and high density of crop remains, that was mixed with much less barley (grain and chaff), lentil and grass pea in a floor sample in close proximity to clay bins (Fig. 4.4, sample KYN23). In general, emmer seems to prevail among glume wheats at Kynos judging by the abundance and ubiquity of both grain and chaff remains (Fig. 4.3). Free-threshing wheat, identified as both grains and chaff, shows very low frequency of presence (7%, which corresponds to one sample) and

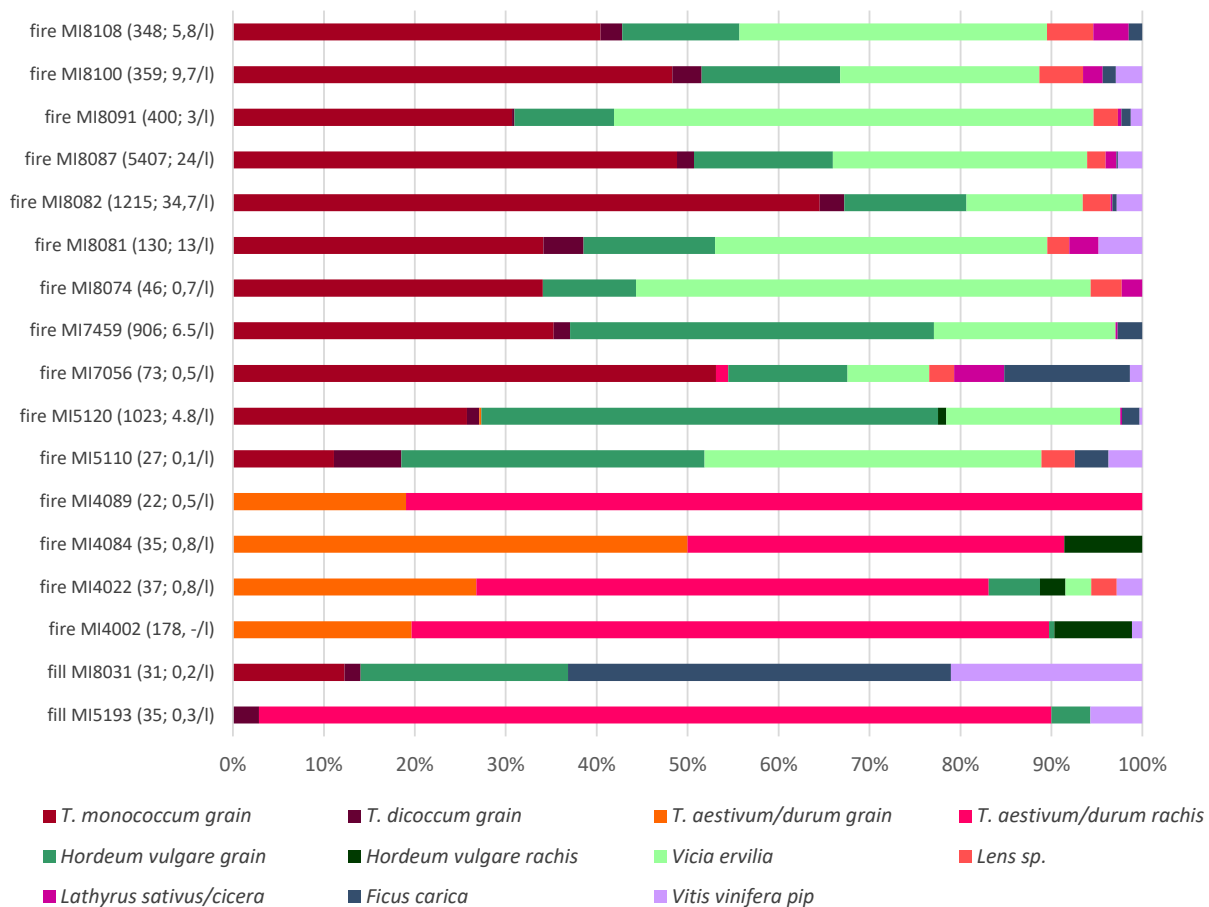


Fig 4.5 Chart showing the composition of each fully studied sample (with >20 counted crop/fruit items) from Mitrou, expressing the relative proportions of the crop/fruit categories identified. Identification categories that never constituted more than 5% of the crop component at any sample were not included, namely *T. monococcum*, *T. dicoccum*, *T. timopheevii* and *T. spelta* glume bases, *Cicer arietinum*, *Vicia faba*, *Linum usitatissimum*, *Vitis vinifera* stalk. Intermediate/broad categories (e.g. *T. monococcum/dicoccum*, *Triticum* sp., *Vicia/Lathyrus* sp., etc) were also excluded. Total numbers of crop/fruit items and their density (items per litre of soil) per sample are given in parentheses.

absolute numbers (5 items in total) (Fig. 4.3). A small quantity of lentils mixed with grass pea and bitter vetch seeds were found in an oven (Fig. 4.4, sample KYN28). For all those mixed samples, it is difficult to assess separate or combined crop cultivation/processing and/or pre-/post-depositional mixing.

The same lack of clarity as regards the formation processes that generated the archaeobotanical remains holds for the crop species attested at Mitrou as the sampled fire destruction layers were severely disturbed (Aleydis van de Moortel, pers. comm.). This, combined with the rather bulky sampling applied (sample volume ranging between 10 to 225 litres), produced several mixed but quite rich samples (crop/fruit/wild totals ranging between 48.5 and 6211.5 items), albeit of low density (0.3-41 items per litre), especially when compared to Kynos (see above). The most rich and dense of them, represent cereal grain and pulse

seed concentrations. Einkorn, barley, and bitter vetch, all of high abundance and ubiquity (Fig. 4.3), are found as cleaned crops in these mixed grain/seed concentrations (Fig. 4.5, “fire” samples MI5110 up to MI8108). Emmer and einkorn have the same high ubiquity (Fig. 4.3), yet emmer, unlike einkorn, is present in low absolute numbers (Fig. 4.3 and Fig. 4.5). Although this might suggest at first sight that emmer was a crop contaminant of einkorn, the mixed composition of the samples calls for caution as regards such an interpretation. In addition to bitter vetch, grass pea and lentil, also present in these samples in various combinations (Fig. 4.5, “fire” samples MI5120 up to MI8108) were less ubiquitous and less numerous compared to bitter vetch (Fig. 4.3). Chickpea and Celtic bean despite not shown in Fig. 4.5 as they never constituted more than 5% of the crop/fruit component in any sample, were also present in ca 30% of the samples (Fig. 4.3). Unlike bitter



Fig 4.6 Charred olive remains from Late Bronze Age Kynos.

vetch for which we have strong evidence that it was a crop in its own right, the other pulse species we have identified were probably cultivated, yet we are unable to comment on their importance for the Mitrou inhabitants during the Late Bronze Age, nor can we exclude the possibility that some were mere contaminants of the other crops. At the same site, other floor and fill samples of even more mixed composition, are dominated by bread/macaroni wheat rachises and grain (Fig. 4.5, samples MI4002, MI4022, MI4084, MI4089, MI5193), both of which show quite high ubiquity values (>30%, Fig. 4.3). Free-threshing rachises are unlikely to accompany the glume wheat dehusking by-products in floor fills as the former are removed at early stages of the processing sequence. Thus, it is unlikely that they correspond to contaminants of the glume wheats; in all likelihood they were consumed as crops. The occurrence of free-threshing and glume wheat remains in the mixed floor fills resulted from complex taphonomy routes and multiple sources of origin (i.e. cooking accidents, chaff-and/or dung-consisting fuel remains, crop-processing residues, etc).

Regarding plants with oily seeds a wide range of species has been identified in the Middle and Late Bronze Age assemblages, all of which have a wide range of uses besides food including medicinal, hallucinogenic, aromatic and weaving: *Papaver* cf. *somniferum* (opium poppy), *Linum usitatissimum* (flax), *Pistacia* sp., *Olea europaea* (olive), *Camelina* sp., cf. *Lallemantia* sp. and *Myrtus communis* (myrtle) (Table 4.8, Fig. 4.3). *Pistacia* sp. is present only at Agia Paraskevi (Table 4.8; Gkotsinas et al 2014) while the latter four (olive, *Camelina* sp., cf. *Lallemantia* sp., myrtle) have so far been identified only in the Late Bronze Age, namely at Kynos (Table 4.8, Fig. 4.3). Of those four, only myrtle has been found in a small concentration of 40 seeds inside a barley-containing *pithos* (Fig. 4.3). Olive stones, in some cases whole or in halves (Fig. 4.6), and cf. *Lallemantia* sp. occur only sporadically at Kynos (Fig. 4.3), though this picture is likely to change once all of the samples are fully studied. Likewise, flax and opium poppy seeds are rarely found among the Middle Bronze Age assemblages of Mitrou and Agia Paraskevi respectively (Table 4.8; Gkotsinas et al

2014). Flax and opium poppy are also very rare at Kynos (Fig. 4.3, see also Kounouklas et al 2021).

Finally, *Ficus carica* (fig), *Rubus* sp., *Pyrus/Malus* sp. (pear/apple) and *Vitis vinifera* (grape) represent the fruit identified throughout the Bronze Age (Table 4.8). Fig (represented by drupelets at all sites and only at Late Bronze Age Mitrou by few potential flesh fragments too) and grapevine remains (pips and stalks), are both continuously present since the Early Bronze Age (Table 4.8). In the Late Bronze Age, they are the most ubiquitous and dominant fruits in the studied samples (Fig. 4.3). At Mitrou, grape and fig occur in ca 50% of the samples (Fig. 4.3) from both fills and on-floor fire destruction layers (Fig. 4.5), indeed dominating a fill sample of a rather mixed composition (Fig. 4.5, sample MI8031). At Kynos, both fruits are present in nearly half of the samples but fig drupelets are far less abundant than grape, the latter represented by more stalks than pips (Fig. 4.3). Grape, though usually present in small quantities in all kinds of contexts sampled at this site (KYN29 from bin, KYN5 and KYN39 from *pithoi*, KYN9 and KYN42 from on-floor fire destruction layers, Fig. 4.4), dominates a rather mixed in composition bin sample (Fig. 4.4, sample KYN2). *Rubus* sp. and *Pyrus/Malus* sp. on the other hand, are rarely attested at Middle Bronze Age Agia Paraskevi (Table 4.8) and Late Bronze Age Kynos (Table 4.8, Fig. 4.3) respectively.

A long list of wild plant taxa have already been identified in the assemblages, while analysis is ongoing. Certain among them, like *Lolium* sp., *L. temulentum* and *Buglossoides arvensis*, all so far identified in the two Late Bronze Age sites and Middle Bronze Age Agia Paraskevi (*Lolium* sp.), are considered typical weeds growing on arable land. At Mitrou, both *Lolium* sp./*L. temulentum* and *B. arvensis* were found in nearly all the mixed cereal grain- and pulse seed-rich on-floor concentrations (namely “fire” samples MI5110 up to MI8091 and MI8108, Fig. 4.5), suggesting their potential association with any of the crops identified at the site. In the fully studied samples from Kynos, *Lolium* sp. and *Lolium temulentum* occur in association with barley (Fig. 4.4, sample KYN39) and Celtic bean (Fig. 4.4, sample KYN5) in certain storage concentrations (see above). As the study of wild/weed taxa is in progress, only a coarse resolution of the areas represented in the samples that could point to habitats beyond fields or to usual field conditions (e.g. fields potentially waterlogged at times of the year), can be provided here. For instance, certain taxa we have identified are indicative of wet and dry/rocky grassland/pasture habitats (Table 4.9). Caution is needed however, as many among the taxa listed in the relevant table have a wide range of habitats and besides being harvested with crops as weeds they could have been grazed by domestic animals, ending in their dung which could have been used

Species/Genus	Habitat	Site
<i>Carex</i> sp.	wet/marshes	LBA Mitrou
<i>Cladium mariscus</i>	wet/marshes	LBA Mitrou
Cyperaceae	wet/marshes	MBA Agia Paraskevi and LBA Mitrou
<i>Eleocharis</i> sp.	wet/marshes	LBA Mitrou
cf. <i>Schoenus nigricans</i>	wet/marshes/sandy areas by the sea	LBA Mitrou
<i>Alkanna</i> sp.	open dry grassland/hills and mountains	LBA Mitrou
<i>Echium</i> sp.	open dry grassland	LBA Mitrou
<i>Hypericum</i> sp.	open dry grassland/rocky pasture/hills and mountains/rocky terrain	LBA Mitrou

Table 4.9 Wild non-wood plant species/genera/families identified so far in the preliminarily/fully analysed assemblages tabulated according to major habitat preferences (i.e. wetland and dry/rocky grassland/pasture).

Cultural Period	Site	Total number of grape pips	Wild	Domesticated	Non allocated	% Wild	% Domesticated	% Non allocated
MBA	Agia Paraskevi	77	50	17	10	64.9%	22.08%	12.99%
LBA	Mitrou	89	32	49	8	36.0%	55.06%	8.99%
	Total	166	82	66	18	71.0%	20.11%	8.91%

Table 4.10 Number of pips allocated to the wild and domesticated compartment.

as fuel (cf. Valamoti 2004). At present, we cannot exclude the possibility that some of the Late Bronze Age samples may have contained dung-derived material that could have contributed some at least of these wild/weed taxa in the samples studied here. Dung was used to manure certain Late Bronze Age crops as recent isotopic analysis of einkorn, emmer and barley grains from Kynos has indicated (Styring et al. 2022).

4.5.6 Morphometric study of *Vitis* remains: an attempt to identify wild vs cultivated grapevines in the landscape

Of the 166 archaeological grape pips that have been compared to the modern reference collection mentioned above, 82 grapes pips (71%) have been classified as wild, 66 (20.11%) as domesticated and 18 (8.91%) cannot be classified with a posterior probability ≥ 0.75 , which we consider as reliable (Table 4.10).

Grape pips from Middle Bronze Age Agia Paraskevi are mostly classified as wild (64.9%), but quite a high proportion of the assemblage (22.08%) is assigned to the domesticated compartment. Domesticated morphotypes are dominant at the later site, Late Bronze Age Mitrou (55.06%), but a significant part of the grape pips is classified as wild (36%).

4.6 Discussion

Archaeobotanical studies at Agia Paraskevi, Kynos and Mitrou, the three Bronze Age settlements, provide insights as regards the management of the landscape through the opening up of fields, orchards and pastures as well as the procurement of natural woody resources for fuel and crafts. Our research sheds light into diverse economic activities carried out in

relation to crop cultivation and wild plant management and/or procurement as well as the long-term effects of human activity in a well-defined area sharing similar general environmental conditions, at the same time displaying variability as regards proximity to the coast and altitude. Thus, our approach allows the characterisation of vegetation in different parts of the landscape used by the different communities studied here during the course of the Bronze Age.

Throughout the Bronze Age, a variety of cereal and pulse crops appear to have been cultivated. Glume wheats (einkorn, emmer and *T. timopheevii*) and barley were favored in the area, but free-threshing wheat may have been less important. The status of *T. spelta* cannot be assessed on the available data. It is of interest to note the absence of millet among the cereal remains from the sites examined here, a cereal species that appears at several northern Greek sites of the Late Bronze Age and perhaps even earlier. This crop may have not been of interest to the prehistoric farmers of the region, reinforcing suggestions that millet might have been an identity signifier in the Bronze Age Aegean (Valamoti 2016, 2017, 2023). Alternatively, it might have been cultivated, yet, its remains may have been associated with other types of sites not investigated yet archaeobotanically, e.g. farmsteads. Celtic bean, bitter vetch, and lentil were certainly cultivated, but the status of grass pea and chickpea is more obscure. It would not be safe, however, to assume that chickpea was a crop as this species is nearly absent from the Neolithic and Bronze Age of Greece (Valamoti 2009).

In addition to crop-fields, fruit trees were harvested at all sites and both wood charcoal and fruit remains of the grapevine, olive and fig suggest that these trees were managed by the Bronze Age communities we have

investigated archaeobotanically. Tree-cultivation of pomegranates is for the moment a hypothesis based on few charred wood remains attributed to cf. *Punica granatum* at Agia Paraskevi and Kynos.

The grapevine finds and especially the morphometric analysis has revealed that at Agia Paraskevi domesticated grapevines were being cultivated. This, on the basis of our current knowledge, together with evidence from Middle Bronze Age Tsoungiza (Allen and Forste 2020; Bonhomme et al this volume) is the earliest evidence of the domesticated type in the Aegean. Given the wider context of early grapevine use in Greece, a local process of domestication is very likely and would be undetected in grape-pip morphology for a certain period of time during which grapevines were cultivated but pips did not morphologically change (cf. Dikili Tash and P.O.T.A. Romanou, Valamoti 2015; Valamoti et al 2020; Pagnoux et al 2021). Indeed, this ongoing and incipient process is perhaps reflected here by the high proportion of morphologically wild pips from Agia Parakevi and Late Bronze Age Mitrou. However, management of grapevines (pruning, harvesting) in the wild cannot be excluded, especially since grapevines could have been growing close to Agia Paraskevi, in the alluvial woodlands and marshes which are well-documented in the wood charcoal assemblage from the site. In addition, trade networks and contacts with other regions could have contributed stock of grapevine varieties from other parts of the Aegean and beyond (cf. Pagnoux et al 2015). Although local processes cannot be excluded, more archaeobotanical evidence from earlier periods is needed to investigate a local process or an introduction from elsewhere.

Fig tree harvesting is represented almost exclusively by drupelets and isolated wood charcoal remains. The only exception is Late Bronze Age Mitrou where few potential flesh fragments were attested. Figs were indeed consumed by humans as has been suggested elsewhere by the caches of whole fig fruits found for example at Neolithic Dikili Tash (Valamoti 2015) and Late Bronze Age Kakovatos (Kotzamani 2011) amongst others, while they could be fed to animals in certain cases (cf. Valamoti 2004). Wood charcoal remains are few but constant. Although fig tree wood is an unpleasant smoke producing fuel when green and unseasoned, it could have been used in such state for smoking and/or smudge fires when necessary.

The case of the olive, based on our study, is particularly interesting. The wood charcoal dataset provides the earliest direct evidence for the abundant local presence of *Olea* in the mid-3rd mill BC mainland Greece, similar to finds from the Cyclades or Crete (Valamoti et al 2018). The abundant and frequent use of olive wood at Mitrou is unprecedented in the Holocene wood charcoal record of southern mainland Greece. The new data contrast the absence of olive during the Early Neolithic around

Sarakenos Cave in Boeotia (Moskal-del Hoyo and Ntinou 2016) and its sparse presence in other Early to Final Neolithic sites in the Peloponnese (Valamoti et al 2018). Since the early 3rd mill BC, olive characterised the local lowland vegetation of the area and/or was cultivated in parts of the landscape dedicated to this end. Its wood was systematically used and olive remained a stable source of firewood and timber throughout the Early and Middle Bronze Age in the study area. We suggest that this stability in an otherwise changing vegetation setting most probably reflects the cultivation of the olive. Nevertheless, there is as yet no evidence for the use of its fruit in preliminary analysis of non-wood archaeobotanical remains of the Early and Middle Bronze Age. It is only in the Late Bronze Ages that olive stones appear at Kynos.

Wood charcoal analysis points to diverse habitats and types of vegetation located close to the sites or at some distance from them developing in succeeding altitudinal zones and/or in different ecological niches (Table 4.4 and 4.6, Fig. 4.2). The wood charcoal dataset from the three sites reflects the management of a wide range of woodland resources. Mixed evergreen and deciduous woodlands and brushwood were the source for fuel and timber. More distant resources, such as the coniferous woodlands on the mountains were also managed for timber uses in construction and probably shipbuilding or maritime exchanges. During the 3rd mill BC deciduous oak was a dominant component of mixed thermophilous woodlands in eastern central Greece. Other thermophilous taxa such as evergreen oaks and Aleppo pines became prominent elements of the coastal areas of the region probably not earlier than the 2nd mill BC as reflected in their abundance in the Late Bronze Age compared to their low relative frequency in the Early and Middle Bronze Age. The latter observation may be seen in correlation with the increase of *Arbutus* in the Middle Bronze Age, probably reflecting the gradual opening of the mixed woodland canopy and the expansion of Ericaceae as a result of farming and grazing activities. In line with such processes are the wild taxa, *Alkanna* sp., *Echium* sp., and *Hypericum* sp. identified in the Late Bronze Age Mitrou that primarily thrive in open dry grasslands and often rocky terrain (Table 4.9).

Wetlands would have existed around the sites and are reflected both in wood charcoal analysis and the preliminary results of the wild seeds analysis. The presence of alluvial woodlands and Mediterranean riverine vegetation (*Salix/Populus*, *Platanus orientalis*, *Alnus*, *Ulmus*, *Vitex agnus-castus*, *Myrtus communis*, *Laurus nobilis*) and/or brackish habitats (*Tamarix*, Chenopodiaceae) is testified at all three sites. This picture is enriched by the presence of wet-loving plants at Agia Paraskevi (Cyperaceae), while at Mitrou aside from the generally wet places (*Carex* sp., Cyperaceae), shallow waters/marshes (*Eleocharis* sp., *Cladium mariscus*)

and potentially sandy places near the sea (cf. *Schoenus nigricans*) would have been present. The existence of such habitats at both prehistoric sites has been proved by the palaeogeographical investigations (Vouvalidis et al 2010; Green 2012) and is further supported by aquatic faunal evidence at Agia Paraskevi (Syrides 2008; Gkotsinas et al 2014). All the above suggest that seasonal lakes, marshes and/or saltmarshes existed in the surroundings. Such habitats would have provided building material or plants for making mats and baskets, some might have been grazed by domestic animals, their dung subsequently burnt at the sites; we cannot exclude the possibility, however, that some of the crop fields were in parts seasonally waterlogged.

Although agricultural and arboricultural activities appear to have been constant over time in the investigated region, it is through the anthracological evidence that we have indications for a reduction, over time, of deciduous woodland vegetation and changes in woodland composition in the proximity of the sites. Moreover, the exploitation of arboreal vegetation from further upland is more conspicuous in the Middle and Late Bronze Age compared to the Early Bronze Age. These observations are in agreement with the socio-economic activities of the three communities we have investigated here. The arable parts of the landscape were exploited through the cultivation of cereals and pulses, evidenced through the wide range of species identified in the assemblages of the Bronze Age. Tree crops, on the other hand, like the olive and the grapevine, may well adapt in lands far less suited for the cultivation of cereals and pulses (cf. Renfrew 1972). As Colin Renfrew argued in his influential work (1972), in the Early Bronze Age the Mediterranean triad (wheat, olive, vine) allowed the diversification of the lands used for cultivation of different crops, olives and grapevines, which would have led to the need for redistributive centers. The settlements presented in this study became important centers in their respective territories at different periods throughout the Bronze Age. There is evidence for intense building activity and spatial organization, large storage facilities and trade with other areas. Undoubtedly, the coastal location of all three sites played an important role in the networks connecting the hinterland with the Aegean through the north Euboean Gulf. In this line, agricultural production, tree-crops and abundant timber resources would have been commodities managed, stored and traded by the communities investigated here. In such a context and on the basis of our results we suggest that an additional product of the lands managed by the settlements would have been the coniferous woodlands. Such resources would have been highly valued in Bronze Age shipbuilding and maritime activity.

4.7 Conclusions

Our integrated approach towards human-plant interaction during the Bronze Age in a well-defined area of East-Central Greece has allowed us to observe continuity and change over time in a resolution much finer than attempted before for Greek prehistoric sites. Archaeobotanical macro-remains including wood charcoal, combined with morphometric analyses of grape-pips have allowed us to reconstruct patches of managed and wild vegetation in the landscape: fields of a wide range of cereals and pulses, some more demanding than others in terms of nutrients and moisture, fields of oil-crops and beyond or amidst this cultivated land, areas where fruit was grown. Although olive trees, fig trees and grapevines could have grown also in the wild, it is most likely that during the period we have studied the remains of fruit we have identified originated from orchards where fruit trees were grown. The grapevines were either imported to the area or locally domesticated, something that we hope will be clarified in the future with more data from the region. We have observed, however, an increasing predominance of the domesticated type that suggests a systematic cultivation during the Bronze Age that led to increasingly domesticated-looking grape-pip morphotypes. Olive cultivation was also significant in our study area, thus expanding the locations of known olive cultivation in Greece during the Bronze Age. Beyond the managed landscape for plant cultivation, areas where animals potentially grazed, including marshland, have been identified through wild plant taxa of herbaceous and arboreal vegetation. Moreover, in addition to the lowlands and low hills where fields and orchards would have been located, human activity in higher altitudes has been demonstrated through the remains of wood charcoal. We believe that this first attempt towards an integrated approach of plant use and land management over a long period of time has highlighted the significance of such studies for a better understanding of past human-environment interaction and will be applied in the future to other parts of Greece, covering longer time periods.

Acknowledgements

This research has been funded by the European Research Council, in the context of the Project PLANTCULT “Identifying the Food Cultures of Ancient Europe”, conducted under the European Union’s Horizon 2020 Research and Innovation Program Grant Agreement no. 682529, Consolidator Grant 2016-2021. AK has also received financial support from the A.G. Leventis and Onassis foundations, during her doctoral research in which the material from Late Bronze Age Mitrou and Kynos were studied. We are thankful to the excavators of the sites M.F. Papakonstantinou, A. van de Moortel and the late F. Dakoronia and E. Zahou, for giving us the opportunity to study the plant remains. We are grateful to Amy Bogaard for facilitating the study of the material from Mitrou.

References

- Allen SE, Forste KM (2020) Archaeobotanical Remains. In: Wright JC and Dabney M (eds) *The Mycenaean Settlement on Tsoungiza Hill, Nemea Valley Archaeological Project Vol. III*. Princeton, pp 1029-1062
- Asouti E, Austin P (2005) Reconstructing woodland vegetation and its exploitation by past societies, based on the analysis and interpretation of archaeological wood charcoal macro-remains. *Environ Archaeol* 10:1-18
- Blamey M, Grey-Wilson C (2004) *Wild flowers of the Mediterranean*. A & C Black, London
- Bohn U, Neuhausl R, Gollub G, Hettwer C, Neuhauslova Z, Raus Th, Schluter H, Weber H (2002/2003). Map of the Natural Vegetation of Europe. Scale: 1:2.500.000. *Landwirtschaftsverlag*, Munster
- Bouby L, Bonhomme V, Ivorra S, Pastor T., Rovira N, Tillier M, Pagnoux C, Terral F (2018) Back from burn out: are experimentally charred grapevine pips too distorted to be characterised using morphometrics? *Archaeol Anthropol Sci* 10:943-954. <https://doi.org/10.1007/s12520-016-0425-x>
- Bouby L, Wales N, Jalabadze M, Rusishvili N, Bonhomme V, Ramos-Madrigal J, Evin A, Ivorra S, Lacombe T, Pagnoux C, Boaretto E, Gilbert MTP, Bacilieri R, Lordkipanidze D, Maghradze D (2021) Tracking the history of grape cultivation in Georgia combining geometric morphometrics and ancient DNA. *Veg Hist Archaeobot* 30:63-76. DOI 10.1007/s00334-020-00803-0
- Chabal L (1997) Forêts et sociétés en Languedoc (Néolithique final, Antiquité tardive): l'anthracologie, méthode et paléoécologie. *Doc Archeol Fr* 63
- Czajkowska BI, Bogaard A, Charles M, Jones G, Kohler-Schneider M, Mueller-Bieniek A, Brown TA (2020) Ancient DNA typing indicates that the “new” glume wheat of early Eurasian agriculture is a cultivated member of the *Triticum timopheevii* group. *J Archaeol Sci* 123:105258. <https://doi.org/10.1016/j.jas.2020.105258>
- Dakoronia F (2010) *Κύνος*. Εργαστήριο Χαρακτικής Ηλία Ν. Κουβέλη, Athens
- Eleftherochorinos EG, Giannopolitis KN (2009) *Ζιζάνια*. Οδηγός αναγνώρισης. Εκδόσεις ΑγροΤύπος, Athens
- Finné M, Holmgren K, Sundqvist HS, Weiberg E, Lindblom M (2011) Climate in the eastern Mediterranean and adjacent regions during the past 6000 years – A review. *J Archaeol Sci* 38:3153-3173
- Finné M, Woodbridge J, Labuhn I, Roberts CN (2019) Holocene hydro-climatic variability in the Mediterranean: A synthetic multi-proxy reconstruction. *The Holocene* 29(5):847-863. doi:10.1177/0959683619826634
- French DH (1971) An experiment in water-sieving. *Anatolian Studies* 21:59-64
- Gennadios P. (1914) *Λεξικόν Φυτολογικόν*. Paraskevas Leonis, Athens
- Gkotsinas A, Karathanou, A, Papakonstantinou MF, Syrides G, Vouvalidis K (2014) Approaching Human Activity and Interaction with the natural environment through the archaeobotanical and zooarchaeological remains from Middle Helladic Agia Paraskevi, Central Greece. In Touchais G, Laffineur R., Rougemont F (eds) *PHYSIS. L'environnement Naturel et la Relation Homme-Milieu dans le Monde Égéen Protohistorique*. Peeters, Leuven-Liege, pp 487-491
- Green MD (2012) A geographical analysis of the Atalanti alluvial plain and coastline as the location of a potential tourist site, Bronze through Early Iron Age Mitrou, East-Central Greece. *Applied Geography* 32(2):335-349
- Huxley AJ, Taylor AW (1984) *Flowers of Greece and the Aegean*. Chatto & Windus, London
- Jones G, Valamoti S, Charles M (2000) Early crop diversity: a “new” glume wheat from northern Greece. *Veg Hist Archaeobot* 9(3):133-146
- Kabukcu C, Chabal L (2021) Sampling and quantitative analysis methods in anthracology from archaeological contexts: achievements and prospects. *Quat Int* 593-594:6-18
- Karathanou A (in prep) Η ανθρώπινη δραστηριότητα στην ηπειρωτική Ελλάδα κατά την Ύστερη Εποχή του Χαλκού μέσα από τα αρχαιοβοτανικά δεδομένα. PhD dissertation in preparation, Aristotle University of Thessaloniki, Greece
- Karathanou A (2019) Intra-settlement use of space in Late Bronze Age mainland Greece: a preliminary archaeobotanical study on crop storage and refuse disposal strategies in the 2nd millennium BC. *Bulgarian e-Journal of Archaeology Supplements* 7:221-235
- Karathanou A, Valamoti SM (2013) The archaeobotanical investigation of human activity in Late Bronze Age Greece. In: Abstracts Book of the 16th Conference of the International Work Group for Palaeoethnobotany, Thessaloniki, School of History and Archaeology, Aristotle University of Thessaloniki (ISBN 978-960-243-690-5), pp 221-222. Available at http://iwgp2013.web.auth.gr/images/Posters/karathanou%20%20valamoti%202013_phd%20poster.pdf
- Karkanas P, Van de Moortel A (2014) Micromorphological analysis of sediments at the Bronze Age site of Mitrou, central Greece: patterns of floor construction and maintenance. *J Archaeol Sci* 43:198-213
- Kenward HK, Hall AR, Jones AK (1980) A tested set of techniques for the extraction of plant and animal microfossils from water-logged archaeological deposits. *Science and Archaeology* 22:3-15
- Kavnadas D (1954-1964) *Εικονογραφημένον Βοτανικόν Φυτολογικόν Λεξικόν*. Pelekanos Publications, Athens
- Kotzamani G (2011) *Επίμετρο Β*. In: Nikolentzos K. (ed) *Μυκηναϊκή Ηλεία: Πολιτική και Πολιτιστική Εξέλιξη, Εθνολογικά Δεδομένα και Προβλήματα*. Athens, pp 399-400

- Kounoukias P (2011) The LHIII Middle-Early PG settlement at Kynos, East Lokris, Greece: Architecture, spatial organisation, pottery, and function. PhD Dissertation, University of Bristol, UK
- Kounoukias P (2015) Ο Κύνος στην Υστεροελλαδική IIIΓ μέση και νεώτερη περίοδο. *Archaeological Work in Thessaly and Central Greece* 4:829-839
- Kounoukias P, Gkotsinas A, Isaakidou V, Karathanou A (2021) Ιεροτελεστία στον Κύνο. Η επισφράγιση μιας καταστροφής. In: E Karantzali (ed) 3rd International Interdisciplinary Colloquium, The Periphery of The Mycenaean World Recent Discoveries and Research Results. Lamia, Greece. Ministry of Culture, Athens, pp 209-230
- Kramer-Hajos M, O'Neill K (2008) The Bronze Age site of Mitrou in East Lokris: Finds from the 1988-1989 surface survey. *Hesperia* 77:163-250
- Logothetis V (1970) Η εξέλιξις της αμπέλου και της αμπελοργίας εις την Ελλάδα κατά τα αρχαιολογικά ευρήματα της περιοχής. *Επιστημονική Επετηρίς της Γεωπονικής και Δασολογικής Σχολής, Πανεπιστήμιο Θεσσαλονίκης* 13:167-249
- Logothetis V (1974) Συμβολή της αμπέλου και του οίνου εις τον πολιτισμόν της Ελλάδος και της Ανατολικής μεσογείου. *Επιστημονική Επετηρίς της Γεωπονικής και Δασολογικής Σχολής, Πανεπιστήμιο Θεσσαλονίκης* 17:5-286
- Mangafa M, Kotsakis K (1996) A new method for the identification of wild and cultivated charred grape seeds. *J Archaeol Sci* 23:409-418
- Margaritis E (2013) Distinguishing exploitation, domestication, cultivation and production: the olive in the third millennium Aegean. *Antiquity* 87(337):746-757. doi:10.1017/S0003598X00049437
- Moskal-del Hoyo M, Ntinou M (2016) Charcoal remains from Sarakenos Cave (Boeotia, Greece). In: Kaczanowska M, Kozłowski JK, Sampson A (eds) *The Sarakenos Cave at Akraephnion, Boeotia, Greece 2, The Early Neolithic, the Mesolithic and the Final Palaeolithic (Excavations in Trench A)*. Polish Academy of Arts and Sciences, Krakow, pp 47-59
- Pagnoux C, Bouby L, Ivorra S, Petit C, Valamoti SM, Pastor T, Picq S, Terral JF (2015) Inferring the agrobiodiversity of *Vitis vinifera* L. (grapevine) in ancient Greece by comparative shape analysis of archaeological and modern seeds. *Veg Hist Archaeobot* 24:75-84. doi:10.1007/s00334-014-0482-y
- Pagnoux C, Bouby L, Valamoti SM, Bonhomme V, Ivorra S, Gkatzogia E, Karathanou A, Kotsachristou D, Kroll H, Terral JF (2021) Local domestication or diffusion? Insights into viticulture in Greece from Neolithic to Archaic times, using geometric morphometric analyses of archaeological grape seeds. *J Archaeol Sci* 125:105263. <https://doi.org/10.1016/j.jas.2020.105263>
- Papakonstantinou MF, Krapf T (2020) Μεσοελλαδικός οικισμός Αγίας Παρασκευής Λαμίας. *Ανασκαφικές έρευνες 2012-2013. Archaeological Work in Thessaly and Central Greece* 5: 863-876
- Papakonstantinou MF, Krapf T, Koutsokera N, Gkotsinas A, Karathanou A, Vouvalidis K, Syrides G (2015) Αγία Παρασκευή Λαμίας, θέση Πλατάνια. Το πολιτισμικό και φυσικό περιβάλλον ενός οικισμού στη δελταϊκή πεδιάδα του Σπερχείου κατά τη Μέση Εποχή του Χαλκού. *Archaeological Work in Thessaly and Central Greece* 4: 989-998
- Papiomitoglou V (2006) *Wild flowers of Greece*. Mediterraneo Editions
- Polunin O (1969) *Flowers of Europe. A field guide*. London, Oxford University Press, New York, Toronto
- Renfrew C (1972) *The emergence of civilisation: the Cyclades and the Aegean in the third millennium BC*. Methuen, London
- Rutter J (2001) The Prepalatial Bronze Age of the Southern and Central Greek Mainland. In: Cullen T (ed) *Aegean Prehistory: A Review*. Archaeological Institute of America, Boston, *AJA Supplement I*, pp 95-147
- Schweingruber FH (1990) *Anatomie Europaischer Holzer*. Haupt, Bern Stuttgart
- Smith H, Jones G (1990) Experiments on the effects of charring on cultivated grape seeds. *J Archaeol Sci* 17:317-327
- Styring AK, Carmona CU, Isaakidou V, Karathanou A, Nicholls GK, Sarpaki A, Bogaard A (2022) Urban form and scale shaped the agroecology of early 'cities' in northern Mesopotamia, the Aegean and Central Europe. *Journal of Agrarian Change* 22:831-854. DOI: 10.1111/joac.12497
- Syrides G (2008) Marine mollusk fauna and Holocene stratigraphy of the marsh of Agia Paraskevi, (Lamia, Fthiotida) Greece. *Bulletin of the Geological Society of Greece* 45:1-14
- Terral J-F, Tabard E, Bouby L, Ivorra S, Pastor T, Figueiral I, Picq S, Chavance J-B, Jung C, Fabre L, Tardy C, Compan M, Bacilieri R, Lacombe T, This P (2010) Evolution and history of grapevine (*Vitis vinifera*) under domestication: new morphometric perspectives to understand seed domestication syndrome and reveal origins of ancient European cultivars. *Annals of botany* 105:443-455
- Tutin TG, Heywood VH, Burges NA, Valentine DH (1964-1993) *Flora Europaea*, vol. 1-5. Cambridge
- Uccesu M, Orrù M, Grillo O, Venora G, Paglietti G, Ardu A, Bacchetta G (2016) Predictive Method for Correct Identification of Archaeological Charred Grape Seeds: Support for Advances in Knowledge of Grape Domestication Process. *PLOS ONE* 11:e0149814. <https://doi.org/10.1371/journal.pone.0149814>

- Valamoti SM (2004) Plants and people in the Late Neolithic and Early Bronze Age northern Greece: An archaeobotanical investigation. BAR IS 1258. Archaeopress, Oxford
- Valamoti SM (2009) Plant food ingredients and ‘recipes’ from Prehistoric Greece: the archaeobotanical evidence. In: Morel JP and Mercuri AM (eds) Plants and Culture: seeds of the cultural heritage of Europe. Edipuglia, Bari, pp 25-38
- Valamoti SM (2015) Harvesting the ‘wild’? Exploring the context of fruit and nut exploitation at Neolithic Dikili Tash, with special reference to wine. *Veg Hist Archaeobot* 24(1):35-46
- Valamoti SM (2016) Millet, the late comer: on the tracks of *Panicum miliaceum* in prehistoric Greece. *Archaeol Anthropol Sci* 8(1):51-63
- Valamoti SM (2017) Culinary landscapes and identity in prehistoric Greece: An archaeobotanical exploration. In: Gori M, Ivanova M (eds) *Balkan Dialogues*. Routledge, London, pp 169-193
- Valamoti SM (2023) *Plant Foods of Greece: A Culinary Journey to the Neolithic and Bronze Ages*. University of Alabama Press
- Valamoti SM, Gkatzogia E, Ntinou M (2018) Did Greek colonisation bring olive growing to the north? An integrated archaeobotanical investigation of the spread of *Olea europaea* in Greece from the 7th to the 1st millennium BC. *Veg Hist Archaeobot* 27(1):177-195
- Valamoti SM, Pagnoux C, Ntinou M, Bouby L, Bonhomme V, Terral JF (2020) More than meets the eye: new archaeobotanical evidence on Bronze Age viticulture and wine making in the Peloponnese, Greece. *Veg Hist Archaeobot* 29(1):35-50
- Van de Moortel A, Zahou E (2012) Five years of archaeological excavation at the Bronze age and early Iron Age Site of Mitrou, East Lokris (2004-2008). Preliminary results. *Archaeological Work in Thessaly and Central Greece* 3:1131-1146
- Van de Moortel A, Zahou E, Rutter JB (2018) Mitrou and Proskynas in Prehistoric East Lokris: Chronology, Interconnections, and Society. In: Papakonstantinou M, Kritzas H, Touratsoglou IP (eds) Πύρρα. Μελέτες για την αρχαιολογία στην Κεντρική Ελλάδα προς τιμήν της Φανουριάς Δακορώνια, τόμος Ι, Προϊστορικοί χρόνοι. Athens, pp 169-193
- Vouvalidis K, Syrides G, Pavlopoulos K, Papakonstantinou M, Tsourlos P (2010) Holocene palaeoenvironmental changes in Agia Paraskevi prehistoric settlement, Lamia, central Greece. *Quat Int* 216(1-2):64-74
- Weiberg E, Bevan A, Kouli K, Katsianis M, Woodbridge J, Bonnier A, Engel M, Finné M, Fyfe R, Maniatis Y, Palmisano A, Panajiotidis S, Roberts N, Shennan S (2019) Long-term trends of land use and demography in Greece: A comparative study. *The Holocene* 29(5):742-760
- Zahou E (2009) Ο πρωτοελλαδικός οικισμός του Προσκυνά. PhD dissertation, Aristotle University of Thessaloniki
- Zahou E (2019) Conspicuous Consumption in the Settlement Context of Early Bronze Age Proskynas in East Lokris, Central Greece. In: Marthari M, Renfrew C, Boyd M (eds) *Early Cycladic Sculpture in Context from beyond the Cyclades: From mainland Greece, the north and east Aegean*. Oxbow Books, Oxford, pp 190-200

