VNIVERSITAT DE VALÈNCIA
Facultat de Geografia i Història
Departament de Prehistòria, Arqueologia i Història Antiga

# Uses of wood and tree management in the Bronze Age Aegean (Greece).

## The cases of Akrotiri on Thera and Heraion on Samos.

Usos de la madera y gestión de los árboles durante la Edad del Bronce en el Egeo (Grecia).
Los casos de estudio de Akrotiri en Thera y Heraion en Samos.

**Tesis Doctoral**
por
**ANTIGONI MAVROMATI**

Programa de Doctorado 3157: Geografia e Historia del Mediterráneo desde la Prehistoria a la Edad Moderna

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**València**
**Septiembre 2019**

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# Acknowledgements

These last five years have been a long journey, with its ups and downs. There were moments of great anxiety and others full of joy and excitement. All in all, though, I am grateful: I met many wonderful people along the way. I will always keep you in my heart.

I gratefully acknowledge the Holy Synod of the Church of Greece, which partially funded my research during the first three years, and especially Metropolitan Sir Ierotheos of Nafpaktos and Agios Vlasios, who provided me with a recommendation letter. I would also like to thank the Excavations of Heraion and especially Associate Professor Ourania Kouka for covering the expenses for two months at the Malcolm H. Wiener Laboratory for Archaeological Science at the American School of Classical Studies at Athens: this generosity enabled me to study part of the material from Heraion.

I would like to express my gratitude to Professor Emeritus Christos Doumas, director of the excavations at Akrotiri, as well as Associate Professor Ourania Kouka, director of the excavation at Heraion, for entrusting me with the anthracological material of the two sites. Both gave me full access to the unpublished excavation diaries, archaeological reports, and archaeobotanical forms and they provided me with all the photos, plans, and sketches needed. Ourania, I think you are one of the most organized archaeologists I know. I always remember our first meeting, when you had already thought out and organized everything: you came prepared to give me all the information I needed for my research, at a time when I was not sure what I was going to do with the material. Thank you for always answering my questions and always being so good to me. A cordial expression of thanks goes to Dr. Tania Devetzi, the guardian angel of the excavations at Akrotiri. Ms Devetzi, I thank you warmly for providing me with all information necessary for my research throughout these years, for solving all the bureaucratic problems for the transfer of the material to the university of Valencia and also for your hospitality during my stay at the site and for your kindness and support.

Of course, none of this would have been possible without my supervisors Dr. Ernestina Badal Garcia and Dr. Maria Ntinou. Tina, my sweet "academic mom", I owe you more than I can express for accepting me as your student, the language barrier notwithstanding, and even though you knew that I could never stay for too long in Spain. The researcher I am now is due to your guidance, but mostly I thank you for making me a nicer person. From the first time you met me, you embraced me and were my guide on this difficult journey. You have this magic touch: any time I came to you confused, with just one sentence you could put my thoughts in order. Thank you for your endless energy, for never complaining that you got tired of me, and finally for all the excursions, the hours in the laboratory, and all discussions we had. I am really proud to have been your student. Maria, once more there are not enough words to express my gratitude. Thank you for encouraging me to start this Ph.D, for walking beside me on the path and for chiding me 'chin up' every time I felt ready to quit. You spent countless hours on the phone and in person with me to answer my questions, you helped me with the identification process during my stay at the Wiener Laboratory and to structure this thesis. Thank you for your kindness, patience, and support. If it was not for you, I would have never made it. Last but not least, I am indebted to you and Guillermo for hosting me at your house in Valencia during the months I spent there.

I would also like to kindly acknowledge the efforts of Dr. Anaya Sarpaki, archaeobotanist of the site of Akrotiri and Dr. Evi Margaritis, archaeobotanist of the site of Heraion and their teams, for flotating and processing a vast amount of sediment samples. Evi, it has been almost fifteen years since we first met. You advised me through my BA and MSc years, and awoke in me the love for environmental archaeology. Thank you for considering me your friend.

I am grateful to Dr. Panagiotis Karkanas, director, and Dr. Dimitris Michailidis, coordinator of the Malcolm H. Wiener Laboratory for Archaeological Science at the American School of Classical Studies at Athens, for their support during my stay at the Laboratory.

Sincere thanks goes to Dr. Katerina Papagiannis for helping me decide which material I should include in my research from the site of Akrotiri. Katerina, if it was not for you, I would still be at storeroom 40 on the site of Akrotiri trying to figure out which samples I should study.

My deep appreciation goes to my colleagues Dr. Yolanda Carrion and Dr. Paloma Vidal Matutano for helping me during the identification process of the specimens of Akrotiri, for their support and kindness during my stay at Valencia.

Carmen Martínez Varea and Miguel Angel Bel, you are the best labmates I could ever ask for. You made the hours in the laboratory bearable. Thank you for all the lunch and coffee breaks. Thank you for teaching me how to use the coffee vending machine, how to order coffee with alcohol in (when needed), and useful Spanish words. Thank you for all the fun and small talk. Carmen, I am grateful to you for guiding me through the bureaucracy of the University and for being always available. I owe you for this. You are one of the nicest and sweetest persons I know.

Guillermo Pascual, thank you for hosting me at your house during my stay in Valencia and for showing me everything I needed to know in order to survive in a foreign country. I am in debt to you for translating the abstract into Spanish for me.

Special thanks goes to Catalina Duta for adding the samples of Heraion in AutoCAD and for discussing with me various architectural terms, to Olga Pavlidou for editing the photos found in this thesis, and to Giorgos Doulfis for visiting the library for me and photographing hundreds of pages so I can work from home.

My appreciation goes to Doniert Evely for correcting the English text, for his precious comments and humour in the darkest of times, and to Tertios Publishing and especially Giorgos Beinas for doing the pagination of the present thesis.

I would also like to thank Dr. Yolanda Carrion, Dr. Llorens Picorneli, Dr. Eleni Asouti, Dr. Ethel Allué, Dr. Cristina Real, and Dr. Magdalena Moscal for accepting to review my thesis.

Last but naturally not least, I would like to thank my family: my parents Ioanna and Giorgos, for always believing in me and for their ethical and financial support during my studies all these years. I am grateful to both my parents and my parents in law, Giannis and Kallirroi, for taking care of my little twin daughters during my stay in Valencia. I also thank my brother, Vassilis, for always encouraging me with phrases like "We have all been there, you can make it" and always calling me on the phone no matter where he was. But above all I would like to express my gratitude to my husband, Thanasis. Thanasi, thank you for your patience all these years, for taking care of me and the minions, but mostly I thank you for always offering me your help unconditionally. We made this together.

# List of Abbreviations

Ch: Chalcolithic

EB: Early Bronze

EC: Early Cycladic

LB: Late Bronze

LC: Late Cycladic

LH: Late Helladic

LM: Late Minoan

MB: Middle Bronze

MC: Middle Cycladic

m a.s.l.: metres above sea level

NPS: new pillar shaft

# Abstract

The present study deals with wood charcoal macroremains recovered from the archaeological sites of Akrotiri, Thera and Heraion, Samos. The main objectives of this thesis are to examine first the transformation of the vegetation in the surroundings of the aforementioned sites overtime and then to account for the reasons behind these changes; finally the taxa preferred by the inhabitants in the construction of their buildings are scrutinized to elucidate the reasons for their choices.

The samples studied from Akrotiri date from the Early Cycladic to the Late Cycladic I periods, while those of Heraion are from assemblages dated between the Chalcolithic to the Middle Bronze periods, as well as the Archaic and the Roman periods. In both cases, the anthracological diagrams indicate a transformation of the natural landscape towards a more controlled environment, at least from the Middle Bronze period onwards. The inhabitants exploited the surrounding vegetation to collect fuel wood and probably edible fruits, which latter habit led to the systematic management of fruit-bearing taxa, like *Olea europaea* and *Prunus amygdalus*. The surrounding vegetation was also the main source of construction timbers, which were selected first according to their availability and secondarily with regard to their individual physical properties.

The extensive architectural study by Palyvou (1999), along with the systematic sampling and the analysis of anthracological specimens from the interior of the buildings of Akrotiri, has allowed suggestions to be made on the taxa used for the construction of the wooden floors of the upper storey, the infrastructure of the walls, and the windows and doors. The main species used were *Olea europaea*, *Pinus* type *brutia/halepensis*, *Quercus* type evergreen and deciduous. Exceptional here is the recovery of exogenous taxa, *Cupressus sempervirens* and *Castanea sativa*, which were also used in constructions. The anthracological samples recovered from the interior of the houses of Heraion are related more to their wooden roofs. The study of relevant contexts dated from the Chalcolithic to the Middle Bronze period allowed comparisons to be made between the taxa used at each period. Overall, the taxa mostly utilized were *Olea europaea*, *Fraxinus* sp., and *Quercus* type evergreen and deciduous.

# Resumen

## 1. Marco Arqueológico

La Edad de Bronce en el Egeo se caracteriza tanto por el crecimiento y la especialización de la producción agrícola y el aumento del excedente como por la intensificación de los contactos comerciales e intercambios de productos. Ello condujo a una gradual estratificación de la sociedad y al surgimiento de élites sociales. Sin embargo, aquella gradación no se produjo de manera simultánea en todo ese ámbito. En el Egeo, en su sentido más amplio, aquel períodose caracterizó por la presencia de diferentes grupos sociopolíticos con identidades culturales propias. Principalmente, esa división quedó dictaminada por la geografía ya que el mar separa la Grecia continental de las islas. Además, aunque desde un momento muy temprano se observan vínculos e interacciones, también son patentes diferentes características culturales entre islas como Creta, las Cícladas o las del nordeste del Egeo. Del mismo modo, son evidentes los contrastes culturales entre el norte y el sur de la Grecia continental. Dada esta complejidad, resulta evidente que los distintos períodos culturales no siempre se desarrollaron de manera paralela en cada una de las diferentes áreas del Egeo.

Esta tesis doctoral trata sobre muestras antracológicas recuperadas de los yacimientos de Akrotiri, en Thera y de Heraion, en Samos, ambos localizados en islas del mar Egeo. Tanto uno como el otro florecieron durante la Edad del Bronce. En la Tabla II.1 se muestra la cronología de los períodos arqueológicos que hemos utilizado de ambos yacimientos, así como también, por razones comparativas, los de Creta. Akrotiri estuvo influenciado culturalmente por Creta ya que sus habitantes, ricos navegantes y comerciantes, adoptaron sus nuevas tecnologías e ideas que transformaron en sus propios estándares (Nikolakopoulou, 2009). Al mismo tiempo, Heraion formó una *koine* cultural con los asentamientos localizados en el litoral de Anatolia y las islas del noreste del Egeo (Kouka, 2015). Tal y como se desprende de la excavación de edificios comunales y otros datos arqueológicos, este yacimiento también tuvo un carácter urbano y una sociedad estratificada (Kouka y Menelaou, 2018). Durante los períodos Arcaico y Romano, Heraion fue un asentamiento próspero relacionado con el culto a la diosa Hera, cuyo templo se encuentra cerca de la zona recientemente excavada.

El yacimiento de Akrotiri se localiza en la isla de Thera (Fig. II.1), la más grande de las islas que forman el grupo conocido como Santorini, que pertenece al archipiélago Cicládico y forma parte del arco volcánico del Egeo (McCoy y Heiken, 2000). Existen evidencias de presencia humana, como fragmentos cerámicos o útiles de piedra, que se pueden remontar hasta el Neolítico Final I (Sotirakopoulou, 2008a). No obstante, el yacimiento fue ocupado ininterrumpidamente desde Cicládico Antiguo II hasta la catastrófica erupción del volcán que tuvo lugar en el Cicládico Reciente I (Doumas, 1983; Knappett y Nikolakopoulou, 2008). Tal y como lo conocemos hoy día, el paisaje de Santorini es el resultado de aquella erupción que sepultó bajo la tefra y otros materiales volcánicos el yacimiento de Akrotiri (Friedrich, 2000; McCoy y Heiken, 2000; Nikolakopoulou, 2002; Palyvou, 2005) y otros más antiguos o contemporáneos a él.

Las muestras antracológicas de Akrotiri (Fig. II.2) analizadas en este estudio proceden de los depósitos que se excavaron al realizar los pozos para los pilares 18, 35, 66Π y 67 (Fig. II.7 a II.11, Tabla II.2) y de las intervenciones en la *plaza del Cenotafio* (Fig. II.12, Tabla II). Estas cuatro profundas calicatas se ejecutaron durante los trabajos de construcción de una nueva cubierta de protección del yacimiento. En todas ellas se descubrieron habitaciones excavadas en la roca piroclástica y, además, en las número 35, 66Π y 67, se encontraron restos arquitectónicos de edificios. Asimismo, se documentaron depósitos identificados como rellenos y vertederos que se utilizaron para amortizar las estructuras abandonadas o nivelar la superficie de la de roca natural.

A partir del estudio de la cerámica, estos depósitos se han fechado desde el Cicladico Antiguo II (2.800 BC-2.300 a.C.) hasta el Cicládico Final I (1.550-1.500 a.C.). En el caso de la *plaza del Cenotafio* estaban formados por los rellenos y vertederos sobre los que se asentó la propia plaza (Cicládico Medio Final-Cicládico Final I). También se han analizado muestras procedentes de los niveles de destrucción de dos edificios; uno de ellos conocido como *Xeste 3* (Fig. II.13) y el otro como *Casa de las Damas* (Fig. II.14). Ambos fueron edificios de tres pisos que estuvieron en uso durante la última fase de ocupación del asentamiento. *Xeste 3* fue caracterizado por sus excavadores como semi-público debido a la presencia de un altar en su interior, mientras que la *Casa de las Damas* se considera que fue una vivienda particular (Doumas, 1983) (Ver capítulo II.1).

Heraion está situado en la costa sur de Samos, 7 km al oeste de la ciudad de Kastro-Tigani y entre dos brazos del río Imvrassos. La isla de Samos se encuentra en la zona central-este del Egeo, a 1,8 km del litoral occidental de Anatolia (Fig. II.15). De este yacimiento se estudiaron todas las muestras antracológicas recuperadas durante las recientes excavaciones (2009-2013) desarrolladas en tres sectores: Sur, Central y Norte, los cuales están situados al norte de una vía conocida como *Calle Sagrada* (Fig. II.17). Estas muestras proceden de los escombros de destrucción del interior de las casas y de los rellenos y vertidos de las áreas abiertas del yacimiento. Por una parte, las muestras recuperadas de espacios abiertos se datan desde el Calcolítico (4.500 – 3.100 a.C.) hasta el Bronce Medio (2.000 a 1.700 a.C.), así como en los períodos Arcaico (fines del s. VII -VI a.C.) y Romano (s. II-IV d.C.). Por otra parte, los restos arquitectónicos de las casas han sido fechados desde el Calcolítico hasta el Bronce Medio y Final. Con mayor detalle, en el Sector Sur se excavaron tres casas que datan del Calcolítico y otras cinco del Bronce Inicial. En el mismo sector también se descubrió el *Edificio Comunal I*, el cual estuvo formado por dos pisos y probablemente se usó como almacén. En el Sector Central se desenterraron una casa fechada en el Bronce Inicial y otra en el Bronce Medio. Finalmente, en el Sector Norte, fueron descubiertos los restos de cuatro viviendas del Bronce Medio.

## 2. Objetivos

Teniendo en cuenta el carácter urbano de los yacimientos que analizamos, la intención de esta tesis doctoral ha sido investigar cómo sus habitantes interactuaron con su entorno natural y lo transformaron con el fin de obtener recursos útiles tales como maderas de construcción, leña y frutas comestibles. El primer objetivo fue estudiar los cambios del paisaje en torno a los dos asentamientos y, en el caso de Akrotiri, comparar los resultados con aquellas otras investigaciones arqueobotánicas que ya se habían llevado a cabo en el yacimiento para, así, obtener una imagen mucho más concisa de la vegetación. Además, en Akrotiri se conservan numerosos frescos que, tal vez, representan el ambiente natural que hubo cuando fueron pintados. Se fijó, pues, un objetivo adicional consistente en estudiar cómo los habitantes visualizaron y percibieron sus alrededores mediante la comparación de las representaciones de los frescos con los taxones que, según la antracología, crecían en la isla.

Como ya se ha indicado, la economía de las sociedades de la Edad de Bronce está relacionada, en gran medida, con la intensificación y especialización de la producción agrícola. Teniendo esto en cuenta, el segundo objetivo fue el estudio del avance en la arboricultura y el cultivo de especies a partir de la evidencia antracológica de los dos yacimientos. Esto, además, podría permitirnos hacer sugerencias sobre la transformación del paisaje, ya que los pobladores de los yacimientos modificaron sus alrededores para obtener tierras de cultivo y maderas de construcción.

En ambos yacimientos se analizaron muestras antracológicas de los interiores de edificios con el fin de estudiar los taxones utilizados para la construcción de diferentes parte de ellos, y también para investigar las diferencias que pudieran existir entre los que fueron privados y públicos. En el caso de Heraion, donde se recuperaron restos de construcciones que datan de sucesivos períodos arqueológicos, se estableció un objetivo adicional para estudiar las diferencias en los taxones utilizados en la construcción de los edificios de cada período arqueológico. Finalmente, otro punto de interés fue justificar las razones para el uso preferencial de taxones específicos.

## 3. Metodología

El carbón de madera se forma cuando la combustión se detiene por ausencia de oxigeno y queda parte del combustible, es decir, se forman los carbones (Braadbaart y Poole, 2008). Este material carbonizado mantiene la estructura anatómica de la madera de la cual se originó y se puede conservar en el suelo (Braadbaart y Poole, 2008; Chabal et al., 1999). En arqueología, los micro-restos de carbón de madera se utilizan no solo para obtener dataciones del $^{14}C$, sino también para extraer la información paleoecológica y paleoetnobotánica que puedan ofrecer ya que se consideran indicadores de la interacción entre los seres humanos y su entorno (Asouti y Austin, 2005; Chabal, 1997; Chabal et al., 1999; Ntinou, 2002; Théry-Parisot et al., 2010).

En Akrotiri, con el fin de estudiar el uso de la madera en la arquitectura durante la Edad del Bronce y buscar similitudes y/o diferencias en los taxones empleados en el edificio público (*Xeste 3*) y el privado (*Casa de las Damas*, 66Π y 67), se analizaron muestras de contextos que estaban relacionados con los escombros de destrucción. Para obtener resultados óptimos, todas las muestras del nivel de destrucción en contacto con el suelo se estudiaron según las propuestas de Grau-Almero (1992). Por otra parte, los especímenes más grandes de carbón se analizaron siguiendo las directrices de Chabal (1988), ya que éstos podrían proporcionar información crucial sobre el calibre de la madera utilizada, mientras que los más pequeños lo harían sobre la variedad de taxones empleados. De acuerdo con su posición en el edificioa partir de las descripciones recogidas en los diarios de excavación, las muestras relacionadas con estos niveles de destrucción fueron divididas en cinco categorías: (1) las que procedían de los rellenos de las habitaciones; (2) del interior de los muros (escombros de destrucción); (3) de los suelos de madera de la planta superior (primer y segundo nivel de los suelos de madera); (4) de las puertas/ventanas y (6) del interior de los contenedores cerámicos.

Tanto para *Xeste 3* como para la *Casa de las Damas*, la principal forma de muestrear el material antracológico de los sedimentos del interior de las habitaciones de los edificios fue mediante el tamizado en seco con una malla de 1 cm. Además, se muestrearon a mano grandes piezas de carbón que principalmente procedían de las vigas utilizadas para construir la capa basal de los pisos superiores o de los techos que se encontraron caídos en el suelo de los edificios. Estas grandes vigas, en la mayoría de los casos, también fueron dibujadas y su posición exacta ha quedado reflejada en los diarios de excavación. Junto a estos métodos, a partir de 1981, cuando se inició el muestreo arqueobotánico sistemático del yacimiento, se fueron tomando muestras selectivas del interior de ambos edificios que han sido procesadas en una máquina *Ankara* de flotación.

La información paleoecológica en antracología se puede obtener a partir del estudio de restos de leña de fuegos domésticos que se encuentran dispersos en depósitos acumulados durante un largo periodo de tiempo. Además para un estudio paleoecológico es necesario que el muestreo antracológico abarque el espacio suficiente del área excavada y que los resultados obtenidos del análisis de diferentes muestras sean reproductibles (Asouti y Austin, 2005; Badal, 1992, 1990; Chabal, 1992, 1988; Grau Almero, 1992; Moskal, 2010; Ntinou, 2002). Del yacimiento de Akrotiri se analizaron las muestras recuperadas de rellenos y vertederos en un esfuerzo por averiguar la paleovegetación predominante en la isla. El muestreo sistemático de los depósitos estratificados excavados, tanto durante las intervenciones antiguas de la *plaza del Cenotafio* como durante la excavación de los ejes de los nuevos pilares 18, 35, 66Π y 67, así como la recuperación de macro-restos de carbón mediante flotación, han brindado una oportunidad única para estudiar la vegetación y sus cambios desde el Cicládico Inicial II hasta la destrucción del asentamiento durante el Cicládico Tardío. Las muestras se procesaron en una máquina *Ankara* de flotación fabricada para ello. Para la recuperación de macro-restos vegetales se utilizaron tamices de malla de 1 mm y 0,3 mm respectivamente, y el residuo pesado quedó depositado en una malla de 1 mm (Sarpaki, 1987; Sarpaki y Asouti, 2008). En general, la cantidad de litros de sedimento muestreados de cada nivel estratigráfico dependió del tamaño y espesor de cada uno. La media de sedimento procesado para cada muestra oscila entre 20 y 32 litros (ver Capítulo III).

En Heraion, en la excavación al norte de la *Calle Sagrada*, el método de muestreo fue el mismo, tanto para contextos cerrados (escombros de destrucción) como para las áreas abiertas. Así pues, durante las excavaciones, las muestras de sedimento de cada una de las Unidades Estratigráficas fueron recogidas de manera sistemática y procesadas con una máquina de flotación para obtener los restos arqueobotánicos. El volumen medio de sedimento por muestra fue de aproximadamente 10 a 12 litros. La máquina de flotación se utilizó siguiendo las directrices marcadas por Peterson (2009). El tamaño de malla del tamiz para separar los elementos flotantes fue de 0,3 mm, mientras que los residuos pesados quedaron depositados en una de 1 mm.

Respecto a los métodos seguidos en el laboratorio, los macro-restos antracológicos de Akrotiri se estudiaron en el Laboratorio Milagro Gil-Mascarell del Departamento de Prehistoria, Arqueología y Historia Antigua de la Universidad de Valencia, España, mientras que los de Heraion fueron analizados en el *Malcolm H. Wiener Laboratory for Archaeological Science of the American School of Classical Studies at Athens*, Grecia. Para separar los macro-carbones de las muestras arqueobotánicas de Heraion, éstas se tamizaron con una malla de 2 mm y luego se escanearon usando un microscopio Leica M10 Sterozoom con baja ampliación para excluir todos los elementos no carbonizados. En el caso de las muestras de Akrotiri, este proceso ya había sido llevado a cabo *in situ* por la arqueobotánica A. Sarpaki y su equipo. Por lo tanto, los fragmentos de carbón grueso y el residuo se tamizaron en una pila de tamices de 4 mm y 2 mm.

Fueron analizados todos los fragmentos que excedían de 2 mm. A cada uno de ellos se le realizó un corte manual en la superficie de los tres planos anatómicos (transversal, longitudinal tengencial y longitudinal radial). Las piezas obtenidas de Heraion se estudiaron utilizando un microscopio industrial DMLM de campo claro-oscuro y magnificaciones x100, x200 y x500, mientras que las procedentes de Akrotiri se analizaron con un microscopio Leica DM6000 M con campo claro-oscuro y aplicando las mismas magnificaciones.

La identificación de los especímenes la hemos realizado utilizando atlas de anatomía (Fahn et al., 1986; Schweingruber, 1990) y las colecciones de referencia del *Wiener Laboratory* y del Laboratorio de Archaeologia de la Universitat de Valencia. La microfotografía de las muestras de Akrotiri se hizo en el Servicio Central de Apoyo a la Investigación Experimental de la Universidad de Valencia con un microscopio electrónico de barrido Hitachi S-4800 y un sistema de toma de imágenes QUANTAX 200. Por su parte, para las muestras de Heraion se empleó el microscopio electrónico JEOL, JSM-IT300LV del *Wiener Laboratory*.

Tras completar así la identificación de los carbones extraídos de las muestras, los resultados se resumieron en tablas con taxones por muestra y divididos en función del contexto. La metodología de cuantificación empleada, tanto para los materiales de Akrotiri como para los de Heraion, fue mediante el recuento de los carbones. Las muestras provenientes de rellenos y basureros se analizaron para obtener información sobre el paisaje antiguo de la isla en que se encuentra cada uno de los dos yacimientos y sobre la gestión de los árboles y de la leña. Se crearon curvas de saturación para averiguar, mediante su estabilización (o no) si el número de fragmentos analizados en cada conjunto era suficiente para una representación óptima de taxones (Badal, 1990; Chabal, 1988).

En Akrotiri, a partir de las curvas de saturación (ver Cap. III) se observa la presencia de al menos diez taxones en todos los niveles arqueológicos (Fig. III.10), a excepción de la primera cubierta de la *Plaza de los Cuernos Sacros*. Además, la tendencia observada en todas las curvas obtenidas es que los taxones más comunes aparezcan entre los primeros 50 fragmentos analizados. Como se puede ver en las curvas de saturación relacionadas con las muestras que datan del Cicládico Inicial

(Fig. III.1 a III.3), los taxones más comunes de aquel período son *Pinus* tp. *brutia/halepensis, Olea europaea, Juniperus* sp. y Fabaceae, los cuales permanecen invariables en todos los contextos correspondientes a este período. En la mayoría de los casos, estos taxones se identificaron entre los primeros 50 fragmentos estudiados. Además, se observa que más de la mitad de los taxones identificados en cada uno de los conjuntos de este período aparecieron entre los primeros 100 fragmentos analizados, mientras que tras analizar 150 fragmentos este porcentaje se sitúa por encima del 90%.

En las muestras del Cicládico Medio, *Olea europaea* es el taxón más común, ya que en todas las curvas de este período (Figures III.4 a III.7) aparece entre los primeros fragmentos analizados. Otros taxones cuya presencia es casi constante entre los cincuenta primeros especímenes fueron Fabaceae, *Juniperus* sp., *Arbutus* sp. y *Tamarix* sp. En las dos curvas de saturación de NSP 66Π (Fig. III.5 y III.6), aproximadamente el 40% del número total de taxones identificados aparecía entre los primeros cincuenta fragmentos analizados. En la curva del relleno de la habitación excavada en NPS 67 (Fig. III.7), para el mismo número de fragmentos, el porcentaje pasaba al 61.53%. En las dos curvas de NPS 66Π mencionadas, se identificó el 60% de los taxones después de que se contabilizaran 100 fragmentos en una de ellas y 150 en la otra. Sobre todo, en todos los conjuntos del Cicládico Medio se observa una homogeneidad en cuanto a los taxones representados. El mayor número de fragmentos necesarios para que las curvas de esfuerzo-rendimiento del período de Cicládico Medio se saturen en relación a las del período anterior podría justificarse como resultado del mayor número de taxones presentes en el primero. En las curvas de saturación del Cicládico Inicial, el número máximo de taxones identificados fue de 14, procedentes del relleno de la *Habitación 2* (Pilar 35) (Fig. III.1), mientras que en todas las curvas del Cicládico Medio aparecieron más de 20 taxones y llegando a ser 27 en la primera capa del *Suelo 3* (Pilar 66Π) (Fig. III.6).

De manera similar, durante el Cicládico Medio Tardío, *Olea europaea* fue nuevamente la especie más común seguida por *Punica granatum*. Otros taxones presentes en al menos dos de las tres curvas de este período (Fig. III.8 a III.10) son: *Arbutus* sp. y *Juniperus* sp. En todos los casos, el porcentaje de los taxones identificados en los primeros 50 fragmentos superaba el 60% del total. Además, en las muestras de esta fase, y especialmente aquellas relacionadas con vertederos, se identificaron taxones exógenos, que podrían haber sido productos de carpintería (*Castanea sativa, Pinus* tipo *nigra/sylvestris*) o del cultivo (*Punica granatum*). A pesar de la presencia de estos taxones, la reproducibilidad de las muestras y el hecho de que, en casi todas, los más comunes permanecieron invariables durante todo el Bronce Medio, hacen que los resultados sean adecuados para proporcionar información sobre el paisaje de la isla y el uso de los arboles durante aquel período.

Finalmente, las muestras recuperadas de los depósitos del Cicládico Tardío I (Fig. III.12 a III.14) eran muy pocas y, en su mayoría, no contenían un gran número de fragmentos. Sin embargo, entre ellos, la especie más común nuevamente fue *Olea europaea*, que se identificó entre los primeros fragmentos estudiados en todos los casos y, además, los taxones contenidos en las muestras fueron más o menos los mismos. Por lo tanto, como en el caso del Cicládico Medio, el hecho de que los resultados sean reproducibles permite su uso para el estudio del paisaje y de la gestión de árboles que se produjeron en la isla durante aquella fase.

En Heraion, las muestras recogidas en espacios abiertos provienen de depósitos que datan de los períodos Calcolítico, Edad de Bronce Inicial y Media, Arcaico y Romano. Sin embargo, de los depósitos calcolíticos y arcaicos sólo se tomó una muestra de cada uno, por lo que, sólo se tuvo en cuenta la presencia de los taxones. Las curvas de las Unidades Estratigráficas 66/13 (Fig. III.16) y 69/13 (Fig. III.17), ambas datadas en el Bronce Inicial III, presentan homogeneidad en los taxones incluidos. Los más comunes entre estos depósitos son *Prunus* sp.*, Fabaceae, Arbutus* sp. y *Quercus* de hoja caduca. Todos ellos aparecían entre los primeros 20 fragmentos analizados. Asimismo, en ambos casos, las curvas se saturan cerca de los 50 fragmentos. Todo ello sugiere que estos depósitos son buenos indicadores de la vegetación que hubo en los alrededores de Heraion durante el Bronce Inicial.

Debido al escaso número de fragmentos recuperados de depósitos del Bronce Medio, solo fue posible producir dos curvas de esfuerzo-rendimiento (estrato 34/13 y Unidad Estratigráfica 100/12 - Fig. III.18 y III.19) y ninguna de las dos llegó a saturarse. Sin embargo, el hecho de que en ambos casos se identificaron *Olea europaea, Arbutus* sp. y *Quercus* de hoja caduca y perenne entre los primeros 12 fragmentos analizados, así como la homogeneidad general de los taxones representados, indica que estos conjuntos pueden utilizarse para estimar los taxones del paisaje que rodeaba el sitio y los que, en principio, fueron usados para cubrir las necesidades de leña de los habitantes del yacimiento. Del mismo modo, las curvas de las Unidades Estratigráficas 17/11 (Fig. III.20) y 35/10 (Fig. III.21), que datan del período romano, no se saturan. Sin embargo, el hecho de que en ambos casos los taxones presentes sean más o menos los mismos, y también que *Platanus orientalis, Arbutus* sp. y *Olea europaea* se identificasen dentro de los cuatro primeros fragmentos, sugiere que estas muestras son suficientes para indicar los principales taxones de presentes en torno al yacimiento durante la época romana.

Los resultados cuantitativos de los carbones dispersos en los rellenos, basureros y espacios abiertos de ambos yacimientos, se presentan en los diagramas antracológicos. El propósito principal de estos diagramas es permitir observaciones sobre las diferencias en la frecuencia de los taxones recuperados. De esta manera, se pueden estudiar los cambios a lo largo del tiempo en el entorno que rodeaba los yacimientos, así como el impacto que los habitantes causaron en él (Chabal, 1988).

En el caso de los edificios de los dos yacimientos, donde las muestras representan principalmente elementos de construcción, el objetivo principal del estudio de los macro-fragmentos del interior de los edificios fue investigar: (1) la dispersión de los taxones dentro de cada habitación, y (2) averiguar si hubo preferencia sobre alguno para la construcción de elementos específicos, es decir, puertas, pisos, etc. Para investigar lo anterior, se prefirió la ubicuidad como método de cuantificación sobre la frecuencia, ya que aquella puede proporcionar información sobre la distribución de los taxones en el interior de los edificios y sobre la frecuencia de su uso. Además, los resultados de este método de cuantificación no se ven afectados por la sobre-fragmentación de las maderas de construcción quemadas como resultado de causas tafonómicas (para los detalles, ver Capítulo III).

## 4. Discusión y conclusiones

Esta tesis doctoral se ha centrado en el análisis de los macro-restos de carbón recuperados en los yacimientos arqueológicos de Akrotiri, en Thera, y de Heraion, en Samos. Los principales objetivos de la misma fueron tres:

El primero, investigar la paleoflora del entorno de los dos yacimientos mientras éstos fueron ocupados y cómo los habitantes transformaron el paisaje para la obtención de recursos.

El segundo fue estudiar el progreso de la arboricultura y el cultivo de especies y cómo ello afectó la economía de los asentamientos.

Finalmente, el tercer objetivo fue analizar los taxones utilizados en la construcción de los edificios de los asentamientos, identificar las especies empleadas en la construcción de los edificios privados y públicos y examinar el motivo de la preferencia de unos taxones específicos sobre otros.

### 4.1 Akrotiri

La interpretación del diagrama antracológico de Akrotiri (Capítulo V.1) (Fig. V.1) sugiere que durante el Cicládico Inicial hubo en la isla un bosque abierto de pino y cuyo componente principal era *Pinus* del tipo *brutia/halepensis* con *Juniperus* sp., *Olea europaea* y *Fabaceae* como taxones co-dominantes. Además, existían áreas en las que podían crecer taxones hidrófilos como *Quercus* de hoja caduca, *Salix/Populus y Alnus/Corylus* (Tablas V.1 a V.4). Las evidencias antracológicas están respaldadas por los estudios tanto de fitolitos (Vlachopoulos y Zorzos, 2014), que sugieren la presencia de suelos que retienen agua, como de microfauna (Papagianni, 2012) y los análisis entomológicos realizados por Panagiotakopulu (2000), que indican la existencia de zonas forestales en la isla antes de la erupción volcánica.

Desde el Cicládico Medio en adelante (Tablas V.5 a V.12) se observa un cambio en la economía del asentamiento. La presencia de *Olea europaea, Punica granatum, Prunus amygdalus* y otros árboles frutales se incrementa significativamente al tiempo que se reduce el *Pinus* tipo *brutia/halepensis* y aparecen taxones como el *Quercus* de hoja perenne. Desde el punto de vista económico, esta circunstancia indica que los habitantes favorecieron la gestión de árboles frutales cuyos productos podían consumirse en el asentamiento o transferirse y venderse a través del comercio. El paisaje se caracterizaría por la presencia de olivares, mientras que más cerca de las fuentes de agua, además de los taxones hidrófilos, existirían huertos donde crecían los árboles frutales. La evidencia antracológica, con los porcentajes incrementados de *Olea europaea* y el analyses de los anillos de crecimiento en especímenes de este taxón, atestigua el cultivo de esta especie muy probablemente desde el Cicládico Medio. La carpología pone de manifiesto el cultivo de olivos y la producción de aceite de oliva en el yacimiento durante del Cicládico Tardío I (Sarpaki, 1987). Este aumento en la presencia de *Olea europaea* y otros taxones frutales como indicación de su uso/cultivo coincide con los registros de polen de Creta y Grecia continental (leer, entre otros, a: Bottema, 1994; Bottema and Worldring, 1990; Kotthoff et al., 2008; Triantaphyllou et al., 2010).

Junto con la vegetación que crecía en la isla de Akrotiri, en los conjuntos del Cicládico Medio y del Cicládico Tardío I, se identificaron taxones exógenos como *Cupressus sempervirens, Pinus* tipo *nigra/sylvestris, Castanea sativa* y *Cedrus libani*. Su presencia pone de manifiesto la importación de maderas y, probablemente, también de objetos de lujo fabricados con ese material. Así pues, estos taxones conforman un testimonio de las conexiones comerciales de Thera con Creta, Grecia continental, Chipre, Asia Menor y las islas del norte y este del Egeo.

La información procedente del estudio de la arquitectura de los edificios de Akrotiri (Palyvou, 1999, 2005) indica el amplio uso de madera en la construcción de los pisos superiores, tabiques y puertas interiores (pier-and-doors partitions), elementos estructurales de los muros, etc. Esta información se ha combinado con nuestros análisis antracológicos en los edificios de la fase final del asentamiento, *Xeste 3* y *Casa de las Damas*. En general, no se observaron diferencias entre los taxones utilizados en los edificios públicos y en los particulares (ver Capítulo V.2). Los constructores de Thera aprovecharon al máximo la vegetación que crecía en la isla para obtener el material necesario en la construcción de los pisos de madera, puertas, ventanas y marcos de madera de sus edificios.

En concreto, seha observado que para la construcción de las vigas de la capa basal de los suelos del piso superior (Fig. V.11 y V.12, Tablas V.15-V.16), donde se necesitan postes largos y gruesos, se utilizaron *Pinus brutia/halepensis*, posiblemente también *Juniperus* sp. y, en menor medida, *Cupressus sempervirens* y *Quercus* de hoja caduca. Además, la presencia de vigas de *Olea* en esta primera capa basal de los suelos sugiere la existencia en la isla de árboles con largas ramas capaces de producir la madera necesaria para cubrir la distancia entre las paredes de los edificios. Probablemente, al menos durante el Bronce Final, el uso de esta especie concreta estuvo más relacionado con su abundancia en el paisaje de la isla. La mayor variedad de taxones utilizados en las segundas capas de estos suelos (p.ej. *Juniperus* sp., *Quercus* de hoja perenne y *Prunus amygdalus)* pudo haber sido recolectada de la vegetación y los cultivos que crecía en las proximidades o cerca del asentamiento (Tablas V.15 y V.16).

De manera similar, resulta significativa la variedad de taxones empleados en la construcción de otras partes de los edificios tales (p.ej. Fabaceae, Cistaceae, *Ficus carica*, *Quercus*de hoja caduca y perenne, *Tamarix* sp.) como tabiques y puertas interiores (pier-and-doors partitions), elementos estructurales de los muros, etc., aunque la especie más generalizada es *Olea europaea* (Tablas V.19 a V.21). Finalmente, la identificación de *Cupressus sempervirens* y *Castanea sativa* en contextos relacionados con escombros resulta un sólido indicador que hace referencia a la importación de madera para estructuras y no sólo de objetos más o menos suntuosos de madera.

En general, tanto el cultivo de *Olea europaea* y los taxones frutales, entre los que se destaca *Punica granatum* como una especie introducida, como la importación de maderas lujosas y la construcción de edificios decorados con espléndidos frescos, son indicadores de la situación económica de los habitantes de Akrotiri. El cultivo de olivos para la producción de aceite está relacionado con la existencia de una sociedad estratificada en el asentamiento, lo cual es algo que ha sido puesto de manifiesto para todo el Egeo durante el Cicládico Tardío (Valamoti et al., 2018). Además, la capacidad de los habitantes para importar y poseer objetos ostentosos, algunos de los cuales fueron hechos de madera, refleja tanto su riqueza como las relaciones comerciales que mantuvieron con áreas de todo el Egeo. A medida que la influencia de Creta aumentó a partir de finales de la Cicládico Medio, los habitantes de Thera adoptaron nuevas técnicas y comportamientos culturales y sociales (Nikolakopoulou, 2009).

### 4.2 Heraion

La investigación antracológica de Heraion (Capítulo VI) se encontró con algunos obstáculos. El más importante de ellos fue la escasa cantidad de fragmentos de carbones que pudieron ser recuperados de los depósitos calcolíticos y arcaicos, lo cual dificultó la reconstrucción del paisaje de la isla de aquellos períodos. Por lo que respecta a la información del paleoambiente en torno al asentamiento durante las fases prehistóricas, ésta proviene principalmente del Bronce Inicial. El registro antracológico (Fig. VI.1, Tablas VI.1, VI.3, VI.4) sugiere la existencia de un bosque ribereño donde el *Quercus* de hoja caduca fue dominante, aunque también hubo *Fraxinus* sp., *Ulmus* sp. y *Platanus orientalis*. Además, en las proximidades del yacimiento debieron existir bosques abiertos, con *Arbutus* sp*.* y *Quercus* de hoja perenne, que también serían el hábitat natural de *Olea europaea* ya desde el Calcolítico. Durante la Edad del Bronce, para cubrir sus necesidades de leña, los habitantes de Heraion dependían exclusivamente de los árboles que podían encontrar cerca del asentamiento ya que no se han identificado taxones exógenos en ese período.

Ha sido de especial importancia la identificación de anillos de crecimiento en carbones de *Olea*. Esto, unido a la recuperación de huesos de aceitunas en contextos relacionados con la producción de aceite (Kouka, 2015; Margaritis, 2013) y la presencia de contenedores adecuados para su transporte que datan del Bronce Inicial (Kouka and Menelaou, 2018) dan fe del uso regular e intencional de *Olea europaea* en el yacimiento desde el Bronce Inicial II. Tal y como sugieren los registros antracológicos y carpológicos, durante el Bronce Inicial, además de *Olea,* también fueron explotados por sus frutos el *Prunus amygdalus* y *Ficus carica*. Por último, cabe señalar que la presencia de anillos estrechos en los especímenes del taxón *Quercus* de hoja caduca indica que, muy probablemente, los habitantes de Heraion pudieran podarlos con el fin de obtener forraje para sus animales.

Durante el período romano (Tabla VI.6), en Heraion se observa un giro hacia un paisaje más antropizado. La apertura de los bosques mixtos próximos al yacimiento debió haber sido mayor que en el período anterior (Edad del Bronce). Los taxones pirófilos predominantes (*Arbutus* sp., *Quercus* de hoja perenne y *Erica* sp.) apuntan a incendios que quizás fueron intencionados y pudieron estar relacionados con la creación de tierras de pastoreo y/o áreas de cultivo (Houérou Le, 1974). Además, el aumento en los porcentajes de *Platanus orientalis* sugiere que la vegetación del bosque ribereño se degradó, ya que ésta es la única especie que puede crecer en suelos de ribera (Dafis, 2010) ocasionados por la erosión de los depósitos aluviales en las áreas cercanas al yacimiento tras la extinción del bosque *Quercus* de hoja caduca que había crecido allí desde el Bronce Inicial. Por supuesto, otra posibilidad es que el aumento de *Platanus orientalis* sea el resultado de comportamientos culturales, ya que determinadas especies como esta pudieron haber sido valoradas como ornamentales en el asentamiento. Probablemente, los altos porcentajes de *Olea europaea* reflejan su cultivo durante este período. Por último, también se recuperaron fragmentos de *Pinus nigra/sylvestris*, un árbol que hoy solo crece en las cimas más altas de la isla. Su presencia en el yacimiento nos habla, pues, de la explotación de las zonas montañosas de la isla para la recolección de leña o maderas adecuadas para artículos de carpintería y construcciones.

La arquitectura de las viviendas calcolíticas no se conoce debido a la mala conservación de los restos descubiertos. Las del Bronce Inicial presentan largas habitaciones rectangulares o trapezoidales (7 a 10 m de longitud y un ancho de 3.5 a 4.5 m). Las casas del asentamiento se erigieron siguiendo un patrón radial de dos maneras: bien independientes o bien con paredes laterales comunes. La única parte de madera de los edificios eran sus techos, los cuales fueron planos y se parecían a los del litoral occidental de Anatolia (Erkanal, 2011; Kouka, 2002). A partir de paralelos en Creta y las Cícladas aquellos techos han podido ser reconstruidos. Según Lenuzza (2013) estaban formados por cuatro capas. De ellas, la inferior estaba hecha con grandes vigas que se disponían en perpendicular a la línea de las paredes y eran las encargadas de soportar el peso del techo. La segunda capa estaba hecha con ramas de menor diámetro dispuestas para cubrir los huecos entre las vigas. Sobre esta capa de ramas se colocaban varias de arcilla superpuestas que sellaban el conjunto. En el caso concreto de Heraion, sobre la arcilla, generalmente, también se disponía un suelo de losas de piedra (informes arqueológicos no publicados de Kouka, para más detalles, véase el § II.1.4). Por último, las dimensiones excavadas del *Edificio Comunal I* son 9 x 10 metros, mientras que sus paredes tenían un ancho de 1.05/1.10 m. Este es el único edificio que probablemente tuvo un segundo piso a modo de desván o almacén.

Los depósitos más adecuados para estimar cuáles fueron las maderas utilizadas en la construcción de aquellos techos planos provienen del Calcolítico (Fig. VI.2, Tabla VI.6), del Bronce Inicial (Fig. VI.3, VI. 4, Tabla VI.7), y del Bronce Medio (Fig. VI.7, VI.8, Tabla VI.9). En general, de un período a otro se observan cambios en los taxones preferidos para ello y entre los utilizados en edificios privados y en los comunales del Bronce Inicial II.

Durante Calcolítico, las maderas preferidas procedían de las formaciones ribereñas próximas al yacimiento. El taxón principal utilizado fue *Fraxinus* sp., aunque *Olea europaea* y *Quercus* de hoja perenne también quedan reflejados en un número significativo de muestras. Durante las siguientes dos fases, la presencia de taxones hidrófilos se reduce y solamente se aprecia un aumento del *Quercus* de hoja caduca. Al mismo tiempo, en las muestras analizadas queda de manifiesto un aumento de la presencia de los taxones que crecen en formaciones mixtas abiertas, como *Quercus* de hoja perenne, *Fabaceae, Arbutus* sp. y *Olea europaea*. De hecho, durante ambos periodos, la madera de *Olea europaea* parece que fue la más utilizada. El aumento en la presencia porcentual de *Olea europaea* en los edificios de Heraion probablemente esté relacionado con la gestión de este árbol desde el Bronce Inicial en adelante y, por tanto, de la mayor disponibilidad de ramas susceptibles de ser utilizadas en la construcción de los techos.

Las diferencias observadas entre los taxones utilizados en las casas particulares y el *Edificio Comunal I* del Bronce Inicial II (Fig. VI.5, Tabla VI.8) indican cómo los habitantes del yacimiento adaptaron sus necesidades al área circundante. Puesto que el *Edificio Comunal* era mucho más grande que las casas privadas, los taxones identificados reflejan el uso de troncos largos, como *Fraxinus* sp., *Salix/Populus y Ulmus* sp., a modo de elementos esenciales.

Para concluir, la presente tesis indica que los habitantes de ambos yacimientos explotaron la vegetación de las proximidades de sus asentamientos tanto para aprovisionarse de leña como de elementos para la construcción de sus viviendas. A partir del Bronce Medio, en ambos casos se observa un giro hacia un paisaje más antropizado que queda plasmado en el aumento de los taxones de árboles aprovechables desde el punto de vista económico como *Olea europaea*. Tanto en Thera como en Heraion esta antropización del entorno también conllevó cambios en la vegetación que reflejan la economía de las sociedades que vivieron en ellos durante la Edad del Bronce. En cuanto a los edificios de los yacimientos, se han podido identificar los taxones utilizados en las diversas partes de los mismos (puertas, techos, pisos, etc.). En general, a pesar de que hemos puesto de manifiesto que los constructores que trabajaron en los yacimientos tenían un gran conocimiento de las propiedades de las maderas que utilizaban, la selección de taxones específicos para ello estuvo condicionada principalmente por su disponibilidad en el medio ambiente que los rodeaba.

Por último, pero no menos importante, para el caso de Akrotiri, este estudio ha permitido enriquecer tanto el número de taxones endógenos como el de los exógenos ya conocidos y se ha verificado la presencia, hasta ahora dudosa en los estudios previos llevados a cabo, de algunos como *Juniperus* sp. y *Tamarix* sp. (Asouti, 2003). Asimismo, se ha confirmado la importación desde otras áreas del Egeo de maderas que fueron utilizadas como elementos estructurales en determinados edificios. Por su parte, en el caso de Heraion, nuestra tesis no sólo ha supuesto el primer estudio antracológico realizado en la isla de Samos, sino también el primero elaborado de modo sistemático en relación a las islas del norte del Egeo. Esperamos que este análisis sea el punto de partida para futuros trabajos sobre la antigua vegetación y los usos de la madera en la zona.

# I. Introduction

Prehistoric populations transferred wood into their settlements in order to satisfy their energy needs (heat, light, cooking and many more), as well as for other purposes such as the construction of buildings and the making of objects of everyday use. In this way, the collection and study of wood charcoal macroremains found scattered in archaeological deposits, as a result of the repeated cleaning out of domestic fires over a long period of time, can provide information on the vegetation prevailing in the surroundings of a settlement and its progressive alteration due to human impact. Additionally, the analysis of wood charcoal macroremains from more closed contexts can reveal the taxa used in construction and manufacture and enables one to examine the reasons for the selection of specific taxa.

The present thesis deals with anthracological samples recovered from the archaeological sites of Akrotiri, Thera and Heraion, Samos. More specifically, from the site of Akrotiri come samples from the Square of the Cenotaph and the deep shafts of Pillars 18, 35, 66Π, and 67, excavated for the construction of the new shelter of the archaeological site, as well as others from two buildings, namely Xeste 3 and the House of the Ladies. In the case of Heraion, all anthracological samples from three excavation sectors, namely South, Central, and North excavated north of the Sacred Road were studied.

During the Bronze Age period, the urban settlement of Akrotiri was culturally influenced by Crete. Its inhabitants, wealthy sailors and merchants, through their contact with this island to the south, adopted new technologies and ideas which they transformed to their own standards, while at the same time they took advantage of their commercial connections with other areas of the Aegean (Nikolakopoulou, 2009). On the other hand, the settlement of Heraion, during the same period, was part of a cultural "*koine*" with settlements situated on both the Anatolian littoral and the other islands of the northeast Aegean (Kouka, 2015). This site also had an urban character and a stratified society, as is indicated by the excavation of communal buildings and deducible from other archaeological data (Kouka and Menelaou, 2018). During the Archaic and Roman periods, Heraion was a prosperous settlement closely linked to the cult of the goddess Hera, whose temple lies near the recently excavated area.

Currently, published systematic anthracological research from the area of the northeast Aegean does not exist. In the Cyclades, evidence comes from the archaeological site of Dhaskalio, Keros (Ntinou, 2013a) and from Akrotiri, Thera (Asouti, 2003; Bottema-MacGillavry, 2005; Mavromati, 2017) itself. In the case of Dhaskalio, Ntinou (2013a) studied assemblages dated to the EC habitation of the site and she discussed the vegetation prevailing in the surrounding of the site during that period, as well as the taxa used for the construction of the buildings of the site. At Akrotiri, studies from Asouti (2003) have focused on samples recovered from fill layers excavated in Pillar 63A, and have allowed an estimation on the palaeoflora existing on the island from the EC to the LC I period, as well as offering suggestions on the management of trees. Additionally, Bottema-MacGillavry (2005) analysed samples from the interior and exterior of the West House. The author also made some suggestions on the taxa growing in the surrounding of the site, as well as on the taxa that might have been used as structural timbers.

Keeping in mind the urban character of both sites under study and the previous publications in the case of Akrotiri, the goal of the present thesis was to investigate how the inhabitants interacted with their natural environment to gain useful resources, like construction timber, firewood and edible fruits. Thus, the initial aim was to study the transformation of the vegetation surrounding the two settlements. In the case of Akrotiri, where previous archaeobotanical studies exist, it was still thought crucial, given the richness of the evidence, to study a larger number of charcoal specimens from a broader area of the excavation to reconstruct the vegetation in greater accuracy. Also, as many frescos depicting the natural environment have survived here, a rare opportunity – the second aim – was provided to study how the inhabitants themselves perceived and visualized their surroundings, by comparing the depictions on the frescos with the actual taxa growing on the island as revealed by the anthracological data. In the case of Heraion, where no other relevant research exists, this present study serves as the base-line for discussing how the inhabitants of the site perceived their natural environment and utilized it.

The Bronze Age period is considered the time when the management of economically valuable taxa begins in earnest, culminating in the cultivation of several species by the LB period. Thus, the third aim here was to study the advances made in arboriculture and the cultivation of species, as indicated by the anthracological evidence of the two sites. This would allow a considered assessment on the transformation on the landscape from a natural one towards a more controlled version, as the inhabitants of the sites altered their surroundings to bring land under cultivation and to harvest construction timber.

Additionally, in both sites a systematic sampling of closed contexts in the interior of the buildings was undertaken. The analysis of these assemblages aimed primarily at identifying and investigating the taxa used for the construction of the buildings and also to explore differences between private and communal buildings. Furthermore, at Heraion where relevant samples are from houses dated from the Ch through to the MB period, it was hoped to detect differences in the taxa used at each archaeological period. Another point of interest was to explore the reasons for the preferential use of specific taxa: to try to understand if prehistoric populations were using these taxa primarily because they were abundant in their environment or because they were also aware of their individual properties as timber.

To handle all this, this thesis is divided into seven chapters, including this introduction (Chapter I). In Chapter II, is given general information regarding the geology and vegetation of the sites under study. Additionally, a broad appreciation on the archaeology of each site is provided as well as detailed descriptions of the archaeological contexts under study, including their stratigraphy. Here too is described the architecture of the buildings of both sites and chronological information is given. Chapter III is dedicated to the Methodology. The history of Anthracology and how its methods are applied during excavation and study of the anthracological samples are first presented. Then, the methods followed on site at Akrotiri, Thera and Heraion, Samos, as well as those in the laboratory, are described in detail. Subsequently, there is discussed how representative of the vegetation are the charcoal samples coming from fill and dump layers of both sites. Finally, the methods used for the study of charcoal specimens coming from the interior of the buildings are presented.

In Chapter IV, information on the taxa identified is provided. The taxa are described one by one: information on their distribution areas, wood properties, and uses are given. In Chapter V, the results and discussion of the anthracological evidence from the archaeological site of Akrotiri are presented. This chapter is divided into two major parts. In the first, the anthracological diagram of the site is described and the transformation of the vegetation of the surroundings of the site over time is discussed, based on the anthracological data. Additionally, the identification of exogenous taxa found in these assemblages is deliberated to estimate in what physical form they were imported to the islands. Finally, a detailed comparison between the woody taxa depicted in the frescos of the site and the anthracological evidence is made to place on a firmer footing our knowledge on how the inhabitants perceived their surroundings. The second part of Chapter V deals with the results of the anthracological samples collected from the interior of Xeste 3, the House of the Ladies and rooms of three houses excavated in Pillars 66Π and 67. The data are presented and discussed feature by feature. Thus, in the first section are described the wooden floors of the upper storeys, in the second the infrastructure of the walls, and in the third the openings such as doors and windows. Fourthly are discussed the samples coming from the fills of the rooms, while an effort (fifth section) is made to reconstruct in more detail the lower layer of the floors of the upper storey of Rooms 7 and 14 of Xeste 3 and Room 5 of the House of the Ladies. In the sixth section, the results of the samples recovered from the earthen floors of the buildings are presented, while the last, and seventh, section is dedicated to the explanation behind the choice of taxa used in construction.

Chapter VI includes all information related to the archaeological site of Heraion, Samos. The structure of this chapter is more or less the same as the previous one. Thus, in the first part, the anthracological diagram of the site is described and discussed. In the second part, the information related to the construction of the wooden roofs of the houses studied is presented by archaeological period. Buildings unearthed have contexts dated from the Ch through the MB period. Then, the results of the samples coming from earth floors, hearths and a threshold from these buildings are presented. Finally, in the last section of the chapter are again discussed the reasons for the selection of specific taxa in construction.

The last chapter of the thesis constitutes the Conclusion.

# II. Geology, Vegetation, and Archaeology of Akrotiri on Thera and Heraion on Samos

During the Bronze Age, the area of the Aegean, in its broader sense, is characterized by the presence of different socio-political clusters, with each having its own cultural identity. This divisionis primarily dictated by the geography of the area, as the presence of the sea separates mainland Greece from the islands. Further, different cultural characteristics are observed within the islands of the Aegean, such as Crete, the Cyclades, and the northeast Aegean islands, though ties and interactions amongst them are observed already from an early period. Similarly, differences are noted between the northern and the southern parts of mainland Greece. Given the complexities of the above, it is clear that cultural periods do not always run in parallel between the areas of the Aegean.

| Relative Chronology (BC) | Akrotiri, Thera | Heraion, Samos | | Crete |
|---|---|---|---|---|
| | Archaeological Period | Archaeological Period | Architectural Phase | Archaeological Period |
| 4,500 | | Middle Chalcolithic | MCh | |
| 4,000 | | Late Chalcolithic | LCh | |
| 3,500 | | | | |
| 3,000 | Early Cycladic I | Early Bronze I | EB 5<br>EB 4 | Early Minoan I |
| 2,800 | | Early Bronze II early | EB 3 to EB 1<br>Heraion I | |
| 2,600 | Early Cycladic II | Early Bronze II late | Heraion II<br>Heraion III | Early Minoan II |
| 2,400 | | | | |
| 2,200 | Early Cycladic III | Early Bronze III | Heraion IV<br>Heraion V | Early Minoan III |
| 2,000 | early Middle Cycladic | Middle Bronze | MB 6 to MB 1 | Middle Minoan I |
| | | | | Middle Minoan II |
| 1,800 | late Middle Cycladic | | | Middle Minoan III |
| 1,600 | Late Cycladic I | | | Late Minoan I |
| 1,400 | | | | |

**Table II.1**: Comparative chronological table of Akrotiri, Heraion and Crete. The dates are based on: Knappett and Nikolakopoulou (2015), Kouka (2015), and Kouka and Menelaou (2018).

In Table II.1 is provided the relative chronology of the different archaeological periods of Akrotiri and Heraion, used at the present Thesis as well as those of Crete for comparative reasons. Furthermore, in the case of Heraion the architectural phases are also presented. Finally, it should be observed that although the archaeological site of Heraion yielded anthracological samples also from deposits dated to the Archaic (end 7th-6th cent. BC) and Roman (2nd-4th cent. AD) eras, these periods are not shown in Table II.1.

## 1. Thera

### 1.1. Geology, Topography, and the Minoan volcanic eruption

Santorini is the collective name given to a complex of islands which belongs to the Cycladic Archipelago and it is part of the volcanic arc of the Aegean (McCoy and Heiken, 2000). The islands comprising this formation are Thera, Therasia, Aspronisi, with Palaia and Nea Kammeni. Of these islands Thera is the largest one (Fig. II.1)(Friedrich, 2000; Palyvou, 2005). The landscape of Santorini, as known today, is the result of a volcanic eruption that took place during the mature Late Minoan IA/Late Cycladic I (LM IA/LC I) period: this buried under tephra and volcanic material the prehistoric settlement of Akrotiri (Friedrich, 2000; McCoy and Heiken, 2000; Nikolakopoulou, 2002; Palyvou, 2005) and other sites earlier or

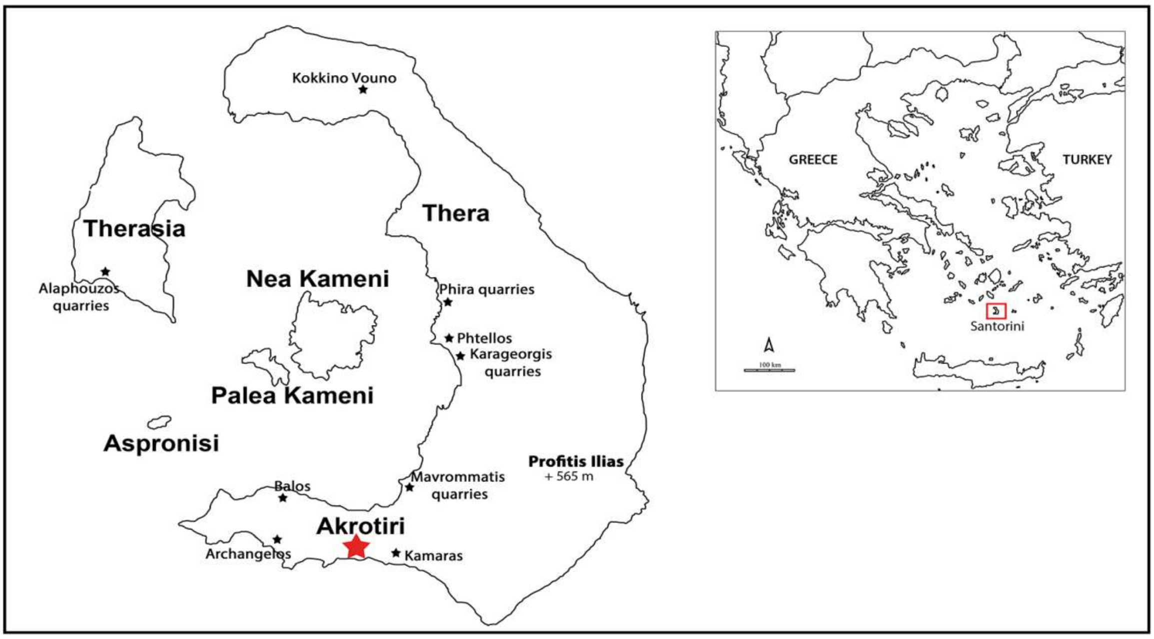



**Figure II.1**: Map of Santorini.

contemporary with it such as Phtellos (MC, LC) (Doumas, 1973; Marthari, 1982), Kamaras (LC) (Nikolakopoulou, 2002), Balos (LC or earlier)(Nikolakopoulou, 2002; Sperling, 1973), Kokkino Vouno (LC), Alaphouzos quarries (LC), Phira quarries (EC) (Sperling, 1973), Karageorghis quarries (MC) (Marthari, 1982), Archangelos, and Mavrommatis quarries (LC I) (Doumas, 1983a).

Several geological studies have been undertaken to determine the pre-eruption form of the island as well as the exact chronology of the eruption. The majority of the scientists argue that the island was ring-shaped with a flooded caldera in the middle which contained the so called pre-Kammeni island (Druitt and Francaviglia, 1990; Eriksen et al., 1990; Friedrich, 2000; McCoy, 2009), although the exact shape and size of the island is still under discussion (Friedrich, 2000; Friedrich and Heinemeier, 2009). Geologically, Thera is formed on Mesozoic metamorphic rocks and Pliocene submarine pillow lavas. Traces of twelve major eruptions, as well as a few more of a smaller magnitude, which occurred during the Pliocene can be detected on the island (McCoy and Heiken, 2000, p. 47). During the Holocene, beside the major eruption that took place during the Bronze Age, twelve more took place from 197 BC to 1950 AD (Friedrich, 2000). Concerning the pre-eruption landscape, Friedrich (2000) suggests that the island was composed of numerous hilltops of modest size and elevation. However, any better appreciation remains problematic, as the pumice has covered over the valleys and low hills likely existed and left a relatively flat and featureless ground surface. Exceptions comprise Mt. Profitis Ilias, Mt. Mesa Vouno, Mt. Megalo Vouno, and Mt. Mikros Profitis Ilias which pre-existed the eruption (Forsyth, 1997). Mt. Profitis Ilias is today the highest hill of the island reaching the 565 m a.s.l. with Mt. Gavrilos it comprises the non volcanic core of the island (Friedrich, 2000; Palyvou, 2005; Vougiouklakis, 2001).

The Late Bronze Age eruption, which ranks on the Volcanic Explosivity Index volume >7 (McCoy, 2009), happened in four major phases ($Bo_1$ to $Bo_4$) with a precursor minor phase ($Bo_0$)(McCoy and Heiken, 2000). During the precursor phase ($Bo_0$) ash, pumice and lithic fragments were deposited on the island, while seismic activity occurred. The absence of any erosion of this layer suggests that the time lapse between the precursor and the next phase was short, probably separated by a few months. The earthquakes happening during this phase caused the destruction of walls at the site; archaeological evidence suggests that the inhabitants made an effort to demolish any building destroyed beyond hope and to rebuilt less damaged constructions (Doumas, 1983a).

The first major phase ($Bo_1$), known also as Plinian pumice fall, deposited at least 7 m of tephra all over Thera, Therasia, and Aspronisi, which buried the LB landscape within hours. According to McClelland and Thomas (1990), the temperature of the volcanic material accumulating on the ground during $Bo_1$ had temperatures between 150°C and 350°C, with the temperature of the majority of the samples tested ranging between 250-300°C. Tema et al. (2013), suggest that the temperature of the Plinian deposit was slightly lower - between 180°C to 240°C. At the site of Akrotiri, the pumice, partially filled the rooms by entering through the doors and the windows, while open spaces caused by the destruction of walls and roofs due to the earthquakes were filled later in the eruption with black lithic-rich sands and ash from lahars (slurry of pyroclastic material, rocky debris, and water)(McCoy and Heiken, 2000). Finally, those buildings still standing from the first eruption were destroyed by the second major eruption ($Bo_2$), whose phreatomagmatic pyroclastic flow and surges reached temperatures of ≈100°C to 300°C (McCoy, 2009; McCoy and Heiken, 2000). During this second phase of the eruption, wide coastal plains were formed by the deposition of debris, especially on the eastern side of the island (Friedrich, 2000; McCoy, 2009; McCoy and Heiken, 2000).

The third eruption phase ($Bo_3$) left a mixture of pumice, ash and large lithic blocks (McCoy and Heiken, 2000; Tema et al., 2013). These accumulations reached over central and southern Thera a depth of 55 m, while their temperature during this process got up to 400°C (McClelland and Thomas, 1990; McCoy and Heiken, 2000). Finally, during the fourth phase of the eruption ($Bo_4$) ignimbrites, lithic-rich base surges, lahars, and debris flows were deposited (McCoy and Heiken, 2000). The depositional temperature of the lithics of this phase rose above 500°C (McClelland and Thomas, 1990). During this last phase, a reordering of pyroclastic material occurred. The lithic-rich mudflows and debris flows in some cases wore away the previous deposits of the Minoan eruption sequence, even reaching the pre-eruption surface of the archaeological site and eroding building walls (McCoy and Heiken, 2000).

The date of the eruption has become a conflict between researchers, with those relaying on archaeological evidence retaining a "low" date around 1550-1500 BC (Doumas, 1983a; Marinatos, 1971; Warren, 1984), whilst others basing their arguments on scientific data propose a "higher" dating at the end of the 17th century BC (Kuniholm, 1990; Manning, 2014; McCoy and Heiken, 2000). The studies the latter group refer to are radiocarbon dating of charred material coming from the excavation of Akrotiri (Friedrich et al., 1990; Housley et al., 1990; Hubberten et al., 1990; Nelson et al., 1990), tree-ring chronology (Baillie, 1990; Pyle, 1990), and acidity peak in the ice-cores of Greenland. The most recent study comes from Friedrich and Heinemeier (2009, p. 59), who dated by radiocarbon analysis two branches of an olive tree found buried alive in the pumice of Minoan eruption at 1,613±13BC.

### 1.2. Climate and Modern Vegetation

Santorini has a Mediterranean climate, with cool winters and dry summers. The mean annual temperature is 17.1°C and the maximum annual precipitation 357 mm. During the winter, storms and violent winds may occur, while snow might fall on its higher hilltops (Friedrich, 2000).

Today, trees are rare on the island, with *Tamarix* sp. (tamarisk) and *Nerium oleander* (oleander) being the most frequently met. *Ficus carica* (fig tree), *Vitex agnus-castus* (chaste tree), *Eleagnus angustifolia* (oleaster), *Ceratonia siliqua* (carob tree), *Cupressus sempervirens* (Mediterranean cypress), *Pinus pinea* (Stone pine), *Pinus brutia* (Cyprus pine), *Pinus halepensis* (Aleppo pine), and *Pistacia lentiscus* (mastic tree) are found less often. Besides these, can be found introduced taxa like *Eucalyptus* sp. (eucalyptus), *Nicotiana glauca* (tobacco tree) and taxa of the family of Mimoseae. The most common shrubs are *Thymelaea hirsuta*, *Thymus* cf. *capitatus* (thyme) and *Capparis spinosa* (caper), while *Asphodelus* sp., *Pancratium maritimum* (sea daffodil) and *Urginea maritima* (sea squill) are the characteristic taxa of the field layer.

*Vitis vinifera* (grapevine) is the most widespread cultivated species on the island. *Ficus carica*, *Olea europaea* (olive tree), *Capparis spinosa,* and *Solanum lycopersicum* (tomato) are also cultivated but in a lesser extent. *Punica granatum* (pomegranate tree) can be found in gardens (Mavromati, 2017).


**Figure II.2**: Plan of the archaeological site of Akrotiri, Thera. The areas from where wood charcoal macroremains were studied are marked with yellow. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

### 1.3. Archaeological background of the site of Akrotiri

The archaeological site of Akrotiri (Fig. II.2) is located on Thera, the largest of the group of islands making up Santorini. The excavation is situated at the southwest of the island at about 230 m away from its south coast and 800 m to the northwest of the modern village of Akrotiri. The site was occupied uninterruptedly from the EC II period until the LC I eruption of the volcano (Table II.1)(Doumas, 1983a; Knappett and Nikolakopoulou, 2008), although slight evidence of human presence on the site, such as pot sherds and stone tools, are attested from the Late Neolithic I period onwards (Sotirakopoulou, 2008a). Until now, approximately 10,000 $m^2$ have been excavated. However the total size of the settlement remains unknown, as buildings have been revealed all around the periphery of the excavation (Palyvou, 2005). The best documented archaeological phase of the site is the one dated to the LC I period as this is the uppermost phase of the settlement. Excavation on this last phase started in 1967 under its first excavator, Spyridon Marinatos. Information on the previous archaeological periods is drawn mainly from the excavation of shafts to take the foundation of the pillars of the new shelter, which took place from 1999 to 2002, under the directions of Christos Doumas.

Briefly, the EB period of the site is characterized by the presence of 27 rock-cut chambers, each consisting of up to three separate spaces (Doumas, 2008; Sotirakopoulou, 2008a). Although in most cases the complete investigation of their interiors was not possible, it can be deduced that the chambers where filled with debris made of earth, stones as well as sherds, animal bones, and fragments of stone vases. The backfilling of the chambers did not happen simultaneously and their content cannot be characterized as homogeneous. The pottery recovered within the debris is dated mostly to the EC II and EC II-III period, though sometimes the fill was contaminated and yielded pottery from more than one archaeological period (Sotirakopoulou, 2008a). The original use of these chambers is not known. According to Doumas (2008), they were part of the EC cemetery of the city, which was demolished during the MC period in order for the city to be expanded further to the north. In contrast, Sotirakopoulou (2008a) suggests that the chambers of Akrotiri was of a domestic use, as their fill consisted mainly of coarse domestic wares.

The excavation of the shafts for the pillars of the new shelter brought to light stratified MC layers. The plan and extent of the MC settlement are not properly known. The site was the biggest on Thera, running down close to the shore, as it was most probably a harbour-site (Nikolakopoulou et al., 2008). As for the plan of the settlement it is at least now clear that it was different from that of the later LC period: many open spaces in the later have demolished MC buildings bellow them (Kariotis, 2003; Nikolakopoulou et al., 2008). The buildings of this earlier period had two-storeys, with probably the ground floor given over to storage, while the presence of street network and a sewage-disposal system indicates urban planning for the settlement (Knappett and Nikolakopoulou, 2008; Nikolakopoulou et al., 2008). The prosperity of the site during this period is reflected by the rapid reconstruction of the buildings after the destruction which took place at the transition from the MC period to the LC (Doumas, 1983a), as well as by the presence of introduced pottery demonstrating the contact of the inhabitants of Akrotiri with Crete and mainland Greece (Doumas, 1983a; Knappett and Nikolakopoulou, 2008; Nikolakopoulou et al., 2008).

Regarding the destruction just mentioned above, this happened due to a severe earthquake. As a result the upper parts of the houses collapsed, if not the entire structure. The inhabitants, to deal with the problem of the resultant rubble, spread the debris across the open spaces and even pulled down some rooms. Thus, the level of the settlement was raised, and the town plan underwent changes (Doumas, 1983a; Marthari, 1984; Palyvou, 2005, 1999; Panagiotakopulu, 2000).

The uppermost phase of the settlement of Akrotiri is naturally the best excavated and studied so far. During the LC I period, Akrotiri kept its urban character as it is indicated by the presence of both structures of public/special use and private buildings as well as by the presence of a network of streets, open spaces, and sewage-disposal system (Doumas, 1983a; Palyvou, 2005) (Fig. II.2). Buildings with some special use have been characterized as Xeste buildings, from which only Xeste 3 is excavated. This characterization is based on their ashlar facades, and the presence of an altar at the eastern part of Xeste 3 (Doumas, 1983a; Palyvou, 2005). Buildings of private use include the West House, the House of the Ladies, and the building blocks Alpha, Beta, Gamma, and Delta. Inside these two-storey houses, working and storage areas were excavated. Cooking installations and food-processing areas were unearthed at their ground floor, while on the upper floor private rooms and sanitary installations were found (Michailidou, 2001; Palyvou, 2005).

Before the eruption of the volcano, which buried the settlement, a short period of time occurred during which earthquakes took place. This latest period is characterized by the efforts of the inhabitants to rehabilitate the buildings of the city and to organize their life again (Doumas, 1983a; Nikolakopoulou, 2003). Among these efforts the inhabitants of Akrotiri dealt with the fallen debris inside and out of the buildings, by closing rooms entirely by filling them with debris or walling off entire areas of buildings by constructing barriers which prohibited access (Nikolakopoulou, 2003). In sorting out the exterior areas, debris were spread across the open spaces or on top of abolished rooms. Further, stones and other structural materials were collected in piles ready to be reused during the reconstruction of the buildings (Nikolakopoulou, 2003; Palyvou, 1999). Beside such raw materials, the inhabitants rescued also tools, furniture, and vessels. Finally, in the open spaces there were created hearths and other facilities which served the needs of the inhabitants during this phase (Nikolakopoulou, 2003).

### 1.4. Architecture of the Buildings at Akrotiri, Thera

The main materials used for the construction of the LC I buildings of Akrotiri were stone, wood, and clay, of which the first two were the main building components. Across the settlement, there may be observed a standardization in the architecture of the buildings, with many similarities in their construction techniques perceivable, as well as their form and design, with minor exceptions (Palyvou, 2005). Thus, the majority of the walls, both exterior and interior were rubble walls, except Xeste buildings whose exterior facades were made of ashlar. However, even in Xeste buildings the inner face of these walls was composed of rubble and covered with plaster. All rubble walls were reinforced with a wooden infrastructure and a thick layer of clay plaster. In general, the ground floors had thicker walls, while at the upper storeys did not exceed 0.45 m in thickness. Beside ashlar and rubble walls in Akrotiri, mudbrick walls were also excavated. These were found exclusively in the interior of the buildings. The bricks are placed upright to form light partitions approximately 0.20 m wide (Palyvou, 2005).

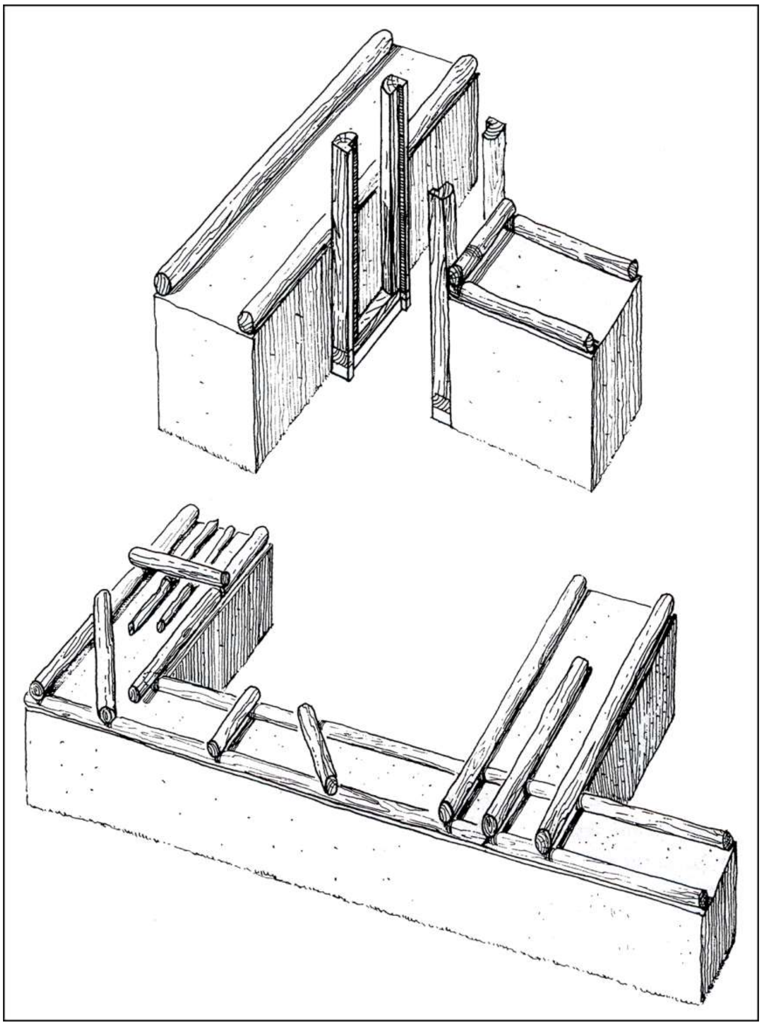


**Figure II.3**: Wooden reinforcement of the rubble walls at Akrotiri, Thera. Palyvou 1999, Fig. 17.

According to Palyvou (2005, 1999), for the construction of the wooden frame reinforcing the rubble walls, branches at their natural form were used (Fig. II.3). Beams were placed horizontally, parallel with the two sides of the wall, and then joined together with others placed transversely. These horizontal grids were embedded at the thickness of the walls at various levels to increase their stability. Special care was taken first at the meeting point of walls, where extra beams were added to the grid, and again at the meeting point of the wall with the wooden frame of an opening (door, window, etc.), where timbers overlapped each other or they were cut to fit each other. Finally, at the building's corners, the ashlar stones are usually reinforced with timbers placed between every second or third stone course (Palyvou, 2005). In addition to the horizontal grid, in some cases (like the south wall of Xeste 3) pairs of beams were placed vertically in the wall. These beams were also bonded with transverse-placed timbers at their lower and upper parts. The addition of a wooden frame at the buildings of Akrotiri is believed to have worked as a method to inhibit their collapse during the frequent earthquakes, by adding elasticity to the walls (Palyvou, 2005).

The floors of the ground levels of the buildings were usually made of beaten soil mixed with gravel and pebbles. The thickness of these floors was approximately 0.10 m and they were usually paved with slab stones alongside the walls. Exceptions to the rule involved the flooring of the entrance halls of the buildings, which were completely covered with slabs. In some cases like those of the ground floor of Xeste 3, House of the Ladies, and Sector Beta, slabbed floors are also found in other rooms beside the entrance lobby (Palyvou, 2005). All floors of the upper storeys were constructed in more or less the same way. These upper floors had four layers; the lowest layer was the one bearing the weight of the construction. It consisted of round or rectangular beams of some 0.12 m thick placed at distances of approximately 0.60 m from each other. These beams were placed at right angles to the line of the walls and inserted into them by some 0.30 m. Above this layer, smaller branches were positioned covering the gaps in between the beams. This layer was covered by a thick layer of clay (0.20 m) which was covered with beaten soil, stone slabs, and more rarely lime plaster (Palyvou, 2005, 1999).

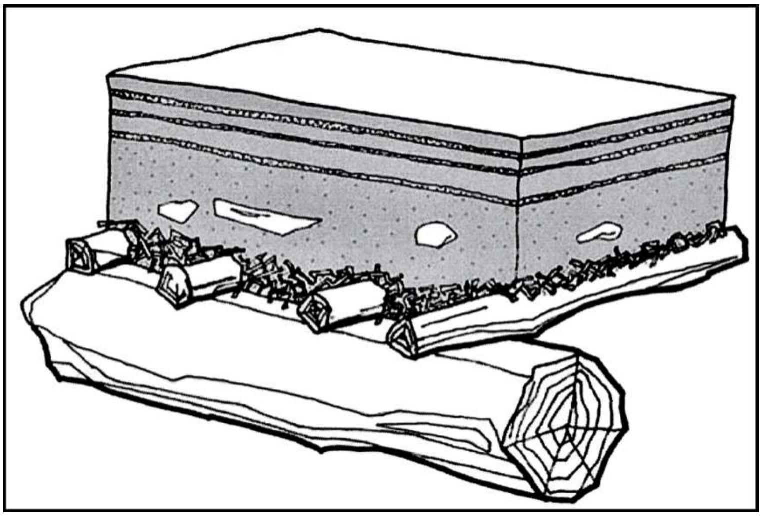


**Figure II.4**: Representation of the construction of a flat roof. McEnroe 2010, Fig. 2.3.

The construction of the flat roofs of the buildings of Akrotiri, which were accessible through staircases (Fig. II.4), was achieved in much the same way. Here, though, the two upper layers were replaced by a thick layer of packed soil, on top of which several thin layers of clay with waterproofing character were set (Lenuzza, 2013; McEnroe, 2010; Palyvou, 2005). The ceilings of the upper floors of the buildings were covered with plaster. In order to keep the plaster in position, the builders of Akrotiri attached a layer of reeds to the underside of the beams of the floor/roof and then added the plaster. In contrast, the ceilings of the ground floors were usually left with the layer of branches visible (Palyvou, 2005).

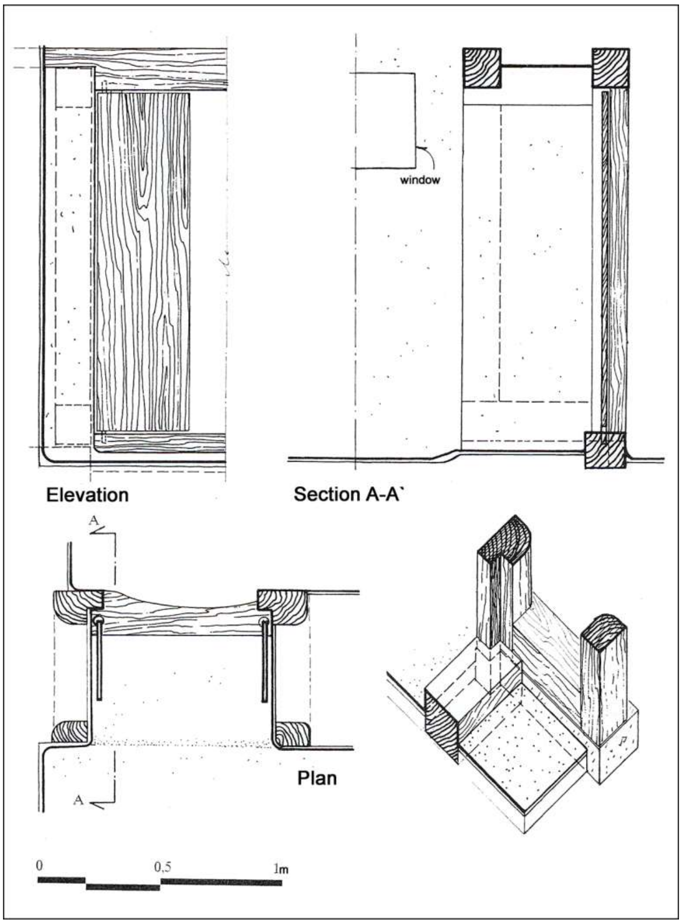



**Figure II.5**: Constructing details of a door at Xeste 3, Akrotiri. Palyvou 1999, Fig. 176.

The openings for the buildings, doors, and windows were constructed in more or less the same way (Fig. II.5). The wooden framework of the jambs of the doors was made of two pairs of posts resting on transverse beams, while two more transverse beams were placed on top of them to hold them all together. The lintel was formed with two or more horizontal beams. The whole structure was held secure in the wall, as it was attached to the wooden grid. The only difference between interior and exterior doors was that interior doors had smaller dimensions (Palyvou, 2005, 1999). Finally, both interior and exterior doors had most probably two leaves (Palyvou, 2005). Windows followed the same constructional method with the difference that the vertical components were placed on top of two horizontal beams (the sill, comparable to the threshold in doors), forming thus a wooden rectangular/parallelepiped frame (for more details on the types of windows of Akrotiri, see Palyvou, 2005, 1999). Finally, a very common element in Akrotiri is the presence of pier-and-door partitions and pier-and-window partitions. The frame of these wooden structures was built in the same way as described above. As Palyvou (2005, p. 144) mentions, for the construction of these features consumed a great amount of wood, while their use as load bearing elements bears witness to the experience and competence of the builders (Fig. II.6).

The architecture of the LC I buildings of Akrotiri has much in common with that of Crete of the same period. Typical is the extensive use of wood in the buildings of the settlement, which is explained  by the propensity of Therans to adopt Cretan prototypes whilst adjusting them to their own needs (Nikolakopoulou, 2009;

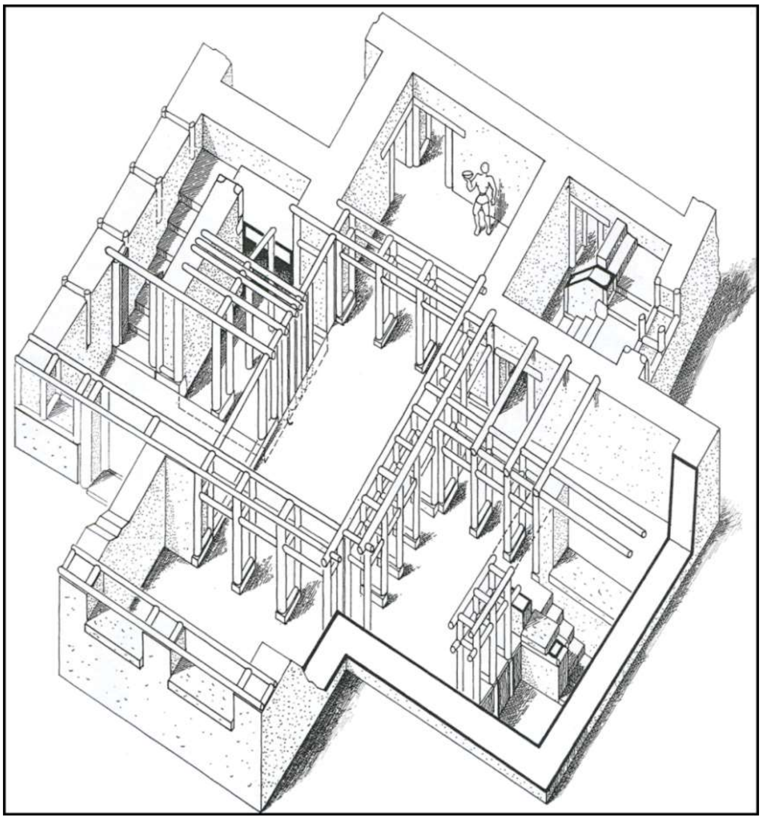


**Figure II.6**: Representation of the ground level of Rooms 1 to 8 at Xeste 3, where the wooden infrastructure of the pier-and-door partitions is shown. Palyvou 1999, Fig. 192.

Palyvou, 2005; Tsakanika-Theohari, 2009). Rubble walls are also a characteristic of Minoan architecture, although in Akrotiri stone is used as the main construction material in all storeys in contrast to the practice in Crete, where the upper floors are usually of mudbricks (Palyvou, 2005). Stone can easily be found in the natural environment of Thera as well as other Cycladic islands, like Kea and Melos where the use of stones as building material was the rule (Palyvou, 1999). Regarding the form of the buildings, in both Crete and Thera is observed the ample use of openings, i.e. windows, pier-and-window partitions as well as pier-and-door partitions (Palyvou, 1999).

### 1.5. Archaeological and stratigraphic background of the units under study

In this study, wood charcoal macroremains from the pillar shafts 18, 35, 66Π, and 67 of the new shelter of the archaeological site of Akrotiri were analysed. Additionally, samples from the area of the Square of the Cenotaph, as well as from Xeste 3, and the House of the Ladies were studied. All information mentioned below in regard to the new pillar shafts was extracted from the unpublished archaeological reports and the excavation diaries, unless stated otherwise. Information on the rest is coming from the excavation diaries and relevant publications.

| | PILLAR 18 | | PILLAR 35 | | | PILLAR 66Π | | | PILLAR 67 | | | SQUARE OF THE CENOTAPH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Layer | Description | Layer | Description | | Layer | Description | | Layer | Description | | Context | Description |
| | | Fills/Dumps | | Fills/Dumps | Closed contexts | | Fills/Dumps | Closed contexts | | Fills/Dumps | Closed contexts | | Fills/Dumps |
| LCI | | | 3 to 4 | Second Deck of the Square of the Sacral Horns | | 8 | | Window of the 2nd storey - LCI building | 6 to 11 | | Destruction level of Room 1 | Drainage channel at Daimonon Str. | Dump |
| | | | 5 to7 | First Deck of the Square of the Sacral Horns | | 11 | | Floor 2 - 2nd storey | | | | Deck of the Square of the Cenotaph | Sub-layers of the Deck |
| | | | | | | 15 | | Destruction layer/lower part of Floor 2 | | | | | |
| late MC/ early LC I | 1 | Dump | 9 | | Floor of Room 1 | | | | 12 | | Destruction layer of the interior of Room 2 | Trial trenches east of old Pillar 17 | Accumulation of debris and household refuse formed by earthquake |
| | | | 10 to 12 | Sub-layers of floor of Room 1 | | | | | 13 to 14 | | Later Floor of Room 2 | | |
| late MC | | | 14 | | Floor 4 (Room 3) | | | | 15 | | Earlier Floor of Room 2 | | |
| MC | | | | | | 18 to 21 | Fill of the MC Room - 1rst phase | | | | | | |
| | | | | | | 21 | Levelling of the natural rock | Floor of the MC Room (Floor 3) | | | | | |
| | | | | | | 22 | Levelling of the natural rock/fill of the "entrance" of the Chamber - 2nd Phase | | | | | | |
| | | | | | | 23 to 24 | Fill of the "entrance" of the Chamber - 1rst Phase | | | | | | |
| early MC | | | 15 to 20 | Levelling of the natural rock/sub-layers of Floor 4 (Room 3) | | | | | 16 | Fill of the Chamber - levelling of the natural rock | | | |
| ECIII/ early MC | | | | | | 25 to 26 | Fill of the Chamber - 2nd Phase | | | | | | |
| ECIII | | | 24 to 35 | Fill of the West Chamber | | | | | | | | | |
| ECII/ECIII | | | 21 to23 | Fill of the East Chamber | | 28 to 32 | Fill of the Chamber - 1rst Phase | | | | | | |
| ECI/ECII | 2 | Fill of the Chamber | | | | | | | | | | | |

**Table II.2**: Summary of the stratigraphy of the Pillars under study and the Square of the Cenotaph, by archaeological period and by context.

### 1.5.1. Pillar Shaft 18

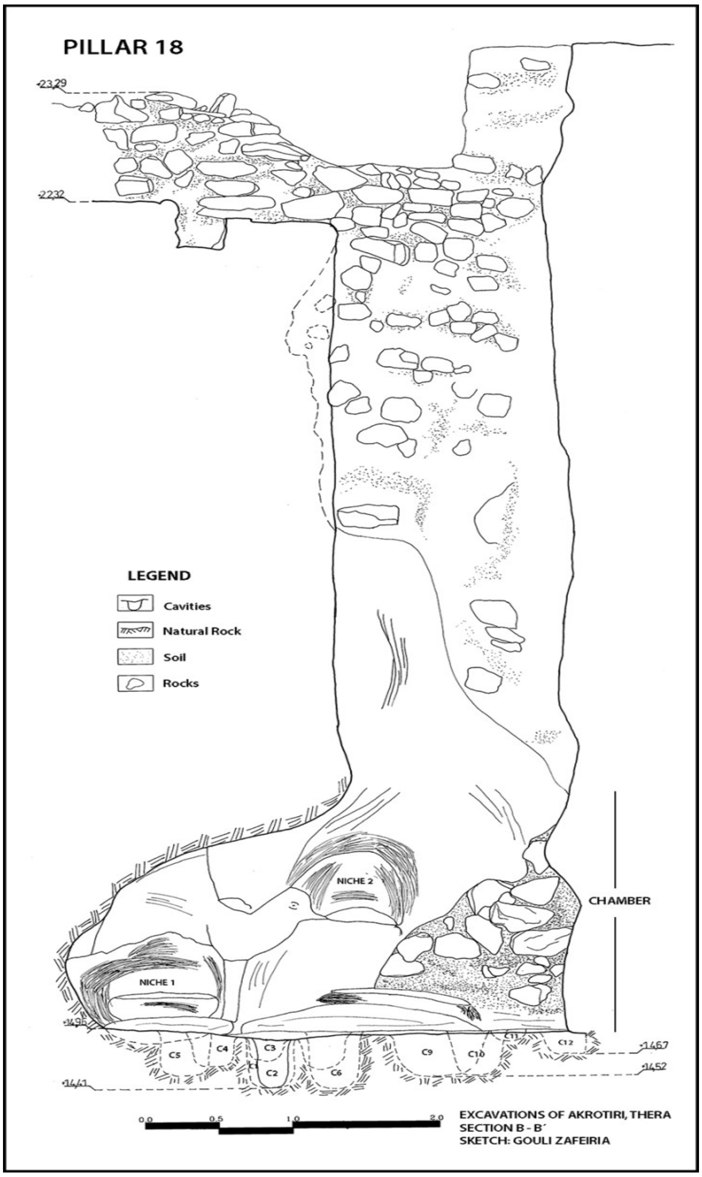



**Figure II.7**: Cross-section of Pillar 18. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

Pillar Shaft 18 (Fig. II.7, Table II.2) is situated south of the Square of the Cenotaph and north of room D17A (Fig. II.2). At the modern ground surface, the diameter of the pit is 1.30 m (E-W), while on the surface of the pyroclastic rock at the base, the dimensions of the pit are on the east-west axis 3.55 m, and on the north-south axis 2.27 m. The depth of the pit is approximately 7 metres.

At 17.25 m a.s.l., and cut into the pyroclastic rock base of the shaft was discovered a large chamber with three niches. On its eastern side, two walls existed which marked the entrance to the chamber. Additionally, eleven cavities were excavated scattered over the floor. The chamber was filled with soil and EC (EC I/EC II) pot sherds, stones, and stone tools (layer 2). Finally, in the deposit of cavity 7 was unearthed a vessel dated to the EC period containing bones, most probably of an infant. As the use of the chamber ended during EC period and filled with general debris, it is not sure if the chamber had been used as a grave.

Above the chamber, the deposit of the pit is composed of a single fill (layer 1) made of hard dark brown soil mixed with large stones and parts of broken pyroclastic rocks. The contexts whence the wood charcoal samples were recovered within this deposit contained vessels and pot sherds dated to the late MC period. These are related, according to the excavator Fragula Georma, to the destruction which took place during the late MC/early LC I period. Additionally, at the north face of the shaft a wall was excavated, which had been constructed to retain the deposits of the Square of the Cenotaph. In this wall was a spout, which drained the water of the Square.

### 1.5.2. Pillar Shaft 35

Pillar shaft 35 (Fig. II.8 & Fig. II.9, Table II.2) is situated at the Square of the Sacral Horns, north of Xeste 2 and west of building ID (Fig. II.2). The dimensions of the sides of the shaft were 3.60 m x 4.90 m x 2.00 m x 2.72 m.

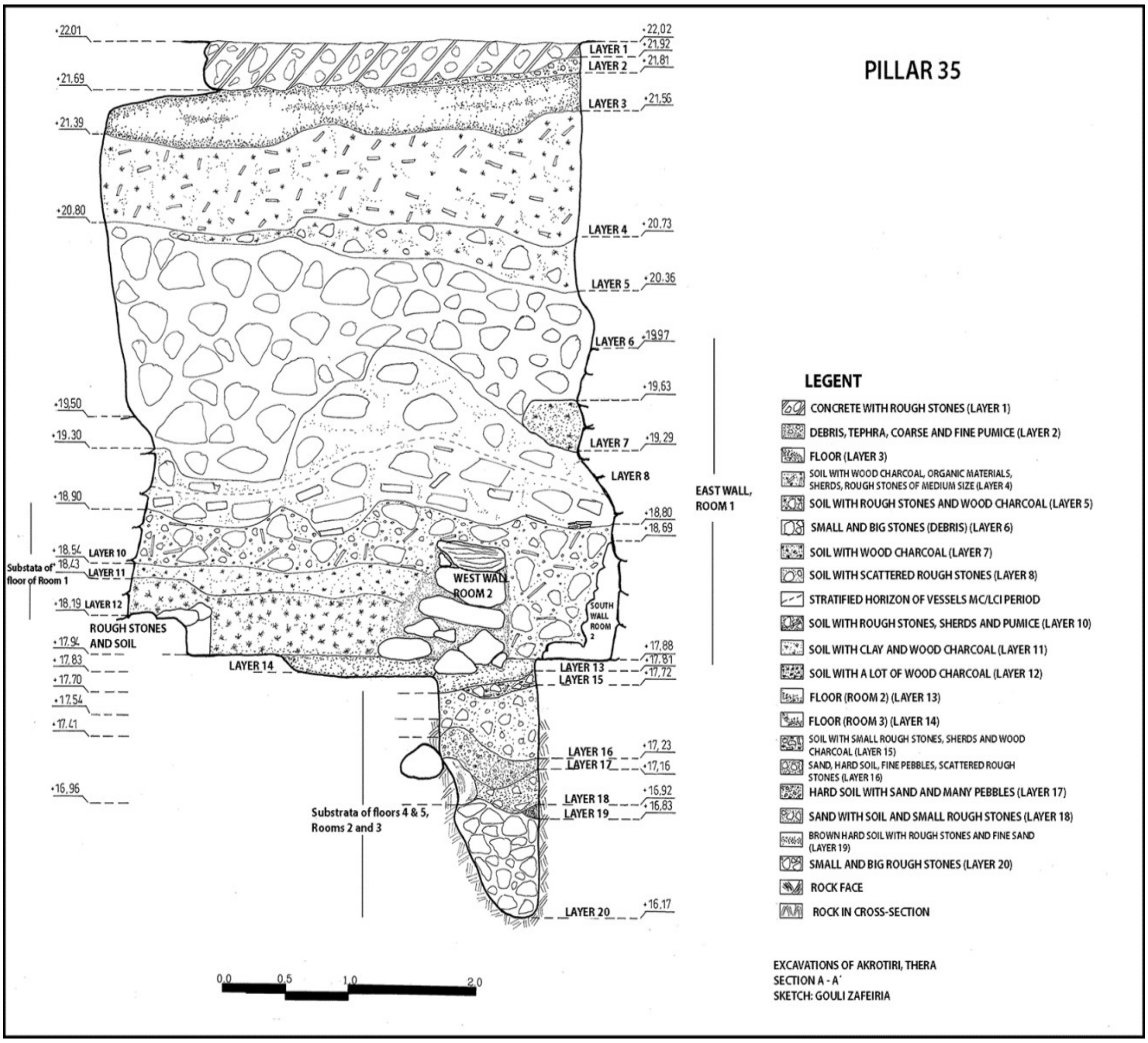



**Figure II.8**: Cross-section of Pillar 35 – Section A-A'.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

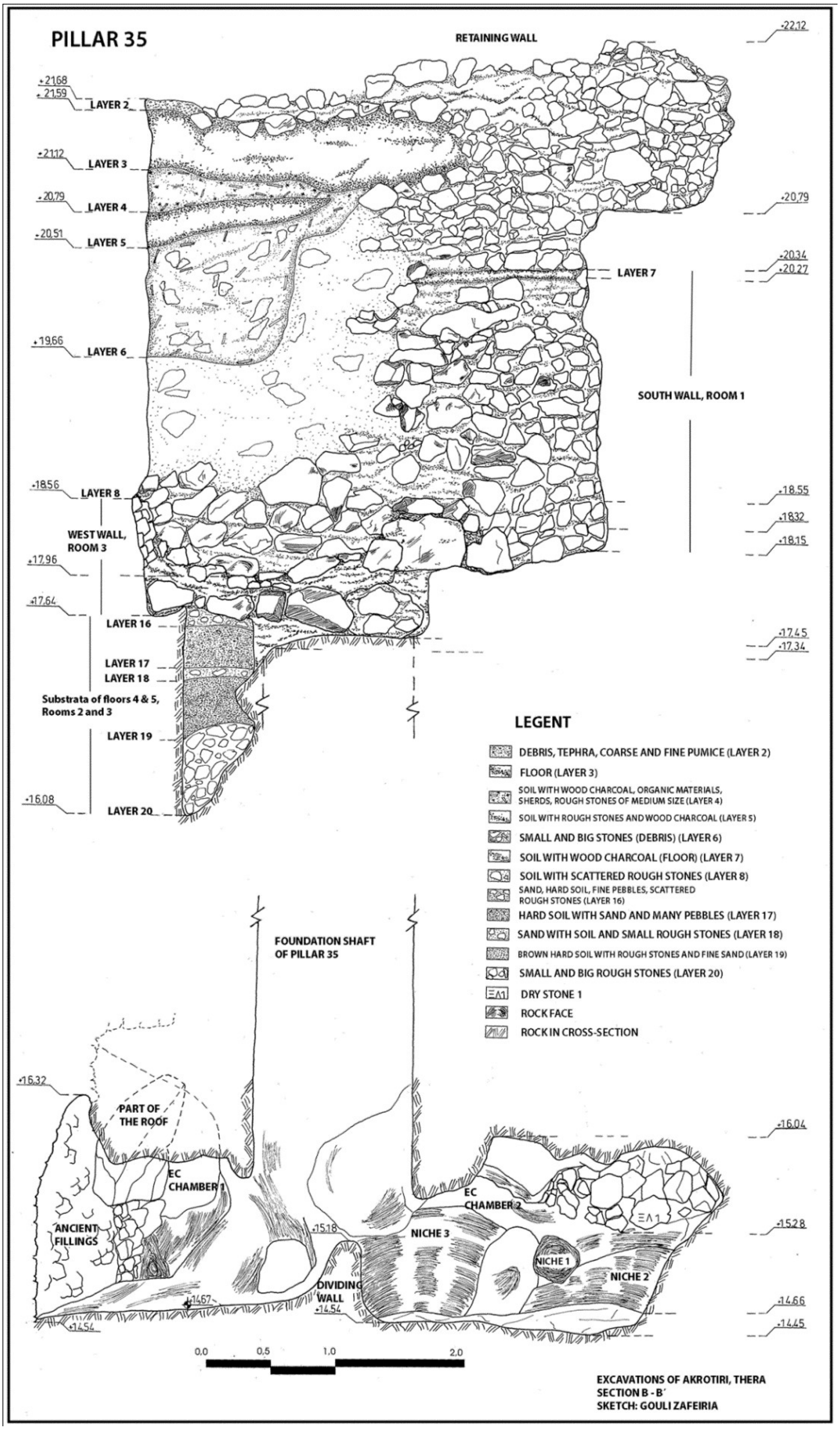



**Figure II.9**: Cross-section of Pillar 35 – Section B-B'.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

In the interior of the shaft were excavated 35 archaeological layers, in six distinct structural phases, which are dated from the EC II/IIIa period to the LC I period (Kariotis, 2003). More specifically, to the EC period are dated two distinct chambers (first structural phase) dug into the natural rock. Chamber 1 (east-layers 21 to 23) was dated, based on pottery found in the debris filling it, to the EC II-IIIA period while Chamber 2 (west-layers 24 to 35) to EC III. The deposit excavated within these chambers comprises debris, which consisted mainly of stones and parts of stone tools, broken animal bones and potsherds (Kariotis, 2003). The second, third, and fourth structural phases correspond to three superimposed rooms dated to the MC period, of which Room 1 is the latest and Room 3 the earliest. Before the foundation of Room 3, the natural rock was levelled by five thin sediment layers (layers 15 to 20) composed of sand and small stones. Room 2 was set within the walls of Room 3, with its walls and floor (layer 13) placed on of the floor (layer 14) of the earlier room (Kariotis, 2003). Finally, Room 1 was constructed after the earlier rooms were filled with debris (layers 10 to 12), containing mainly of stones of different sizes, potsherds, and wood charcoal.

The upper layers, dated to the LC I period, correspond to the two phases of the flooring of the Square of the Sacral Horns. The first deck (fifth structural phase-layers 5 to 7) was constructed on top of the MC Room 1, which had been destroyed by the earthquake that took place during early LC I period (layers 8 and 9) (Kariotis, 2003). The surface was made of compact soil, while its sublayers consisted of debris containing stones, animal bones, shells, mortars, and potsherds. The second flooring (layers 3 and 4) of the Square of the Sacral Horns comprises the sixth structural phase: its composition is similar to that of the previous deck (Kariotis, 2003).

### 1.5.3. Pillar Shaft 66Π

The shaft of Pillar 66Π (Fig.II.10, Table II.2) is located 5 m north of the northeast corner of Xeste 2 (Fig. II.2). The pit's dimension on the east-west axis is 3 m and on its north-south axis it is 2.50 m.

In this shaft, two superimposed buildings and a chamber dug in the natural rock have been excavated. The chamber must have been in use during the EC period. The greater part of it (layers 28 to 32) was filled with debris during EC II/III period. This deposit was of a silty-clay, light brown in colour mixed with pebbles, a few bits

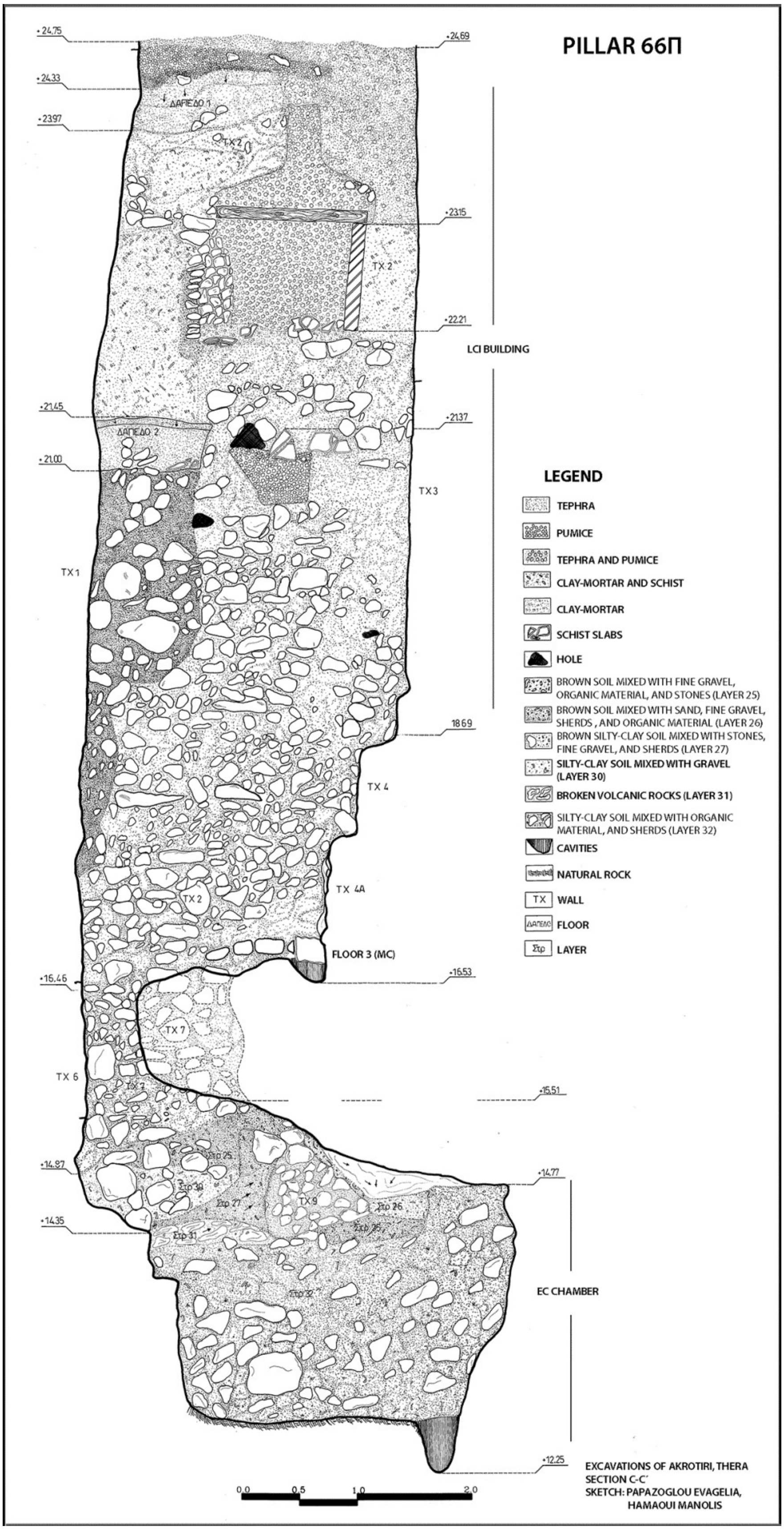



**Figure II.10**: Cross-section of Pillar 66Π.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

of charcoal, and animal bones, as well as potsherds characteristic of this period (EC II/IIIa). The rest of the chamber (layers 25 to 26) was filled during late EC III period or early MC period. These fills comprised of soft dark brown soil mixed with pebbles and stones of various sizes, alongside animal bones, stone tools, and charcoal fragments, as well as potsherds dated to the EC III/early MC period. From the upper part of the roof of the chamber cut into the pyroclastic rock, a vertical opening leading to the interior of the chamber was excavated. It is not sure if that was the main entrance to the chamber during the period of its use or if this opening was cut later in. The vertical entrance was filled with debris in two phases. These deposits were made up of soft brown soil, small and medium-sized stones, some stone tools, and many potsherds. The lower strata (layers 24 and 23) are dated to the MC period, while the upper (layer 22) goes with the mature MC period. Additionally, there were recovered a ditch, other cavities and three walls of small dimensions dated to late EC III/early MC.

The filling of the upper part of the vertical entrance of the chamber and the flattening of the upper surface of the pyroclastic rock were undertaken to build the ground level and floor (Floor 3 – layer 21) of the building located right above the chamber. Floor 3 was made of beaten dark brown soil, containing many charcoal fragments. This earlier room was also filled with debris in two phases, of which the first one (layers 18 to 20) is dated to mature MC period and the second (layer 17) to the mature or final MC period. The deposit of the first backfill is composed of brown soil mixed with pebbles, stones, animal bones, shells, charcoal fragments, and potsherds, while the second phase of the fill is characterized by small stones, potsherds, pebbles, and many stone tools mixed into the dark brown to red-brown soil.

Set over the walls of the earlier room, were excavated rooms of a building which had two main storeys and a third smaller storey (layers 16 to 1). This building was constructed during early LC I period; it was still in use at the final destruction of the settlement by the volcanic eruption. Within the rooms of this building were unearthed a window (layer 8) and the floor (layer 11) of the second storey (Floor 2). This floor had a wooden framework on top of which were placed slabs covered with beaten soil.

### 1.5.4 Pillar Shaft 67

The shaft of Pillar 67 (Fig. II.11, Table II.2) is situated east of Xeste 5 and south of NPS 68 (Fig. II.2). Its final, slightly irregular, dimensions are 6.20 m (North) x 4.00m (East) x 6.60 m (South) x 2.60 m (West).

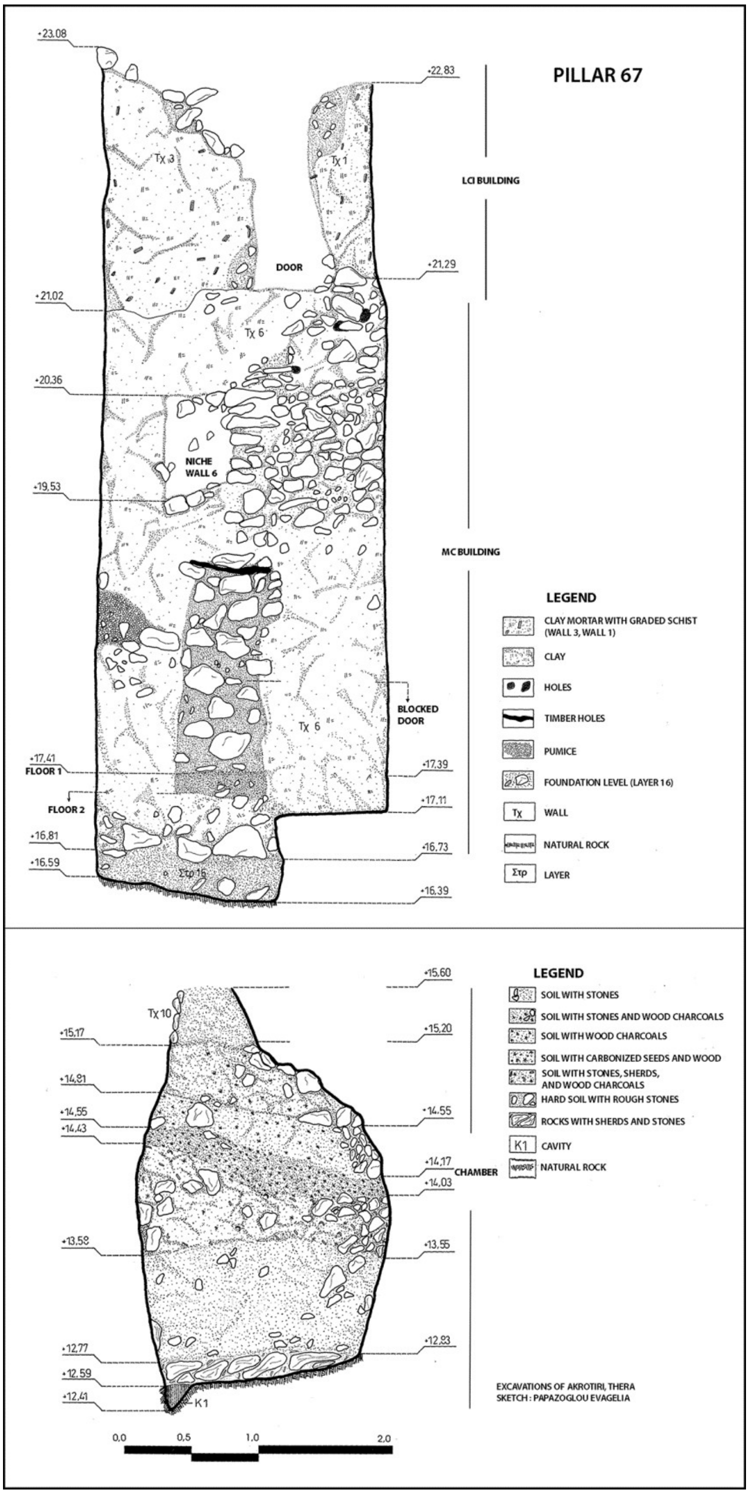



**Figure II.11**: Cross-section of Pillar 67.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

At the bottom of this pit were unearthed a chamber dug into the natural rock and two rooms of superimposed buildings. The use of the chamber ceased probably during the EC III period and it was backfilled with debris during early MC period, as is evident from the pottery excavated within its deposit (layer 16) (Tsoulakou, forthcoming). The natural rock was levelled with the same deposit as the one filled the chamber (layer 16). This deposit consisted of black-brown soil mixed with potsherd and stones. Later, during the late MC period Room 2 was founded on top of this layer. This room was the lower of the two excavated in this pit.

In Room 2 were two floors, of which the earlier (layer 15) is dated to late

MC period, while the later (layers 13 and 14) to late MC/early LC I. The earlier floor consisted by soil while the later floor was made of beaten earth with small charcoal fragments and sherds. According to the excavator, Room 2 was damaged in the earthquake which took place at the end of MC /early LC I period. Its walls were not demolished, but its content (mainly vessels) suffered, so producing layer 12. The room was not filled with debris by the inhabitants, but simply abandoned and the only entrance was walled up. During the next period this room would have been a basement or semi-basement as the level of the roads outside had risen from the arrangement of debris. The walls of this earlier room served as the foundation of the walls of the later Room 1, while the later floor was positioned following the methods used for the construction of the wooden floors of the upper storeys. Room 1 based on the pottery excavated in its interior (layers 11 to 6) is to be dated to the LC I period. This room was destroyed by the eruption of the volcano (Tsoulakou, forthcoming).

### 1.5.5 The Square of the Cenotaph

The Square of the Cenotaph is situated north of Sector Delta and west of Xeste 5 (Table II.2, Fig. II.12). From the area of the Square, samples are included from: (1) two trial trenches excavated to the east of Pillar 17 within the deposits of the terrace made up of debris (Square of the Cenotaph), (2) the west part of the Square of the Cenotaph immediately to the north of Sector Delta, and finally (3) from the drainage channel excavated in the narrow alley between the Square of the Cenotaph and Xeste 5.

The terrace of the Square of the Cenotaph was formed by an arrangement of debris derived from the destruction of the settlement by an earthquake during the late MC/early LC I period. This terrace was held up by a retaining wall in a Γ-shape, at least 3.5 m in height: this was situated to the west of Xeste 5, curving towards the northwest (Doumas, 1985; Palyvou, 2005; Sotirakopoulou, 1999). Between Xeste 5 and the retaining wall, a narrow alley existed. A trial trench excavated in this alley brought to light a drainage channel of a width of 0.22-0.30 m and a depth of 0.25-0.37 m. The bottom of the channel was paved with slabs of stone and pebbles, its walls were made of small stones while its top must have been closed with rectangular slabs (Doumas, 1993). Finally, to the north of Room D4 and D5 of Sector

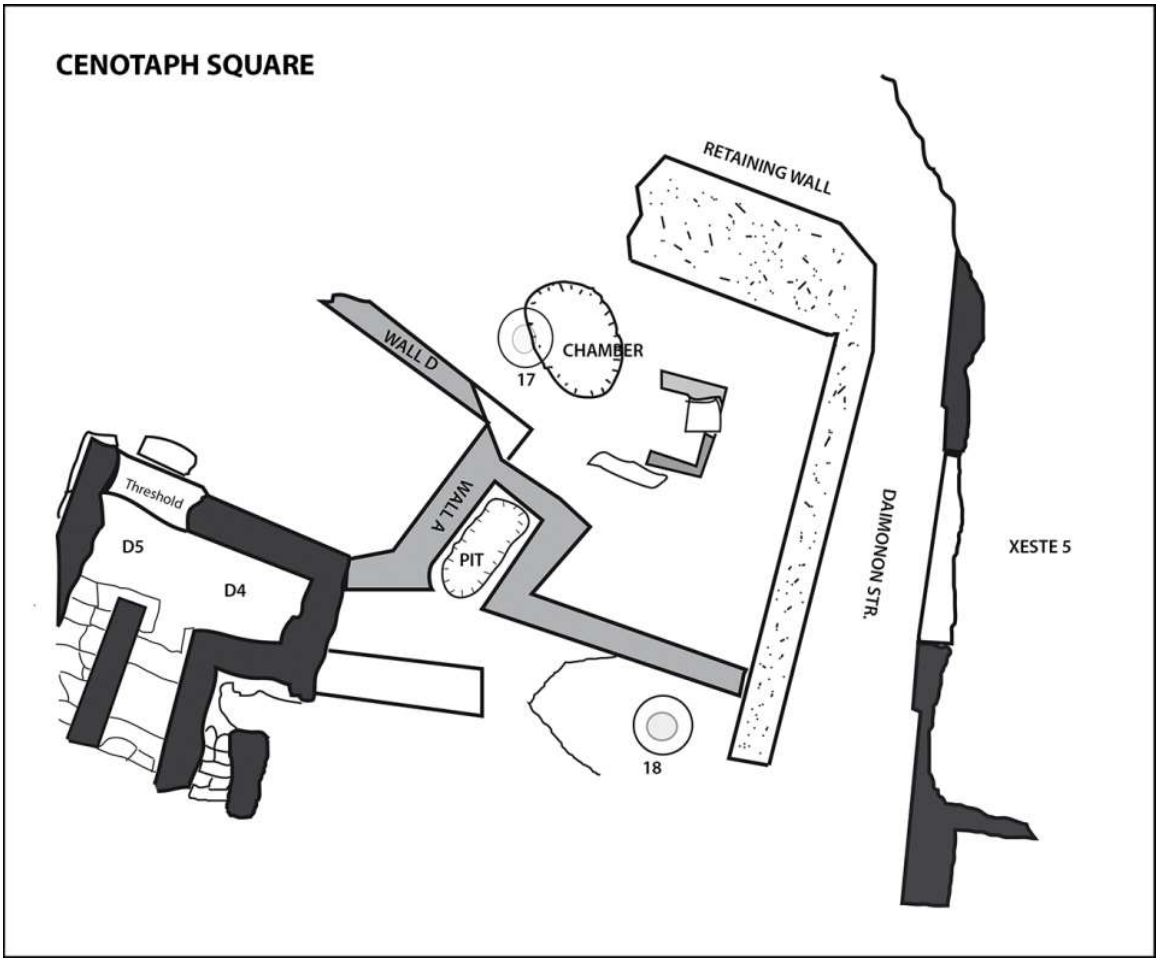



**Figure II.12**: Plan of the Square of the Cenotaph.

Delta, two sub-layers of the flooring (thickness: 0.28 m) of the Square to the north of this Sector have been excavated: both were made of beaten clay and mixed with stones, pebbles, bones, and potsherds dated to the LC I period.

### 1.5.6 Xeste 3

Xeste 3 (Fig. II.13) is a three-floored building, situated to the south-west of Sector Gamma-South and to the north of the House of the Benches (Fig. II.2). The building had fifteen rooms in each of the first two floors, while the upper floor (which has not survived today) must have extended only over the west part of the building. The plan of the second floor replicates that of the ground floor with minor differences (Palyvou, 2005, 1999). The entrance of the building was on the east side, where the main staircase to the first floor was located (Room 5). Another auxiliary staircase leading to the first and second floors existed at the north (Room 8). The two of the three exterior walls excavated today (the north and east ones) are made

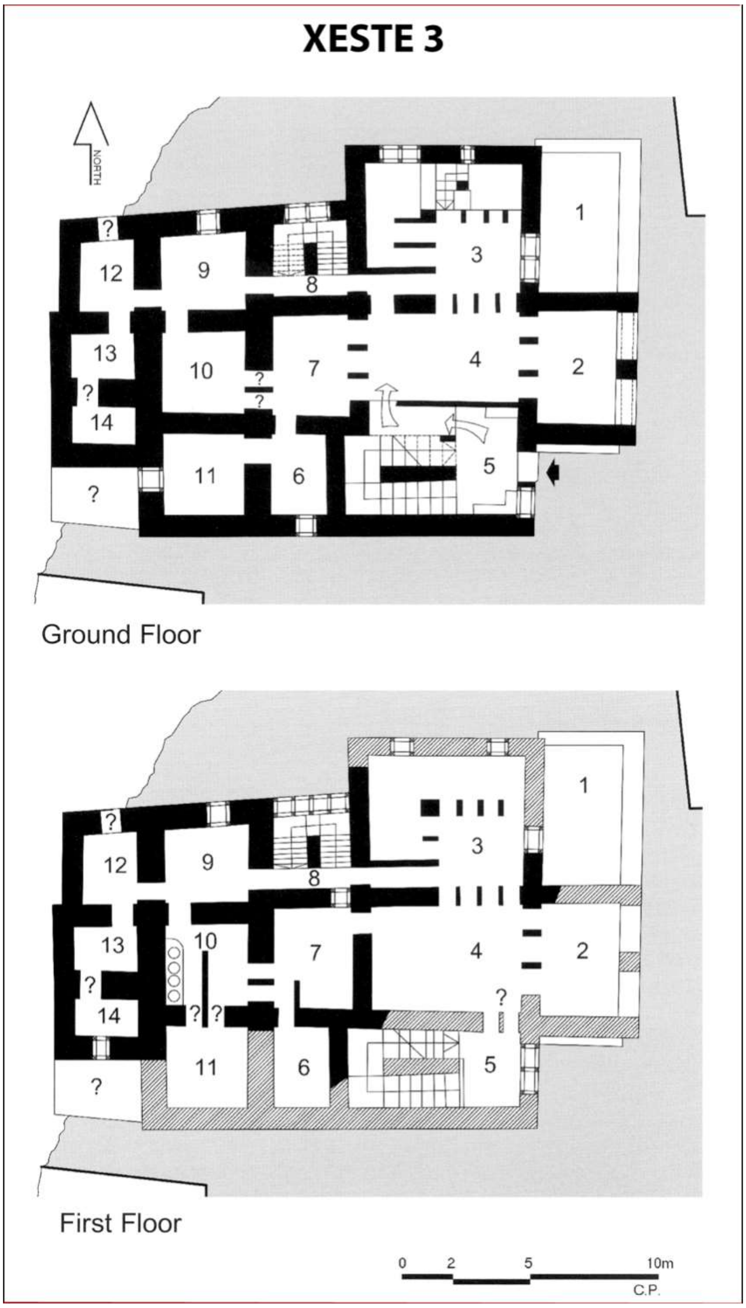



**Figure II.13**: Plan of Xeste 3.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

of ashlars, while the other one (south) is made of hammer-dressed blocks covered with plaster (Palyvou, 2005). In the interior of the building, rubble walls covered with plaster separated the rooms, while pier-and-door partitions (polythera) have been used extensively in all three floors (Palyvou, 2005).

The floors of the ground floor level were made of beaten soil mixed with gravel, pot sherds, bones, charcoal fragments, etc. Exceptions to this are the entrance of the building, as well as those of Room 3 and Room 12, which were paved with slabs. The main construction of the upper floors of Xeste 3 follows the typical flooring-composition seen in Akrotiri (for details see § II.1.4) and they are covered either with slabs or beaten soil (Palyvou, 2005, 1999).

In general, the east part of Xeste 3 was more elaborate in terms of construction and form, while the west part would have been used as a service area (Palyvou, 2005). The building must have been built at the latest during the early MC period (Doumas, 1993, p. 169): it has been characterized as a public building. The excavators reached this conclusion based on the presence of the elaborate ashlar facades, the open spaces surrounding the building on the three excavated sides, the wall paintings covering all rooms of its eastern part, and in particular due to the existence of a lustral basin (adyton) at Room 3 of the ground floor, where rites-of-passage must have taken place (Palyvou, 2005, 1999). According to Palyvou (2005), the arrangement of the ground floor with the presence of a broad entrance lobby with built benches and the high number of pier-and-door partitions which allowed the simultaneous presence of a high number of people in the interior of the building defines its special character.

### 1.5.7 House of the Ladies

House of the Ladies is situated north of the Square of the Cenotaph and west of Daktylon Street (Fig. II.2). The house, which occupies an area of 184 m$^2$, had three storeys (Palyvou, 2005) and it had been founded during the MC period (Fig.

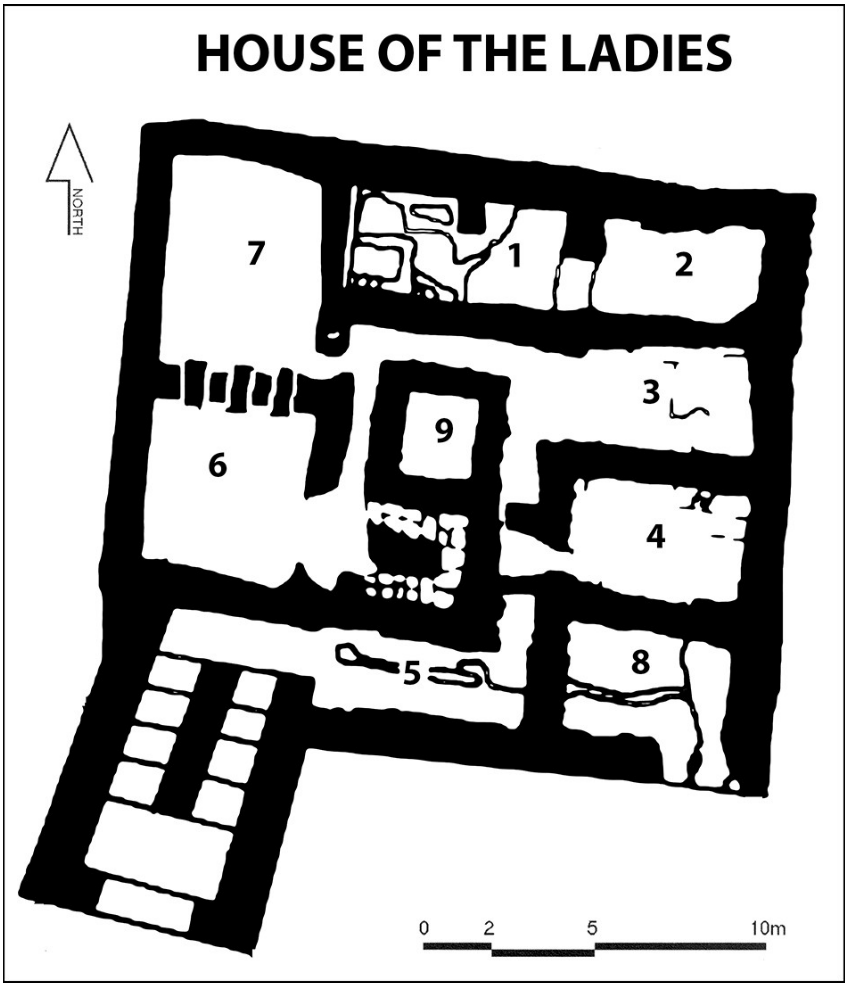



**Figure II.14**: Plan of the first floor of the House of the Ladies.
Courtesy of the Archaeological Society in Athens, Excavations at Thera.

II.14)(Doumas, 1987). The ground floor of the building was a semi-basement during the last occupation phase of the house, as the disposal of the debris from the destruction in the late MC/early LC I period had as its consequence a rise in the levels of the streets and the open spaces. The entrance of the building, where the main staircase occurred, was situated to the south and it must have been added later, after the accommodation of the destruction debris as mentioned above, because it is higher than the interior ground floor level (Palyvou, 2005).

The building had nine rooms in the first floor; on the second floor, Rooms 3 and 2 would not have been roofed (Michailidou, 2001). Room 9 was a light well, whose purpose was to let the light reach the auxiliary staircase situated at the centre of the building (Doumas, 1992a; Palyvou, 2005). Both the exterior and the interior walls of the House of the Ladies were rubble walls reinforced with a wooden framework, although in the interior of the building there existed also mudbrick walls as partitions between rooms on the upper floors (Michailidou, 2001; Palyvou, 1999). The floors of the upper storeys were made in the same technique as those of Xeste 3 and they were covered mostly with slabs (i.e. Room 1, Room 7) or clay mortar. The floors of the ground floor were made of beaten earth (Doumas, 1990, 1987; Michailidou, 2001; Palyvou, 1999).

## 2. Samos

### 2.1 Geology and Topography

The island of Samos is situated in the central-eastern part of the Aegean, just 1.8 km away from the Western Anatolian littoral (Fig. II.15). It has an area of 477 $km^2$ and three mountain masses composed of metamorphic rocks, mainly marbles and schist. These mountains are Mt. Karvounis (1,150 m) at the central part of the island, Mt. Kerkis (1,434 m) at its western part, and a lower mountain named Oros (432 m) towards the east (Christodoulakis and Georgiadis, 1990; Stiros, 1998). The main valleys of the island between the mountain massifs are the basin of Karlovassi to the west and the basin of Kokkari-Mytilinii to the east. The sediments of these basins are characterized by fluvial limestones, marls and breccias (Stiros, 1998). Finally, non-metamorphic rocks exist at the south-western part of the island while at the southern part alluvial formations also are met with (Institute of Geological and Mining Research, 1979; Kouka, 2002; Stiros, 1998).


**Figure II.15**: Map of Samos.

In general, the northwest part of the island is mountainous while the east and south eastern part has a lower altitude and a smoother relief with sandy or sandy-gravel beaches (Stiros, 1998). Several streams, springs, and a few rivers rise in the mountainous area, while the largest river, the Imvrassos, discharges to the southeast, where the site of Heraion is situated. To date, though, due to reduced precipitation rates and increased irrigation, many of the streams and rivers of Samos have dried up (Körner et al., 2005; Kouka, 2002).

### 2.2 Climate and Modern Vegetation

The island of Samos has a typical Mediterranean climate with dry summers and mild winters. The mean precipitation rate is above 900 mm, with the majority of the rainfall occurring between late October and early April. The mean annual temperature is 18.4°C. During winter months the temperature can fall below zero at elevations above 300 m a.s.l., while in summer the temperature can reach 40°C

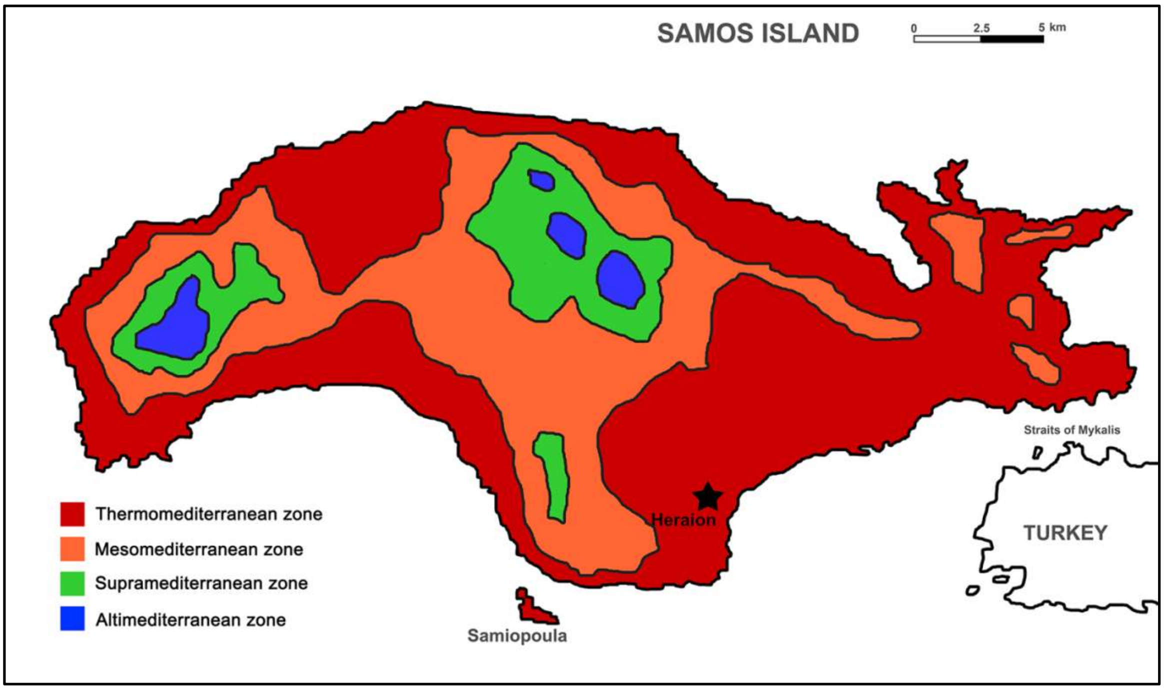



**Figure II.16**: Vegetation zones on the island of Samos.
Map based on Christodoulakis and Georgiadis (1990), Fig. 8.

(Christodoulakis and Georgiadis, 1990; Körner et al., 2005).

The present vegetation of Samos can be divided into four zones (Fig. II.16). The most characteristic taxa of the Thermomediterranean zone, which extends from the coast up to 250 m a.s.l., are *Pistacia lentiscus* (mastic tree) and *Olea europaea* subsp. *oleaster* (wild olive), while other sclerophyllous, evergreen shrubs also occur. These shrubs sometimes are also growing as under-storey vegetation of the *Pinus brutia* (Cyprus pine) forests present on the island. In areas where fire or clearances have occurred, phrygana have developed with members of the family of Cistaceae (rock-rose family) being the most characteristic taxa. The Mesomediterranean zone starts at the upper limits of the previous zone and reaches 600-700 m a.s.l. In this zone, the main taxa are, *Quercus ilex* (holm oak), *Fraxinus ornus* (manna ash), and *Arbutus unedo* (strawberry tree). *Pinus brutia* is also well established (Christodoulakis and Georgiadis, 1990).

The Supramediterranean zone occupies the area between 600-700 and 900-1000 m a.s.l. There deciduous taxa, like *Crataegus* sp. (hawthorn), *Rosa* sp. (rose), *Prunus* sp. (plum family) and *Quercus pubescens* (downy oak), replace the thermophilous evergreen shrubs of the lower zones. Additionally, at Mt. Karvounis from 700 m a.s.l. and above, *Pinus brutia* gives way gradually to *Pinus nigra* subsp.

*pallasiana* (Crimean pine), which finally predominates at 850 m a.s.l. Finally, the vegetation of the Altimediterranean zone is present on the highest tops of Mt. Kerkis and Mt. Karvounis: it is characterized by spiny shrubs like *Astragalus* sp. (milkvetch), *Genista parnassica* (broom), and *Acantholimon androsaceum* (prickly thrift), while shrubs like *Quercus coccifera* (kermes oak), *Phillyrea latifolia* (mock privet), *Lithodora hispidula*, and *Centaurea spinosa* can appear also in this zone (Christodoulakis and Georgiadis, 1990).

On the sides of ravines grow hydrophilous taxa, like *Platanus orientalis* (oriental plane), *Nerium oleander* (oleander), *Vitex agnus-castus* (chaste tree), and *Myrtus communis* (myrtle), as well as herbs like *Ranunculus sp.* and *Mentha sp.* (mint family). The vegetation of the rocky coasts is dominated by *Crithmum maritimum* (sea fennel), *Silenes edoides* (hairy catchfly), and *Limonium* sp. (sea-lavender)(Christodoulakis and Georgiadis, 1990).

On the island, *Olea europaea* (olive) and *Vitis vinifera* (vine) are mostly cultivated, followed in popularity by fruit-bearing taxa like *Citrus limon* (lemon), *Malus* sp. (apple-tree) and *Prunus persica* (peach-tree), and vegetables. *Olea europaea* is mainly cultivated in the Thermomediterranean zone, along with vegetables. *Vitis vinifera* is to be found at the Meso- and Supramediterranean zones where fruit-bearing trees are also being planted (Christodoulakis and Georgiadis, 1990).

### 2.3 Archaeological background of the site of Heraion

The archaeological site of Heraion is situated on the southern coast of Samos, 7 km west of the town of Kastro-Tigani, between two branches of river Imvrassos. The site is mostly known for the temple of goddess Hera, whose cult started during the Mycenaean period (or earlier) and survived until the end of antiquity (Isler, 1973). Excavations in the area of the temple had taken place by the 19th century, with systematic investigations started in 1925 by the German Archaeological Institute (Kouka, 2002). In the course of the excavations which took place near the temple during 1953 and 1955 by Milojčić, from 1958 to 1960 by Walter, and in 1966 by Isler, architectural phases dated to the EB period were unearthed, suggesting the presence of a settlement with an urban character already by that period (Isler, 1973; Kouka, 2002, 2014; Kouka and Menelaou, 2018).

In 1980 and 1981, excavations took place to the north of the Sacred Road, directed by Kyrieleis and Weisshaar. During these excavation periods, and under the Roman and Archaic strata three architectural phases dated to the EB I period (3,200-2,750 BC) were unearthed. The first architectural phase of this early period consisted of a wall with rectangular bastions running east-west. Made of rubble stones, it was part of a fortification wall, and most probably a communal work (Kouka, 2002). The second phase excavated included a rectangular building, whose south wall (1 m thick) had supporting buttresses. It consisted of two rooms oriented north-south. Finally, to the third phase belong a stone ramp built to support the fortification wall towards its north end (Kouka, 2002).

During the recent excavations (2009-2013), to the north of the Sacred Road, held by the University of Cyprus and directed by Kouka, architectural phases dated from the Ch through to the Roman period have been unearthed, although with gaps in occupation between the MB up to Archaic and again after the Archaic to the Roman periods (Fig. II.17, Table II.1). The excavation took place in three sectors, which occupy an area of approximately 500 m$^2$. In brief, the Ch level is founded on virgin soil: it consists of a few architectural remains like house floors, roof-clay remains, and a hearth (Kouka, 2015; Margaritis, 2013). These layers were very disturbed, not only due to the high water table in the area, but also due to the destruction down to the very foundations of the buildings of the later EB phases. To this later period belong long-room houses where food processing areas have been identified, *Communal Building I*, and fortification walls. Additionally, there have been identified areas for wine and olive oil production dated to EB II period (Kouka, 2015). According to Kouka (2015), the presence of communal constructions such as the fortification wall and the *Communal Building I* imply the presence of a stratified society in the settlement as early as the EB II period. During EB III period, the settlement was expanded to the west; long-roomed houses were built on top of the fortification wall of the previous phase (EB II period). A new fortification wall was then constructed along the east branch of the river Imvrassos. Thus, Heraion covered an area of 35.000 m$^2$ and it was the most extensive island settlement in the area of East Aegean (Kouka, 2015, 2014). Worth noting is the recovery of such small finds as blades of Melian obsidian and bronze artefacts (EB II), as well as imported pottery (EB III) which testify connections with the Cyclades even in the EB period (Kouka, 2015).

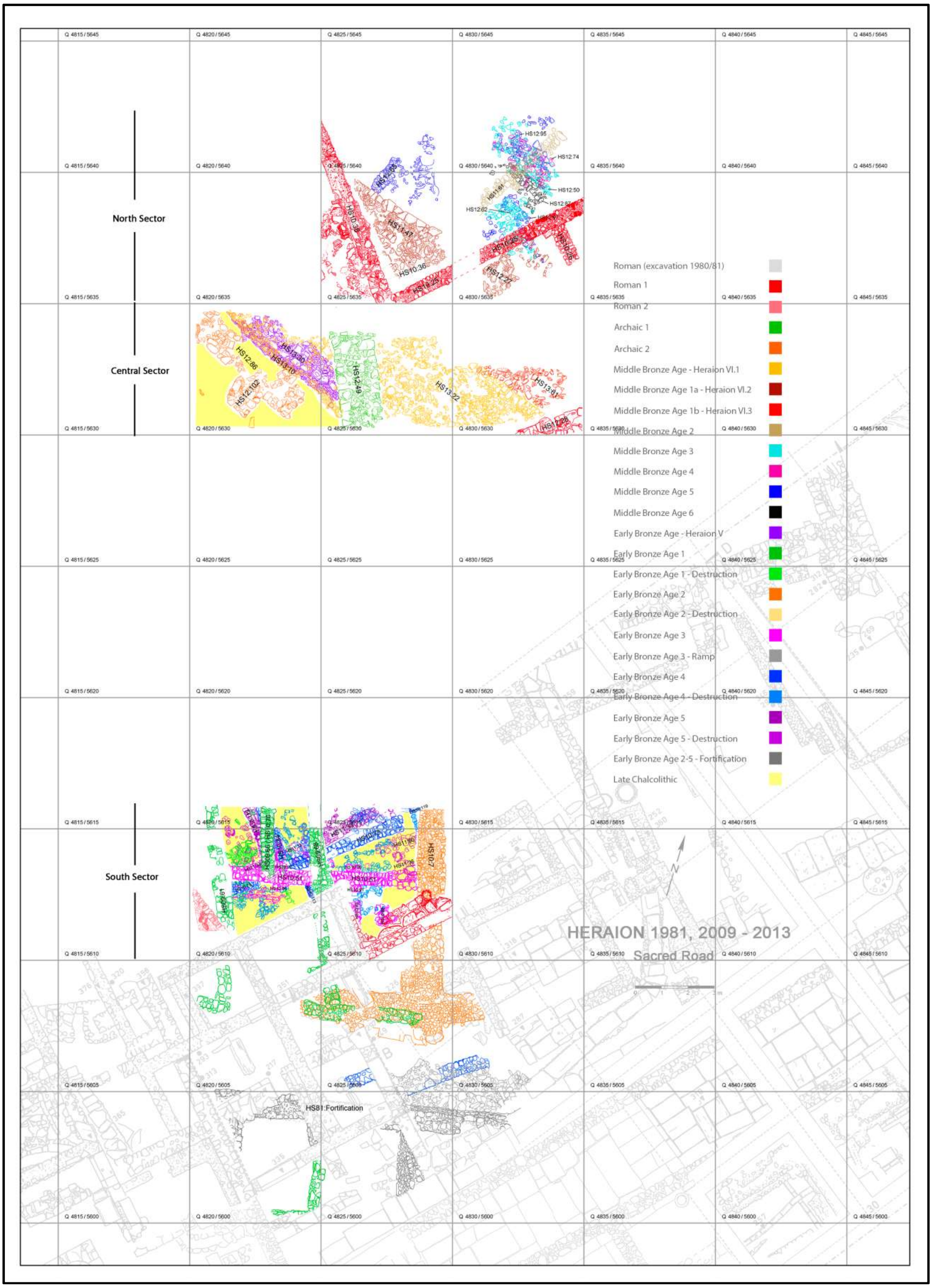



**Figure II.17**: Plan of the archaeological site of Heraion, North of the Sacred Road. Excavation period 2009-2013. Courtesy of the Excavation of Heraion.

The Middle Bronze period of the settlement is characterized by the presence of long-roomed houses and a fortification wall on the same orientation as the one of the EB III period. The fortification wall had three constructional phases, of which the latest is dated to late MB period. According to the excavator, it was constructed to protect the settlement from the inundations of the Imvrassos River (Kouka, 2015). As in the previous period, there is evidence of food processing and industrial activities, while the presence of obsidian and introduced pottery testify commercial connections with mainland Greece, Cyclades, and Crete (Kouka, 2014).

To the Archaic period are dated the two phases of a wall which was most probably erected as a flood-protection measure. The facades of both phases were built with slab-like limestones and the inner space was filled with smaller limestones. Both phases were overwhelmed by floods as they were found under thick layers of sand (Kouka, unpublished archaeological reports). Finally, in all three sectors there have been unearthed architectural remains dated to the Roman period. The study of this later debris has shown the existence of four Roman phases, all dated to the 2$^{nd}$to 4$^{th}$ centuries AD. The architectural remains are parts of walls of the building complex of this period that existed to the east of the Sanctuary of Hera (Kouka, unpublished archaeological reports).

### 2.4. Architecture of the Buildings at Heraion, Samos

The architecture of the buildings at Heraion remained the same throughout the Bronze Age period. This chapter will focus on the architecture of the buildings of the same, as anthracological samples were not recovered from the interior of buildings dated to the Archaic and Roman periods.

According to the excavator (Kouka, 2015, 2013), the buildings of Heraion were rectangular or trapezoidal long-roomed houses with one or two rooms, whose length was 7 to 10 m with a width of 3.5 to 4.5 m. The houses of the settlement were set in a radial pattern: either free-standing or they had common sidewalls (Fig. II.17). The foundation of the walls of both the houses and the communal building of the settlement (*Communal Building I*) were of rough stones or slabs of stone. In the case of the houses, this socle could reach 0.60 m in height, with the upper part of the walls being of mudbricks. None of the buildings excavated seems to have more than one storey, with the exception of *Common Building I*, which had most probably a second storey in the form of a loft. The floors constructed either from clay, pebbles or from slab-stones.

The only wooden part of the buildings was their roofs, which were flat and resembled those of the western Anatolian littoral (Erkanal, 2011; Kouka, 2002). These roofs can be reconstructed, based on parallels from Crete and Cyclades. Thus, according to Lenuzza (2013), flat roofs consisted of four layers from which the lower was made of large beams placed perpendicular to the line of the walls that carried the weight of the roof. The second layer was made of wooden branches of smaller diameter, covering the gaps between the beams. Above these branches were placed several superimposed strata of clay that sealed the whole. In the case of Heraion on top of the clay were usually placed slabs of stone as the final layer (Kouka unpublished archaeological reports - for details see §II.1.4).

### 2.5 Archaeological and stratigraphic background of the units under study

In this study are included all the samples containing wood charcoal macroremains from all archaeological periods of the site unearthed during the recent excavations (2009-2013). The samples were taken from the interior of the buildings, as well as from open spaces in between them. Below are presented the buildings, per period, as well as the composition of the strata of the site wherever it was possible to deduce information from the unpublished archaeological reports, unless stated otherwise. The description is made by sector. Once again, I would like to express my gratitude to the excavator, Ourania Kouka, who allowed me to use unpublished data of the excavation. In the text are mentioned the stratigraphic units which provided anthracological samples.

#### 2.5.1 South Sector

South Sector (Fig. II.17) occupies quarters 4820/5610, 4825/5610 and part of quarters 4820/5615, and 4825/5615. This sector lies immediately to the north of the sectors excavated during 1980 and 1981 by Kyrieleis and Weisshaar (Erkanal, 2011; Kouka, 2015, 2002). In this sector layers dated from the Chalcolithic through to the Early Bronze period have been unearthed. The Ch period is represented by the remains of three houses which are severely damaged by the foundation of the walls of the later phase: thus no suggestions can be made on their architecture. The Ch house recovered under EB wall HS11:33 had two phases, of which the earlier is represented by a pebble floor (unit 91/11), and the later by a slab floor (unit 84/11) and house deposits (units 85/11, 89/11, 90/11). The house deposit excavated above the slab floor composed of silty-clay soil mixed with red clay and stones, as well as potsherds and pyrite stones. From the house to the south-east of EB wall HS10:51, roof deposits (unit 19/11) were recovered composed of silty-clay sporadically mixed with red-clay. At the west part of the south sector were excavated deposits of the interior of the third Ch house which were formed of soil containing burnt clay and potsherds. Finally, the only open space of the Ch period was unearthed south of the west part of wall HS10:73. The deposit was made of compact clay and it contained bones and potsherds.

The worthwhile architectural remains excavated at this sector, dated to the Early Bronze period, belong to five houses and *Communal Building I*. These houses were not built simultaneously, but rather in five distinct architectural phases, with architectural phase 5 (EB5) being the earliest and phase 1 (EB1) the latest. As it can be seen from Table II.1 the time gap between these five phases is short (Kouka and Menelaou, 2018; Kouka, 2015).

More specifically, the house to the west of wall HS10:112 is dated to EB5. The destruction layer (unit 70/11) of the house contained the destroyed upper structure of wall HS10:112 made of mudbricks, fallen stones from the same wall and red clay from the destruction of its roof. The house excavated to the north of wall HS10:73 and east of wall HS10:84 belongs to the EB4. There, under the destruction layer composed of burnt clay mixed with potsherd (units 76/10, 105/10), the floor of the house made of pebbles (unit 81/11) and its sub-layer (unit 44/11) have been unearthed. Additionally, a hearth (unit 32/11) has been excavated there. Two houses are dated to EB3; these houses were built to the north of HS10:51; they were divided by wall HS10:70. In the house to the east of HS10:70 has been excavated a destruction layer composed of burnt roof clay (unit 58/10) and stones from wall HS10:51 (unit 9/11), all found above the pebble floor of the house. A threshold (units 68/10, 111/10) at the east part of wall HS10:51 belongs also to this building. Similarly, a destruction layer (unit 5/11, wall HS10:51-54/11) with the same composition as the aforementioned came to light in the house to the west of wall

HS10:70. Finally, wall HS09:68 comprised the mid-wall of a house with two rooms (EB1), whose west external wall was wall HS09:66 (founded on top of wall HS10:70 of the previous architectural period). In the East Room (east of HS09:68), deposits were excavated above its pebble floor, composed of sandy dark brown soil (units 75/09, 76/09). In the west room (the space between walls HS09:66 and HS09:68), an earlier floor has been unearthed. Above this earlier floor a layer of soil mixed with clay has been unearthed (unit 82/09).

*Communal Building I* is dated to the EB II-early (c. 2,500 BC): it belongs to EB2 architectural phase of the site (Fig. II.17). It was a two-storey building used most probably as a storage space, extending east and west of wall HS10:7. The excavated dimensions of this building are 9 x 10 metres. Wall HS10:7 is 1.05-1.10 m wide, but only its first five courses are preserved, made of limestone. This building had been destroyed by fire. In its destruction layer, two distinct contexts were possible to be distinguished. The first context is related to the destruction of its flat roof (units 43/10, 53/10) and it consists mainly by burnt roof clay and wood charcoals. The second context was the one unearthed on top of its pebble floor (units 13/10, 53/10, 78/10) and it consisted of destroyed mudbricks, burnt roof clay, and wood charcoals.

Open spaces in the south sector were excavated south of wall HS10:51, at the foundation level of HS10:07, and in between walls HS09:61 and HS09:66. The area south of wall HS10:51 comprised most probably the courtyard of the house to the east of wall HS10:70. This yard was paved with stone slabs and pebbles (unit 98/10), which was founded on a yellowish silty-clay layer mixed with pebbles (unit 115/10). Between walls HS09:61 and HS10:66 an open area existed which was used for the production and processing of food. There were excavated numbers of pounders and mortars on top of a dark brown layer of soil mixed with red clay (units 73/09, 94/09, 98/09, 102/09).

### 2.5.2 Central Sector

The Central Sector lies approximately fifteen metres north of South Sector, and it occupies quarters 4820/5630, 4825/5630, and 4830/5630 (Fig. II.17). In this sector archaeological remains dated to the Early and Middle Bronze periods, as well as to the Archaic period have been unearthed. Architectural remains of three houses have been unearthed at this sector dated to EB II-late to EB III. These houses employed the same architectural approach as those mentioned above in the South Sector. From the house lying at the west part of the sector, deposits were unearthed belonging to its interior (unit 39/13). These deposits composed of burnt silty-clay soil mixed with charred seeds. The deposits of the interior (unit 44/13) of the house close to fortification wall HS13:30 also were made of burnt silty-clay mixed with destroyed mudbricks. Finally, the deposits (unit 47/13) of the interior of the house to the south of fortification wall HS13:30 were mostly muddy.

Additionally, the remains of a house dated to the MB period have been unearthed in this sector, south of fortification wall HS13:30. The house, whose east wall was wall HS13:10, was destroyed by the later wall HS12:86 of the Archaic period. In the interior of the house the deposit (units 6/13, 11/13, 28/13, 31/13) consisted of superimposed layers of ash mixed with burnt roof clay, burnt soil, and mudbricks. To the southwest in the house a hearth was unearthed (unit 36/13). To the east of this hearth, bones of sheep/goats and cattle, burnt wood as well as burnt cereals and grapes were also recovered (unit 48/13).

In this sector open spaces were excavated south of fortification wall HS13:30 as well as west of it, at the foundation level of wall HS13:10, and finally above walls HS12:86 and HS12:102. In more detail, the deposits (unit 69/13, 60/13, 66/13) excavated along the southwest façade of the fortification wall HS13:30 consisted of dark brown silty-clay soil, fallen mudbricks, most probably part of its upper structure, animal bones, potsherds, and burnt wood. These deposits are dated to the EB III period. To the MB period are dated the silty-clay deposits mixed with wood charcoals (units 29/13, 34/13) on top of which wall HS13:10 was founded. These deposits are most probably the result of a flooding episode caused by the river Imvrassos. Finally, to the second phase of the Archaic period of the site is dated the deposit under which wall HS12:86 and HS12:102 were found. This deposit was thick and it composed of sandy soil mixed with pebbles and fragments of pyrite.

### 2.5.3 North Sector

The North Sector is situated immediately to the north of Central Sector: it occupies quarters 4825/5635, 4830/5635, 4825/5540, and 4830/5640 (Fig. II.17). In this sector, the archaeological remains unearthed are dated to the MB and Roman periods. To the MB period are dated four houses and open spaces, while from the Roman period anthracological samples were recovered only from open spaces. The houses of the MB period had the same architectural characteristics as those of the EB period described above (see §II.2.4). The only difference noted by the excavator is a change in the orientation as the buildings of the EB oriented E-W, while those of the MB period are oriented N-S. In the North Sector, the MB period is represented by architectural remains belonging to six superimposed phases, with phase 6 (MB6) being the earliest and phase 1 (MB1) the latest.

The house extending east of wall HS12:87 is dated to MB6. Above this wall and towards its west side was excavated the destruction layer of the house roof, as well as of the wall itself. This deposit (unit 89/12) contained traces of burnt roof clay mixed with potsherds and animal bones. In this sector were excavated also the architectural remains of three houses dated to MB5. However, only the house extended east of wall HS12:65 yielded anthracological samples. Here the first to be unearthed is the thick destruction layer of its roof composed of burnt roof clay (units 56/12, 64/12, 78/12). Under this layer and among the stones of the pebble floor of the house existed a thick layer of ash, containing also a great amount of potsherds (unit 67/12, 90/12). Wall HS12:74 comprised the east part of a house from MB4. The destruction level of the house (unit 73/12), extending to its west, was composed of burnt roof clay mixed with ash and potsherds. Finally, to MB3 is dated the house occupying the area west of wall HS12:62. Along the west façade of this wall was excavated a deposit (unit 70/12) composed of burnt red clay and potsherds.

Open spaces dated to the MB period have been excavated at this sector in relation to the area north of fortification wall HS11:47, as well as the foundation level of walls HS12:62 and HS12:87. In more detail, the deposits unearthed along the north façade of the fortification wall HS11:47 (MB1) were composed of limestone mixed with potsherds (unit 34/12), while the deposits from the curvilinear construction (unit 27/12) at its eastern part consisted of limestone mixed with animal bones and potsherds. Another open area was that unearthed under the foundation level of wall HS12:62 (MB3). This layer was made of small and medium stones (units 81/12, 83/12). Finally, to the MB period is dated the open space under the foundation of wall HS12:87 (MB6). This layer was unearthed under the destruction layer west of this wall (unit 100/12).

No anthracological samples related to the interior of houses dated to the Roman period have been recovered, as mentioned above. All samples coming from open spaces belong to the first phase of the Roman period of the site. The deposits (units 35/10, 100/10, 108/10) found north of wall HS10:25 were made up of dark brown sandy soil mixed with mudbricks, roof tiles, mortar, and potsherds. Bellow the foundation level of walls HS10:25 and HS10:38, which comprised part of a building complex dated to this period were unearthed debris (unit 17/11) composed of mid-sized stones mixed with broken tiles and bricks, and potsherds. Under this was excavated a deposit (unit 34/11) made of gray-brown soil mixed with small pebbles. Finally, fill deposits (unit 94/10) were excavated south of wall HS10:62 and to the east of wall HS10:38.

# III. Methodology

## 1. A brief history of Anthracology

Wood charcoal is formed when wood is heated in the absence of oxygen or when the supply of oxygen is very limited and thus combustion is incomplete (Braadbaart and Poole, 2008). This charred material retains the anatomical structure of the wood from which it came. It can survive in the soil (Braadbaart and Poole, 2008; Chabal et al., 1999), in contrast to wood, whose preservation requires extremely wet or dry conditions. In archaeology, wood charcoal macroremains are used for the extraction of $^{14}C$ dating, but also investigated for the palaeoenvironmental and palaeoethnobotanical information they can offer, as they are considered indicators of the interaction between humans and their environment (Asouti and Austin, 2005; Chabal, 1997; Chabal et al., 1999; Ntinou, 2002; Théry-Parisot et al., 2010).

As wood charcoal macroremains are the most common plant residue found in archaeological contexts (Smart and Hoffman, 1988), they had attracted the attention of analysts as early as the second half of the 19th century, when the Italian, G. Passerini, and a little later, the Swiss, O. Heer, expressed interest in the study of such material from Neolithic and Bronze Age dwellings found in the Alps. Other studies, from the same period, come from Germany, France and Hungary (Asouti, 2001; Badal, 1990, 1992; Chabal et al., 1999). However, during this early period, the study focused only on charcoal retrieved from hearths, and the main objective of the analysts was to compose lists of plants which were used to evaluate the taxa utilized as fuel-wood (Badal, 1992, 1990).

The first attempt to use wood charcoal macroremains as a means to evaluate the palaeovegetation was made by the British scholars E.J. Salisbury and F.W. Jane in 1940, who studied wood charcoal from archaeological sites in the region of Dorset (Asouti, 2001; Chabal et al., 1999; Moskal, 2010). In the Mediterranean region, the first people who used wood charcoal macroremains for the reconstruction of the palaeoenvironment were J. Momot, M. Couvert, S. Santa, L. Balout and M. Follieri, during the years between 1950 and 1970 (for an extensive description of the history of anthracology see: Asouti, 2001; Badal, 1990, 1992; Badal and Heinz, 1991; Chabal et al., 1999). However, it was not until the utilization of reflected light microscopy at the beginning of the 1970s, which allowed the simplification of the procedure needed for the analysis of the specimens (Vernet, 1973), that a large number of assemblages could be studied. Under this new technique, statistically meaningful results could be easily obtained, in turn allowing palaeoecological interpretations to be developed (Asouti, 2001; Badal, 1992; Chabal et al., 1999; Ntinou, 2002).

During the 1970s and 1980s, the so-called *"Montpellier School"* (Asouti and Austin, 2005) of J.L. Vernet and his students codified the methodology of anthracology and defined its lines of investigation. These researchers (Badal, 1992, 1990; Badal and Heinz, 1991; Chabal, 1992, 1988; Figueiral, 1992; Grau Almero, 1992; Vernet, 1973), gaining experience in their work on various archaeological sites, developed on-site sampling strategies distinguishing between assemblages that were capable of providing ecological and ethnobotanical information. Among others, they established laboratory protocols in the quantification methods to be followed. By introducing statistical analysis of the results they facilitated the palaeoecological representativeness of the charcoal datasets deriving from archaeological contexts.

More recently, alongside the "traditional" aspects of the field, namely palaeoecology and palaeoethnobotany, several studies have been confronting other important matters relevant to the discipline of anthracology, such as taphonomy, dendrology, morphometry, combustion properties of wood and GIS applications. The post-depositional processes affecting the anthracological assemblage and especially the fragmentation of archaeological charcoal have been the subject of several studies (e.g. Braadbaart et al., 2009; Chrzazvez et al., 2014; Lancelotti et al., 2010; Théry-Parisot et al., 2010), along with studies investigating microorganisms infecting wood charcoal macroremains (e.g. Moskal-del Hoyo et al., 2010) and others dealing with problems that can result from the recovery techniques followed during the excavation (e.g. Arranz-Otaegui, 2017; Scott and Damblon, 2010; Théry-Parisot et al., 2010). Additionally, dendrological studies have provided information on the physiological and phenological state of wood before combustion, whilst ecological information is being furnished by the study of the tree rings, and yet others deal with woodland management (e.g. Carrión, 2007; Dufraisse, 2006; Marguerie and Hunot, 2007; Masi et al., 2013; Paradis et al., 2013). Moreover, advances in morphometry has allowed distinctions to be made between species with very similar anatomy, based on the observation of phenological characteristics and the application of statistical analyses (e.g. Terral, 1996). Studies dedicated to the combustion behaviour of the different woody taxa are augmenting our understanding on the different types of fire used by human groups in the past (e.g. Braadbaart and Poole, 2008; Lingens et al., 2005; McParland et al., 2010). Last but not least, GIS application enhances the study of the spatial distribution of wood charcoal macroremains and illuminates the relation between scattered and concentrated specimens (Vidal-Matutano, 2017). It also allows the formation of models for the better understanding of the strategies followed by prehistoric population on the collection of wood (Marston, 2009).

In Greece, the earliest wood charcoal analysis was made by Western, who studied the wood charcoal macroremains from a post-hole excavated at the Neolithic site of Knossos (Evans, 1964). In 1972, the results of the analysis of the wood charcoal macroremains coming from the Early Bronze settlement of Myrtos, Crete, were published by Rackham (1972) and a few years later in 1978, J.M. Shay and T.C. Shay published their study on the wood charcoal macroremains and seeds recovered during the excavation at Nichoria, in the Peloponnese (Shay and Shay, 1978). More recent studies are those of Rackham (1986), who analysed wood charcoal macroremains from the Neolithic/Bronze Age site of Sitagroi, Macedonia and those of Shay and Shay (Shay et al., 1995; Shay and Shay, 2000) who studied anthracological material coming from Bronze Age and Iron Age deposits excavated at Kommos, Crete. Furthermore, Ntinou (2002) dealt with the wood charcoal macroremains from the Late Glacial rock shelter of Boila and the Neolithic sites of Makri and Dispilio. Asouti (2003) and Bottema-MacGillavry (2005) also conducted anthracological analysis on assemblages coming from Akrotiri on Thera, dated to the Bronze Age. During the last decade, in Greece, research at several sites – largely in mainland Greece, the Cyclades, Crete and the Sporades – has been conducted by Ntinou in particular (e.g. Badal and Ntinou, 2013; Karkanas et al., 2011; Ntinou, 2013a, 2013b, 2012, 2011a, 2011b, 2010; Ntinou and Kyparissi-Apostolika, 2016; Ntinou and Stratouli, 2012).

## 2. The two aspects of anthracology: palaeoecology and palaeoethnobotany

As wood charcoal macroremains recovered from archaeological excavations are part of human culture (Smart and Hoffman, 1988), one of the main questions asked of anthracology is to investigate what were the criteria for the selection of specific woody taxa and to determine to what degree the anthracological assemblages can provide sufficient palaeoecological information.

According to Badal (1992, 1990), a sampling unit in anthracology is every deposit from the same archaeological layer, every single structure or closed context, while as observation unit is considered each charcoal fragment, regardless of its size. The most commonly used quantifying methods are counting or weighing the wood charcoal macroremains for each taxon. The results of the two methods are closely correlated (Chabal, 1988). Counting the charcoal fragments of each taxon is usually employed during the analysis of the samples.

The anthracologist, to evaluate the palaeoecological and palaeoethnobotanical information, must have a good understanding of the archaeological context from where the samples were recovered (Badal, 1992). For this reason, during the archaeological excavation, specific protocols should be adhered to when sampling assemblages of anthracological interest. Palaeoethnographic information on the uses of wood by the inhabitants of a site can be obtained by sampling closed archaeological contexts, such as construction debris, kilns, wooden tools, funerary pyres, etc. (Chabal, 1988). The samples collected from kilns, hearths and funerary pyres, although they do represent wood used as fuel, cannot by themselves alone be used for ecological estimations, as they mirror only the last fire event. Overall, samples from closed contexts are expected to produce a low number of taxa as these are subjected to a high rate of selection, related to their physical or cultural properties (Badal, 1992; Chabal, 1992, 1988; Moskal, 2010; Ntinou, 2002). For example, studies have shown the preference of specific woody taxa as timber or for tool manufacture, based on their quality (e.g. Carrión and Rosser, 2010; Dufraisse, 2008; Figueiral, 1996; Gale and Cutler, 2000; Ntinou et al., 2013; Sadori et al., 2008).

According to Chabal (1988) and Grau-Almero (1992), concentrated wood charcoal macroremains related to construction timber (i.e. beams, poles) must, on discovery, be first drawn and then photographed in situ, second the larger specimens must be sampled by hand and then the rest of the sediment wet-sieved to collect the smaller pieces. In the case of thick destruction layers caused by fire, it is essential to sample in detail the part of the destruction in contact with the ground, as it is here that will be found the construction elements (Grau Almero, 1992). The biggest pieces of charcoal can provide information on the initial size of the poles used, while an extensive sieving of the destruction layers can bring to light a great amount of stems, twigs and such of a smaller calibre, as well increasing the variety of taxa which will provide crucial information on the architecture of the structures (Chabal, 1988).

Regarding the ecological value of the anthracological assemblages, a divergence of opinion remains between the specialists concerning their ecological representativeness. Smart and Hoffman (1988), although not totally opposed to the relation between fuel wood and palaeovegetation, argue that any woody taxa brought to a site is subjected to cultural selection and thus fuel wood would have been chosen due to its properties or due to cultural factors which inevitably distort an accurate image of the palaeovegetation.

The specialists of the *"Montpellier school"*, on the other hand, have demonstrated that palaeoecological information from the archaeological charcoal assemblages can be obtained when these meet specific criteria: (a) the wood charcoal macroremains are the remains of domestic fires, (b) the deposits containing the wood charcoal macroremains have been accumulated over a long period of time and, finally (c) the sampling covered a sufficient area of the excavated space, and the results of the different samples from the same deposit are reproducible (Asouti and Austin, 2005; Badal, 1992, 1990; Chabal, 1992, 1988; Grau Almero, 1992; Moskal, 2010; Ntinou, 2002). The second viewpoint is justified by the fact that in prehistoric societies wood was one of the main energy sources, and thus past human groups would have gathered wood randomly on a daily basis to cover their needs (Chabal, 1988). Critical factors of selection would be primarily availability and economy in the collection effort (Asouti and Austin, 2005; Chabal, 1988), as well as other physical parameters such as the size and diameter of the piece of wood, its humidity content and whether it was fresh or altered (Asouti and Austin, 2005; Chabal, 1992; Ntinou, 2002; Théry-Parisot, 2002; Théry-Parisot et al., 2010). Thus, as wood would be selected according to the activity it was needed for, and as several taxa in the environment would cover these parameters, the selection of taxa in domestic fires would be more or less random (Moskal, 2010; Ntinou, 2002). Attention must be drawn to the use of samples coming from domestic hearths as environmental indicators. Wood charcoals found in domestic hearths represent the last fire event: thus quantitative and qualitative results obtained are inaccurate as there will be an over-representation of the dominant taxa. Consequently, deposits of domestic hearths must be studied separately from the dispersed charcoals. They can be used only to complement the results obtained from the study of the scattered charcoals (Badal, 1992, 1990; Chabal, 1992, 1988; Ntinou, 2002).

For an accurate representation of the palaeovegetation, it is essential that a sufficient number of fragments be sampled, enough to provide meaningful statistical results for each archaeological layer. This number is estimated through 'saturation curves', whose stabilization signifies that the optimum number of fragments has been reached and hence all taxa included have been identified (Badal, 1992, 1990; Chabal, 1988; Ntinou, 2002). This number is around 250-400 fragments per stratigraphical unit in temperate environments (Chabal, 1988). Badal and Heinz (1991), nonetheless, suggest that the number of identified fragments may climb to 800 pieces, depending on the diversity of the plant formations growing in the area under study. If a sufficient number of fragments cannot be obtained, because the archaeological layers are poor (meaning less than 100 fragments; Carrión, 2005), then an area of at least 4 $m^2$ must be sampled (Badal, 1992, p. 175). Statistical analyses on the fragmentation of wood charcoal have demonstrated that all taxa are subjected to the same rate of fragmentation: thus in archaeological deposits can be found a large number of small fragments and a small number of big ones (Badal, 1992, 1990; Chabal, 1992, 1988). In fact it is only the most frequent taxa that are represented in the largest fragments (Chabal, 1992). Consequently, the systematic recovery of wood charcoal macroremains from their archaeological sediments requires the use of water-separation machines for their recovery. This is essential: when manual recovery alone is applied, there is a tendency for only the bigger specimens to get collected, something which could lead to the absence of the less frequent taxa and subsequently to an erroneous ecological interpretation (Chabal, 1988). To obtain optimal results during the analysis and the observation of wood charcoal macroremains, the specimens must be at least 4 mm (Chabal, 1992). However, in many cases, when the quantity of the available material is low, fragments whose size fluctuates between 2 mm and 4 mm can be used (Ntinou, 2002).

### 3. Palaeoecological interpretation: the anthracological diagrams

After the identification of the optimal number of fragments, the anthracological diagrams are formed, in which the results are set out. Here are presented the total counts and percentages of each taxon identified per stratigraphical unit in successive archaeological periods. The main purpose of these diagrams is to allow observations of differences in the frequency of taxa collected from superimposed archaeological layers. In this way, the changes in the environment surrounding an excavation site over time can be studied, as well as the impact of the inhabitants upon it (Chabal, 1988). However, the relative variations shown in the diagrams cannot be directly interpreted as variations existing in the palaeoenvironment. Instead, what is under study is the dynamics of the past vegetation and its temporal variations (Chabal, 1992). The anthracologist, therefore, is looking for "ecological markers" which can reveal the progressive or regressive evolution of the vegetation (Chabal, 1992, p. 233).

In areas with a high floral diversity the anthracological diagram may reflect a complex picture of the vegetation habitats existing in the surroundings of a site (Asouti and Austin, 2005). Accordingly, for the reconstruction of the palaeoenvironment, beside the percentages of each taxon (which reveal the intensity in which each habitat was exploited; Asouti and Austin, 2005; Asouti and Hather, 2001), other informative approaches required are (1) the study of the modern ecology of vegetation habitats, (2) the co-examination of the anthracological data from different archaeological sites in the same area, and (3) the consideration of the results of other related disciplines, such as palynology, carpology, biogeography, etc. (Asouti and Austin, 2005; Chabal, 1992; Ntinou, 2002).

## 4. Anthracological methods followed on site in Akrotiri, Thera

From the archaeological site of Akrotiri, samples coming from Xeste 3, the House of the Ladies, and the buildings unearthed in Pillars 66Π and 67 were studied. Samples from these closed contexts were analysed to study the use of timber in architecture, following the methodology proposed by Chabal (1988) and Grau-Almero (1992), and to investigate similarities and/or differences on the taxa used in public (Xeste 3 ) and private (the House of the Ladies, and the buildings in Pillars 66Π and 67) buildings.

Additionally, samples coming from fills and dumps were analysed, material which had been collected during the excavation of the deep shafts for the foundation of the Pillars of the new shelter of the site. The systematic sampling of the stratified deposits and the recovery of anthracological samples through water flotation provided a unique opportunity to study the vegetation prevailing at the island of Thera and its alteration from as early as the Early Cycladic II period, down to the destruction of the settlement during the Late Cycladic I period.

The details on the methods followed are presented below in sections III.4.1 and III.4.2. A detail description of the site is provided at Chapter II.

### 4.1. Methods followed at the Square of the Cenotaph and the new shafts for Pillars 18, 35, 66Π, and 67.

The Square of the Cenotaph was created by the Therans through the arrangement of building debris, produced after the destruction of the settlement by an earthquake during late MC-early LC I period (Doumas, 1985). During the excavation season of 1985 and the consequent campaigns, a large number of archaeobotanical samples were collected from this area, both manually and by flotation of the sediments. In this study only those samples processed with a water separation machine were analysed. From the total of 19 samples studied from this area (see Table II.2), eight came from two trenches excavated within the terraces of the Square of the Cenotaph dated to late MC/early LC I, two came from the top-surface of the aforementioned Square north of sector Delta, and nine from the narrow alley between the retaining wall of the Square and Xeste 5, the latter dated to the LC I period. The sediments of the trenches, the top-surface of the square, and the alley all comprise fills, according to the excavator (Doumas, 1993, 1992a, 1985).

During the construction of the new shelter of the archaeological site of Akrotiri (1999-2002), deep shafts were excavated, reaching in most cases the pyroclastic bedrock, to support the ninety-four pillars of this shelter. In this study the wood charcoal macroremains retrieved from four of these shafts are analysed. The anthracological material recovered from these shafts, namely shafts of Pillars 18, 35, 66Π, and 67 was chosen for analysis because it can provide information on the flora characterizing the landscape and the uses of wood on the site through time, from the first stages of its occupation during the EC II period (2,800-2,300 BC) until the LC I period (1,550-1,500 BC), when the eruption of the volcano took place. The material from these shafts was chosen for analysis mainly because it comes from well-defined and dated contexts (for details see Chapter II) which serve the purpose of this study. Their spatial distribution covers all the east part of the excavation.

In all four shafts there were excavated chambers, dug into the pyroclastic bedrock, whose primary construction and use is dated to the EC period (see Table II.2,). The explanation of the use of the chambers in Akrotiri is not certain yet (on the problematic of the chambers in Akrotiri, see § II.1.3). The majority ceased to be used and were filled with debris during the EC period. From the same Pillars were also excavated fills dated to the MC and LC periods.

Additionally, in Pillars 35, 66Π, and 67 were recovered rooms of buildings dated to the MC or LC periods, or to both (see Table II.2). The anthracological data from these rooms allows comparisons on the uses of construction wood between them and the structures of Xeste 3 and the House of the Ladies, both in space and across time. All samples collected from NPS 35 are from fill layers, with the exception of one (WF2000(771)) coming from the floor of Room 3. This floor was made of beaten earth, and it was in use during the occupation of the Room. Thus, this sample does not provide any information on the uses of wood as construction materials, but will be used in a complimentary fashion, when studying the flora of the area. The destruction layers of the LC I building excavated in NPS 66Π contained one sample coming from a window of the building, as well as others from the sub-layers of the floor of the first storey. The building excavated in NPS 67 was founded during the MC period, and destroyed by the earthquake of the late MC/early LC I period. According to the excavator, the interior of the building was not filled in with debris after the earthquake, rather the samples collected from these layers are in situ destruction debris. More particularly the samples from layer 12, which is the layer immediately above the floor of Room 2 (MC), comprise the contents of the room, while layers 9 to 11 comprise the wooden structure of the floor of the upper building (Mairi Tsoulakou, forthcoming).

As it is evident from the archaeobotanical forms, sediment samples for the purpose of flotation were taken from every stratigraphical layer and every group of finds within them, both during the earlier excavation of the Square of the Cenotaph and during the excavation of the shafts of the new Pillars 18, 35, 66Π, and 67. Stratigraphical layers in these excavations were considered to be those with the same context and soil composition. Specific features, such as floors and vessels were sampled separately. The samples were processed in an Ankara water-separation machine, made of concrete. The coarse flots and the fine flots were collected in sieves of mesh size 1 mm and 0.3 mm, respectively, and the heavy residue was held in a 1 mm mesh (Sarpaki, 1987; Sarpaki and Asouti, 2008). In general, the amount of litres sampled from each stratigraphical layer depended on its size and depth. The mean litres of soil processed for each sample range between 20 to 32 lt. The flots were collected in clean paper towel and left to dry in the shade.

### 4.2. Methods followed at Xeste 3 and the House of the Ladies

The anthracological samples analysed in this study from Xeste 3 and the House of the Ladies are related to construction debris. According to their position in the building, they are divided to five categories, namely wood charcoals (1) from the fill of the rooms, (2) from the interior of the walls (in destruction debris), (3) from the wooden floors (first and second layers of the wooden ceilings/floors), (4) from the doors/windows and finally, wood charcoals (5) found in the contents of vessels. This division is based on the descriptions found in the excavation diaries. Wood charcoal macroremains sampled from the tumbled walls were considered as representative of the wooden infrastructure built into the walls. Wood charcoal macroremains described as from contexts related to the floors of the upper storeys, the doors or the beams of the buildings were used to extract information on the uses of wood for the construction of these specific features. All wood charcoal samples taken from the fills of the interior of the buildings are considered to mainly represent construction debris. However, as they are not related by the excavators to a specific feature, they will be used in a complementary manner to provide general information on the uses of wood in the construction of the buildings of the site. Additionally, the frequency of occurrence of the taxa identified within these samples (see §III.7.2) will be compared to those of the samples related to the floors (structural elements and beams) to see if any differences emerge in the taxa identified and to reveal the presence of other wooden objects, e.g. furniture, fuel wood etc. Finally, the wood charcoal fragments found in the interior of the vessels are thought to have got into them accidentally during the destruction of the buildings: thus they will be used to compliment those coming from the construction debris of the rooms of the buildings.

The main technique of sampling the anthracological material here was by dry sieving the sediments from the interior of the rooms of the buildings, using a mesh size of 1 cm. This procedure took place, primarily, to collect the smaller plaster fragments fallen from the wall-paintings of the rooms, but along with them, other artefacts and ecofacts were also retrieved. Additionally, large wood charcoal pieces, coming mainly from the beams used to support the basal layer of the upper storeys or the roofs, that were found fallen on the ground floors of the buildings, were sampled by hand. These large beams, in most cases, were also drawn and their exact position noted in the excavation diaries.

Finally, from 1981 onwards, when systematic sampling of archaeobotanical samples started at the site, under the instruction of the archaeobotanist A. Sarpaki, archaeobotanical samples from the interior of Xeste 3 and the House of the Ladies were sampled selectively and processed in the Ankara water-separation machine, alongside the other two methods. The process followed during the processing of the sediments is similar to that described in §III.4.1. The mean litres processed were 40.

The methods used for the recovery of the samples from the buildings of the site followed more or less those suggested by Chabal (1988) and Grau-Almero (1992) regarding the sampling of closed contexts related to construction debris. In this way, there is a sufficient recovery from the construction debris of both the bigger specimens from beams, but also through dry and wet sieving of the other and smaller charcoal fragments.

## 5. Anthracological methods followed on site in Heraion, Samos

The excavation at the archaeological site of Heraion, north of the Sacral Road was conducted in three sectors: it has brought to light assemblages dated from the Ch to the MB period, as well as from the Archaic and Roman periods. Anthracological samples were collected from architectural remains of houses dated to the Ch, EB, and MB periods as well as from *Communal Building I*, a storeroom, dated to the EB II-early period. The majority of these houses were destroyed through fire. The main aim of the analysis of these deposits was to study the taxa used in the construction of the wooden parts of the buildings and to investigate any differences in the taxa used between the different architectural phases, as well as between private and public buildings.

Furthermore, anthracological samples were recovered from fills and dumps from all archaeological period of the site. Their analysis is expected to allow assessments on the vegetation prevailing in the surroundings of the settlement and the changes occurring due to human impact.

### 5.1. Methods followed in the excavation Sectors

The work in three sectors mentioned above, namely the South, the Central and the North lasted from 2009 to 2013. In this study are analysed all the anthracological samples recovered from this site, from all periods and contexts. During the excavation, sediment samples were collected systematically from every stratigraphical unit and processed in a water flotation machine in order that the archaeobotanical remains be recovered. No hand-picked wood charcoal macroremains were collected separately. A stratigraphical unit was defined as any archaeological layer given a distinct context. The volume of the soil, however, was not measured consistently, especially during the last years of the excavation. Overall though during the excavation, the mean volume of soil processed was approximately 10 to 12 litres per sample. The flotation machine was operated as described by Peterson (2009). The mesh size of the sieve used to hold the flots was 0.3 mm, while the heavy residues were held in a 1 mm mesh. The flots were collected in clean paper towels. Both the flots and the heavy residues were left to dry in the shade.

On site, sediment samples were collected from each archaeological period and context. Hence, open spaces and spaces in-between buildings were sampled for scattered wood charcoal macroremains. Additionally, samples taken from the interior of buildings were divided according to their position as above or under the floors. This distinction was made as it was considered that the deposits under the floors represented the phase of preparation for the construction of the building and thus wood charcoal macroremains within them are thought to be scattered rather at random (Grau Almero, 1992), whilst samples above the floors represent constructional debris in situ as the buildings were destroyed by fire. The wood charcoal macroremains recovered above the floors of the buildings belong to the flat wooden roofs, as the walls of these buildings were made of only stone and mudbricks. The remains of specific features such as hearths and thresholds were sampled separately.

One of the problems encountered during the excavation was the high water table. This was reached in the South Sector at 1.34 m a.s.l. and in the North and Central Sectors at 1.20 m a.s.l. Virgin soil was reached at -0.08m and -0.23 m, that is below the sea level, respectively. As a result, the excavation was often conducted in muddy soil, and sometimes it was impossible to distinguish stratigraphical units (unpublished archaeological reports). In addition, the continuous habitation of the area caused, by the destruction of the buildings and their rebuilding, the disturbance of the horizons of the earlier phases by the later ones. For all the above reasons, all samples belonging to stratigraphical units which have not been securely dated have been excluded from this study.

## 6. Methods followed in the laboratory

The wood charcoal macroremains of Akrotiri were studied at the Laboratory of Prehistory and Archaeology of the University of Valencia, Spain, while those coming from Heraion were studied at the Malcolm H. Wiener Laboratory for Archaeological Science at the American School of Classical Studies at Athens, Greece. In order for the wood charcoal macroremains to be sorted from the archaeobotanical samples from Heraion, the samples were processed in a sieve of mesh size of 2 mm and then scanned under a Leica M10 Sterozoom microscope in a low magnification, so as to exclude all the non-charcoal elements. In the case of the samples from Akrotiri, this process had already been done on site by the archaeobotanist, A. Sarpaki and her team. Thus, the wood charcoal fragments from the coarse flots and the residue were sorted in a stack of sieves of 4 mm and 2 mm.

All wood charcoal fragments exceeding 2 mm were analysed. In each charcoal fragment a fresh surface of the three anatomical planes (i.e. transverse, tangential longitudinal and radial longitudinal) was produced by hand. Such pieces from Heraion were then studied under a Leica DMLM industrial microscope with dark and bright fields at magnifications of x100, x200, x500, while those from Akrotiri were viewed under a Leica DM6000 M microscope with dark and light fields and polarization, at the same magnifications. The identification of the specimens was based on comparisons with wood anatomy atlases (Fahn et al., 1986; Schweingruber, 1990) and the charred wood reference collection of the Wiener Laboratory and the Laboratory of Prehistory and Archaeology of the University of Valencia, respectively. Microphotography of the samples from Akrotiri was carried out with a Hitachi S-4800 Scanning Electron Microscope with spotlight of field emission and digital image acquisition system QUANTAX 200, held at the Central Service for Experimental Research Support at the University of Valencia, while for the samples from Heraion the JEOL, JSM-IT300LV electron microscope of the Wiener Laboratory was used.

During the analysis of the wood charcoal macroremains, an effort was made to identify the specimens to the species level. However, this was possible only in few cases and most fragments are identified to the genus level. At the species level could be identified, alphabetically, *Castanea sativa, Cedrus libani, Ficus carica, Olea europaea, Platanus orientalis, Prunus amygdalus,* and *Punica granatum*. In some cases, the identification was only possible to the family level, either due to similarities of the taxa within the family, i.e. Maloideae, Fabaceae, or due to the small size of the fragments that prohibited a more accurate classification. In the case of *Pinus* type *brutia/halepensis* and *Pinus* type *nigra/sylvestris*, as well as *Quercus* type deciduous and *Quercus* type evergreen, a more accurate identification is not possible due to the similarities within the species. Finally, though *Rhamnus* and *Phillyrea* sp. belong to different families, a distinction between them is yet very difficult. The same observation applies for *Ulmus* sp. and *Celtis* sp, which belong to the same family (see also Chapter IV).

Those fragments that did not possess all the criteria to be identified securely to a specific level, but had some, are here characterized as "*cf. taxon*" where *cf.* stands for *"confer"*. Angiosperms were characterized fragments, which were too small for a more precise identification, while those angiosperms which had the characteristic structure of monocotyledons, i.e. scattered vascular bundles, were characterized as Monocotyledons.

In addition to the recording of the taxa represented, other dendroanthracological characteristics like the presence of tyloses, fungal hyphae, insect degradation, and pith and bark were also listed, whenever possible. Tyloses is formed only in specific taxa, like *Quercus* type deciduous: it is created when living cells of axial or ray parenchyma adjacent to vessels grow through the pits into the vessel cavity (Marguerie and Hunot, 2007). Fungi infection can be recognized by the presence of collapsed cell walls and white filaments, while insect infestation is obvious by the presence of large holes or tunnels and coprolites (Agrios, 1997; Carlile et al., 2004; Moskal-del Hoyo et al., 2010).

Last but not least, the presence of both pith and bark on the same fragment provides secure information on the size of the branch used. Bark or pith found individually can give information on the location of the specific fragment in the stem (Marguerie and Hunot, 2007). In this study, an effort was made to evaluate the curvature of fragments coming from samples recovered at the houses of the two settlements analysed. This was to facilitate observation on the size of the beams used in each feature of the buildings, as growth-ring curvature can provide indications on which part of the tree (i.e. trunk, branches) was utilized (Dufraisse, 2006; Marguerie and Hunot, 2007). In order for the estimation of the curvature to take place, all fragments with a radial length of 5 mm or more were compared to Marguerie and Hunot's (Marguerie and Hunot, 2007) test card, using consistent magnification. Each piece was recorded as having "Weak", "Moderate" or "Strong" curvature, while fragments which were indistinct were accorded a zero rating (0). Unfortunately, in the case of Heraion, the small size of the majority of the fragments analysed hindered the study of this characteristic. In contrast, the analysis of the fragments recovered from the interior of the houses of Akrotiri was more fruitful, mainly due to the large size of the fragments recovered through dry-sieving.

## 7. Methods of analysis

### 7.1. Frequency

After the completion of the identification of the wood charcoal fragments contained in the samples as described above, the results were summarized in tables by taxon, by sample and divided by context. The quantification method followed in both the assemblages of Akrotiri, Thera, and of Heraion, Samos was the counting of the wood charcoal fragments. Beside the presentation of the total counts, the results were also expressed in percentages in order for comparisons to be possible. Total counts of wood charcoal fragments were calculated for the samples coming from dumps and fills.

Additionally, the total counts and the percentages extracted of the samples collected from the buildings of both sites are also presented in tables. However, as these samples are related to construction elements and the main aim here is to study the uses of wood as a structural material, the frequency of the taxa represented will be used only in complementary comparisons. Those samples collected from the floors' sub-layers, placed to level the surface of the natural rock in the construction of the floor, constitute fill layers and as such will be used to provide environmental information.

#### 7.1.1. Representativeness of the charcoal samples – Akrotiri

All samples containing wood charcoal macroremains from every stratigraphical layer of the shafts of the Pillars under study from Akrotiri, Thera, have been analyzed, with the exception of those collected by hand in the area of the Square of the Cenotaph and those where either the context is not securely dated or is contaminated. Samples come from both fills and dumps: they were analysed to extract information on the past vegetation of the island and to detect any information on tree cultivation, and firewood management. In order to check if a sufficient number of taxa was represented in the assemblages studied, saturation curves have been produced per stratigraphical layer for each shaft. As there is no in-

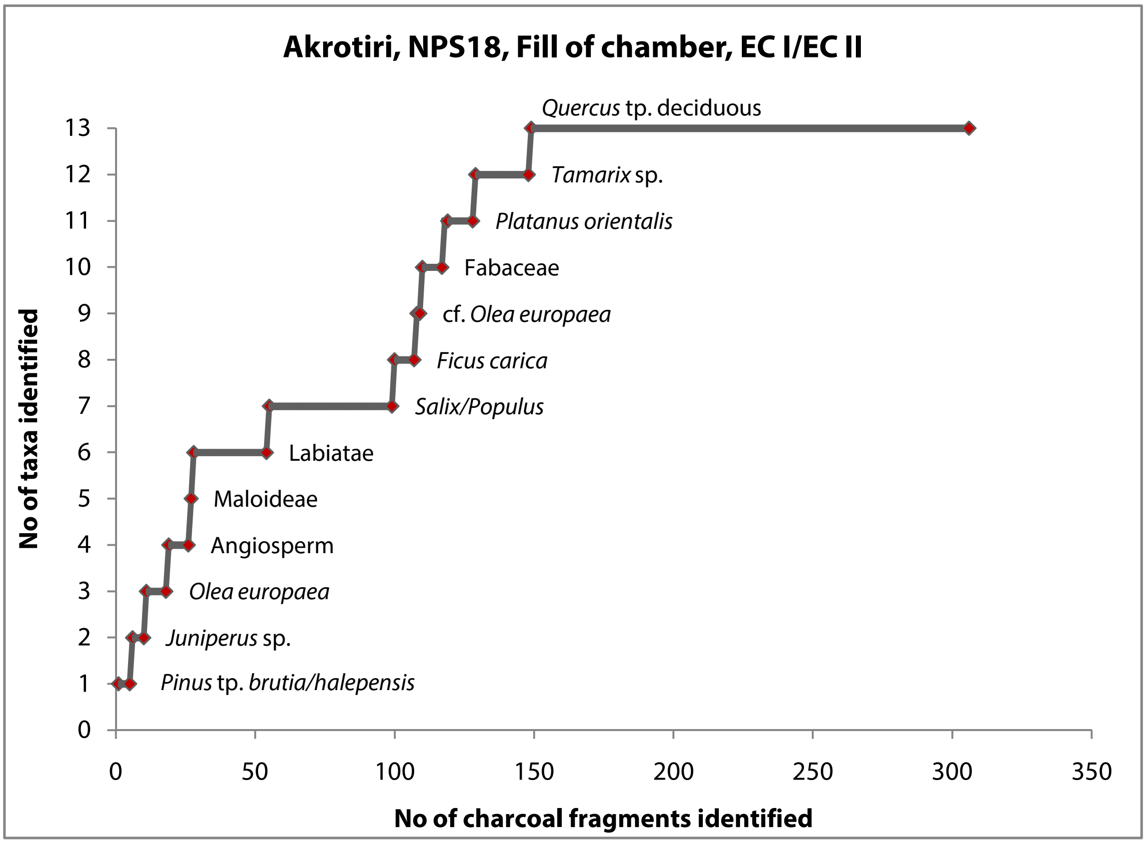



**Figure III.1:** Saturation curve of Chamber of NPS18, Akrotiri, Thera.

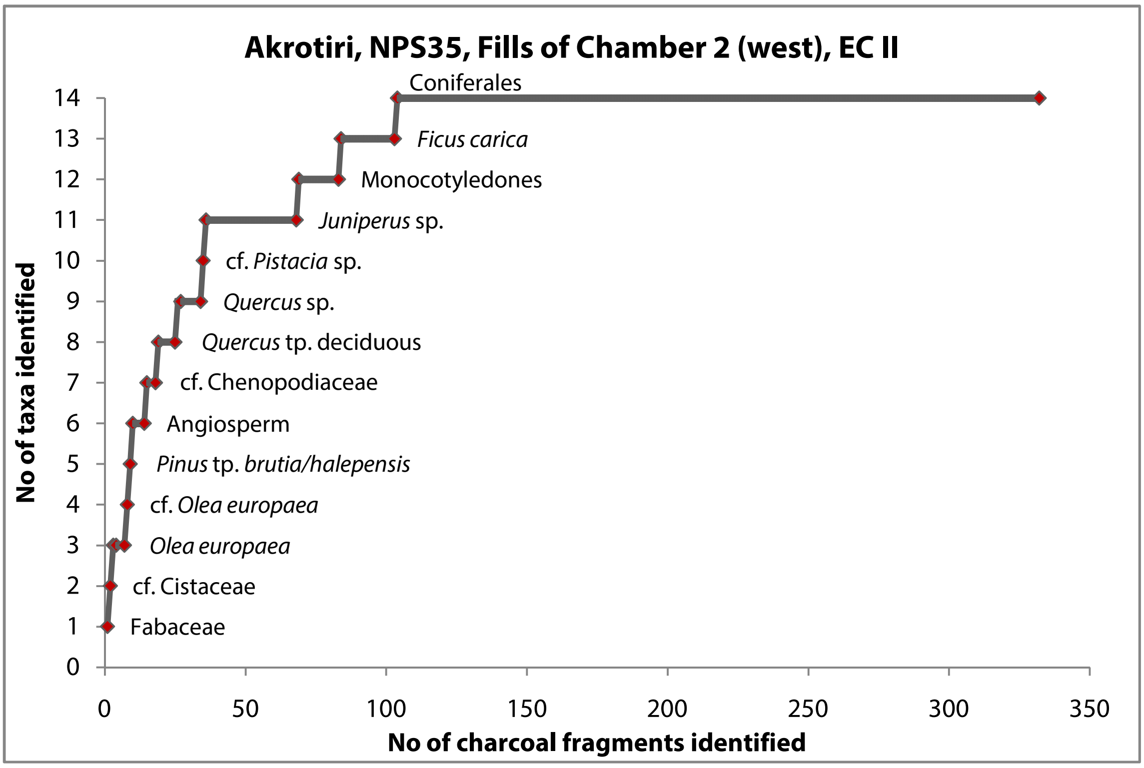



**Figure III.2:** Saturation curve of Chamber 2 of NPS35, Akrotiri, Thera.

formation on how stratigraphical layers are spread across the excavation or which stratigraphical layers are held in common between the shafts, the saturation curves are presented here by shaft and by stratigraphical layer per period.

Deposits dated to the EC period derive from the chambers of NPS18, the west chamber of NPS35, and NPS66Π. As it can be seen from Figure III.1, which represents the fill of the chamber of NPS18, the effort-return curve saturates at fragment 149. A shorter period of stabilization is met with from fragment 56 to fragment 99. Important is the fact that the three most common taxa of the period, namely *Pinus* type *brutia/halepensis, Juniperus* sp., and *Olea europaea* were found by fragment 12. In the case of the west chamber of NPS 35 (Fig. III.2), the curve at first increases rapidly until fragment 19, while a short stabilization point is met with between fragments 36 to 68. The curve finally saturates from fragment 104 onwards. The three of the four most common taxa, namely, *Pinus* type *brutia/halepensis, Olea europaea* and Fabaceae were identified by fragment 9, while *Juniperus* sp. was only presented from fragment 36 and on.

During the transitional period between the EC III and the MC periods, the common taxa, namely *Olea europaea*, *Pinus* type *brutia/halepensis*, Fabaceae, and *Juniperus* sp., remained the same as before. As can be seen in Figure III.3, where the first phase of the backfill of the chamber of NPS 66Π is presented, *Pinus* type *brutia/halepensis*, *Olea europaea*, and Fabaceae where identified among the first three fragments, while *Juniperus* sp. was found within the first forty specimens analysed. Although the total number of fragments is low, the curve seems to saturate around the first forty fragments, especially if it is considered that the last taxon is characterized as *confer*. Similarly, in the deposit of the second phase (Fig. III.4), *Pinus* type *brutia/halepensis*, *Olea europaea*, and *Juniperus* sp. were identified first, while Fabaceae occurs among the first fifty fragments. The saturation curve presented below (Fig. III.4) increases fast until fragment 14, and then more gradually until fragment 104, where it meets its first point of stabilization. The curve seems to finally saturate from fragment 156 and on.

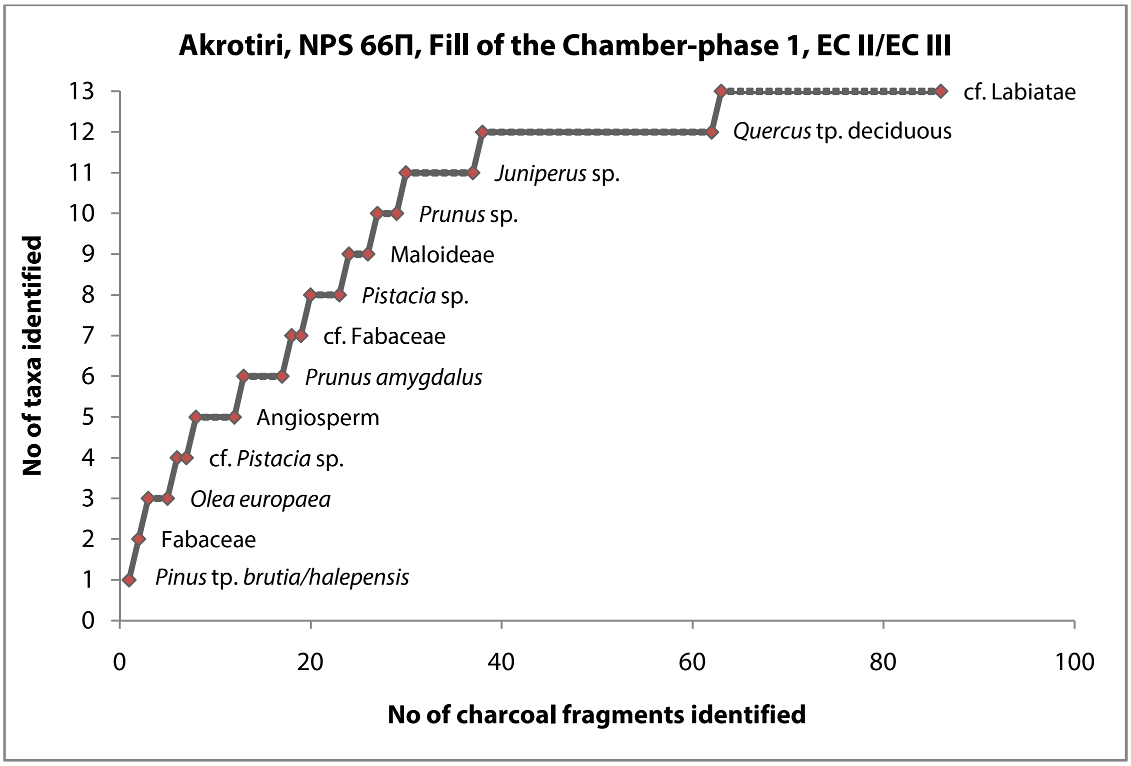



**Figure III.3**: Saturation curve of Chamber (phase 1) of NPS66Π, Akrotiri, Thera.

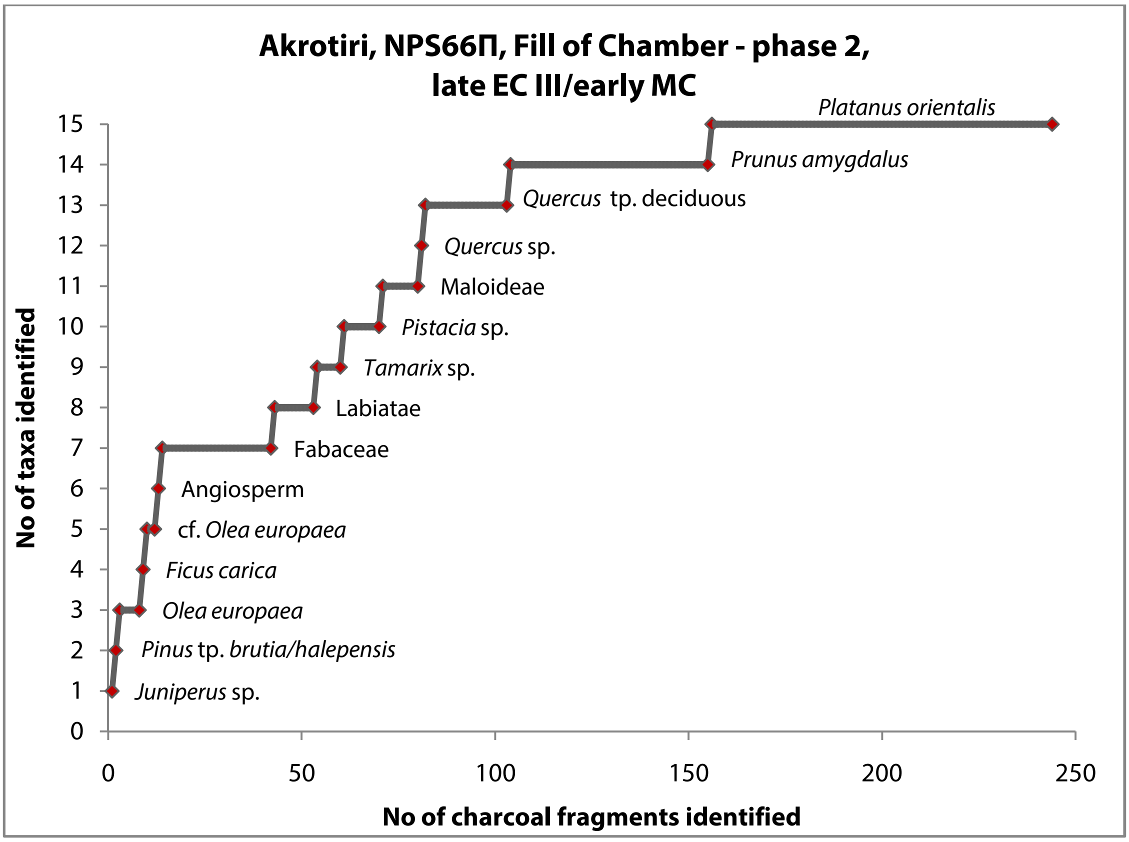



**Figure III.4**: Saturation curve of Chamber (phase 2) of NPS66Π, Akrotiri, Thera.

In the MC period, are dated the fills of the abandoned ground floor of the building excavated in NPS 66Π, as well as the sub-layers of Floor 3 found at the same shaft. Additionally to this period are dated the fills covering the chamber of NPS67and its entrance, the substrata of the floor of Room 1 of NPS35 and finally, the first deck of the Square of the Sacral Horns by the same shaft.

The fill of the abandoned ground floor of the building excavated within NPS66Π contained 477 wood charcoal fragments. The effort-return curve of this deposit (Fig. III.5) increases rapidly almost until fragment 101, by which point 65% of the taxa identified has been presented. From fragment 102 until fragment 145, a short period of stabilization exists. Then, the curve rises fast until fragment 195. The curve finally saturates from fragment 305 on. It is observed that *Olea europaea*, Fabaceae, *Juniperus* sp., and *Pinus* type *brutia/halepensis* were identified among the first ten taxa. However, only *Olea europaea* and Fabaceae were found within the first fifty fragments.

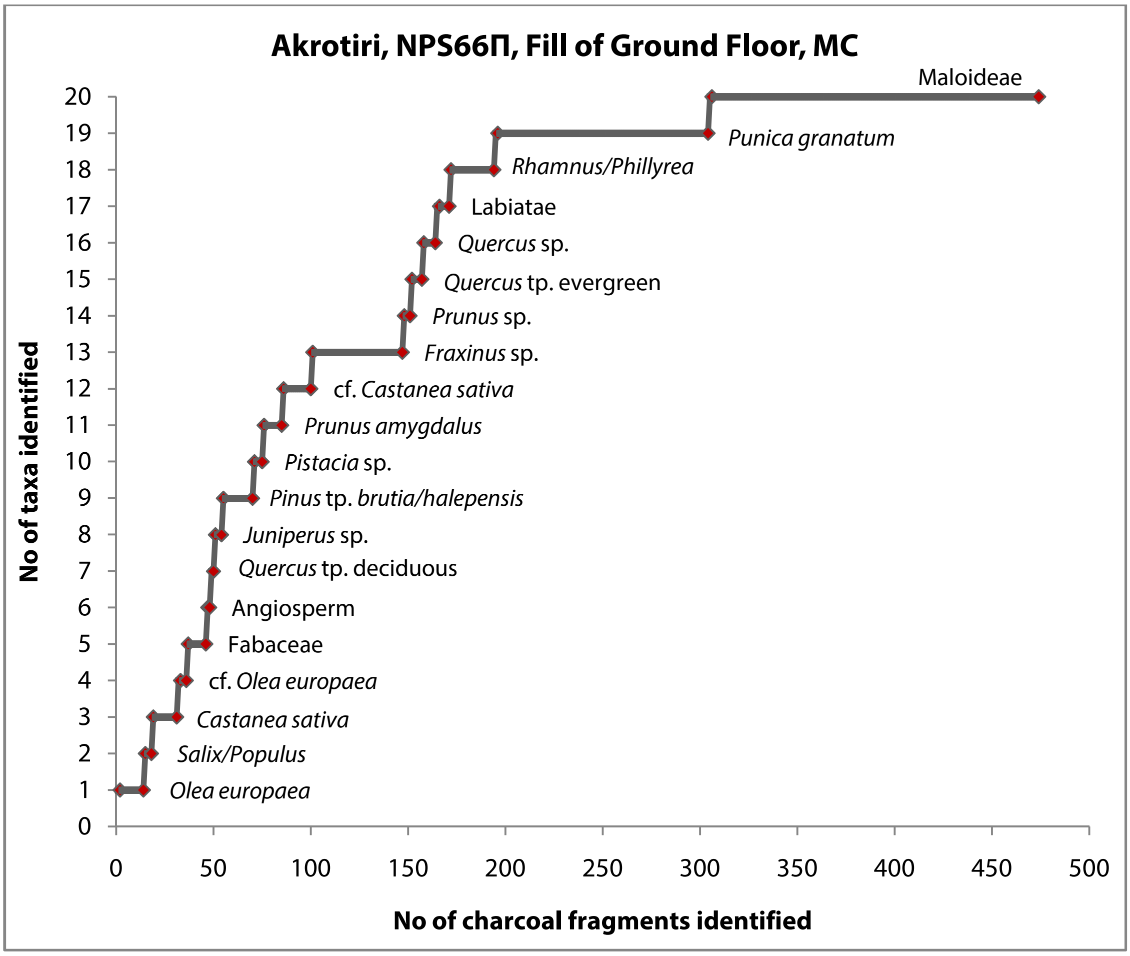



**Figure III.5**: Saturation curve of the fill of Ground Floor of the building excavated at NPS66Π, Akrotiri, Thera.

The substrata of Floor 3 at NPS66Π were excavated in three distinct layers. Figure III.6 presents the saturation curve of layer 21, the first substratum of Floor 3. This layer contained in total 721 fragments. As it can be seen, the curve rises abruptly until fragment 57 and then more gradually until fragment 271. At this point 23 out of 27 taxa identified in this deposit had been found. From fragment 272 and for almost 100 further fragments, the curve achieves a short stabilization point, after which four more taxa were introduced by fragment 506. Of these four taxa, only Cistaceae and *Cedrus libani* could be characterized as new, as the other two represent taxa characterized only as *confer*. *Olea europaea*, *Juniperus* sp., and Fabaceae were identified among the first fifty specimens studied. Additionally, in this deposit within the same number of fragments were found also *Arbutus* sp. and *Tamarix* sp., which from the MC period onwards are present in almost all the curves.

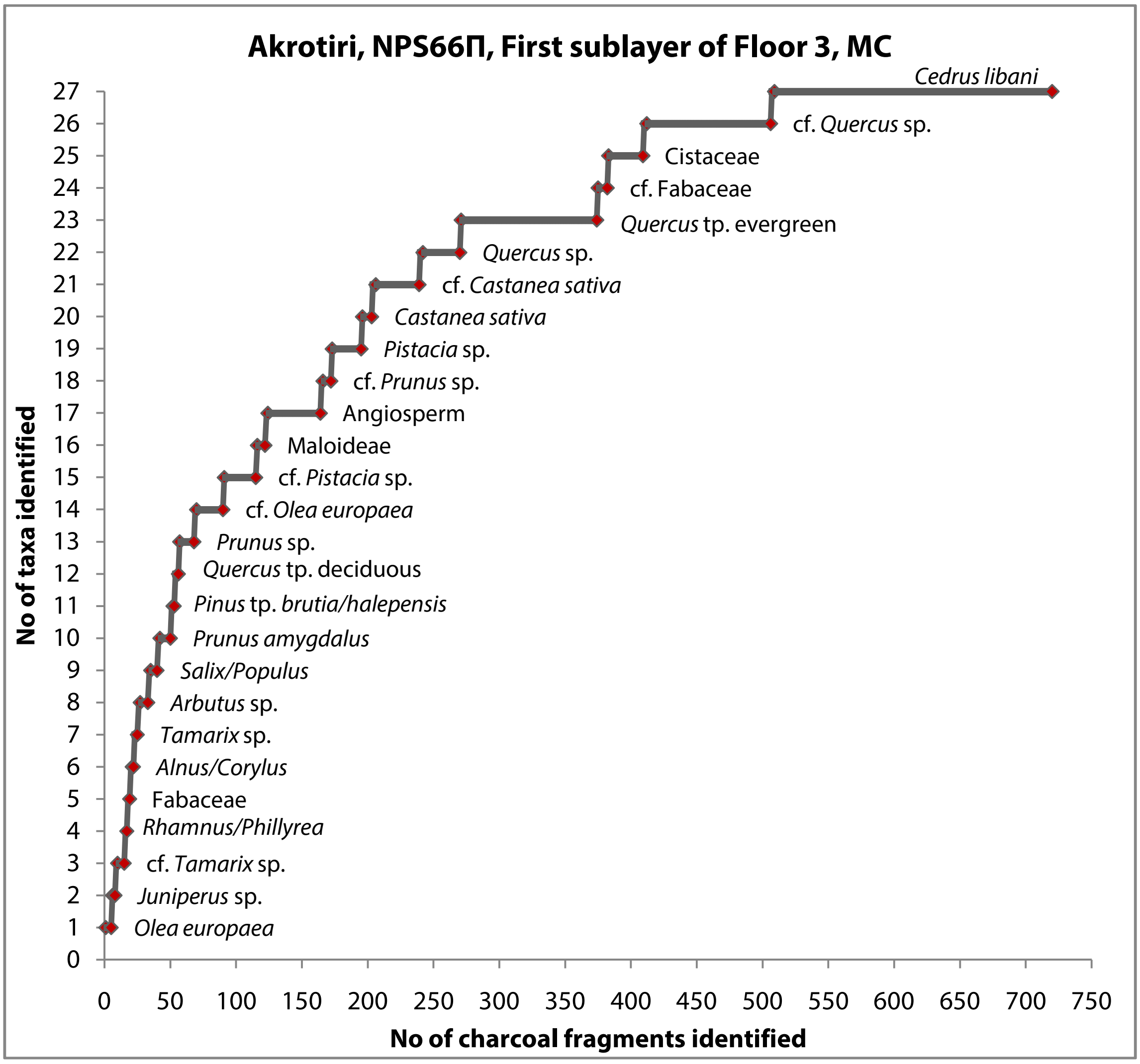



**Figure III.6**: Saturation curve of the first substratum of Floor 3, NPS66Π, Akrotiri, Thera.

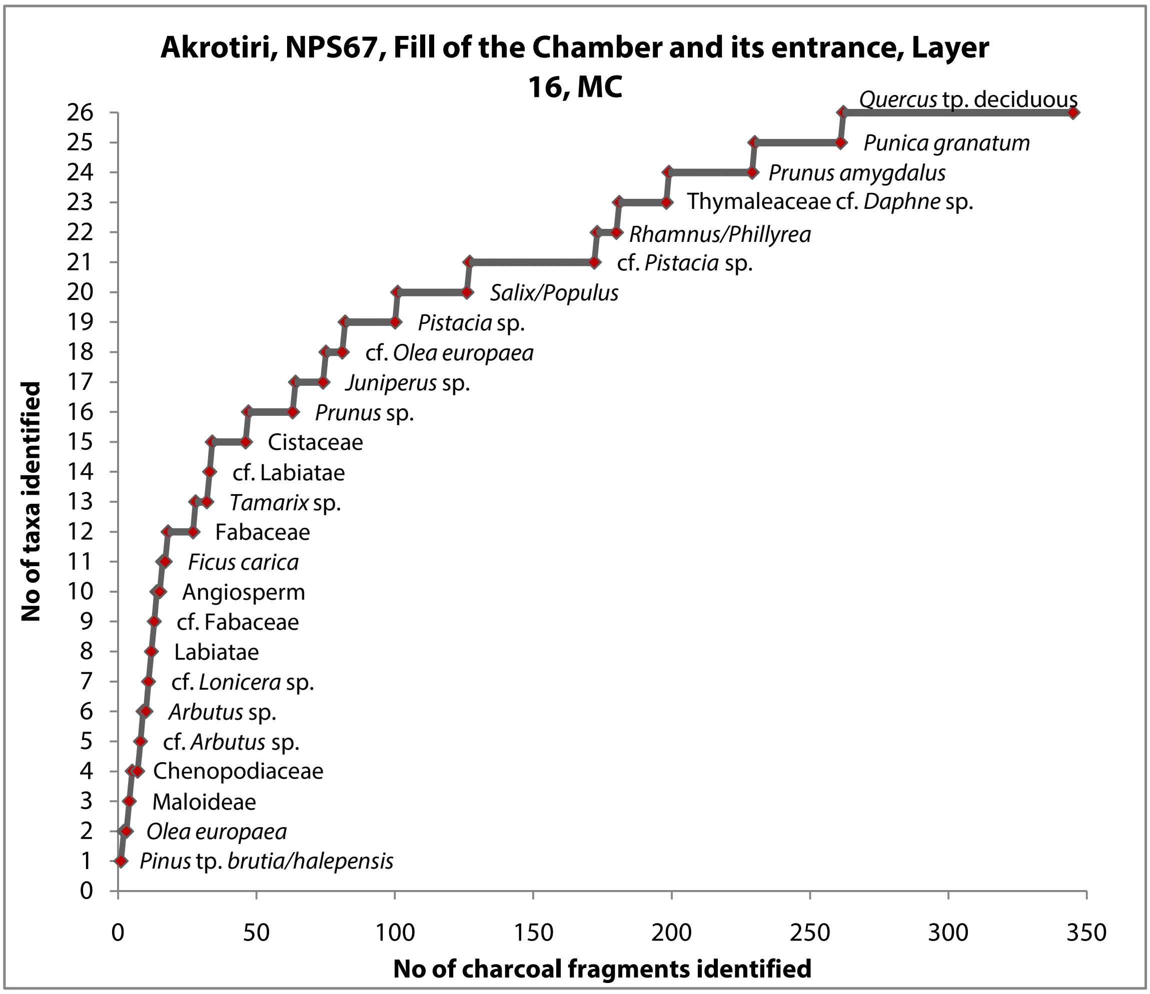



**Figure III.7**: Saturation curve of the fill and entrance of the Chamber of NPS67, Akrotiri, Thera.

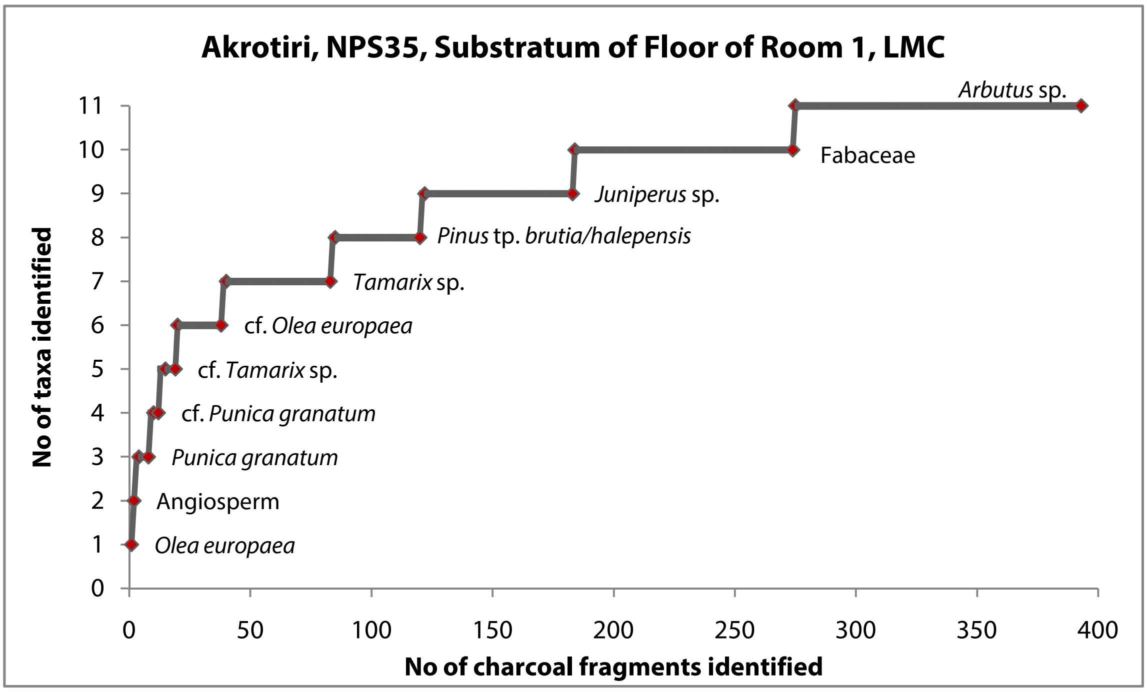



**Figure III.8**: Saturation curve of the Substratum of Floor of Room 1 excavated in NPS35, Akrotiri, Thera.

The samples taken from the layer (layer 16) which filled the chamber of NPS 67 and its entrance (Fig. III.7) enclosed 345 wood charcoal fragments. The saturation curve of this layer rises abruptly for almost the first 127 fragments. At this point, 80.76% of the taxa identified in this assemblage had been recovered. From fragment 127 until fragment 262 the curve continues to rise by five more taxa. *Olea europaea* was again identified among the first fragments studied, while *Arbutus* sp., Fabaceae, and *Tamarix* sp. were presented within the first fifty specimens, as in the previous curve.

The fills coming from the substrata of the Floor of Room 1 and the first (earlier) deck of the Square of the Sacral Horns, both excavated in NPS 35, are dated to the late MC period. The saturation curve of the substratum of floor of Room 1 (Fig. III.8) rises fast for the first 20 fragments, at which point 54.5% of the taxa found has been identified. After this point, the curve increases at a slower rate and seems to saturate from fragment 274 onwards. The two taxa identified first were *Olea europaea* and *Punica granatum*. In this curve some of the common taxa of the MC period, like *Tamarix* sp., *Juniperus* sp., Fabaceae, and *Arbutus* sp. are also present, but they were identified only after the first 100 specimens. This pattern is also observed at the other curves of this period.

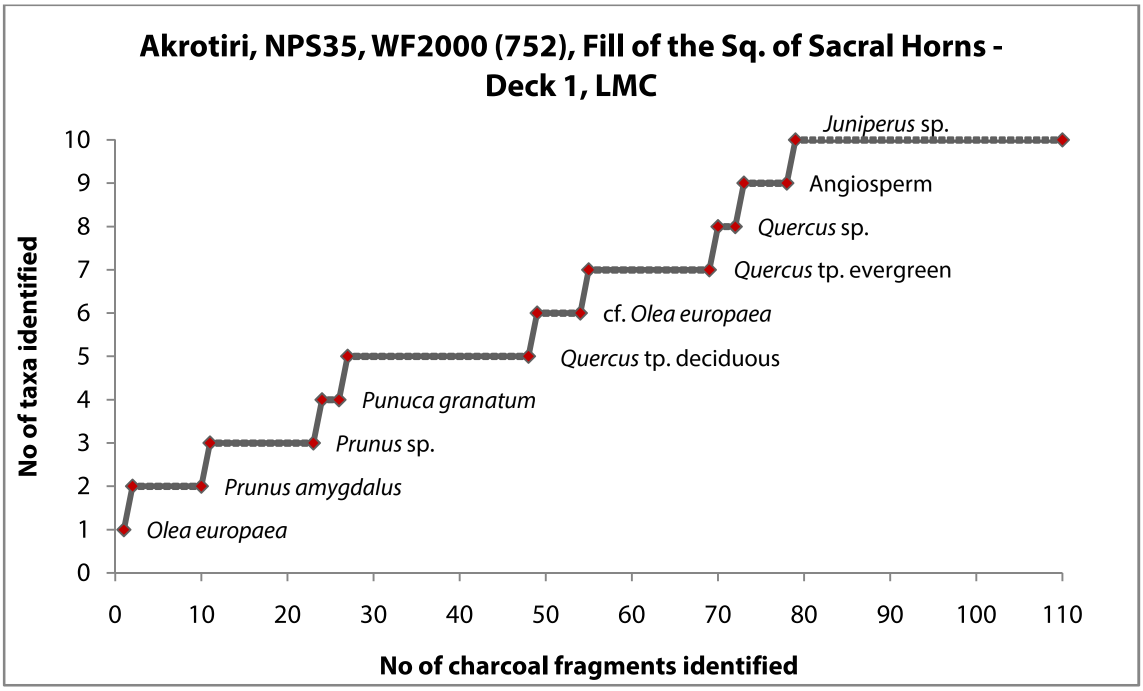



**Figure III.9**: Saturation curve of Deck 1 (layer 5) of the Square of the Sacral Horns, NPS35, Akrotiri, Thera.

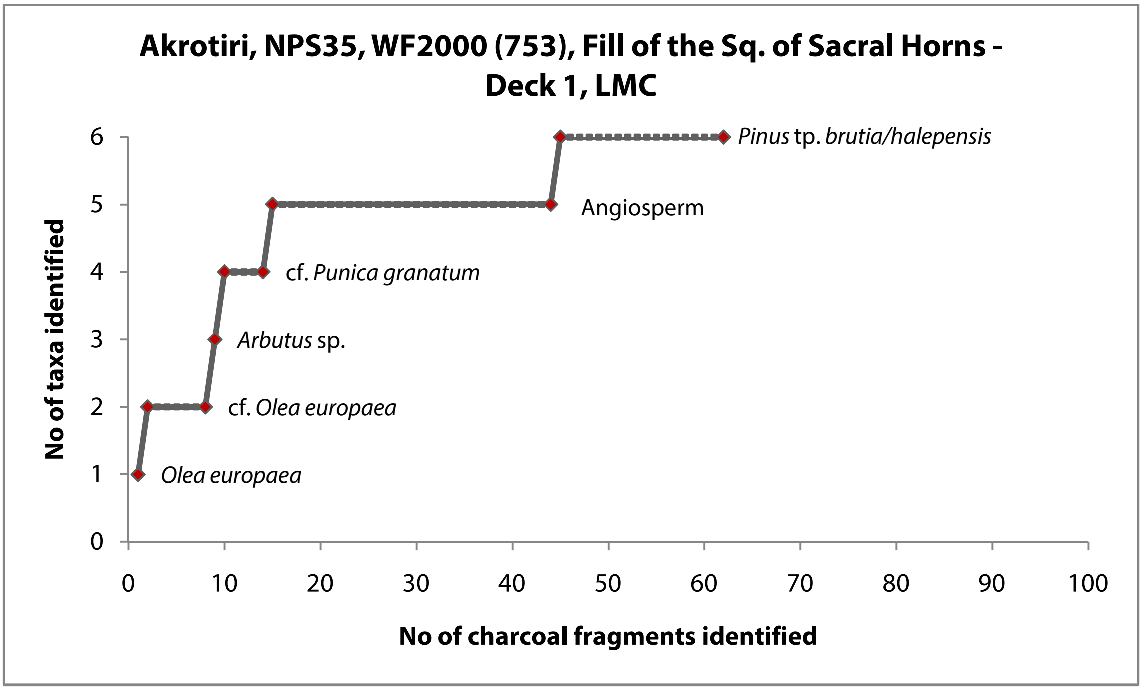



**Figure III.10**: Saturation curve of Deck 1 (layer 7) of the Square of the Sacral Horns, NPS35, Akrotiri, Thera.

Finally, the first (earlier) deck of the Square of the Sacral Horns was excavated in three distinct layers, of which only two contained wood charcoal macroremains. Layer 5 contained in total 111 fragments, while layer 7 had only 62. As can be seen from their saturation curves (Fig. III.9 and Fig. III.10), none of them saturates at all, due to the low number of fragments recovered. However, it is to be observed that *Olea europaea*, among the common taxa throughout the MC period, was identified within the first fragments.

The samples collected during the excavation from the two trial trenches at the terrace of the Square of the Cenotaph are dated to the late MC/early LC I period. As can be seen from Figure III.11, this assemblage is very rich in taxa. The saturation curve of this deposit rises for the first 63 fragments, at which point it achieves a stabilization point until fragment 103. After this point two more taxa were added, while from fragment 106 and on the curve finally saturates. *Olea europaea*, the most common species during the late MC and LC I period (see below), was identified within the first ten fragments. Other taxa which were identified among the first fifty fragments in the majority of the assemblages from the aforementioned periods were *Punica granatum* and *Prunus amygdalus*.

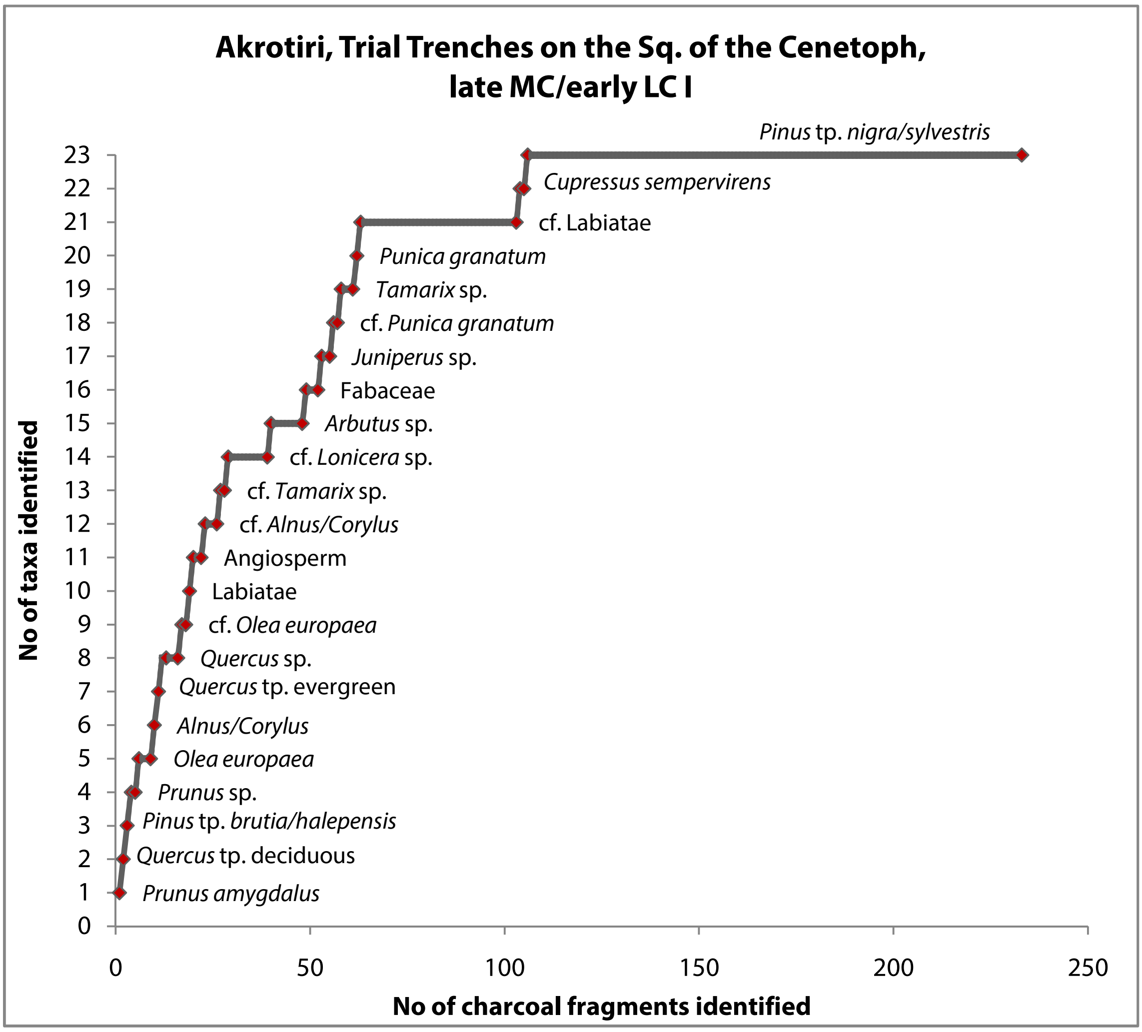



**Figure III.11**: Saturation curve of the Trial Trenches in the Square of the Cenotaph, Akrotiri, Thera.

Fill layers dated to the LC I period come from NPS35 and the Square of the Cenotaph. More specifically, samples are from the second deck of the Square of the Sacral Horns (NPS35) and from the drainage pipe excavated in the alley between Xeste 5 and the Square of the Cenotaph, as well as the top-surface of the same square.

The second deck of the Square of the Sacral Horns (NPS35) is composed of two archaeological layers which contain a very low number of wood charcoal macroremains. Neither of the two curves (Fig. III.12 and Fig. III.13) presents a saturation point, although both have longer stabilization periods after fragment 50. In both curves, *Olea europaea* was the species identified first, while *Juniperus* sp., *Quercus* sp., *Punica granatum*, and *Prunus amygdalus* were identified among the first fifty specimens.

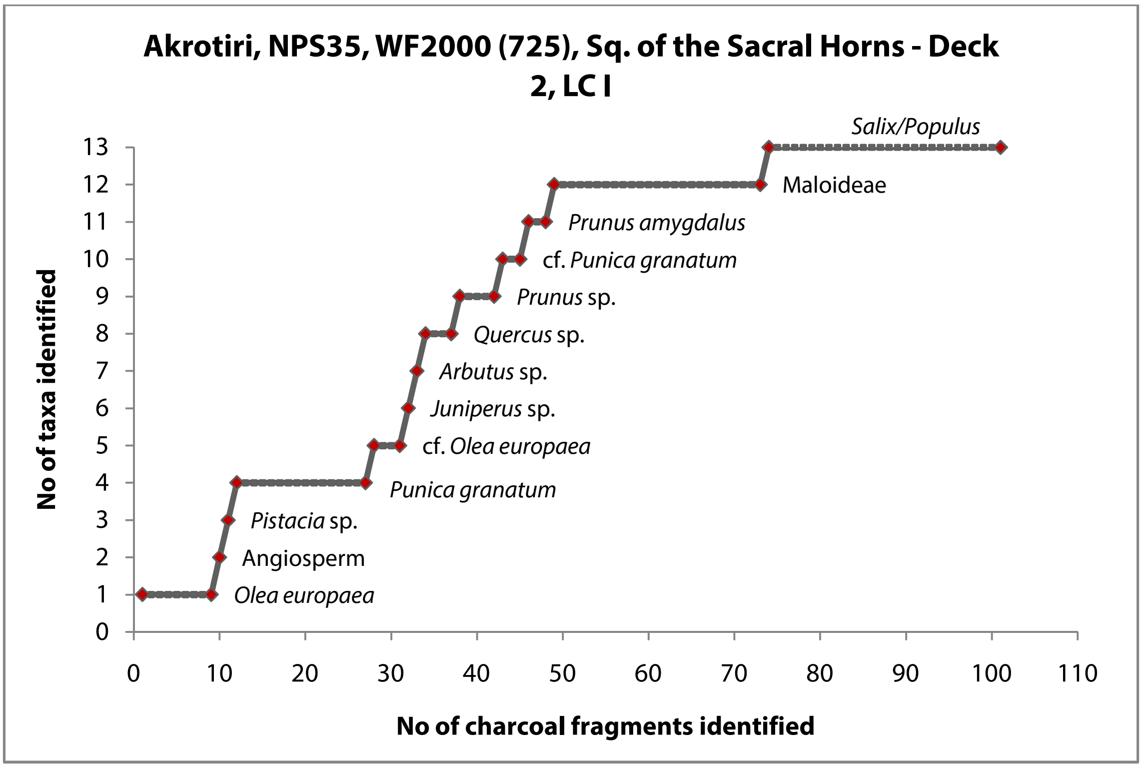



**Figure III.12**: Saturation curve of Deck 2 (layer 3) of the Square of the Sacral Horns, NPS35, Akrotiri, Thera.

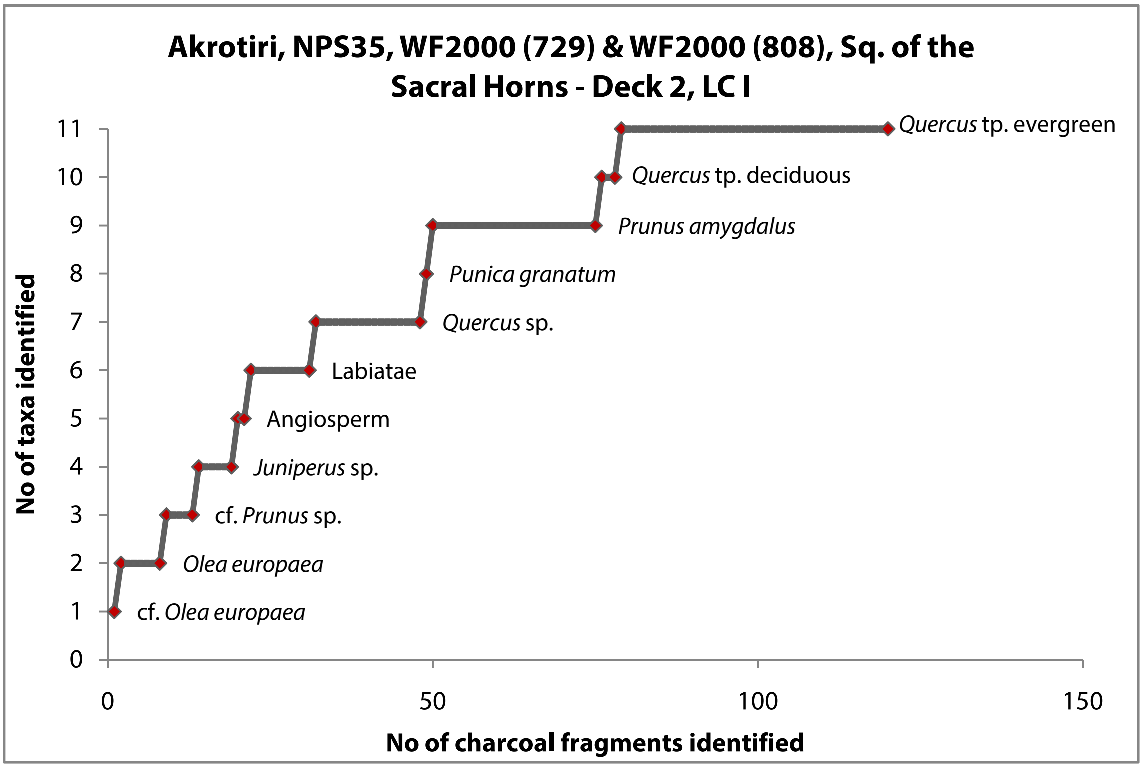



**Figure III.13**: Saturation curve of Deck 2 (layer 4) of the Square of the Sacral the Horns, NPS35, Akrotiri, Thera.

Finally, the aforementioned taxa are also common in the saturation curve of the samples recovered from the drainage pipe of the alley between the Square of the Cenotaph and Xeste 5 and the top-surface of the same Square. This curve rises for the first 36 fragments (Fig. III.14). From here to fragment 55, the curve presents a stabilization point, before it rises again until fragment 76. From this point on the curve finally saturates.

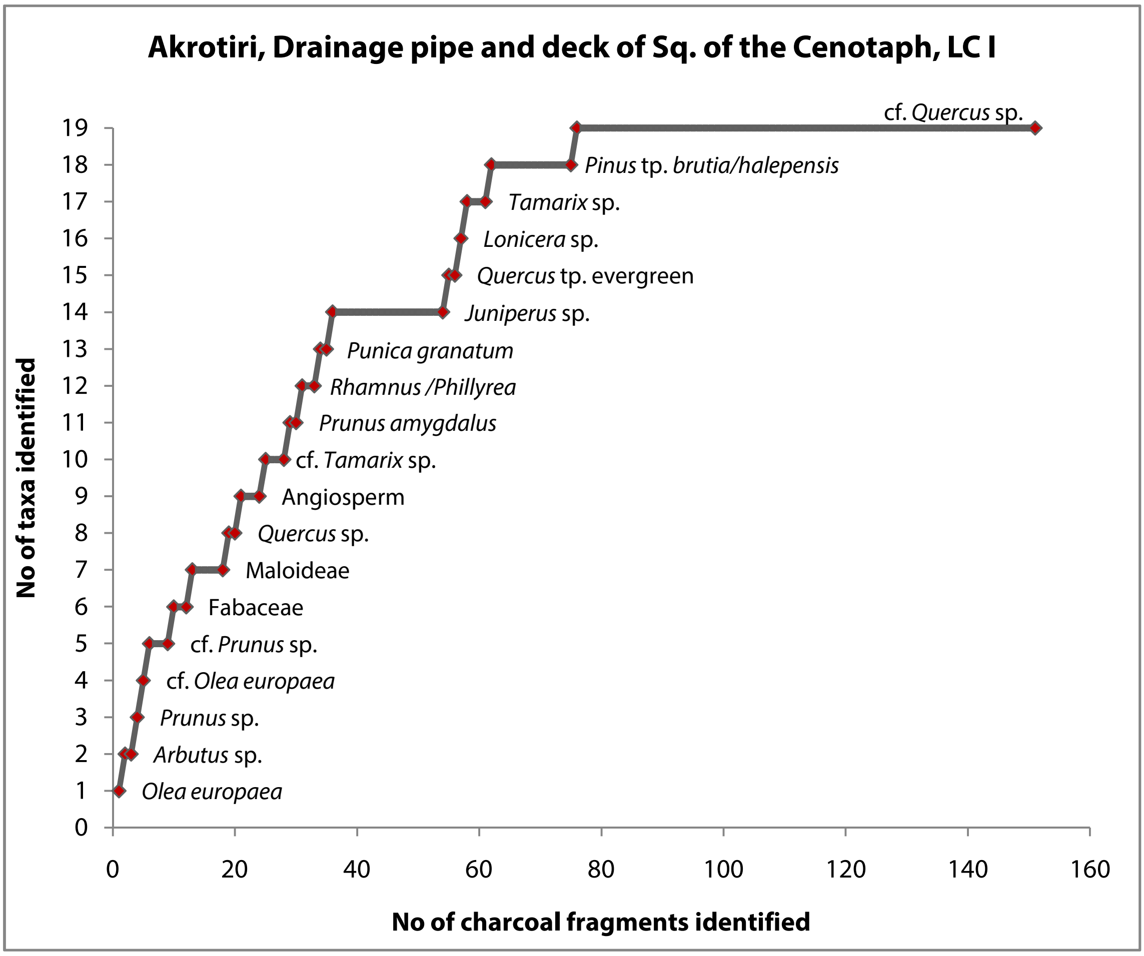



**Figure III.14**: Saturation curve of deposits from the drainage pipe and the deck of the Square of the Cenotaph, Akrotiri, Thera.

Overall, all stratigraphical layers contain at least ten taxa, with the only exception being that of the first deck of the Square of the Sacral Horns (Fig. III.10). Moreover, in each period the common taxa were identified among the first 50 specimens of each deposit, establishing a trend observed at all curves. As can be seen in the saturation curves relating to samples dated to the EC period (Figures III.1 to III.3), the most common taxa of this period are *Pinus* type *brutia/halepensis, Olea europaea, Juniperus* sp., and Fabaceae. This remained so for all contexts from this period; every time they were identified among the first taxa during the analysis of the samples, and in the majority of cases from among the first 50 fragments studied. Additionally, it is observed that in each of the assemblages of this period, after the analysis of the first 100 specimens, more than half of the taxa identified were present, while at 150 fragments this percentage has risen to above 90%. The aforementioned observations, along with the rather high number of fragments coming from each context, make these samples appropriate for providing information on the taxa present on the island during the EC period.

During the MC period, *Olea europaea* was the most common species: it is identified within the first fragments analysed in all curves from this period (Figures III.4 to III.7). Other taxa with an almost constant presence among the fifty first specimens analysed were Fabaceae, *Juniperus* sp., *Arbutus* sp., and *Tamarix* sp. In the two curves from NSP66Π (Fig. III.5 and III.6), approximately 40% of the total number of taxa identified was present by fragment 50. In contrast, at the same number of fragments in the curve of the fill of chamber excavated in NPS67 (Fig. III.7) 61.53% of the taxa were present. In the two curves of NPS66Π mentioned, 60% of the taxa was present after 100 and 150 fragments were encountered, respectively. The higher number of fragments needed for the effort-return curves of the MC period to achieve saturation in comparison to those of the previous period could be explained as result of the higher number of taxa present in the former. Overall, homogeneity is observed in the taxa identified in all assemblages of the MC period.

Similarly, during the late MC period, *Olea europaea* was again the most common species, followed by *Punica granatum*. Other taxa present in at least two of the three curves of this period (Fig. III.8 to III.10) are *Arbutus* sp. and *Juniperus* sp. In all cases the percentage of the taxa identified in the first 50 fragments exceeds 60% of the total. Additionally, in the samples of this phase and especially those related to dumps, exogenous taxa were identified, which could have been products of carpentry (i.e. *Castanea sativa, Pinus* type *nigra/sylvestris*) or cultivation (i.e. *Punica granatum*). Despite the presence of these taxa, the reproducibility of the samples and the fact that the common taxa remained the same throughout the MB period in almost every case, make the results able to provide information on the vegetation of the island during this period, as well as on tree management.

Finally, samples coming from deposits dated to the LC I period (Figures III.12 to III.14) were very few. For the most part, they did not contain a large number of fragments. However, the most common species, which was again *Olea europaea,* was identified among the first fragments studied in all cases and in addition the taxa contained in the samples were more or less the same. Thus, as in the case of the MC period, the fact that the results are reproducible allows their inclusion in the study of the vegetation and tree management occurring on the island during this phase.

#### 7.1.2. Representativeness of the charcoal macroremains–Heraion

In Heraion, samples from open spaces come from deposits dated to the Ch, EB, MB, Archaic, and Roman periods. In general, these deposits are poor in wood charcoal fragments, as the fragment counts rarely exceed 150 specimens. Exceptions comprise the samples coming from the Central Sector dated to the EB III period and those from the North Sector dated to the Roman period.

The only Ch deposit coming from an open area has been excavated in the South Sector. From this deposit, one sample was collected, containing 157 wood charcoal fragments. The effort-return curve (Fig. III.15) saturates at fragment 53, while the taxa identified among the first fragments were *Quercus* type evergreen and *Olea europaea*. However, as there is only one sample from this period, these results are not reproducible, thus only the presence of the taxa will be taken into consideration.

Samples dated to the EB period are from the South and the Central Sectors. The number of wood charcoal fragments recovered from the deposits of the South Sector dated to the EB II period is very low, just 53 specimens in total. These deposits, and consequently the samples within them, belong to different archaeological phases (Heraion 4 to Heraion 1). The low number of wood charcoal macroremains from these layers makes the production of saturation curves meaningless.

Samples from the Central Sector dated to the EB III period were recovered from three distinct stratigraphical units. Figure III.16 presents the saturation curve of stratigraphical unit 66/13, and Figure III.17 shows the curve of stratigraphical unit 69/13. No saturation curve was made for stratigraphical unit 60/13, as this contained only 7 wood charcoal fragments.

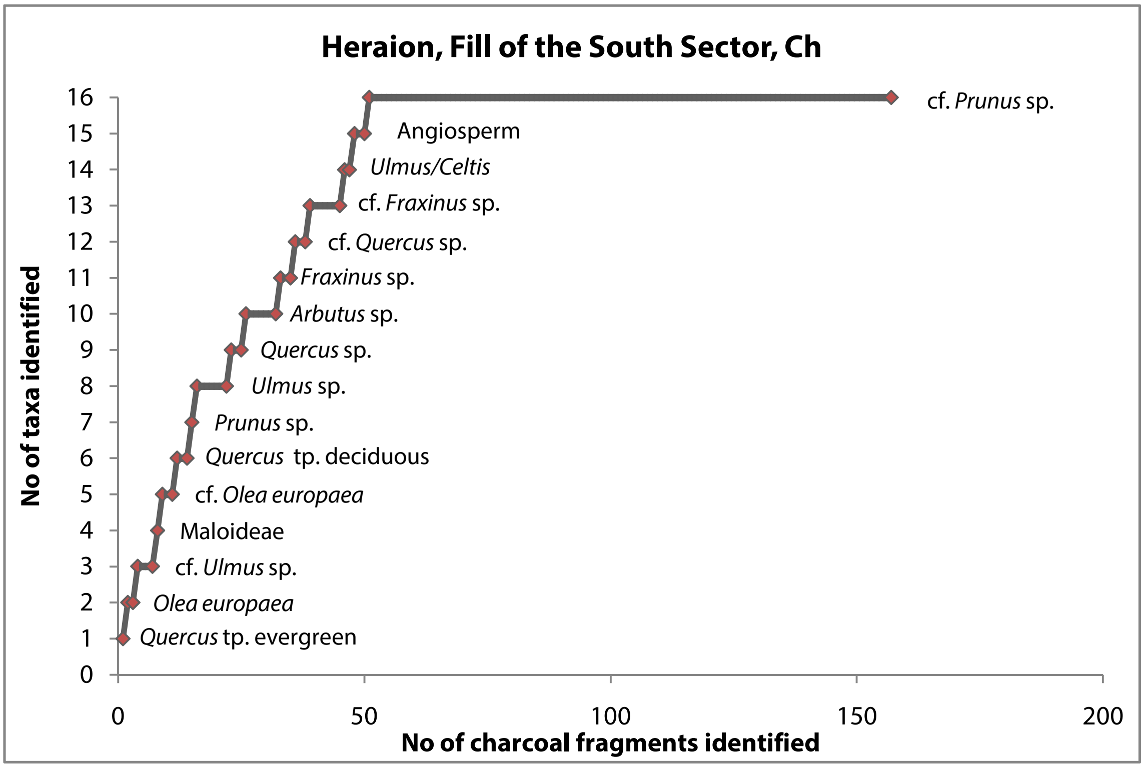



**Figure III.15**: Saturation curve of the Chalcolithic deposit of South Sector, Heraion, Samos.

The curve of stratigraphical unit 66/13 (Fig. III.16) seems to stabilize from fragment 57 onwards, although after this point three more taxa were identified. From these three taxa only *Prunus amygdalus* can be considered a new species, as the other two correspond to cf. *Prunus* sp. and *Ulmus/Celtis*, meaning taxa which were not possible to be identified more accurately. Additionally, *Prunus* sp. and *Ulmus* sp. have been identified earlier, as can be seen in the same curve. Similarly, the curve of stratigraphical unit 69/13 (Fig. III.17) stabilizes between fragments 49 and 83, and then two more taxa are introduced. Again these taxa correspond to fragments characterized as *confer*. Both curves present homogeneity in the taxa included. Common taxa between these deposits are *Prunus* sp., Fabaceae, *Arbutus* sp., and *Quercus* type deciduous. All these were among the first eight taxa identified and they were present in the first 20 fragments analysed. Additionally, in both cases the curves saturate close to 50 fragments. All the above suggest that these deposits are good indicators of the vegetation in the surroundings of Heraion, during the EB period.

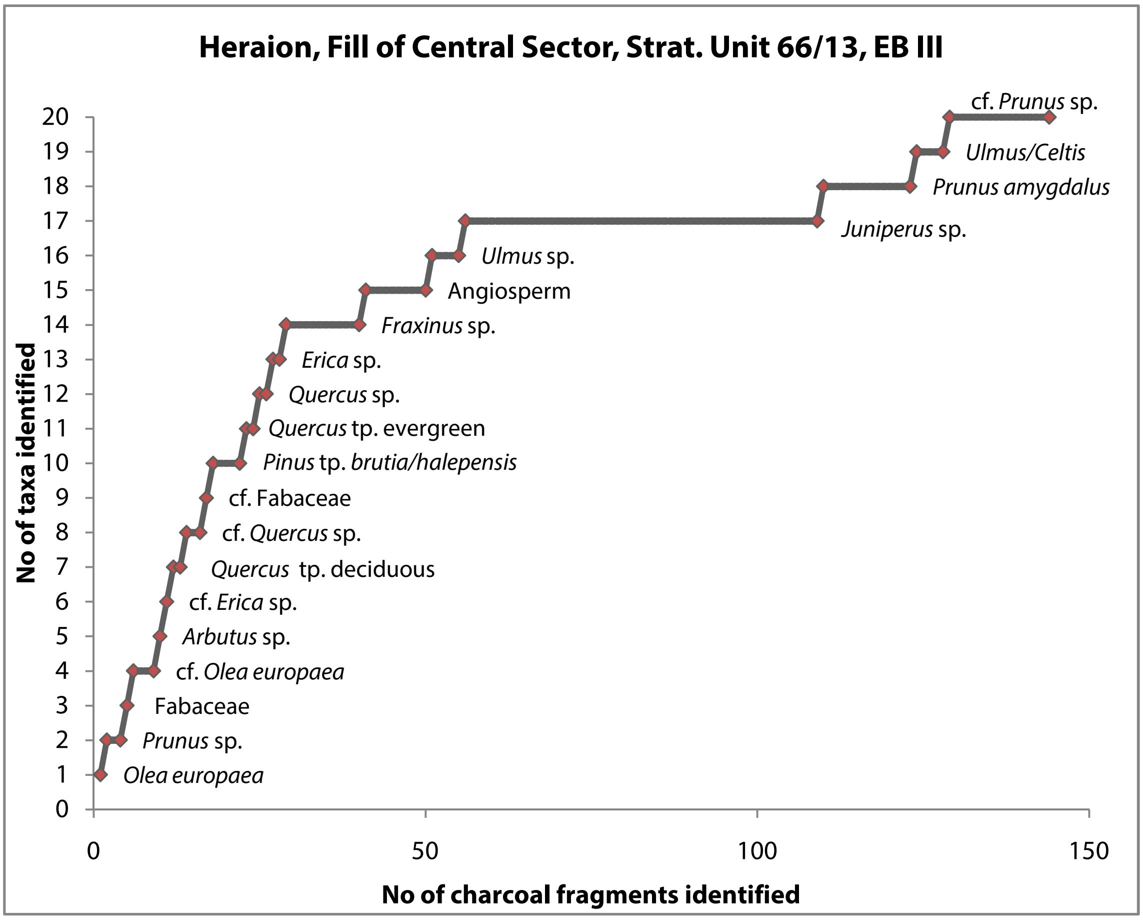



**Figure III.16**: Saturation curve of Strat. Unit 66/13 of Central Sector, Heraion, Samos.

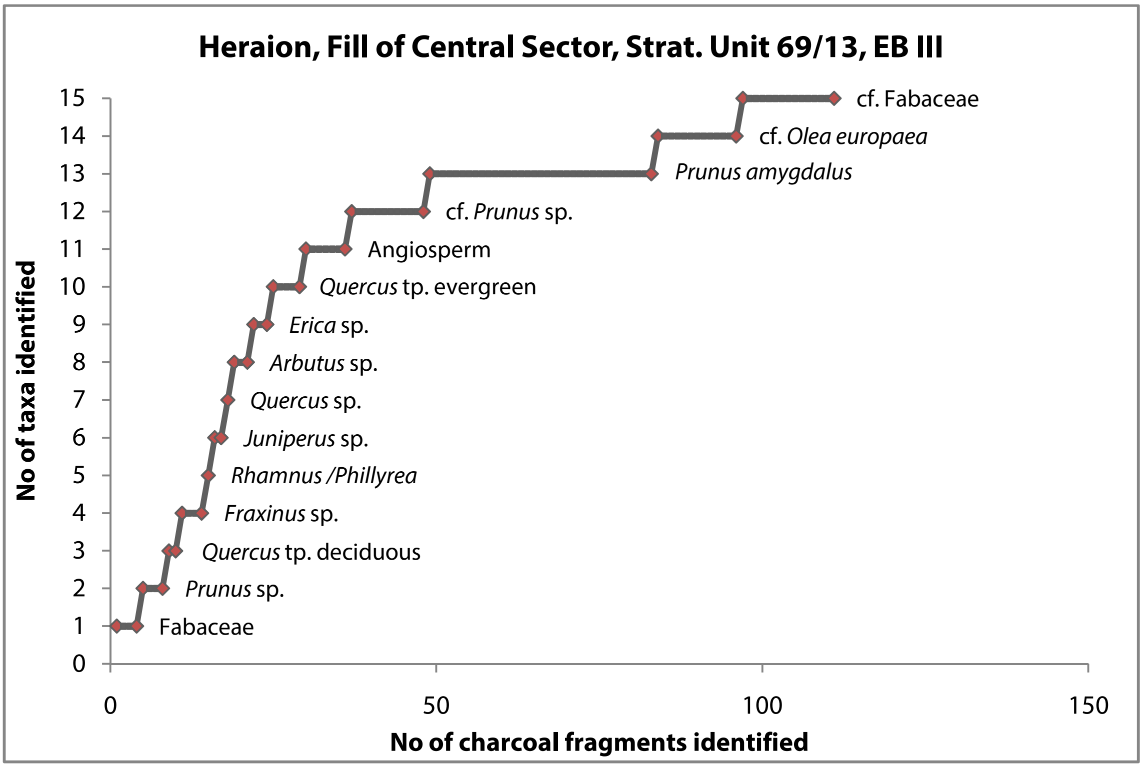



**Figure III.17**: Saturation curve of Strat. Unit 69/13 of Central Sector, Heraion, Samos.

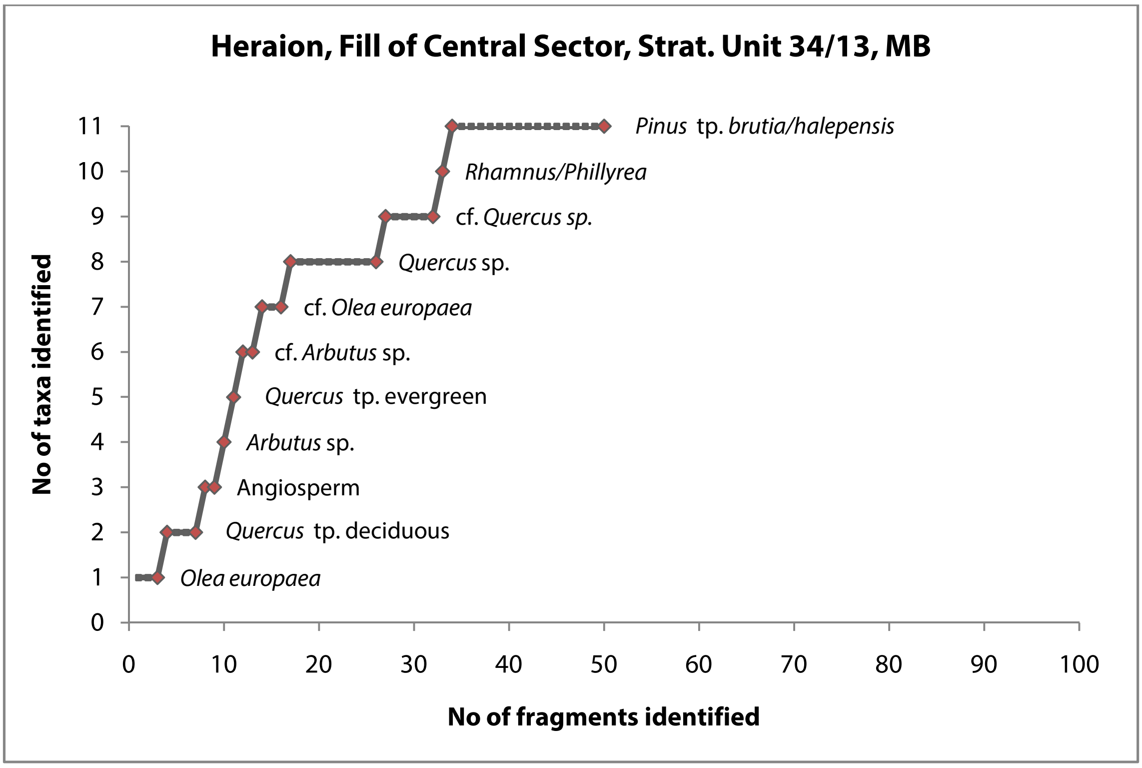



**Figure III.18**: Saturation curve of Strat. Unit 34/13 of Central Sector, Heraion, Samos.

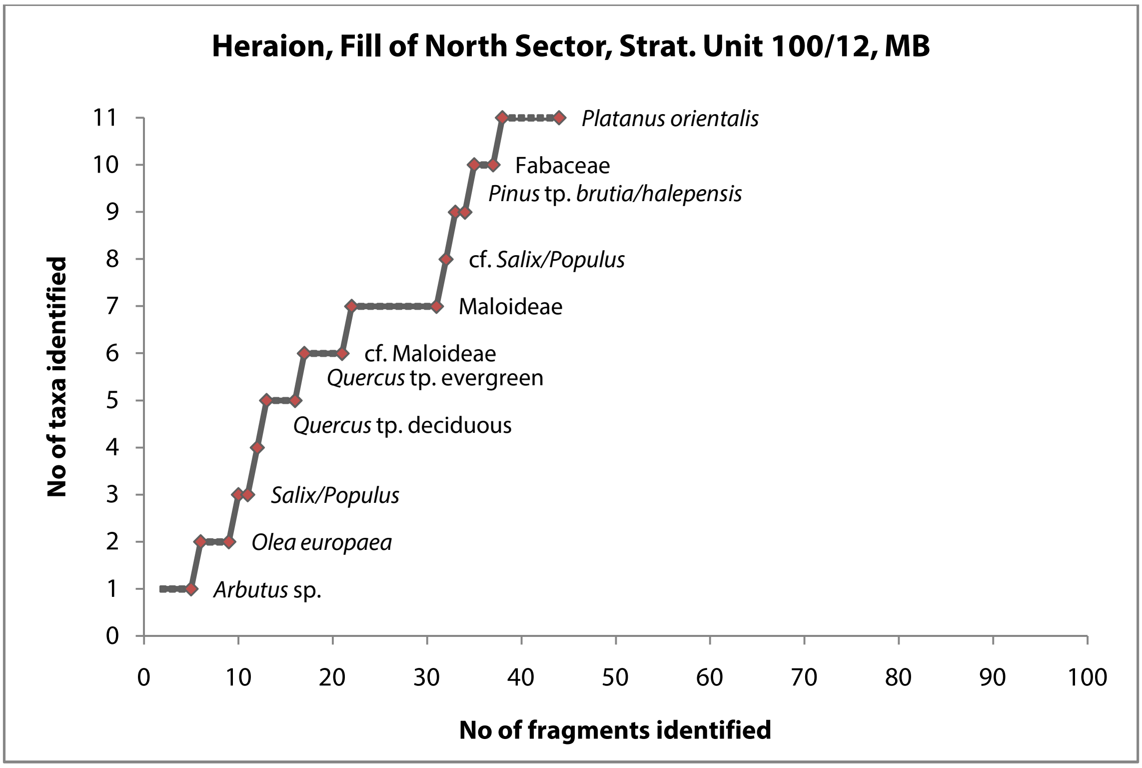



**Figure III.19:** Saturation curve of Strat. Unit 100/12 of North Sector, Heraion, Samos.

The total count of wood charcoal fragments dated to the MB age rises to 135 fragments. These fragments come from three different archaeological phases of this period. More specifically, the samples were recovered from the North and the Central Sectors and they are dated to the MB I, MB III and MB VI. Due to the low number of fragments, only two effort-return curves were possible to be produced. Figure III.18 presents the saturation curve of stratigraphical unit 34/13 and Figure III.19 that of stratigraphical unit 100/12. As can be seen, neither curve saturates. However, the facts that in both cases *Olea europaea*, *Quercus* type deciduous, *Arbutus* sp., and *Quercus* type evergreen were identified among the first 12 specimens and that an overall homogeneity of the taxa represented exists, indicate that these assemblages can be used to estimate the common taxa of the vegetation surrounding the site and the taxa used in principal to cover the needs for firewood by the inhabitants.

Very few wood charcoal fragments were recovered from the Archaic deposits excavated at the Central Sector, from where the only sample collected contained 20 fragments. In this case the results cannot be used to extract accurate palaeoecological information, thus only the presence of taxa will be considered during discussion.

Finally, in the North Sector were excavated archaeological layers dated to the Roman period, which belong to the archaeological phase Roman I of Heraion. The two stratigraphical units with the highest number of wood charcoal fragments are 17/11 (Fig. III.20) which comprise the deposit of the foundation of HS10:25 and HS10:38, and 35/10 (Fig. III.21) which was excavated to the north of HS10:25. The saturation curve of 17/11 looks to stabilize after fragment 56 (Fig. III.20); nonetheless in the absence of more wood charcoal specimens, this cannot verified. The saturation curve of stratigraphical unit 35/10 (Fig. III.21) rises fast until fragment 23 and then more slowly, achieving a stabilization point between fragments 73 and 107. However, after this point three more taxa were introduced, of which *Ulmus/Celtis* is met with for the first time in this context. Although neither of these two curves saturate, the fact that in both cases the taxa present are more or less the same and also that *Platanus orientalis*, *Arbutus* sp., and *Olea europaea* were identified within the four first taxa suggest that these samples are sufficient to indicate the main vegetation taxa present around the site during the Roman period.

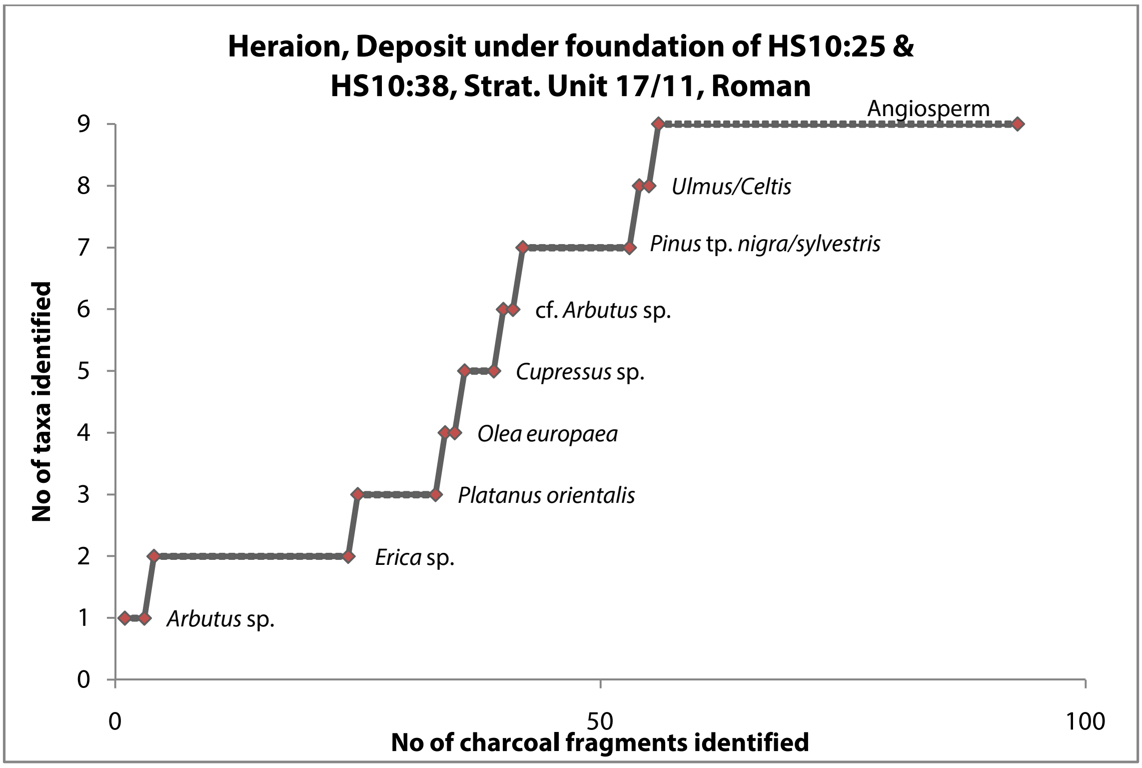



**Figure III.20:** Saturation curve of Strat. Unit 17/11 of North Sector, Heraion, Samos.

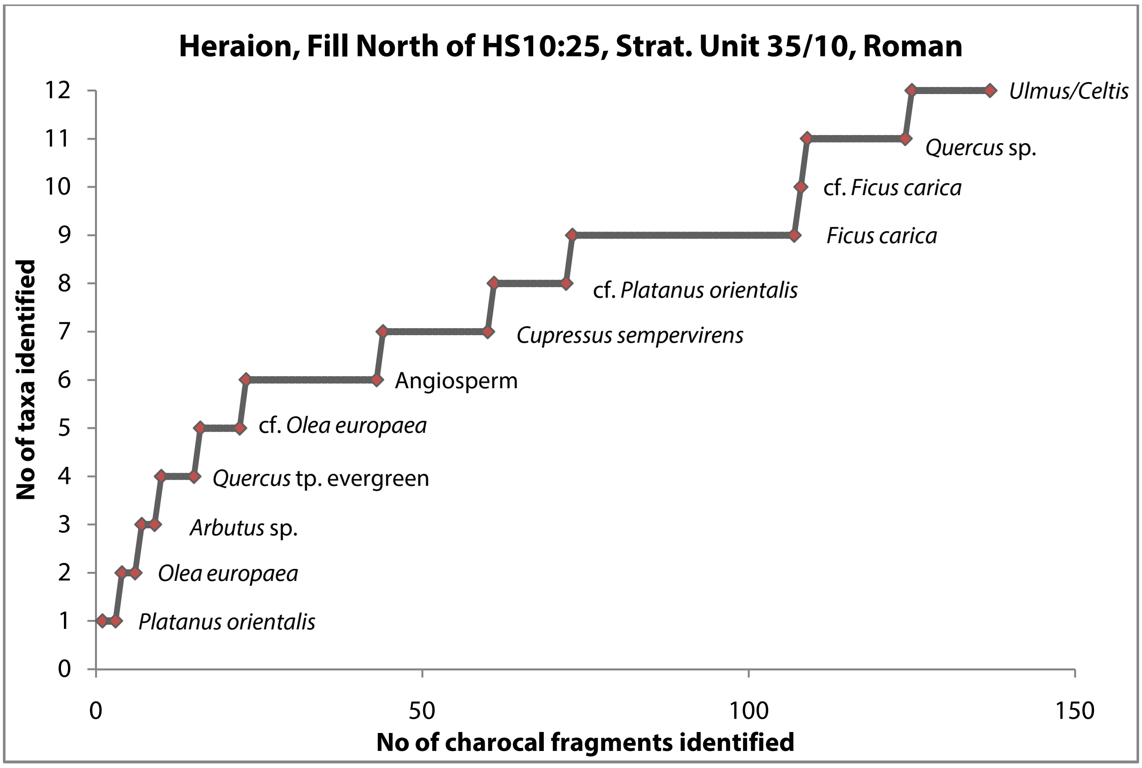



**Figure III.21:** Saturation curve of Strat. Unit 35/10 of the North Sector, Heraion, Samos.

To summarize, in the curves of Heraion it is observed that the maximum number of taxa identified within the first 50 specimens range between 7 and 15. In fact, only in the stratigraphical units dated to the Roman period is the minimum number of taxa met, but in those cases the total number of taxa did not exceed 12. In those stratigraphical units where the total number of fragments exceeds 100, it is noticed that by fragment 100 only two more taxa have been added, while afterwards the curves do not rise as fast or even at all. Additionally, in all curves the common taxa were identified by fragment 20 and overall the curves present a great homogeneity.

### 7.2. Ubiquity

Additional to the count of frequency of each taxon, the ubiquity of the taxa per feature was calculated, while it was also recorded the number of the taxa present by sample. In this way can be studied the presence of a taxon in an assemblage, regardless of the total count of its wood charcoal fragments. Furthermore, the counting of the number of the taxa in each sample may reveal similarities in the composition between them which could not be observed otherwise, especially when samples with a large number of fragments need to be discussed with others having only a low number.

In the case of the buildings of the two sites, where the samples represent mainly constructional elements, the quality of the samples will become the critical aspect and basis of the analysis. The main purpose of the study of the wood charcoal macroremains from the interior of the buildings was to investigate (1) the dispersion of the taxa inside each room, and (2) to reveal preferences for specific taxa for the construction of specific elements i.e. doors, floors etc. To investigate the above, 'ubiquity' was preferred as quantification method over frequency, as it can provide information on the distribution of the taxa in the interior of the buildings and how often they were used. In addition, the results of this quantification method are not affected by the over-fragmentation which might occur. Several studies have highlighted that the fragmentation rate of all plant species is similar, regardless of their mechanical and physical properties before combustion (Chabal, 1997, 1992; Théry-Parisot et al., 2010). However, it has been observed that during post-depositional and recovery processes, wood charcoal macroremains can become divi-

| Akrotiri - Xeste 3 - Room Fills | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ground Floor | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Room** | 3 | | | | | | 7 | | | | 14 | | | | | | | | | | | | | | | |
| **Taxa/Samples** | Δ1 (2) | M8 | M9 | E87 (20) | E87 (21) | E87 (22) | 3 | 4 | Δ3 | E81 (9) | E87 (10) | E87 (4) | E87 (41) | E87 (55) | E87 (6) | E87 (8) | E87(45) | M2/L8 | M3/L1 | M5/L11 | M6/L10 | M9/L11 | M9/L5 | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | | | 1 | | 1 | | | | | | | | | 2 | | | | | | | 1 | | **5** | **1.39** | **4** | **17.39** |
| cf. *Arbutus* sp. | | | | | | 1 | | | | | | | | | | | | | | | | | | **1** | **0.28** | **1** | **4.35** |
| *Cupressus sempervirens* | | | | 1 | | | | | | | | | | | | | | | 1 | | | | | **2** | **0.56** | **2** | **8.70** |
| Fabaceae | | | | | 1 | | | | | | | | | | 1 | | | | | | 1 | | | **3** | **0.83** | **3** | **13.04** |
| *Juniperus* sp. | | | 2 | 2 | | | 1 | | | 2 | | 1 | | | | 1 | | 3 | | | 1 | | | **13** | **3.61** | **8** | **34.78** |
| *Lonicera* sp. | | | | | | 3 | | | | | | | | | | | | | | | | | | **3** | **0.83** | **1** | **4.35** |
| *Olea europaea* | 1 | 2 | 13 | 22 | 28 | 13 | 5 | | | 8 | 1 | 9 | 1 | 8 | 5 | 10 | 1 | 24 | | | 25 | 17 | 27 | **220** | **61.11** | **19** | **82.61** |
| *Pinus* tp. *brutia/halepensis* | | 7 | | 5 | | 1 | | 7 | 1 | 1 | | | | 1 | | | | 4 | | | 1 | 4 | 3 | **35** | **9.72** | **11** | **47.83** |
| *Prunus amygdalus* | | | | | | | | | | | | | | | | 1 | | 1 | | | | 1 | | **3** | **0.83** | **3** | **13.04** |
| *Quercus* tp. deciduous | | | | 1 | | | | | | | | | | | | | | | | | | | | **1** | **0.28** | **1** | **4.35** |
| *Quercus* tp. evergreen | | | | | | | 4 | | | | | | 1 | | | | | 1 | | 11 | 1 | 5 | 8 | **31** | **8.61** | **7** | **30.43** |
| *Tamarix* sp. | | | 4 | | | | | | | | 1 | | | | 2 | | | 4 | | | 1 | 21 | 1 | **34** | **9.44** | **7** | **30.43** |
| cf. *Tamarix* sp. | | | | 1 | | | | | | | 1 | | | | | | | | | | | | | **2** | **0.56** | **2** | **8.70** |
| Angiosperm | | | | 2 | 1 | | | | | | | | | | | | | | | | 3 | | 1 | **7** | **1.94** | **4** | **17.39** |
| **TOTAL** | **1** | **9** | **19** | **35** | **30** | **19** | **10** | **7** | **1** | **11** | **3** | **10** | **2** | **9** | **10** | **12** | **1** | **37** | **1** | **11** | **33** | **49** | **40** | **360** | **100** | | |
| **Min No of taxa** | **1** | **2** | **3** | **7** | **2** | **4** | **3** | **1** | **1** | **3** | **2** | **2** | **2** | **2** | **4** | **3** | **1** | **6** | **1** | **1** | **6** | **5** | **4** | **11** | | | |

**Table III.1:** Samples recovered from fill layers of the ground floor of the rooms of Xeste 3, Akrotiri, Thera. Highlighted are the taxa with the highest ubiquity percentage.

ded into smaller pieces or even decompose (Arranz-Otaegui, 2017; Chrzazvez et al., 2014; Wagner, 1988), either of which can cause a bias in the assemblage (Arranz-Otaegui, 2017). Accordingly, the evaluation of the presence/absence of the taxa was considered necessary, as it was thought that for example the taxa used as the main construction elements would produce a smaller amount of wood charcoal fragments than the thickly laid second layer of the floors of the upper storey in the case of Akrotiri. Consequently, assessment based only on the quantity of the taxa identified would be misleading for the importance of some taxa as building material.

In the example from the fill of the ground floor of the rooms of Xeste 3 (Table III.1), the importance of *Olea europaea* is mirrored in both the high frequency of the taxon (with a percentage of 61.11%), as well as in the high number of samples it was present in (19 out of 23). However, in the case of taxa like *Pinus* type *brutia/halepensis*, *Juniperus* sp., *Quercus* tp. evergreen, and *Tamarix* sp. any study based solely on the frequency of the wood charcoal fragments identified would confuse the correct interpretation of their use as a building material, as their percentages are low. The evaluation of the frequency of occurrence of these taxa provides evidence of their importance as constructional timber: they are present in more than the 30% of the samples, with the ubiquity of *Pinus* type *brutia/halepensis* reaching 47.83%.

In the case of the samples from Akrotiri in particular, one of the main concerns that arose during the selection of the material to be studied was if the taxa identified in the samples from the interior of the rooms, collected through dry-sieving, were representative of the use of wood as a constructional material, as the 1 cm-opening of the sieve-mesh used is considered rather large for this purpose. However, as one of the aims of the study was to make dendroanthracological observations, which would provide information on the initial size of the beams used, as well as on the state of the wood used, it was considered necessary to analyse also the bigger pieces of charcoal collected either by hand or mainly be dry-sieving. Charred wood has the tendency to further fragment during flotation (Arranz-Otaegui, 2017) and thus it would be more difficult to observe these dendroanthracological features on small fragments. Additionally, as the samples are from destruction layers, it is necessary to study both hand/dry-sieved and flotation collected samples (Chabal, 1988; Grau Almero, 1992). As the identification process

| Akrotiri - Xeste 3 - Room Fills | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ground Floor | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Room** | 3 | | | | | | | | | | 14 | | | | | | | | | | | | | | | | | |
| | Flotation samples | | | | | Dry-sieved samples | | | | | Flotation samples | | | | | | | | | Dry-sieved samples | | | | | | | | |
| **Taxa/Samples** | E87 (20) | E87 (21) | E87 (22) | **N** | **%** | Δ1 (2) | M8 | M9 | **N** | **%** | E87 (10) | E87 (4) | E87 (41) | E87 (55) | E87 (6) | E87 (8) | E87(45) | **N** | **%** | M2/L8 | M3/L1 | M5/L11 | M6/L10 | M9/L11 | M9/L5 | **N** | **%** |
| *Arbutus* sp. | 1 | | 1 | **2** | **2.38** | | | | | | | | | | 2 | | | **2** | **4.26** | | | | | 1 | | **1** | **0.58** |
| cf. *Arbutus* sp. | | | 1 | **1** | **1.19** | | | | | | | | | | | | | | | | | | | | | | |
| *Cupressus sempervirens* | 1 | | | **1** | **1.19** | | | | | | | | | | | | | | | | 1 | | | | | **1** | **0.58** |
| Fabaceae | | 1 | | **1** | **1.19** | | | | | | | | | | 1 | | | **1** | **2.13** | | | | 1 | | | **1** | **0.58** |
| *Juniperus* sp. | 2 | | | **2** | **2.38** | | | 2 | **2** | **6.90** | | 1 | | | | 1 | | **2** | **4.26** | 3 | | | 1 | | | **4** | **2.34** |
| *Lonicera* sp. | | | 3 | **3** | **3.57** | | | | | | | | | | | | | | | | | | | | | | |
| *Olea europaea* | 22 | 28 | 13 | **63** | **75.00** | 1 | 2 | 13 | **16** | **55.17** | 1 | 9 | 1 | 8 | 5 | 10 | 1 | **35** | **74.47** | 24 | | | 25 | 17 | 27 | **93** | **54.39** |
| *Pinus* tp. *brutia/halepensis* | 5 | | 1 | **6** | **7.14** | | 7 | | **7** | **24.14** | | | | 1 | | | | **1** | **2.13** | 4 | | | 1 | 4 | 3 | **12** | **7.02** |
| *Prunus amygdalus* | | | | | | | | | | | | | | | | 1 | | **1** | **2.13** | 1 | | | | 1 | | **2** | **1.17** |
| *Quercus* tp. deciduous | 1 | | | **1** | **1.19** | | | | | | | | | | | | | | | | | | | | | | |
| *Quercus* tp. evergreen | | | | | | | | | | | | | 1 | | | | | **1** | **2.13** | 1 | | 11 | 1 | 5 | 8 | **26** | **15.20** |
| *Tamarix* sp. | | | | | | | | 4 | **4** | **13.79** | 1 | | | | 2 | | | **3** | **6.38** | 4 | | | 1 | 21 | 1 | **27** | **15.79** |
| cf. *Tamarix* sp. | 1 | | | **1** | **1.19** | | | | | | 1 | | | | | | | **1** | **2.13** | | | | | | | | |
| Angiosperm | 2 | 1 | | **3** | **3.57** | | | | | | | | | | | | | | | | | | 3 | | 1 | **4** | **2.34** |
| **TOTAL** | **35** | **30** | **19** | **84** | **100** | **1** | **9** | **19** | **29** | **100** | **3** | **10** | **2** | **9** | **10** | **12** | **1** | **47** | **100** | **37** | **1** | **11** | **33** | **49** | **40** | **171** | **100** |
| **Min No of taxa** | **7** | **2** | **4** | **8** | | **1** | **2** | **3** | **4** | | **2** | **2** | **2** | **2** | **4** | **3** | **1** | **8** | | **6** | **1** | **1** | **6** | **5** | **4** | **9** | |

**Table III.2:** Comparison of the results gained by the two sampling methods followed. Fill layers of the ground floor of Room 3 and Room 14 of Xeste 3, Akrotiri, Thera.

progressed, it was observed that flotation and dry-sieved samples were complementing one another, increasing the number of identified taxa. Consequently it was considered reasonable to include all available samples in this study. For example, as can be seen in Table III.2, the dry-sieved samples recovered from the fills of Room 3 of Xeste 3 present a very low number of taxa and specifically only the most frequently represented in the assemblage, namely *Olea europaea*, *Pinus* type *brutia/halepensis*, *Juniperus* sp., and *Tamarix* sp., while the flotation samples bring into play six more taxa, although in low percentages. In contrast, the flotation samples from the fill of Room 14 of the same building include one taxon less than the dry-sieved, as *Cupressus sempervirens* was only identified in the later. Overall, then, it can be proposed that in the case of the constructional elements of the buildings of Akrotiri the study of both the dry-sieved samples and those collected during flotation of the sediments allow a better insight into the taxa used for the construction of the different features of the buildings.

# IV. Identified Flora

The study of the wood charcoal macroremains from the archaeological sites of Akrotiri, Thera, and of Heraion, Samos has revealed in total twenty-five taxa. Of these, ten were identified to the species level and fifteen to the genus level. Additionally, wood charcoal fragments were found which were not possible to be identified further than the family level. These fragments belong to six distinct families (Table IV.1).

| Family | Species/Genera | Akrotiri | Heraion |
|---|---|---|---|
| Cupressaceae | *Cupressus sempervirens* | ● | ● |
| | *Juniperus* sp. | ● | ● |
| Pinaceae | *Cedrus libani* | ● | |
| | *Pinus* type *brutia/halepensis* | ● | ● |
| | *Pinus* type *nigra/sylvestris* | ● | ● |
| Anacardiaceae | *Pistacia* sp. | ● | |
| Betulaceae | *Alnus* sp. | ● | |
| Caprifoliaceae | *Lonicera* sp. | ● | |
| Chenopodiaceae | | ● | |
| Cistaceae | | ● | |
| Ericaceae | *Arbutus* sp. | ● | ● |
| | *Erica* sp. | | ● |
| Fabaceae | | ● | ● |
| Fagaceae | *Castanea sativa* | ● | |
| | *Quercus* type deciduous | ● | ● |
| | *Quercus* type evergreen | ● | ● |
| Labiatae | | ● | |
| Moraceae | *Ficus carica* | ● | ● |
| Oleaceae | *Fraxinus* sp. | ● | ● |
| | *Olea europaea* | ● | ● |
| Platanaceae | *Platanus orientalis* | ● | ● |
| Punicaceae | *Punica granatum* | ● | ● |
| Rhamnaceae/ Oleaceae | Rhamnus/Phillyrea | ● | ● |
| Maloideae | | ● | ● |
| Rosaceae | *Prunus* sp. | ● | ● |
| | *Prunus amygdalus* | ● | ● |
| Salicaceae | *Salix/Populus* | ● | ● |
| Tamaricaceae | *Tamarix* sp. | ● | |
| Thymelaeaceae | | ● | |
| Ulmaceae | *Celtis* sp. | | ● |
| | *Ulmus* sp. | | ● |

**Table IV.1:** Species, Genera, and Families identified in each archaeological site

During the identification process, the analysis of the specimens was hindered from the very first by the small size of the fragments. The charcoal fragments from both sites were very small, with the majority of them ranging between 2 mm to 4 mm. Only the assemblages from the interior of the buildings of Akrotiri were different: such contained also wood charcoal fragments larger than 5 mm. The majority of these fragments were from the structural elements of the buildings (i.e. beams). The bulk amount of the charcoal fragments coming from the earlier periods of Heraion were very fragile most probably as they had remained for a prolonged period of time below the level of the present water table.

The small size of the specimens and the anatomical similarities of some genera belonging to the same family made it impossible for some fragments to be classified further than the family level. Thus, it was not feasible to determine genera or species in the families of Chenopodiaceae, Cistaceae, Fabaceae, Labiatae, Maloideae, and Thymelaeaceae. Similarly, in some cases it was not possible to distinguish between genera belonging to the same family like *Salix* sp. and *Populus* sp., *Ulmus* sp. and *Celtis* sp. and even between genera of different families like *Alnus* sp. (Betulaceae) and *Corylus* sp. (Corylaceae) and, *Rhamnus* sp. (Rhamnaceae) and *Phillyrea* sp. (Oleaceae).

In the following pages each family, genera, or species identified in the assemblages from Akrotiri and Heraion are described one by one. All comments regarding the anatomy of genera and species found in the text are based on the wood anatomy atlases of Schweingruber (1990) and Fahn et al. (1986). Each page is structured as follows:

1st **Name of the taxon presented:** They are given the name of the family to which the genus/species belongs and then the English and Greek common names.

2nd **Microphotographs** of the specimens are presented: these were taken with a scanning electron microscope. In the most cases the transverse and the tangential longitudinal sections are given, although in some cases the radial longitudinal section was preferred over the tangential one, as here it provided better diagnostic criteria for the identification of the taxa. In the cases of Cistaceae and *Pistacia* sp. no microphotography could be taken as the specimens were very small and too fragile for a good surface to be found.

3rd **Anthracological evidence**: Here is mentioned in which site each taxon was identified and particularly in which pillar shaft or building of Akrotiri and in which sector (per period) in Heraion.

4th **Genera/Species present in Greece:** The species of each genus are mentioned which are today present in Greece, and in the case of the families the genera present in the country. Only the native species/genera are included in this list. Where the specimens have been identified to the species level, mention it made as to whether it is native or exogenous.

5th **Distribution:** Here is stated which species of a genus or which genera of a family are most likely to be represented in the assemblages of Akrotiri and Heraion. Additionally, the altitudinal range of each genus is given, as well as the habitats in which it can grow and with which other taxa it is associated. Finally, in those cases thought necessary to clarify how the identification process ended up to specific taxa, comments on the anatomy of those taxa are also included.

6th **Wood properties:** Here are presented the physical and mechanical properties of the species identified in Akrotiri and Heraion. Measurements are given for those species/genera which were most likely to have been used in the construction of the buildings of the two archaeological sites. Such are identified in the relevant samples. More specifically there are presented the values for:

a) Average dried weight: This is a measure which identified the weight of a wood in relation to a preset volume. The measurements given here were calculated for specimens with a moisture content of 12%. The average dried weight of a wood gives information on the weight of species. The weight of a species is related to its hardness and strength, as the heavier a wood is, the harder and stronger it is.

b) Janka hardness: This test estimates the resistance of a wood to denting and wear. The measurement given represents the force which is required to embed half of an 11.28 mm diameter steel ball into a sample of wood. With this measurement to hand, it can be estimated how much effort is needed to saw a wood or how difficult it is to drive a nail into it.

c) Modulus of rupture: This measurement depicts how strong a wood is and how much force needs to be exerted before it breaks. The values of this measurement range for wood between 550 $kg_f/cm^2$ and 1,600 $kg_f/cm^2$.

d) Crushing strength: This measurement describes the compression needed to be exerted to the two ends of a sample, until this crushes. The values of this measurement range between 250 $kg_f/cm^2$ and 950 $kg_f/cm^2$. These values are useful in those cases when the weight is applied in parallel to the grain of the wood, as for pillars.

7th **Uses:** In this section, is described how each taxon had been used in the past, or is now used in construction-work, the manufacture of wooden objects or as firewood. Additionally, if it provides edible fruits or nuts and is suitable as fodder, these facts are noted.

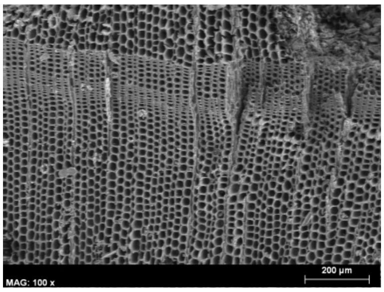
The nomenclature of the species, genera, and families follows the "*Flora of Greece Web. Vascular Plants of Greece: an annotated checklist*" of the Hellenic Botanical Society. (http://portal.cybertaxonomy.org/flora-greece/content). From the same website information was exported as which genera and species of each family are present in Greece, as well as their geographical distribution. For the latter point, data was also taken from Korakis (2015). Information on the ecological distribution of the species and genera, as well as on their uses were based on Korakis (2015), the European Atlas of Forest Tree Species (San-Miguel-Ayanz et al., 2017), the IUCN Red list of Threatened Species (www.iucnredlist.org), Orlandos (1960), and Gale and Cutler (2000). The values for the physical and mechanical properties of the species were based mainly on the information provided by The Wood Database (www.wood-database.com) as well as by Kakaras (2001), Guller (2007), Voulgaridis and Passialis (1995), and Elaieb et al. (2017). Additional data on *Olea europaea* was retrieved from Carrión et al. (2010), and in the case of *Punica granatum* from Asouti (2003).

**Cupressaceae**

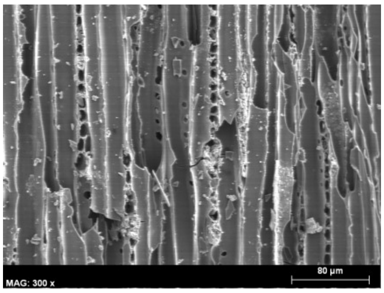
## *Cupressus sempervirens*

Cypress

Κυπαρίσσι




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 66Π, Xeste 3

Heraion, Samos: Roman/ North Sector

**Species present in Greece**

*Cupressus sempervirens*

**Distribution:** *Cupressus sempervirens* (Mediterranean Cypress) is today a common species all over Greece, with the exception of North Central Greece and North Pindos where it is absent. However, it is native only in Crete and some of the East Aegean islands, including Samos, Chios, and Kos. This tree grows up to 35-40 m. and it can be found from sea level up to 2,000 m a.s.l. *C. sempervirens* is usually met in maquis and in *Pinus* or *Juniperus* woodlands and it is a characteristic species of the Mediterranean climate. This species can be distinguished from *Juniperus* sp. by its long rays, which in the case of Akrotiri sometimes exceeded 20 cells in height.

**Wood Properties:**

**Average dried weight:** 535 kg/m$^3$

**Janka Hardness:** 2,490 Newton

**Modulus of Rupture:** 454 kg$_f$/cm$^2$

**Crushing strength:** no data

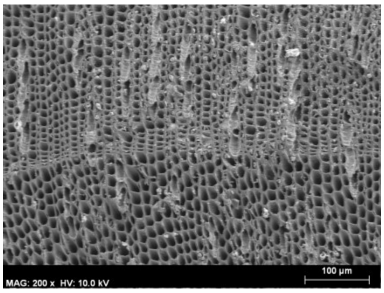
**Uses:** The wood of *Cupressus sempervirens* is resistant to fungi and insect attacks, as well as to moisture and decay. It can produce long timbers suitable for building. During antiquity, the wood of this species was used in the construction of doors, roofs, and floors, as well as in shipbuilding. During the Roman period, the cypress had an ornamental character and it was planted in gardens, cemeteries and alongside roads.

**Cupressaceae**

## ***Juniperus* sp.**

Juniper

Κέδρος

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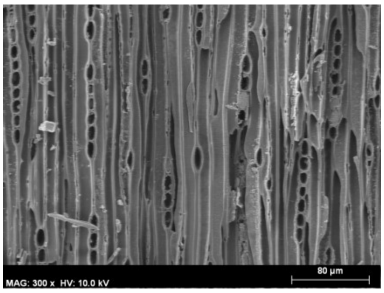



Tangential longitudinal section

### Anthracological Evidence

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: EBA/South and Central Sectors, Roman/ North Sector

### Species present in Greece

*Juniperus communis*

*J. drupacea*, *J. excelsa*

*J. foetidissima*

*J. macrocarpa*, *J. oxycedrus*

*J. phoenicea*, *J. sabina*

**Distribution:** From the total of eight species of *Juniperus* present in Greece, only *J. macrocarpa* and *J. phoenicea* grow naturally in the Cyclades and the East Aegean Islands, while *J. oxycedrus* is present only on the latter. All three species are shrubs or small trees adapted to arid climates. *J. macrocarpa* is usually found in coastal habitats. *J. phoenicea* and *J. oxycedrus* are characteristic taxa of open woodland, maquis, and garrigue vegetation, although the first one is also met within the coastal zone. Among the three, *J. oxycedrus* is that with the highest altitudinal range, as it can grow up to 1,300 m a.s.l. The altitudinal range of the other two extends from the sea level up to 400 m a.s.l.

**Wood Properties: (*J. oxycedrus*)**

**Average dried weight:** 570 kg/$m^3$

**Janka Hardness:** no data

**Modulus of Rupture:** approx. 819 $kg_f/cm^2$

**Crushing strength:** no data

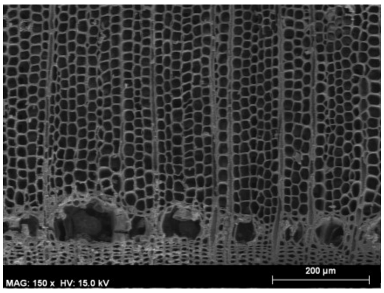
**Uses:** *Juniperus oxycedrus* is a very durable and hard species suitable for carpentry items and construction timber. On the contrary, the quality of the wood of *J. phoenicea* is poorer: it is better used as fuel wood or for small carpentry items.

**Pinaceae**

## *Cedrus libani*

Cedar of Lebanon

Κέδρος Λιβάνου

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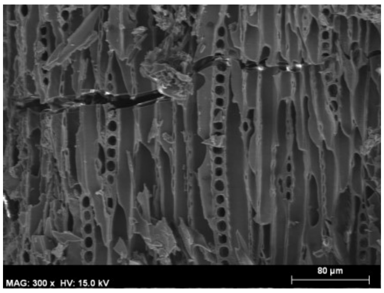



Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: NPS18 and NPS 66Π

**Species present in Greece**

This species is EXOGENUS to Greece.

**Distribution:** *Cedrus libani* is exogenous to Greece, although there is evidence that it once grew naturally in Crete (Vitruvius II, 13). Today, it grows naturally in Cyprus, Lebanon, Syria, and Turkey. This tree can reach a height of 30-40 m. It is usually met from 1,300 to 3,000 m a.s.l., but in Turkey it can be found from as low as 500 m a.s.l. Usually, it grows along with *Juniperus excelsa, J. oxycedrus* or *Pinus nigra,* and *Pinus brutia* in lower altitudes. For the identification of the species characteristic sings are the tracheid pits with scalloped tori and heterocellular rays.

**Wood Properties:**

**Average dried weight:** 520 $kg/m^3$

**Janka Hardness:** 3,670 Newton

**Modulus of Rupture:** 835 $kg_f/cm^2$

**Crushing strength:** 428 $kg_f/cm^2$

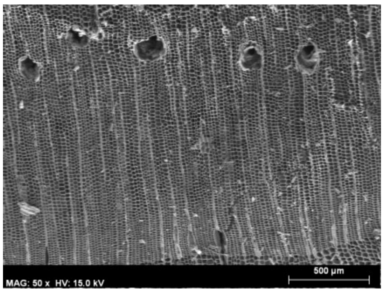
**Uses:** The wood of *Cedrus libani* is durable and resistant to insect attack. The species has been used for the building of ships and temples and the production of furniture. In the construction of buildings, it was used in the floors and ceilings as suited to bearing weight.

**Pinaceae**

***Pinus* type *brutia/halepensis***

Turkish/Aleppo pine

Τραχεία/Χαλέπιος Πεύκη

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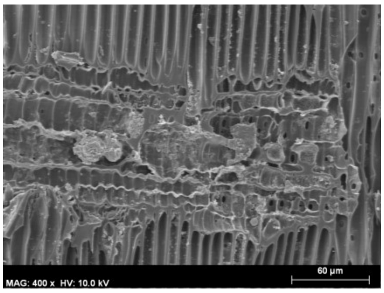



Radial longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/ North and Central Sectors

**Species present in Greece**

Both species are present in Greece

**Distribution:** Both species are characteristic of the thermo- and meso-Medirerranean zone and they can be found from sea level up to 1,500 m a.s.l. *Pinus brutia* is usually located on the eastern coasts of Mediterranean, with *P. halepensis* on the western, including the coasts of Attica, Peloponnese, and Euboea. *P. brutia* and *P. halepensis* form open pine forests with a diverse shrub layer or be part of mixed open woodlands with *Quercus coccifera, Pistacia lentiscus* and other species which can withstand dry conditions. Both species can be found in garrigue and maquis vegetation, pioneering burnt areas or abandoned lands. A distinction between *P. brutia* and *P. halepensis* based on their anatomy is not possible.

**Wood Properties: (*P. brutia/P. halepensis*)**

**Average dried weight:** 570 kg/m$^3$ / 530 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** 633 kg$_f$/cm$^2$/576 kg$_f$/cm$^2$

**Crushing strength:** 423 kg$_f$/cm$^2$/ 482 kg$_f$/cm$^2$

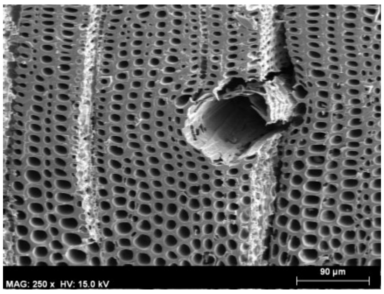
**Uses:** *Pinus brutia* has a good quality wood which is used as construction timber or for fencing post, boxes, and crates. In contrast, the wood of *P. halepensis* is of lower quality and due to the size and shape of this species, it is not valued today. However, during the antiquity the abundance of *P. halepensis* in the Mediterranean led to its use as construction timber for ship and buildings. Additionally, it was used for the production of roofing shingles.

**Pinaceae**

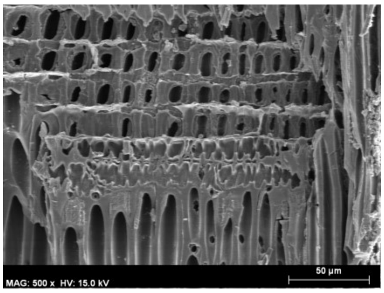
***Pinus* type *nigra/sylvestris***

Black/Scots pine

Μαύρη/Δασική Πεύκη




Transverse section




Radial logitudinal section

**<u>Anthracological Evidence</u>**

Akrotiri, Thera: OPS17, NPS 66, NPS 67

Heraion, Samos: MBA/ North Sector, Roman/ North Sector

**<u>Species present in Greece</u>**

Both species are present in Greece

**<u>Distribution:</u>** *Pinus nigra* and *P. sylvestris* are exogenous to the Cyclades. *P. nigra* can be found in the mountainous zone of mainland Greece and in some of the bigger islands of the Aegean such as Euboea, Lesvos, Thasos, and Samos from an elevation of 400 m a.s.l up to 2,000 m a.s.l. The altitudinal expansion of *P. sylvestris* is between 800 and 1,900 m a.s.l. and it is met with on Mt. Voras, Mt. Vrontou, Mt. Orvilos, as well as in the mountain range of south Rodopi and south Pieria. Both species, which grow up to 40 m in height, can form pure stands or they may grow in mixed formations, and together in association with broadleaved taxa such as *Fagus* sp. An anatomic distinction between *P. nigra* and *P. sylvestris* is not possible. Characteristic of both species is the presence of fenestriform pits in the radial section.

**<u>Wood Properties: (*P. nigra*/*P. sylvestris*)</u>**

**Average dried weight:** 475 $kg/m^3$ /550 $kg/m^3$

**Janka Hardness:** 2,920 Newton/2,420 Newton

**Modulus of Rupture:** 656 $kg_f/cm^2$/ 849 $kg_f/cm^2$

**Crushing strength:** 391 $kg_f/cm^2$/ 423 $kg_f/cm^2$

**<u>Uses:</u>** The wood of these two species of pine is highly valued for its quality and strength. Both *P. nigra* and *P. sylvestris* are used as building timber in the construction of houses, as well as for structures in the interior of buildings such as doors and floors. In the Mediterranean, beside general constructions, their wood is used also as fuel.

**Anacardiaceae**

## *Pistacia* sp.

Mastic/Turpentine tree

Τσικουδιά/Σχίνος

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66, NPS 67

**Species present in Greece**

*Pistacia atlantica*

*P. lentiscus*

*P. terebinthus*

*P. vera*

**Distribution:** *Pistacia atlantica* is a shrub which grows up to 7 m and it is present on the East Aegean islands, but not on the Cyclades. Of the other three species, *P. lentiscus* and *P. terebinthus* are present in both the Cyclades and Samos, while domestic *P. vera* is absent from both areas. More specifically, *P. lentiscus* is the most common *Pistacia* species in Greece: it can be found from sea level up to 2,000 m a.s.l. Generally, its distribution coincides with that of *Olea europaea*, but it can also be found in open oak forests, shrubland habitats and coastal regions. *P. terebinthus* is a characteristic species of maquis vegetation which can grow from sea level up to the lower mountainous zone. It is a light-demanding species which can withstand dryness. Beside maquis vegetation this species can be found in pine forests and dry open woods.

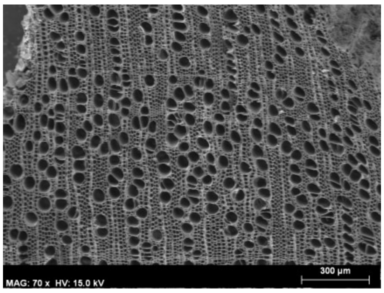
**Uses:** *Pistacia lentiscus* is the source of the resin from which gum is produced. The resin of *Pistacia terebinthus* has similar properties. During the Roman period the wood of *P. terebinthus* was used to produce goblets.

**Betulaceae**

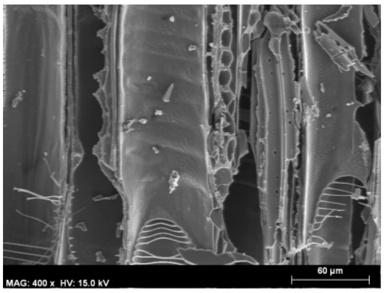
***Alnus* sp.**

Alder

Σκλήθρο



Transverse section



Radial longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17 and NPS 66Π

**Species present in Greece**

*Alnus glutinosa*

*A. incana*

**Distribution:** *Alnus glutinosa* is the species most likely represented in the assemblage of Akrotiri, as *A. incana* grows only in northern Greece. It is a deciduous tree of medium size, attaining between 10 to 25 m tall. This species prefers fresh water habitats and grows along river banks, lake shores or in marshy locations. In Greece, it can be found from sea level up to 1,500 m a.s.l. *Alnus* sp. and *Corylus* sp. can be differentiated from each other by the presence of heterogeneous rays and scalariform plates with 5 to 10 bars in *Corylus* sp., in contrast to *Alnus* sp. which is characterized by homogeneous rays and scalariform plates with 20 bars or more. In the case of Akrotiri, the fact that *Corylus* sp. does not naturally grow in the Cyclades and that the scalariform plates observed, even broken, seem to have more than 10 bars indicate that the genus present in Akrotiri is most probably *Alnus* sp.

**Wood Properties:**

**Average dried weight:** 495 kg/m$^3$

**Janka Hardness:** 2,890 Newton

**Modulus of Rupture:** 773 kg$_f$/cm$^2$

**Crushing strength:**430 kg$_f$/cm$^2$

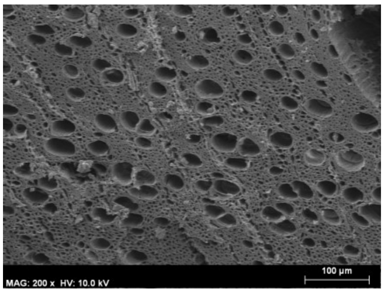
**Uses:** The wood of *Alnus glutinosa* is durable under water, but decays readily above ground. This species has been used for piles, supports and, timber for the construction of retaining walls close to riverbanks. Also, it produces good quality charcoal.

**Caprifoliaceae**

## *Lonicera* sp.

Honeysuckle

Αγιόκλημα




Transverse section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 67, Xeste 3, House of the Ladies

**Species present in Greece**

*Lonicera alpigena*

*L. caprifolium*

*L. etrusca*

*L. implexa*

*L. nigra*

*L. nummularifolia*

*L. periclymenum*

*L. xylosteum*

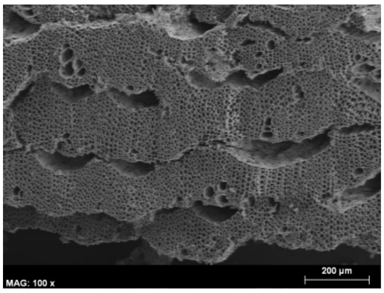
**Distribution:** *Lonicera etrusca* is the species most likely present in Akrotiri, as it is the only one securely present in the Cyclades today. This shrub inhabits maquis vegetation and open Mediterranean woodlands and shrublands. Its altitudinal range extends from sea level up to 700 m a.s.l.

**Uses:** The species of *Lonicera* are grown in gardens as ornamental plants because of the sweet smell of their flowers.

## Chenopodiaceae

Goosefoot Family

Χηνοποδιοειδή




Transverse section

**Anthracological Evidence**

Akrotiri, Thera: NPS 35 and NPS 67

**Genera present in Greece**

*Arthrocaulon* sp., *Atriplex* sp.
*Bassia* sp., *Beta* sp.
*Blitum* sp., *Camphorosma* sp.
*Caroxylon* sp.
*Chenopodiastrum* sp.
*Chenopodium* sp.
*Dysphania* sp., *Halimione* sp.
*Halocnemum* sp., *Lipandra* sp.
*Noaea* sp., *Oxybasis* sp.
*Petrosimonia* sp.
*Polycnemum* sp., *Salicornia* sp.
*Salosa* sp., *Sarcocornia* sp.
*Spinacia* sp., *Spirobassia* sp.
*Suaeda* sp.

**Distribution:** Chenopodiaceae is a family of flowering plants which include small shrubs and herbs. From the twenty-four genera present in Greece, in the Cyclades can be found *Arthrocaulon* sp., *Atriplex* sp., *Beta* sp., *Caroxylon* sp., *Chenopodiastrum* sp., *Chenopodium* sp., *Halimione* sp., *Halocnemum* sp. *Lipandra* sp., *Oxybasis* sp., *Noaea* sp., *Salicornia* sp., *Salsola* sp., and *Suaeda* sp. The majority of these genera grow on agricultural lands and ruderal habitats. Others, like *Atriplex halimus*, *Halocnemum strobilaceum,* and *Sueda maritime* are part of halophytic vegetation, and finally *Suaeda vera* and *Noaea mucronata* are found in phrygana or cliffs and ravines.

**Uses:** Many of the species of the family of Chenopodiaceae are edible, like *Beta vulgaris*, *Chenopodium album,* and *Atriplex* sp. Also, the genera of the family are very palatable as fodder for livestock, as none of them is poisonous.

## Cistaceae

Rockrose Family

Κιστοειδή

**Anthracological Evidence**

Akrotiri, Thera: NPS 35, NPS 66Π, NPS 67, Xeste 3

**Genera present in Greece**

*Cistus* sp.

*Fumana* sp.

*Halimium* sp.

*Helianthemum* sp.

*Tuberaria* sp.

**Distribution:** The taxa of Cistaceae are low shrubs and herbs which can withstand dry conditions: they are distributed across the Mediterranean. On the Cyclades are present the four of the five genera growing in Greece namely, *Cistus* sp., *Fumana* sp., *Helianthemum* sp., and *Tuberaria* sp. All Cistaceae genera found on the Cyclades are characteristic of xeric mediterranean grasslands and phrygana.

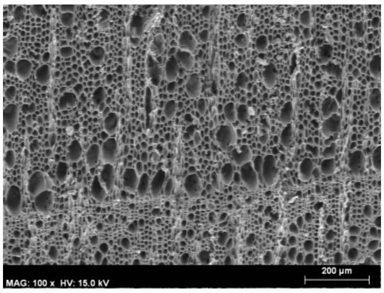
**Uses:** Today, many taxa of the Cistaceae family are planted in gardens as ornamentals.

**Ericaceae**

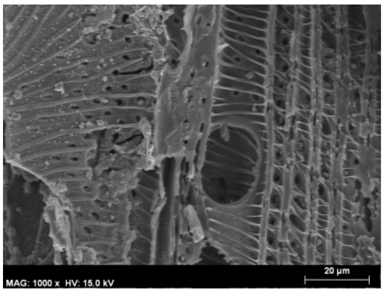
## *Arbutus* sp.

Strawberry tree

Κουμαριά



Transverse section



Radial longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors, Archaic/Central Sector, Roman/North Sector

**Species present in Greece**

*Arbutus andrachne*

*A. unedo*

**Distribution:** *Arbutus unedo* and *Arbutus andrachne* are evergreen shrubs or small trees which can reach the 12 m in height, but in Greece their height is usually only as much as 4 m. These species are drought resistant and they can tolerate salinity. They are common in maquis vegetation and they can grow in rocky slopes and wood margins. Both species can be found on the Cyclades and the East Aegean Islands. Characteristic of both species, which are indistinguishable based on their wood anatomy are the presence of simple perforation plated and spiral thickenings.

**Wood Properties (*A. unedo/A. andrachne*):**

**Average dried weight:** 820 kg/m$^3$/ 770 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** no data

**Crushing strength:** no data / 622 kg$_f$/cm$^2$

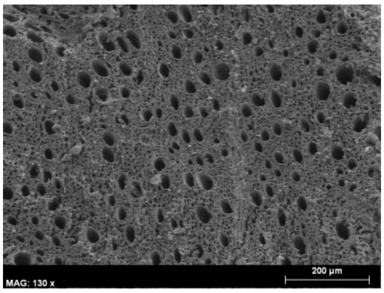
**Uses:** The fruits of *Arbutus* are edible, while its wood is suitable for fuelwood. As its trunk does not usually grow straight, today this genus is not considered suitable for constructions.

**Ericaceae**

***Erica* sp.**

Heath

Ρείκι




Transverse section

**Anthracological Evidence**

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors, Roman/North Sector

**Species present in Greece**

*Erica arborea*

*E. carnea*

*E. manipuliflora*

*E. multiflora*

**Distribution:** The genera most likely to be present in Samos are *Erica arborea* and *Erica manipuliflora*. In Greece, *Erica arborea* is a shrub whose height range lies between 1 m to 5 m. This species is found in maquis shrublands, along with *Arbutus unedo* and *A. andrachne* in the lower mountainous areas. *Erica manipuluflora* does not exceed 0.80 m in height and it is usually met within phrygana and grasslands.

**Wood Properties (*E. arborea*):**

**Average dried weight:** 910 kg/m$^3$

**Janka Hardness:** 9,300 Newton

**Modulus of Rupture:** 500 kg$_f$/cm$^2$

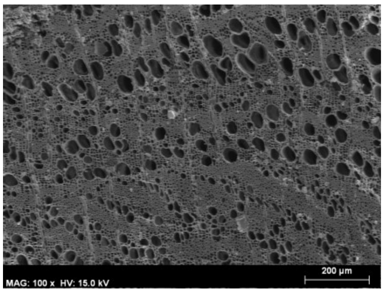
**Crushing strength:** 600 kg$_f$/cm$^2$

**Uses:** The wood of *Erica* is very hard and resistant to heat. Nowadays it is used for the production of smoking pipes, knife handles and other small wooden objects.

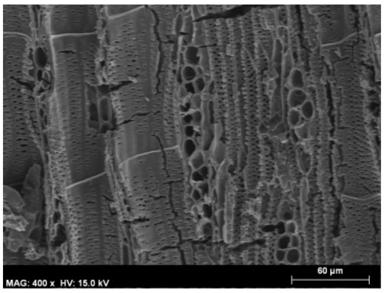
## Fabaceae

Legume Family

Κυαμοειδή




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors

**Genera present in Greece**

In Greece are present 51 genera of the family of Fabaceae

**Distribution:** The high number of genera belonging to the family of Fabaceae present in Greece and the anatomical similarities between them prevent closer identification to the taxon level. This family includes trees, shrubs, and herbs and its members can be found from sea level up to the mountainous zone. In Greece, the most common tree taxa today are *Cercis* sp. and *Ceratonia siliqua.* In the case of Akrotiri and Heraion, the two sites under study, the Fabaceae identified represent most probably shrubs.

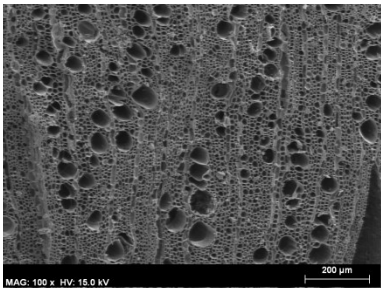
**Uses:** The family of Fabaceae includes many genera whose fruits and seeds are consumable like *Cerarонia siliqua* (carob), and herbaceous *Pisum sativum* (pea) and *Cicer arietinum* (chickpea).

**Fagaceae**

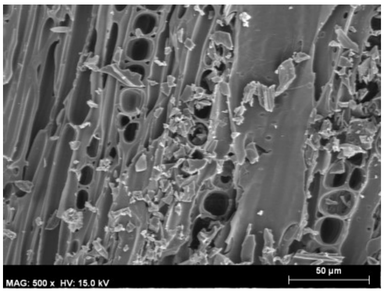
***Castanea sativa***

Sweet chestnut

Καστανιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera : NPS 66Π, NPS 67, Xeste 3, House of the Ladies

**Species present in Greece**

This species is native to Greece

**Distribution:** The initial distribution of *Castanea sativa* in Greece is difficult to be now determined. Today, it is a common species in the mountainous and semi-mountainous regions of the country, although in southern Greece and the islands it must be considered to be introduced. Its altitudinal range spans 200 to 1,800 m a.s.l. and it naturally grows in thermophilous deciduous forests in association with *Ulmus* sp., *Quercus* sp., *Alnus* sp., *Taxus* sp., etc. This species cannot tolerate high temperatures and drought. The most characteristic difference between *C. sativa* and *Quercus* type deciduous is the presence of multiseriate rays in the later. However, the fragments from Akrotiri were very small and in the most cases it was not possible for the multiseriate rays to be observed. Accordingly, those fragments were identified as *C. sativa*, where the tangential longitudinal section had, both uni- and biseriate rays.

**Wood Properties:**

**Average dried weight:** 590 kg/m$^3$

**Janka Hardness:** 3,010 Newton

**Modulus of Rupture:** 728 kg$_f$/cm$^2$

**Crushing strength:** 447 kg$_f$/cm$^2$

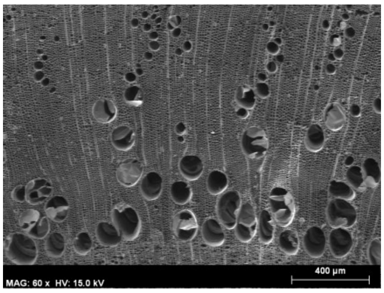
**Uses:** The wood of *Castanea sativa* is hard and resistant to insect and fungi attacks. This species is suitable for constructions due to its properties and its height (30 to 35 m). In antiquity it was used as roof timber or for the production of long poles and wooden furniture.

**Fagaceae**

## *Quercus* type deciduous

Deciduous oak

Δρυς




Transverse section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/ North and Central Sectors, Archaic/Central Sector

**Species present in Greece**

*Quercus cerris*

*Q. frainetto*

*Q. ithaburensis*

*Q. petrea*

*Q. pubescens*

*Q. robur*

**Distribution:** From the deciduous species of *Quercus* growing in Greece, *Q. ithaburensis* subsp. *macrolepis* and *Q. pubescens* grow in both the Cyclades and Samos, while *Q. cerris* and *Q. frainetto* are present only in Samos. The rest of the species do not grow in any of the regions under study. *Q. cerris* and *Q. frainetto* are species of the semi-mountainous and mountainous zones with an altitudinal range between 200 to 1,300 m a.s.l. Both species can form pure stands although they are usually met growing together and in association with *Castanea sativa*, *Carpinus orientalis,* and *Pinus nigra*. These species have a high tolerance of cold, while *Q. frainetto* tolerates water-logged conditions for a short period of time. *Q. pubescens* has the same altitudinal range as the two previous species but it is more commonly found in altitudes between 200 to 800 m a.s.l. This species is met in mainland Greece and some of the big islands of the Aegean in pure stands or along with *Q. frainetto*, *Q. coccifera*, and *Carpinus orientalis*. Finally, *Q. ithaburensis* subsp. *macrolepis* is usually found in coastal regions and in the islands between 0 to 500 m a.s.l. In Akrotiri the species most likely represented is *Q. ithaburensis* subsp. *macrolepis,* as Thera has a low altitude.

**Wood Properties (*Q. cerris*):**

**Average dried weight:** 720 $kg/m^3$

**Janka Hardness:** 5,340 Newton

**Modulus of Rupture:** 1,160 $kg_f/cm^2$

**Crushing strength:** 574 $kg_f/cm^2$

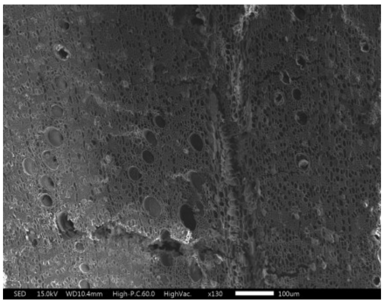
**Uses:** *Q. frainetto* is valued in Greece both for its good quality timber and as firewood, while it is also palatable to animals. On the contrary, the wood of *Quercus cerris* and *Q. pubescens* is considered of lower quality and it is used mainly as firewood. Finally, *Q. ithaburensis* subsp. *macrolepis*, in addition to its timber, was of great economical importance as a source of edible acorns.

**Fagaceae**

## *Quercus* type evergreen

Evergreen oak

Πουρνάρι/Αριά



Transverse section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/ North and Central Sectors, Archaic/Central Sector, Roman/North Sector

**Species present in Greece**

*Quercus aucheri*

*Q. coccifera*

*Q. ilex*

**Distribution:** The presence of *Quercus aucheri* in Greece is limited to the East Aegean Islands. This species, which is very similar to *Q. coccifera,* is usually met in low shrublands and phrygana occurring between the sea level and 500 m a.s.l. *Q. coccifera* is the most common species of *Quercus* in Greece, whose altitudinal range spans between the sea level and 900 m a.s.l, although in Mt. Dikti (Crete) is present up to 1,600 m a.s.l. This species is among the characteristic species of maquis and Mediterranean sclerophyllous vegetation, while it is also met with as an undershrub in open pine forests of *Pinus halepensis* or *P. brutia*. Due to cutting, grazing, and burning it usually grows as a shrub, but it can grow into a tree if left undisturbed. Finally, *Q. ilex* is common in the coastal regions of mainland Greece (0 to 600 m a.s.l), while its presence on the Aegean islands is limited. It is a typical element of the thermo-Mediterranean maquis vegetation, where it grows along with *Olea europaea*, *Ceratonia siliqua*, *Arbutus unedo*, *Phillyrea angustifolia,* and *Rhamnus alaternus*. The wood of the genera of the *Quercus* type evergreen is in general diffuse porous, while that of *Quercus* type deciduous genera, ring porous.

**Wood Properties (*Q. ilex*):**

**Average dried weight:** 800 kg/m$^3$

**Janka Hardness:** 7,150 Newton

**Modulus of Rupture:** no data

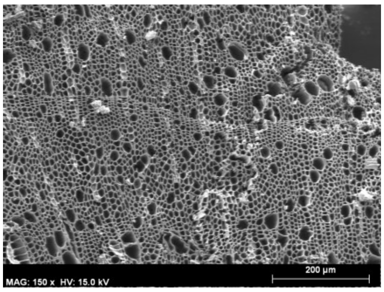
**Crushing strength:** no data

**Uses:** The wood of *Quercus ilex* is very hard and dense and it is used for the production of wooden tools and handles. In the past it was also used for the production of charcoal. The evergreen oak woodlands are used as pasture lands.

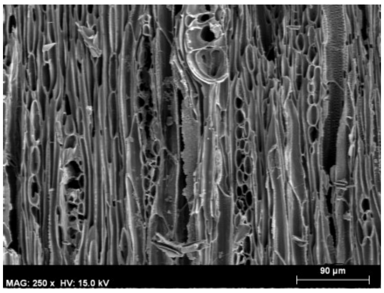
**Labiatae**

Mint Family

Χειλανθή



Transverse section



Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, House of the Ladies

**Genera present in Greece**

In Greece are present 35 genera of the family of Labiatae

**Distribution:** The anatomical similarities between the genera of the Labiatae family do not allow identification to the species level. The members of the family of Labiatae are mostly herbaceous plants and shrubs which grow in garigue vegetation and grasslands. Their high adaptability allows them to grow from the coastal regions up to the mountainous zones.

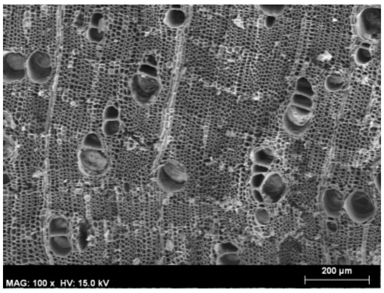
**Uses:** Many of the taxa of the Labiatae family are edible and they are used as aromatics. Additionally, many genera of this family are valued for their medical properties.

**Moraceae**

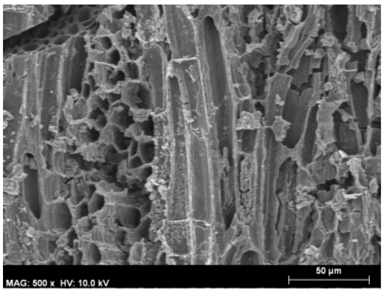
***Ficus carica***

Fig tree

Συκιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: EBA/ South Sector, Roman/ North Sector

**Species present in Greece**

This species is native to Greece

**Distribution:** *Ficus carica* can be found in altitudes between 0 and 1,700 m a.s.l. This species grows in maquis and garigue vegetation across the Mediterranean or in cliffs, ravines, and banks of streams. This tree can withstand drought for a short period of time and it can grow well in poor soils.

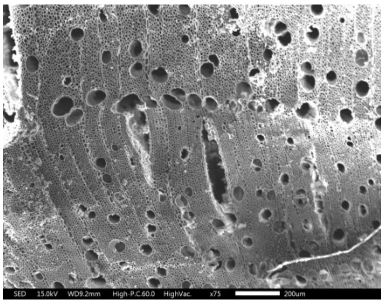
**Uses:** *Ficus carica* timber is of low quality. However, during the antiquity it was used for the production of roof timbers. This tree is mainly valued for its edible fruits.

**Oleaceae**

***Fraxinus* sp.**

Ash

Φράξος



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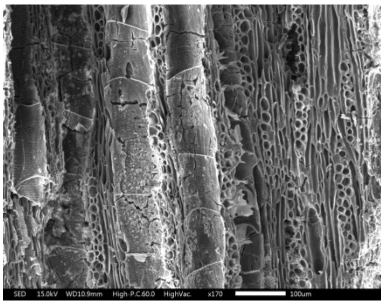


Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: NPS 66Π

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/ Central Sector, Roman/ North Sector

**Species present in Greece**

*Fraxinus angustifolia*

*F. excelsior*

*F. ornus*

*F. pallisae*

**Distribution:** The species most likely present in the assemblage of Akrotiri is *Fraxinus ornus*, as it is the only species of this genus which grows today in the Cyclades. This species is a large shrub which thrives to altitudes up to 400 m a.s.l., usually in deciduous woodlands and sometimes maquis vegetation. This species along with *F. angustifolia* subsp. *oxycarpa* grow in the islands of Samos. The latter prefers cooler conditions and it can be found along rivers and wetlands as it can withstand seasonal flooding. Additionally, it can be found in mixed broadleaved forest along with *Salix* sp., *Populus* sp., *Quercus* sp., *Ulmus* sp., etc.

**Wood Properties (*Fraxinus* sp.):**

**Average dried weight:** 700 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** 1,200 kg$_f$/cm$^2$

**Crushing strength:** 520 kg$_f$/cm$^2$

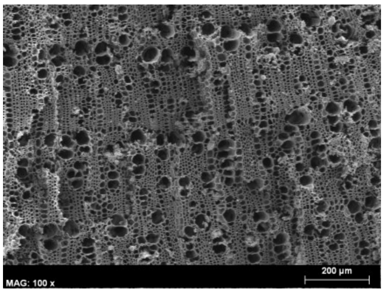
**Uses:** The wood of *Fraxinus* is strong and elastic, and during the antiquity it was used for the manufacture of furniture and in ship-building. Additionally, the leaves of this tree are palatable to livestock and were used as fodder.

**Oleaceae**

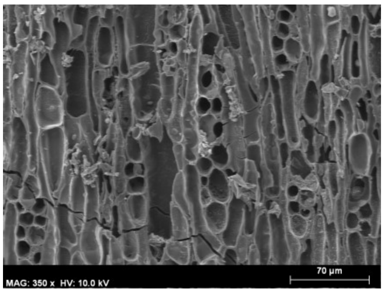
***Olea europaea***

Olive tree

Ελιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors, Roman/North Sector

**Species present in Greece**

This species is native to Greece

**Distribution:** *Olea europaea* is one of the most common species of the thermo-Mediterranean climatic zone in Greece. This tree naturally grows in maquis and garigue, as well as in sclerophyllous evergreen formations with *Ceratonia siliqua*, *Pistacia lentiscus*, *Juniperus* sp., and *Myrtus communis*. As a thermophilous species, *O. europaea* is highly tolerant in drought conditions, while it is also resistant to salinity.

**Wood Properties:**

**Average dried weight:** 990 $kg/m^3$

**Janka Hardness:** 12,010 Newton

**Modulus of Rupture:** 1,583 $kg_f/cm^2$

**Crushing strength:** 786 $kg_f/cm^2$

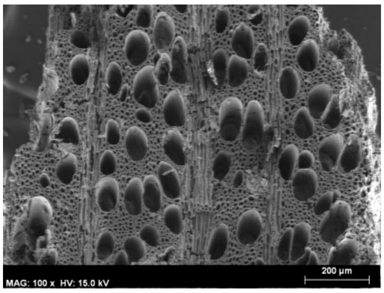
**Uses:** The wood of *Olea europaea* is very tough and heavy and so suitable for the construction of poles and the infrastructure of walls made of stones or bricks. In addition, the wood of this tree is considered good firewood, as it can ignite even wet. The fruits of *O. europaea* and the oil which is extracted from them were highly valued since the antiquity, while the leaves of the tree are suitable fodder for livestock.

**Platanaceae**

***Platanus orientalis***

Plane tree

Πλάτανος

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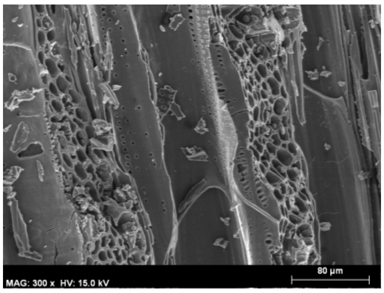



Tangential longitudinal section

## Anthracological Evidence

Akrotiri, Thera: NPS 18, NPS 66Π, NPS 67, Xeste 3

Heraion, Samos: EBA/ South Sector, MBA/North, Roman/North Sector

## Species present in Greece

This species is native to Greece

**Distribution:** *Platanus orientalis* is a common tree in Greece which thrives from sea level up to 1,000 m a.s.l. It grows along streams and rivers, and alluvial depositions in association with other riparian taxa such as Alnus *glutinosa*, *Salix alba*, and *Populus* sp.

## Wood Properties:

**Average dried weight:** 630 kg/$m^3$

**Janka Hardness:** no data

**Modulus of Rupture:** no data

**Crushing strength:** no data

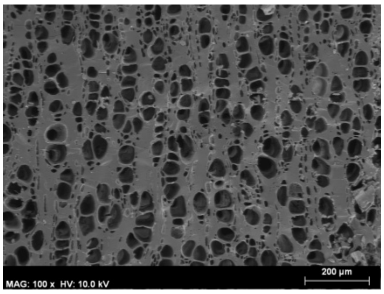
**Uses:** The wood of *Platanus orientalis* can be used for the manufacture of furniture and other wooden objects, such as barrels and crates. Additionally, it is used for the production of paper pulp. During the Roman period this species was planted extensively in urban areas and gardens as an ornamental.

**Punicaceae**

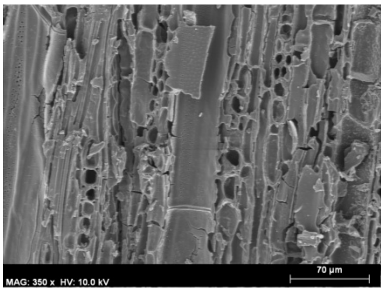
***Punica granatum***

Pomegranate

Ροδιά



Transverse section



Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66Π, NPS 67, House of the Ladies

**Species present in Greece**

This species is native to Greece

**Distribution:** *Punica granatum* is a big shrub or a small tree with a height of up to 5 m, which grows along streams or in the lower mountainous zone. This species is thought to have originated in the region from Iran to northern India. Its presence in Akrotiri at least since the Early Bronze Age suggests a *terminus post quem* for its introduction in the Aegean.

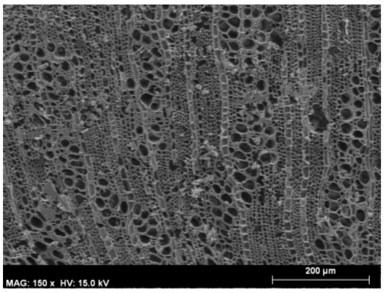
**Uses:** *Punica granatum* it is thought to have been cultivated in the Aegean already since antiquity for its edible fruits.

**Rhamnaceae/Oleaceae**

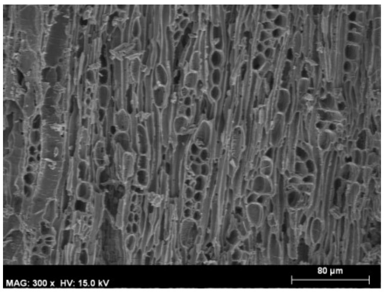
## ***Rhamnus/ Phillyrea***

Buckthorn/Mock privet

Ράμνος/Φιλλύκι




Transverse section




Tangential longitudinal section

**<u>Anthracological Evidence</u>**

Akrotiri, Thera: OPS 17, NPS 18, NPS 66Π, NPS 67, Xeste 3

Heraion, Samos: EBA/ South and Central Sectors, MBA/ North and Central Sectors

**<u>Species present in Greece</u>**

*Phillyrea latifolia*

*Rhamnus alaternus, R. alpine*

*R. cathartica, R. lycioides*

*R. orbiculata, R. pichleri*

*R. pumila, R. saxatilis*

*R. sibthorpiana*

**<u>Distribution:</u>** *Phillyrea latifolia* is a big shrub or a small tree, which occurs in elevations from sea level up to 1,350 m a.s.l. It can be found in maquis shrublands or mixed deciduous forests and it is very resistant to drought and salinity. This species grows on both the Cyclades and Samos. From the *Rhamnus* species, *R. alaternus, R. lycoides,* and *R. saxatilis* subsp. *prunifolia* are present on both Samos and the Cyclades, while *R. pichleri* only on Samos. *Rhamnus* species are also shrubs or small trees. The species presented here grow in low shrublands and sclerophyllous forests and they are characteristic of the thermo-Mediterranean climate. *Rhamnus* sp. and *Phillyrea* sp. although belonging to different families, have a very similar anatomy with distinct growth ring boundaries, vessels arranged in dendritic pattern and ray width of 1 to 3 cells. For this reason they cannot be distinguished based on the wood anatomy alone.

**<u>Wood Properties (*Ph. latifolia*):</u>**

**Average dried weight:** 760 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** no data

**Crushing strength:** 582 kg$_f$/cm$^2$

**<u>Uses:</u>** The wood of both species is used in turnery.

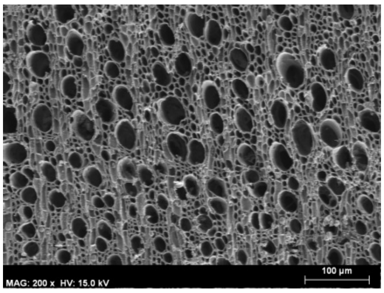
**Rosaceae**

Subfamily

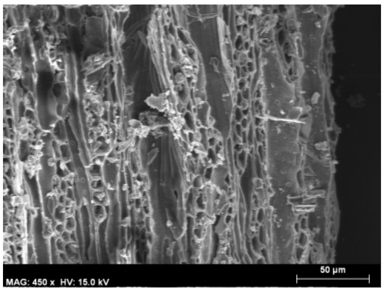
## Maloideae

Apple subfamily

Μηλοειδή




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, MBA/North and Central Sectors

**Genera present in Greece**

*Amelanchier* sp.,
*Cotoneaster* sp
*Crataegus* sp.,
*Malus* sp., *Pyrus* sp.
*Pyracantha* sp., *Sorbus* sp.

**Distribution:** The members of the subfamily of Maloideae are trees and shrubs which are usually up to 5 m tall. These genera occur usually in deciduous shrublands and xeric phrygana. The most common Maloideae in Samos include species of *Crataegus* sp., *Pyrus* sp., *Malus* sp. and *Pyracantha* sp., while in Thera the species of *Crateagus* sp., and *Pyrus* sp. are common.

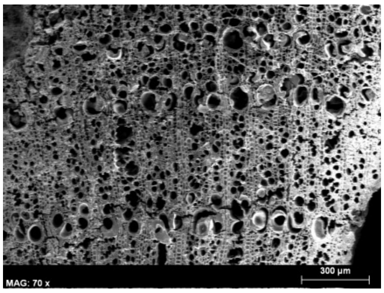
**Wood Properties (*P. communis*):**
**Average dried weight:** 690 kg/m$^3$
**Janka Hardness:** 7,380 Newton
**Modulus of Rupture:** 849 kg$_f$/cm$^2$
**Crushing strength:** 449 kg$_f$/cm$^2$

**Uses:** The wood of Maloideae is hard and resistant to rot. As firewood, it is preferred for cooking, because it is burns slowly. Mostly, the species of Maloideae are valued for their edible fruits, such as apples and pears.

**Rosaceae**

***Prunus* sp.**

Plum/Cherry/Almond/
Apricot trees
Κορομηλιές/Κερασιές/
Αμυγδαλιές/Ροδακινιές



Transverse section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors, Archaic/ Central Sector

**Species present in Greece**

*Prunus amygdalus, P. avium, P. cerasifera,*
*P. cerasus*
*P. cocomilia, P. domestica*
*P. graeca, P. mahaleb*
*P. prostrata, P. spinosa*
*P. webbii*

**Distribution:** Beside *Prunus amygdalus*, the only other species of *Prunus* present in Thera is *P. cerasifera*. Along these, in Samos occur *P. avium*, *P. cocomilia*, *P. spinosa*, *P. webbii*, and the domestic *P. domestica*. The natural range of the species of this genus is very broad, as they can grow from sea level up to the mountainous zone. They occur in open deciduous woodlands and shrublands or in openings and clearings as well as in riparian forests.

**Wood Properties (*P. avium/P. domestica*):**
**Average dried weight:** 600 kg/m$^3$/ 795 kg/m$^3$
**Janka Hardness:** 5,120 Newton / 6,900 Newton
**Modulus of Rupture:** 1,053 kg$_f$/cm$^2$ / 900 kg$_f$/cm$^2$
**Crushing strength:** 509 kg$_f$/cm$^2$ / no data

**Uses:** The wood of the species of *Prunus* and especially of *P. avium* and *P. domestica* is considered of high quality as it is solid and dense. It is suitable for the production of construction timbers and today is also used for the manufacture of musical instruments. The majority of the species of this taxon are important food sources as their fruits are edible by humans and animals.

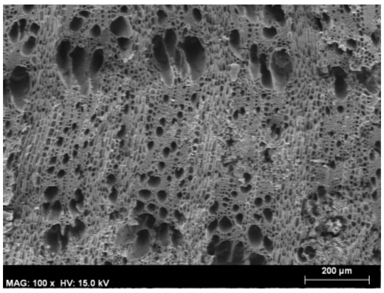
**Rosaceae**

## *Prunus amygdalus*

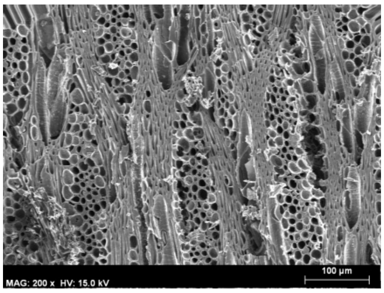
(syn. *Prunus dulcis*)

Almond tree

Αμυγδαλιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors

**Species present in Greece**

This species is native to Greece

**Distribution:** *Prunus amygdalus* are small trees which can grow up to 9 m in height. They are native to the Mediterranean region and the Near East: they have been domesticated since the antiquity. This species is drought tolerant and it can grow in a variety of terrains, including rocky and cliffs. Those fragments characterized as *Prunus amygdalus* in the transverse section had distinct annual rings and at the same time at the tangential longitudinal section the width of their rays ranged between 6 to 8 cells. In all other cases the fragments were characterised as *Prunus* sp.

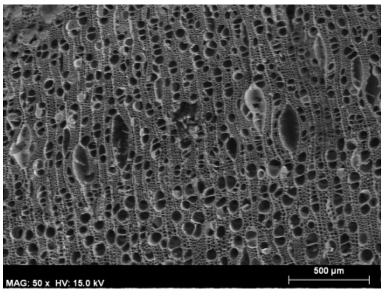
**Uses:** *Prunus amygdalus* is valued for its edible fruits and it has been cultivated in the Near East at least since the Early Bronze Age.

**Salicaceae**

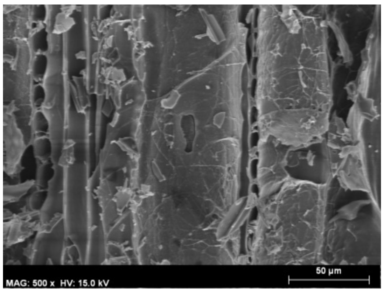
## *Salix/Populus*

Willow/Poplar

Ιτιά/Λεύκα




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: NPS 18, NPS 35, NPS 66Π, NPS 67

Heraion, Samos: EBA/ South Sector, MBA/North Sector

**Species present in Greece**

In Greece are present 15 species of *Salix* and 6 species of *Populus*.

**Distribution:** From the species of genus *Salix* represented in Greece, species *S. fragilis*, *S. pedicellata,* and *S. rubens* are present today in Samos and *S. alba* is present both in Samos and the Cyclades. Accordingly, from the genus *Populus* in both areas are present the species *P. alba* and *P. nigra.* All the aforementioned are heliophellous and frost tolerant, and they grow in alluvial deposition along lakes, rivers and streams in association with *Alnus* sp., *Acer* sp., *Fraxinus* sp., *Ulmus* sp., *Platanus orientalis*, and *Quercus* sp. Their altitudinal range spans in Greece from the sea level up to approx. 1,200 m a.s.l. Both can withstand flooded conditions while *Populus* sp. can also tolerate saline conditions. Additionally, both genera have a very similar wood anatomy with the only exception being the presence of heterogeneous rays with upright marginal cells in *Salix* sp. Where these upright marginal cells are missing, the two taxa are undistinguishable. In Akrotiri and Heraion, the low number and small size of specimens of these genera hindered a more precise identification.

**Wood Properties (*S.alba/P. alba*):**

**Average dried weight:** 400 kg/m$^3$/ 440 kg/m$^3$

**Janka Hardness:** 2,530 Newton / 1,820 Newton

**Modulus of Rupture:** 572 kg$_f$/cm$^2$ / 662 kg$_f$/cm$^2$

**Crushing strength:** 274 kg$_f$/cm$^2$ / no data

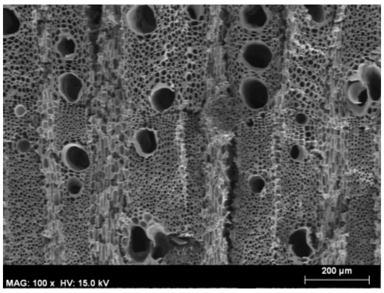
**Uses:** The wood of *Salix* sp. and *Populus* sp. is used for the manufacture of furniture and small wooden objects such as kitchen utensils. Additionally, the elasticity of the steams of *Salix* has been used since the antiquity to weave baskets, while its leaves are used as fodder and in medicine. The wood of *Populus* is also being used as timber.

**Tamaricaceae**

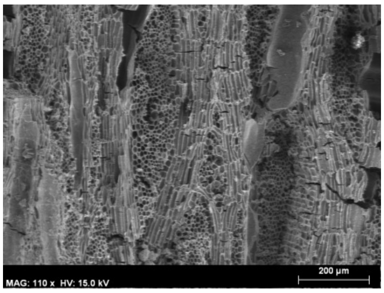
***Tamarix* sp.**

Tamarisk

Αρμυρίκι




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 18, NPS 35, NPS 66Π, NPS 67, Xeste 3, House of the Ladies

**Species present in Greece**

*Tamarix dalmatica*

*T. hampeana*

*T. nilotica*

*T. parviflora*

*T. ramosissima*

*T. smyrnensis*

*T. tetrandra*

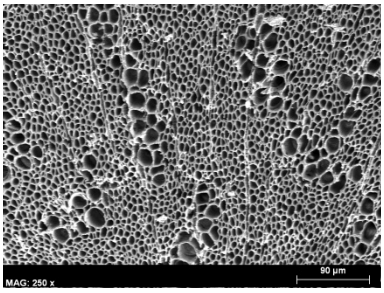
**Distribution:** *Tamarix* sp. was securely identified in the assemblage of Akrotiri. The species of this taxon which could be represented are *T. hampeana*, *T. parviflora* and *T. ramosissima*. *Tamarix* are shrubs or small trees which can withstand saline water and they can survive long periods of water-logging, as well as drought conditions. They are halophytes growing close to the seashores, salty marches and on sandy or gravelly banks.

**Uses:** The wood of *Tamarix* is used as fuelwood.

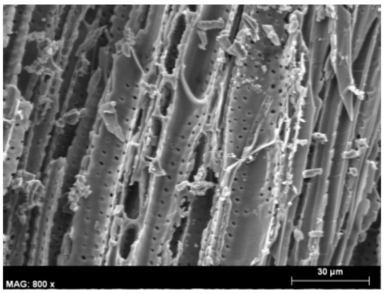
**Thymelaeaceae**

Mezereum Family

Θυμελαιοειδή




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Akrotiri, Thera: OPS 17, NPS 67

**Genera present in Greece**

*Daphne* sp.

*Thymelaea* sp.

**Distribution:** The species most likely present in Akrotiri are *Daphne gnidioides, Thymelaea hirsuta,* and *Th. tartonraira.* All the above species are shrubs growing close to the sea, in grasslands or in low shrublands.

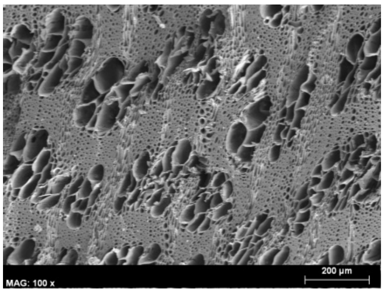
**Uses:** These species are planted today in gardens as ornamentals. The stems of *Thymelaea hirsuta* can be woven to produce rope.

**Ulmaceae**

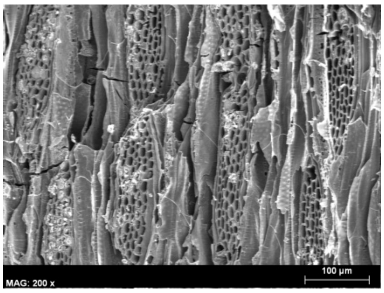
***Celtis* sp.**

Nettle Tree

Μελικουκιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Heraion, Samos: Ch/South Sector, EBA/South Sector, MBA/North Sector

**Species present in Greece**

*Celtis australis*

*Celtis planchoniana*

*Celtis tournefortii*

**Distribution:** From the three species of *Celtis* present in Greece, only *Celtis tournefortii* and *Celtis australis*is are present in Heraion. *Celtis planchoniana* is present only on the Sithonia peninsula. *C. australis* is a 25 m tall tree which can grow from sea level up to 1,200 m a.s.l. This species is found in thermophilous mixed deciduous forests in association with *Quercus pubescens, Fraxinus ornus* and *Coryllus avellana* or in riparian vegetation along with *Salix* sp., *Populus* sp., and *Ulmus* sp. *C. tournefortii* is a much smaller species with a height up to 6 m which grows in ravines, cliffs, boulders, shrublands, and open woodlands. The difference between *Ulmus* sp. and *Celtis* sp. is the presence of heterogeneous rays in *Celtis* sp. which are slightly wider than those of *Ulmus* sp. In the specimens from Heraion which were big enough to observe a significant number of rays in the longitudinal tangential or in radial sections it was possible to determine if they were *Ulmus* sp. or *Celtis* sp., in the rest of the cases the specimens were characterized as *Ulmus/Celtis*.

**Wood Properties (*Celtis* sp.):**

**Average dried weight:** 590 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** 808 kg$_f$/cm$^2$

**Crushing strength:** 432 kg$_f$/cm$^2$

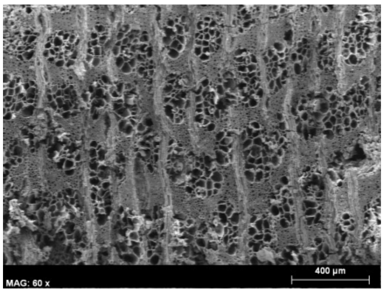
**Uses:** *Celtis australis* besides its edible fruits is also valued for its water-resistant wood. The wood of this species is used in boat-building as well as for the construction of doors and windows. Finally, *Celtis* sp. makes a good quality fuel wood.

**Ulmaceae**

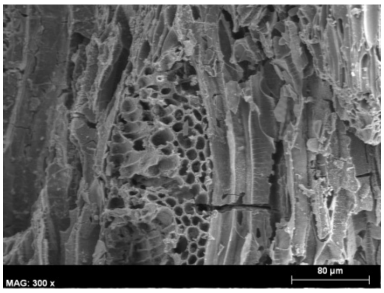
## *Ulmus* sp.

Elm

Φτελιά




Transverse section




Tangential longitudinal section

**Anthracological Evidence**

Heraion, Samos: Ch/South Sector, EBA/South and Central Sectors, MBA/North and Central Sectors

**Species present in Greece**

*Ulmus glabra*

*Ul. laevis*

*Ul. minor*

*Ul. procera*

**Distribution:** *Ulmus minor* and its subspecies, *U. minor* subsp. *canescens* and *minor*, are most likely represented in the assemblage of Heraion. This species is a pioneer, light-demanding tree which inhabits banks of streams and rivers and it can tolerate waterlogged conditions, as well as drought and wind. It is usually found in association with *Fraxinus* sp., *Populus* sp., *Alnus* sp., and *Celtis* sp. in mixed riparian forests.

**Wood Properties (*Ul. minor*):**

**Average dried weight:** 670 kg/m$^3$

**Janka Hardness:** no data

**Modulus of Rupture:** 890 kg$_f$/cm$^2$

**Crushing strength:** 560 kg$_f$/cm$^2$

**Uses:** The wood of *Ulmus minor* is of high quality, very resistant to water decay. It is suitable for the manufacture of furniture and for underwater pipes while it is also used as firewood. Additionally, the leaves of this species are used as fodder.

# V. Landscape, tree management, and uses of wood at Akrotiri, Thera

## 1. Landscape and tree management: Results and Discussion

Wood charcoal macroremains related to assemblages from fills and dumps can provide useful information on the palaeoflora prevailing in the surroundings of Akrotiri, Thera, as well as on the management of the trees: such deposits come mainly from the deep shafts excavated for the construction of the new shelter of the archaeological site. They date from the earlier occupation phases of the site (EC I/EC II) until its destruction by the volcanic eruption (LC I). The need to establish secure foundations for the pillars of the new shelter led the archaeologists to excavate through all the volcanic deposits down to the pyroclastic bed-rock. This exercise permitted the collection of anthracological samples, whose analysis gave the opportunity to study the change of the vegetation through time and the impact of the inhabitants upon it. In addition to these sources, similar assemblages also come from the Square of the Cenotaph, whose deposits are dated from the destruction of the settlement in the earthquake which took place during the late MC/early LC I periods.

Samples were retrieved from all the pillar shafts included in this study, namely Pillars 18, 35, 66Π, 67, as well as from the Square of the Cenotaph (see Table II.2). In total there were analysed 3,964 wood charcoal fragments, corresponding to 31 taxa. Of the total number of wood charcoal fragments studied, 724 belong to assemblages dated to the EC period, 244 to the transitional period between EC III and early MC, 1,472 to the MC period, 679 to the transitional period between late MC and early LC I, and finally 545 to the LC I period. The taxa alphabetically are the following: *Alnus/Corylus*, *Arbutus* sp., *Castanea sativa*, *Cedrus libani*, Chenopodiaceae, Cistaceae, *Cupressus sempervirens*, Fabaceae, *Ficus carica*, *Fraxinus* sp., *Juniperus* sp., Labiatae, Leguminoseae, *Lonicera* sp., Maloideae, *Olea europaea*, *Pinus* sp., *Pinus* tp. *brutia/halepensis*, *Pinus* tp. *nigra/sylvestris*, *Pistacia* sp., *Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Punica granatum*, *Quercus* sp., *Quercus* tp. deciduous, *Quercus* tp. evergreen, *Rhamnus/Phillyrea*, *Salix/Populus*, *Tamarix* sp., and Thymelaeaceae cf. *Daphne* sp.

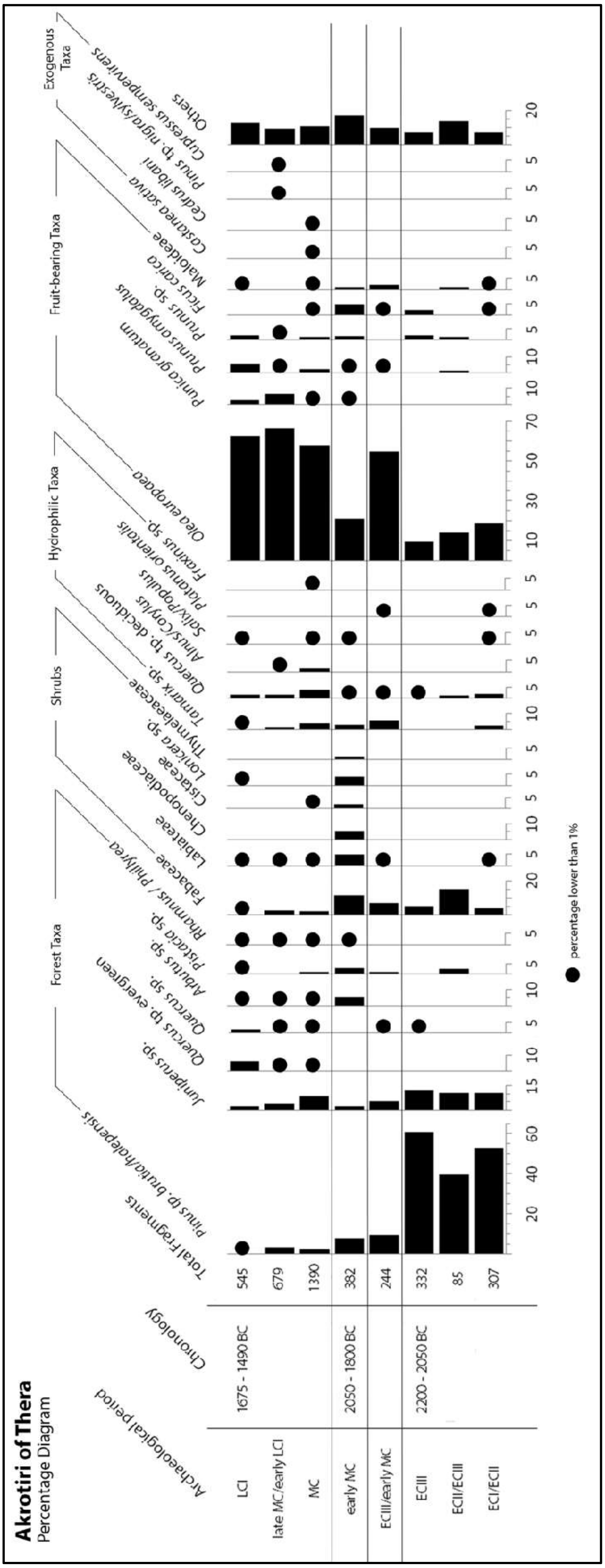


**Figure V.1:** Anthracological diagram of Akrotiri. Taxa with percentage lower than 1% are presented with a dot.

### 1.1. The anthracological diagram

Figure V.1 presents the anthracological diagram of Akrotiri, which covers the period between EC I/EC II and LC I. The diagram can be divided roughly into four zones where Zone I equates to the EC I/EC II to EC III periods, Zone II and Zone III cover the EC III/early MC and early MC period, respectively, and finally the time from MC to LC I comprises Zone IV.

During the EC period (Tables V.1 to V.3), *Pinus* type *brutia/halepensis* is the dominant taxon with percentages which are close to or above 50%, with the exception of the EC II/EC III assemblage where it only reaches close to 40%. *Juniperus* sp. and *Olea europaea* co-dominate here, with percentages that are close to 10%, while *Olea europaea* during the EC I/II period has a percentage of 18.57% (Table V.1). Worth noting too is the presence of Fabaceae, which during EC II/III, when the slight reduction in the percentage of *Pinus* type *brutia/halepensis* is observed, achieves percentages above 15%. Then too, *Pistacia* sp. is identified for the first time, although in low quantities.

| **Akrotiri - Shaft of New Pillar 18** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chamber - EC I/EC II** | | | | | | | | | | | | |
| **Context** | Fill | | | | | | | | | | | |
| **Layer** | 2 | | | | | | | | | | | |
| **Taxa/Sample** | WF2000 (1001) | WF2000 (1004) | WF2000 (1005) | WF2000 (1006) | WF2000 (1014) | WF2000 (1015) | WF2000 (997) | WF2000 (999) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| Fabaceae | 5 | 2 | 1 | 1 | | | 1 | 2 | **12** | **3.91** | **6** | **75.0** |
| *Ficus carica* | | | 1 | 1 | | | 1 | | **3** | **0.98** | **3** | **37.5** |
| *Juniperus* sp. | 7 | 1 | 1 | 2 | 10 | 2 | 1 | 8 | **32** | **10.42** | **8** | **100** |
| Labiatae | 1 | | | | 1 | | | | **2** | **0.65** | **2** | **25.0** |
| Maloideae | | | | | 1 | | | | **1** | **0.33** | **1** | **12.5** |
| *Olea europaea* | 16 | 13 | 5 | 5 | 7 | | 4 | 7 | **57** | **18.57** | **7** | **87.5** |
| cf. *Olea europaea* | 2 | | 2 | | | 1 | 1 | | **6** | **1.95** | **4** | **50.0** |
| *Pinus* tp. *brutia/halepensis* | 36 | 1 | 13 | 1 | 68 | 7 | 11 | 25 | **162** | **52.77** | **8** | **100** |
| *Platanus orientalis* | | | 1 | | | | | | **1** | **0.33** | **1** | **12.5** |
| *Quercus* tp. deciduous | 3 | | | | | | 1 | 2 | **6** | **1.95** | **3** | **37.5** |
| *Salix/Populus* | | | | | 2 | | | | **2** | **0.65** | **1** | **12.5** |
| *Tamarix* sp. | 2 | | | 1 | | | | 4 | **7** | **2.28** | **3** | **37.5** |
| Angiosperm | 3 | | 2 | 1 | 6 | 2 | | 2 | **16** | **5.21** | **6** | **75.0** |
| **TOTAL** | **75** | **17** | **26** | **12** | **95** | **12** | **20** | **50** | **307** | **100** | | |
| **Min No of taxa** | **7** | **4** | **6** | **6** | **7** | **3** | **6** | **6** | **11** | | | |

**Table V.1**: Anthracological results from the Chamber, excavated in Pillar 18, Akrotiri, dated to the EC I/EC II.

**Akrotiri - Shaft of New Pillar 35**

| | Chamber 1 - EC II-IIIa | | Chamber 2 - EC III | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Fills | | Fills | | | Cavity 2 | Cavity 3 | | Cavity 4 | Cavity 5 | Cavity 6 | Cavity 7 | | | | | | |
| **Layer** | 23 | 22 | 24-25 | | | 30 | 31 | | 32 | 33 | 34 | 35 | | | | | | |
| **Taxa/Sample** | WF2000 (1019) | WF2000 (1023) | WF2001 (1022) | WF2000 (1010) | WF2000 (1009) | WF2001 (1065) | WF2001 (1067) | WF2001 (1066) | WF2001 (1068) | WF2001 (1069) | WF2001 (1071) | WF2001 (1074) | WF2001 (1073) | WF2001 (1072) | N | % | Ubiquity | Ubiquity % |
| cf. Cistaceae | | | | | | | | | | | | 3 | | | **3** | **0.90** | **1** | **7.14** |
| cf. Chenopodiaceae | | | | | | | | | | | | 1 | | | **1** | **0.30** | **1** | **7.14** |
| Fabaceae | | | 1 | | | | | | | 1 | 4 | 4 | | 7 | **17** | **5.07** | **5** | **35.71** |
| *Ficus carica* | | | | | | | 5 | | | | 2 | | | | **7** | **2.09** | **2** | **14.29** |
| *Juniperus* sp. | | | 1 | | | 17 | | | 13 | 1 | 3 | | | 6 | **41** | **12.24** | **6** | **42.86** |
| *Olea europaea* | | | 3 | 1 | 4 | 6 | | 1 | 5 | 1 | 2 | 7 | 1 | | **31** | **9.25** | **10** | **71.43** |
| cf. *Olea europaea* | | | | | | | | 2 | | | | 1 | | | **3** | **0.90** | **2** | **14.29** |
| *Pinus* tp. *brutia/halepensis* | 1 | | 37 | 26 | 13 | 55 | | | 11 | 16 | 33 | 3 | | 8 | **203** | **60.60** | **10** | **71.43** |
| *Pinus* sp. | | 1 | | | | | | | | | | | | | **1** | **0.30** | **1** | **7.14** |
| cf. *Pistacia* sp. | | | | | | | | | | | | | | 1 | **1** | **0.30** | **1** | **7.14** |
| *Prunus* sp. | | | | | | | | 7 | | | | | | | **7** | **2.09** | **1** | **7.14** |
| *Quercus* tp. deciduous | | | | | | | | | | | | 1 | | | **1** | **0.30** | **1** | **7.14** |
| *Quercus* sp. | | | | | | 1 | | | | | 1 | | 1 | | **3** | **0.90** | **3** | **21.43** |
| Angiosperm | | | | | 3 | 2 | | 1 | | 1 | | 4 | | | **11** | **3.28** | **5** | **35.71** |
| Monocotyledones | | 1 | 2 | | | | | | | | 1 | | | | **4** | **1.19** | **3** | **21.43** |
| Coniferales | | | | 1 | | | | | | | | | | | **1** | **0.30** | **1** | **7.14** |
| **TOTAL** | **1** | **2** | **44** | **28** | **20** | **81** | **5** | **11** | **29** | **20** | **46** | **24** | **2** | **22** | **335** | **100** | | |
| **Min No of taxa** | **1** | **1** | **4** | **2** | **2** | **4** | **1** | **2** | **3** | **4** | **6** | **6** | **2** | **4** | **12** | | | |

**Table V.2**: Anthracological results from Chambers 1 and 2, excavated in Pillar 35, Akrotiri, dated to the EC II-IIIa and EC III, respectively.

| Akrotiri-Shaft of New Pillar 66Π | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chamber - EC II/EC III | | | | | | | | | | | |
| **Context** | Fill - phase 1 | | | | | | | | | | |
| **Layer** | 28-32 | | | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Taxa/Sample** | WF2001 (1300) | WF2001 (1301) | WF2001 (1314) | WF2001 (1315) | WF2001 (1319) | WF2001 (1321) | WF2001 (1344) | | | | |
| Fabaceae | | 9 | 2 | 2 | | | | **13** | **15.12** | **3** | 42.86 |
| cf. Fabaceae | | | 1 | 1 | | | | **2** | **2.33** | **2** | 28.57 |
| *Juniperus* sp. | 2 | 3 | | 3 | 1 | | | **9** | **10.47** | **4** | 57.14 |
| cf. Labiatae | 1 | | | | | | | **1** | **1.16** | **1** | 14.29 |
| Maloideae | | | 1 | | | | | **1** | **1.16** | **1** | 14.29 |
| *Olea europaea* | 2 | | 3 | 1 | 2 | | 4 | **12** | **13.95** | **5** | 71.43 |
| *Pinus* tp. *brutia/halepensis* | 1 | 5 | 13 | 4 | 4 | 3 | 4 | **34** | **39.53** | **7** | 100 |
| *Pistacia* sp. | | | 2 | | | | | **2** | **2.33** | **1** | 14.29 |
| cf. *Pistacia* sp. | | 1 | 1 | | | 1 | | **3** | **3.49** | **3** | 42.86 |
| *Prunus amygdalus* | | | 1 | | | | | **1** | **1.16** | **1** | 14.29 |
| *Prunus* sp. | | | | 1 | | | | **1** | **1.16** | **1** | 14.29 |
| *Quercus* tp. deciduous | | | | 1 | | | | **1** | **1.16** | **1** | 14.29 |
| Angiosperm | | 2 | 1 | 2 | 1 | | | **6** | **6.98** | **4** | 57.14 |
| **TOTAL** | **6** | **20** | **25** | **15** | **8** | **4** | **8** | **86** | **100** | | |
| **Min No of taxa** | **4** | **4** | **6** | **6** | **3** | **2** | **2** | **10** | | | |

**Table V.3:** Anthracological results from the Chamber, excavated in Pillar 66Π, Akrotiri, dated to the EC II/EC III.

The above data suggest the collection of firewood from an open pine forest during the EC period, which would have grown nearby the site. The decrease in the percentage of *Pinus* type *brutia/halepensis* during the EC II/EC III period and the simultaneous increase of Fabaceae and *Pistacia* sp. indicate the opening up of this forest, though this was a temporary situation as during the next phase (EC III) pines regains its high percentages.

Additionally, the presence of hydrophilic taxa like *Quercus* type deciduous, *Salix/Populus* and *Platanus orientalis*, although in low percentages, argues the exploitation of vegetation growing in moist conditions, which could sustain this kind of taxa. Fruit-bearing taxa, like *Olea europaea*, *Prunus amygdalus*, *Ficus carica*, and Maloideae, were also exploited by the inhabitants, but their overall low percentages indicate that their numbers around the site were few. This, along with the high percentages of forest taxa, attest to a slighter anthropogenic impact on the environment. In regard to *Olea europaea,* one of the co-dominant taxa, it should be mentioned that during this period it most likely constitutes part of the natural open pine forest. In fact, in the anthracological diagram this species presents a peak during the earlier phase (EC I/EC II) but gradually thereafter decreases, at the same time that the percentages of the forest taxa and shrubs rise. This pattern tells against a preferred use of *Olea* through some purposeful exploitation, but rather for a random collection. Reinforcing this assumption are also other dendroanthracological data, like the total absence of annual rings in the specimens studied, which suggests that no kind of management had occurred (see Rackham, 1972).

The transitional period between EC III and MC is characterized by an abrupt drop in the percentages of *Pinus* type *brutia/halepensis* (9.43%) and a slight decrease of other forest taxa like *Juniperus* sp. and *Pistacia* sp. At the same time the visibility of *Olea europapea* increases significantly, reaching percentages above 50% (Table V.4). These changes are most probably human-induced, as the percentages of the rest of the taxa remained more or less the same and no new taxa were introduced, according to the anthracological diagram.

| **Akrotiri-Shaft of New Pillar 66Π** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Chamber - late EC III/early MC** | | | | | | | |
| **Context** | Fill-phase 2 | | | | | | |
| **Layer** | 25-26 | | | | | | |
| **Taxa/Sample** | WF2001 (1239) | WF2001 (1241) | WF2001 (1246) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| Fabaceae | 4 | 8 | 5 | **17** | **6.97** | **3** | **100** |
| cf. Fabaceae | 2 | 1 | | **3** | **1.23** | **2** | **66.67** |
| *Ficus carica* | | 2 | | **2** | **0.82** | **1** | **33.33** |
| *Juniperus* sp. | 3 | 5 | 6 | **14** | **5.74** | **3** | **100** |
| Labiatae | | 1 | 1 | **2** | **0.82** | **2** | **66.67** |
| Maloideae | | 3 | 2 | **5** | **2.05** | **2** | **66.67** |
| *Olea europaea* | 32 | 47 | 54 | **133** | **54.51** | **3** | **100** |
| cf. *Olea europaea* | 4 | 4 | 4 | **12** | **4.92** | **3** | **100** |
| *Pinus* tp. *brutia/halepensis* | | 19 | 4 | **23** | **9.43** | **2** | **66.67** |
| *Pistacia* sp. | | 2 | 1 | **3** | **1.23** | **2** | **66.67** |
| *Platanus orientalis* | | | 1 | **1** | **0.41** | **1** | **33.33** |
| *Prunus amygdalus* | 1 | | 1 | **2** | **0.82** | **2** | **66.67** |
| *Quercus* tp. deciduous | | 2 | | **2** | **0.82** | **1** | **33.33** |
| *Quercus* sp. | | 1 | 1 | **2** | **0.82** | **2** | **66.67** |
| *Tamarix* sp. | 1 | 1 | 12 | **14** | **5.74** | **3** | **100** |
| Angiosperm | 2 | 2 | 5 | **9** | **3.69** | **3** | **100** |
| **TOTAL** | **49** | **98** | **97** | **244** | **100** | | |
| **Min No of taxa** | **5** | **11** | **11** | **13** | | | |

**Table V.4:** Anthracological results from the Chamber, excavated in Pillar 66Π, Akrotiri, dated to late EC III/early MC.

At the early stages of the MC period (Tables V.5 and V.6), the percentage of *Pinus* type *brutia/halepensis* is further reduced, as is that of *Juniperus* sp, while the heliophilous *Arbutus* sp. and *Rhamnus/Phillyrea* appear for the first time. Further to these two changes, the values of *Olea europaea* are also reduced significantly, with its percentage falling back to resemble that of the EC I/EC II period. At the same time, there is to be observed an increase in the presence of shrubby taxa, suggesting a further opening up of the forest canopy: Fabaceae (13.04%) and Labiatae (5.51%) percentages rose and Chenopodiaceae, Cistaceae, *Lonicera* sp., and Thymaleaceae were identified for the first time.

The simultaneous decrease in pines and olive trees and the increase of shrubby taxa, as well as the identification of phyrophilous *Arbutus* sp. might be related to a catastrophic event like a forest fire (Badal et al., 1994; Houérou Le, 1974). Of course, to verify this hypothesis, geomorphological analyses are required. The short time interval between the transitional phase (EC III/early MC) and early MC, when *Olea europaea* was dominant, and its immediate increase during the next phase (MC and onwards) along with the decrease of shrubby taxa all indicate a major event that led to the acute opening up of the canopy.

| Akrotiri - Shaft of New Pillar 35 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Rooms 2 & 3 - early MC | | | | | | |
| **Context** | Fills- Flattening of the natural rock | | | | | | |
| **Layer** | 16 | 17 | 18 | | | | |
| **Taxa/Samples** | WF2000 (891) | WF2000 (894) | WF2000 (895) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| Cistaceae | 1 | | | **1** | **2.70** | **1** | **33.33** |
| *Ficus carica* | | 1 | | **1** | **2.70** | **1** | **33.33** |
| *Olea europaea* | 10 | 7 | 10 | **27** | **72.97** | **3** | **100** |
| cf. *Olea europaea* | | | 2 | **2** | **5.41** | **1** | **33.33** |
| *Pinus* tp. *brutia/halepensis* | 2 | | | **2** | **5.41** | **1** | **33.33** |
| cf. *Quercus* sp. | | 1 | | **1** | **2.70** | **1** | **33.33** |
| Angiosperm | 2 | 1 | | **3** | **8.11** | **2** | **66.67** |
| **TOTAL** | **15** | **10** | **12** | **37** | **100** | | |
| **Min No of taxa** | **3** | **3** | **1** | **5** | | | |

**Table V.5:** Anthracological results from Rooms 2 and 3, excavated in Pillar 35, Akrotiri, dated to early MC.

| Akrotiri-Shaft of New Pillar 66Π | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower Room - MC | | | | | | | | | | | | | | | | | | | | | | | | |
| **Context** | Fill of lower room | | | | | Sub-layers of Floor 3 (Flattening of the natural rock) | | | | | | | | | | | | | | | | | | |
| **Layer** | 18-20 | | | | | 21 | | | | | | | | | | | | 22 | 24 | | | | | |
| **Taxa/Sample** | WF2000 (1013) | WF2001 (1035) | WF2001 (1044) | WF2001 (1184) | WF2001 (1214) | WF2001 (1216) | WF2001 (1225) | WF2001 (1227) | WF2001 (1226) | WF2001 (1228) | WF2001 (1050) | WF2001 (1052) | WF2001 (1053) | WF2001 (1054) | WF2001 (1055) | WF2001 (1057) | WF2001 (1230) | WF2001 (1231) | WF2001 (1234) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Alnus/Corylus* | | | | | | | 6 | | 2 | 3 | | | | | 1 | | 3 | 2 | | **17** | **1.22** | **6** | **31.58** |
| *Arbutus* sp. | | | | | | | | | | 2 | | | | | | | 2 | 1 | | **5** | **0.36** | **3** | **15.79** |
| *Castanea sativa* | 5 | 1 | | | | | | | 1 | | | | | | | | | | | **7** | **0.50** | **3** | **15.79** |
| cf. *Castanea sativa* | | 4 | | | | | | | 1 | | | | | | | | | | | **5** | **0.36** | **2** | **10.53** |
| *Cedrus libani* | | | | | | | | | | | | | | | | 1 | | | | **1** | **0.07** | **1** | **5.26** |
| Cistaceae | | | | | | | | | | | 1 | | | | | | | | | **1** | **0.07** | **1** | **5.26** |
| Fabaceae | 2 | 1 | | | | | | | 1 | 4 | 8 | 1 | | 2 | | 4 | 3 | 5 | 2 | **33** | **2.37** | **11** | **57.89** |
| cf. Fabaceae | | | | | | | | | | | 1 | | | | | | | | | **1** | **0.07** | **1** | **5.26** |
| *Ficus carica* | | | | | | | | | | | | | | | | | | 3 | 2 | **5** | **0.36** | **2** | **10.53** |
| *Fraxinus* sp. | | 2 | | | | | | | | | | | | | | | | | | **2** | **0.14** | **1** | **5.26** |
| *Juniperus* sp. | 8 | 2 | 3 | 5 | | 4 | 6 | 1 | 7 | 21 | 5 | 1 | | 1 | 2 | 35 | 6 | 14 | 2 | **123** | **8.85** | **17** | **89.47** |
| Labiatae | | | | 3 | | | | | | | | | | | | | | | | **3** | **0.22** | **1** | **5.26** |
| Maloideae | 1 | | | | | | | | | 1 | | | | | | | | | 1 | **3** | **0.22** | **3** | **15.79** |
| *Olea europaea* | 90 | 117 | 79 | 40 | 14 | 3 | 7 | 11 | 58 | 86 | 50 | 21 | 17 | 1 | 20 | 41 | 37 | 92 | 19 | **803** | **57.77** | **19** | **100** |
| cf. *Olea europaea* | 11 | 7 | 6 | 3 | 2 | | 1 | 4 | 13 | 3 | 2 | 3 | | 1 | 1 | 4 | 2 | 3 | 5 | **71** | **5.11** | **17** | **89.47** |
| *Pinus* tp. *brutia/halepensis* | | 2 | | | | 1 | | 4 | 1 | 3 | 4 | | | | | 10 | 5 | 4 | | **34** | **2.45** | **9** | **47.37** |
| *Pistacia* sp. | | 2 | 1 | | | | 1 | | 2 | | | 2 | 2 | | | | 1 | 6 | | **17** | **1.22** | **8** | **42.11** |
| cf. *Pistacia* sp. | | | | | | | | | 1 | 1 | | | | | 2 | | | | | **4** | **0.29** | **3** | **15.79** |
| *Prunus amygdalus* | | 2 | | 3 | | | 2 | 2 | 8 | 2 | 2 | 1 | | 1 | | | 2 | 7 | 3 | **35** | **2.52** | **12** | **63.16** |
| *Prunus* sp. | | 1 | | 2 | 2 | | 2 | | | 4 | | 1 | 1 | | | 2 | | 1 | 1 | **17** | **1.22** | **10** | **52.63** |
| cf. *Prunus* sp. | | | | | | | 1 | 2 | 2 | | | | | | | | | 1 | | **6** | **0.43** | **4** | **21.05** |
| *Punica granatum* | | | 2 | 2 | | | | | | | | | | | | | | | | **4** | **0.29** | **2** | **10.53** |
| *Quercus* tp. deciduous | 2 | 2 | 3 | 3 | | | | | 1 | 7 | 1 | | | | | 1 | 29 | 1 | | **50** | **3.60** | **10** | **52.63** |
| *Quercus* tp. evergreen | 1 | | 3 | 2 | | | | | | | | | | | | 1 | 1 | | | **8** | **0.58** | **5** | **26.32** |
| *Quercus* sp. | 3 | | 1 | 2 | | | | 1 | 1 | | 1 | | | | | | | | | **9** | **0.65** | **6** | **31.58** |
| cf. *Quercus* sp. | | | | | | | | | | | 2 | | | | | | 1 | | | **3** | **0.22** | **2** | **10.53** |
| *Rhamnus/Phillyrea* | | | | 1 | | | | | 1 | 3 | | | | | | | | | | **5** | **0.36** | **3** | **15.79** |
| *Salix/Populus* | | 1 | | | | | | | | 1 | | 8 | | | | | | | | **10** | **0.72** | **3** | **15.79** |
| *Tamarix* sp. | | | | | | | | 3 | 7 | 7 | 17 | | | | 3 | 1 | 7 | 3 | 3 | **51** | **3.67** | **9** | **47.37** |
| cf. *Tamarix* sp. | | | | | | | | | | 1 | | | | | | | | 2 | 1 | **4** | **0.29** | **3** | **15.79** |
| Angiosperm | 16 | 6 | 1 | 3 | 2 | | 5 | 2 | 2 | 1 | 4 | 3 | | | | | | 5 | 3 | **53** | **3.81** | **13** | **68.42** |
| **TOTAL** | **139** | **150** | **99** | **69** | **20** | **8** | **31** | **30** | **109** | **150** | **98** | **41** | **20** | **6** | **29** | **100** | **99** | **150** | **42** | **1390** | **100** | | |
| **Min No of taxa** | **7** | **11** | **6** | **9** | **2** | **3** | **6** | **7** | **13** | **14** | **9** | **7** | **3** | **4** | **5** | **9** | **11** | **12** | **8** | **22** | | | |

**Table V.6:** Anthracological results from the Chamber, excavated in Pillar 67, Akrotiri, dated to early MC.

The deposits that make up the MC and LC I assemblages are for the most part layers used to backfill earlier habitation areas. Part of them might originate from previous construction phases or even contemporary materials from the preparation of new buildings. Thus, although characterized as fills by the excavators, some of these samples will surely contain also structural debris. The presence of exogenous taxa in the samples analysed supports this thinking.

Comparing these deposits with those of the EC period, there is easily observed a difference between the percentages of *Olea europaea* and *Pinus* type *brutia/halepensis*, whose frequency seems now to be reversed. However, this change in the proportions of the two taxa had taken place in the EC III/early MC period: thus the dominance of *Olea europaea* (which is also the dominant taxon of the LC I buildings of the site) was already a fact before as well as during MC. This situation cannot then be exclusively put down to the presence of structural elements in the assemblage. As is discussed in §V.2.7, the growing predominance of *Olea* is most probably related to the fact that this was the taxon more readily available in the landscape during the period of construction of the buildings. A closer look at the results reveals a difference between the co-dominant taxa recovered from the deposits excavated in the interior of the LC I buildings from those of the fills and dumps of the same period. In the case of the buildings: *Pinus* type *brutia/halepensis*, *Quercus* type evergreen and deciduous, as well as *Tamarix* sp. all play an important role in the assemblage. In contrast, in the LC I deposits, *Quercus* type evergreen and fruit-bearing taxa co-dominate the assemblage, indicating that the taxa present in the case of the buildings are influenced by selection criteria. Last but not least, the samples of both MC and LC I are consistent in the taxa identified (see Chapter III), with the dominant taxa remaining the same throughout, something which suggests that the main "ecological markers" are indeed correctly recognized. This surety assists when making an appraisal of the landscape surrounding Akrotiri during these archaeological periods.

The final segment of the anthracological diagram demonstrates a turn towards a more controlled landscape, with the dominance of taxa profitable to humans. Furthermore, this is the first time non-endemic taxa are identified, albeit in low quantities, thus affirming the importation of wooden objects and/or timber to the island. More analytically, from the MC period on (Tables V.7 to V.12) is to be de-

| **Akrotiri - Shaft of New Pillar 67** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chamber - Entrance of the Chamber - early MC** | | | | | | | | | | | | | | | |
| **Context** | Fill of the entrance of the chamber | | | | | Fill of the chamber | Fill-Flattening of the natural rock | | | | | | | | |
| **Layer** | 16 | | | | | | | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Taxa/Sample** | WF2001 (1303) | WF2001 (1310) | WF2001 (1317) | WF2001 (1318) | M44/ 67N079 | WF2001 (1305) | M29/ 67N066 | WF2001 (1032) | WF2001 (1036) | WF2001 (1037) | WF2001 (1064) | | | | |
| *Arbutus* sp. | | 3 | | 2 | | | | 13 | | | 3 | **21** | **6.09** | **4** | **36.36** |
| cf. *Arbutus* sp. | | 1 | | 1 | | | | 2 | | | | **4** | **1.16** | **3** | **27.27** |
| Chenopodiaceae | | 2 | | 17 | 2 | | | | | | | **21** | **6.09** | **3** | **27.27** |
| Cistaceae | | | | 5 | 1 | | | | | | | **6** | **1.74** | **2** | **18.18** |
| Fabaceae | 4 | 23 | 5 | 5 | 8 | | | | | | | **45** | **13.04** | **5** | **45.45** |
| cf. Fabaceae | | 4 | | 5 | | | | | | | | **9** | **2.61** | **2** | **18.18** |
| *Ficus carica* | | 12 | | 5 | 1 | | | | | | | **18** | **5.22** | **3** | **27.27** |
| *Juniperus* sp. | 1 | 5 | | 1 | | 1 | | | | 2 | | **10** | **2.90** | **5** | **45.45** |
| Labiatae | | 7 | | 10 | 2 | | | | | | | **19** | **5.51** | **3** | **27.27** |
| cf. Labiatae | | | | 2 | | | | | | | | **2** | **0.58** | **1** | **9.09** |
| *Lonicera* sp. | 1 | 9 | 1 | 2 | 1 | | 1 | | | | | **15** | **4.35** | **6** | **54.55** |
| cf. *Lonicera* sp. | | 1 | | 2 | | | | | | | | **3** | **0.87** | **2** | **18.18** |
| Maloideae | | | 4 | 1 | | | | | | | | **5** | **1.45** | **2** | **18.18** |
| *Olea europaea* | 3 | 7 | 3 | 4 | 2 | 5 | 1 | 8 | 14 | 3 | 3 | **53** | **15.36** | **11** | **100** |
| cf. *Olea europaea* | | 2 | | | | | | 1 | 2 | 2 | 2 | **9** | **2.61** | **5** | **45.45** |
| *Pinus* tp. *brutia/halepensis* | 2 | 14 | 1 | 7 | | 1 | | | 1 | 1 | 1 | **28** | **8.12** | **8** | **72.73** |
| *Pistacia* sp. | | 10 | 1 | | | | | | | | | **11** | **3.19** | **2** | **18.18** |
| cf. *Pistacia* sp. | | 2 | 1 | | | | | | | 1 | | **4** | **1.16** | **3** | **27.27** |
| cf. *Platanus orientalis* | | | | | | | | 1 | | | | **1** | **0.29** | **1** | **9.09** |
| *Prunus amygdalus* | | | | | | | | 3 | | | | **3** | **0.87** | **1** | **9.09** |
| *Prunus* sp. | 2 | 3 | | 1 | | | | | | | | **6** | **1.74** | **3** | **27.27** |
| *Punica granatum* | | | | | | | | 2 | | | | **2** | **0.58** | **1** | **9.09** |
| *Quercus* tp. deciduous | 1 | | | | | | | | | 2 | | **3** | **0.87** | **2** | **18.18** |
| *Rhamnus/Phillyrea* | | 2 | | | | | | | | | | **2** | **0.58** | **1** | **9.09** |
| *Salix/Populus* | | 3 | | | | | | | | | | **3** | **0.87** | **1** | **9.09** |
| *Tamarix* sp. | | 2 | 1 | 4 | 2 | | | 2 | | | | **11** | **3.19** | **5** | **45.45** |
| Thymelaeaceae cf. *Daphne* sp. | | 2 | 2 | | | | | | | | | **4** | **1.16** | **2** | **18.18** |
| Angiosperm | 2 | 4 | 5 | 6 | 1 | | 1 | 3 | 3 | | 2 | **27** | **7.83** | **9** | **81.82** |
| **TOTAL** | **16** | **118** | **24** | **80** | **20** | **7** | **3** | **35** | **20** | **11** | **11** | **345** | **100** | | |
| **Min No of taxa** | **7** | **15** | **8** | **13** | **8** | **3** | **2** | **6** | **2** | **5** | **3** | **21** | | | |

**Table V.7:** Anthracological results from the Lower Room, excavated in Pillar 66Π, Akrotiri, dated to MC.

tected a gradual increase in the percentages of *Olea europaea*, which attains its peak during the late MC/early LC I period, at the same time that *Pinus* type *brutia/halepensis*, and *Juniperus* sp. decrease dramatically. The high values of *Olea europaea*, along with the observation of growth rings, indicate the systematic management of the species to be under way already in the MC period. Simultaneously, the appearance of heliophilous *Quercus* type evergreen for the first time in the assemblage, along with *Arbutus* sp. and *Rhamnus/Phillyrea* and shrubs like Fabaceae, Labiatae and Cistaceae, indicates the disappearance of the pine forest and the spread of maquis. Additionally, the systematic presence of *Punica granatum* and *Prunus amygdalus* in the assemblages dated from late MC/early LC I and onwards

| Akrotiri - Shaft of New Pillar 18 | | | | | | |
|---|---|---|---|---|---|---|
| Ditch - late MC/early LC I | | | | | | |
| **Context** | Dump | | | | | |
| **Layer** | 1 | | | | | |
| **Taxa/Sample** | WF2000 (756) | WF2000 (764) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Cedrus libani* | | 1 | **1** | **1.85** | **1** | **50** |
| *Cupressus sempervirens* | 2 | | **2** | **3.70** | **1** | **50** |
| Fabaceae | 3 | 3 | **6** | **11.11** | **2** | **100** |
| *Juniperus* sp. | 3 | 4 | **7** | **12.96** | **2** | **100** |
| Labiatae | 1 | | **1** | **1.85** | **1** | **50** |
| cf. Maloideae | 1 | | **1** | **1.85** | **1** | **50** |
| *Olea europaea* | 13 | 3 | **16** | **29.63** | **2** | **100** |
| cf. *Olea europaea* | 4 | | **4** | **7.41** | **1** | **50** |
| *Pinus* tp. *brutia/halepensis* | 1 | 11 | **12** | **22.22** | **2** | **100** |
| *Rhamnus/Phillyrea* | 1 | | **1** | **1.85** | **1** | **50** |
| *Tamarix* sp. | 1 | | **1** | **1.85** | **1** | **50** |
| Angiosperm | 1 | 1 | **2** | **3.70** | **2** | **100** |
| **TOTAL** | **31** | **23** | **54** | **100** | | |
| **Min No of taxa** | **9** | **5** | **10** | | | |

**Table V.8:** Anthracological results from the Ditch, excavated in Pillar 18, Akrotiri, dated to late MC/early LC I.

| Akrotiri - Shaft of New Pillar 35 | | | | | | | |
|---|---|---|---|---|---|---|---|
| Room 1 - late MC/early LC I | | | | | | | |
| **Context** | Fills | | | | | | |
| **Layer** | 11 | 12 | | | | | |
| **Taxa/Samples** | WF2000 (760) | WF2000 (765) | WF2000 (769) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | 1 | | **1** | **0.25** | **1** | **33.33** |
| Fabaceae | | 3 | | **3** | **0.76** | **1** | **33.33** |
| *Juniperus* sp. | 1 | | 1 | **2** | **0.51** | **2** | **66.67** |
| *Olea europaea* | 151 | 152 | 10 | **313** | **79.64** | **3** | **100** |
| cf. *Olea europaea* | 8 | 4 | | **12** | **3.05** | **2** | **66.67** |
| *Pinus* tp. *brutia/halepensis* | 1 | | | **1** | **0.25** | **1** | **33.33** |
| *Punica granatum* | 5 | 36 | | **41** | **10.43** | **2** | **66.67** |
| *cf. Punica granatum* | 2 | 2 | | **4** | **1.02** | **2** | **66.67** |
| *Tamarix* sp. | 2 | 1 | | **3** | **0.76** | **2** | **66.67** |
| cf. *Tamarix* sp. | 1 | | | **1** | **0.25** | **1** | **33.33** |
| Angiosperm | 8 | 1 | 3 | **12** | **3.05** | **3** | **100** |
| **TOTAL** | **179** | **200** | **14** | **393** | **100** | | |
| **Min No of taxa** | **5** | **5** | **2** | **7** | | | |

**Table V.9:** Anthracological results from Room 1, excavated in Pillar 35, Akrotiri, dated to late MC/early LC I.

| Akrotiri - Square of the Cenotaph | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Trial Trenches 1 and 2 - late MC/early LC I** | | | | | | | | | | | | |
| **Context** | Dump | | | | | | | | | | | |
| **Taxa/Sample** | E85(3) | E85(7) | E85(11) | E85(20) | E85(21) | E85(22) | E85(25) | E85(30) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Alnus/Corylus* | | | | | | | | 4 | **4** | **1.72** | **1** | **12.5** |
| cf. *Alnus/Corylus* | | | | | | | | 1 | **1** | **0.43** | **1** | **12.5** |
| *Arbutus* sp. | | | | | | | | 1 | **1** | **0.43** | **1** | **12.5** |
| Cupressus *sempervirens* | | | 3 | | | | | | **3** | **1.29** | **1** | **12.5** |
| Fabaceae | 3 | 3 | | 2 | | | 1 | | **9** | **3.88** | **4** | **50.0** |
| *Juniperus* sp. | 2 | 4 | 5 | 3 | | 4 | | | **18** | **7.76** | **5** | **62.5** |
| Labiatae | 1 | | | | | 1 | | 2 | **4** | **1.72** | **3** | **37.5** |
| cf. Labiatae | 2 | | | | | | | | **2** | **0.86** | **1** | **12.5** |
| cf. Lonicera sp. | | | | | | | | 1 | **1** | **0.43** | **1** | **12.5** |
| *Olea europaea* | 38 | 23 | 8 | 5 | 3 | 12 | 17 | 14 | **120** | **51.72** | **8** | **100** |
| cf. *Olea europaea* | 1 | | | 1 | | 3 | 2 | 1 | **8** | **3.45** | **5** | **62.5** |
| *Pinus* tp. *brutia/halepensis* | 4 | 1 | | 2 | | 1 | | 1 | **9** | **3.88** | **5** | **62.5** |
| *Pinus* tp. *nigra/sylvestris* | | | 1 | | | | | | **1** | **0.43** | **1** | **12.5** |
| *Prunus amygdalus* | 2 | | | | | 2 | 1 | 1 | **6** | **2.59** | **4** | **50.0** |
| *Prunus* sp. | 1 | | | | | | | 2 | **3** | **1.29** | **2** | **25.0** |
| *Punica granatum* | 1 | | | | | 1 | 1 | | **3** | **1.29** | **3** | **37.5** |
| cf. *Punica granatum* | 1 | | | | | | | | **1** | **0.43** | **1** | **12.5** |
| *Quercus* tp. deciduous | 3 | 2 | 3 | | | | | 3 | **11** | **4.74** | **4** | **50.0** |
| *Quercus* tp. evergreen | | | | | | | 1 | 3 | **4** | **1.72** | **2** | **25.0** |
| *Quercus* sp. | 1 | | | | | | 3 | 2 | **6** | **2.59** | **3** | **37.5** |
| *Tamarix* sp. | 2 | | | | | 2 | | | **4** | **1.72** | **2** | **25.0** |
| cf. *Tamarix* sp. | | | | | | | | 1 | **1** | **0.43** | **1** | **12.5** |
| Angiosperm | | | 1 | 2 | 2 | 2 | 1 | 4 | **12** | **5.17** | **6** | **75.0** |
| **TOTAL** | **62** | **33** | **21** | **15** | **5** | **28** | **27** | **41** | **232** | **100** | | |
| **Min No of taxa** | **11** | **5** | **5** | **4** | **1** | **7** | **6** | **11** | **16** | | | |

**Table V.10:** Anthracological results from Trail Trenches 1 and 2, excavated in the Square of the Cenotaph, Akrotiri, dated to late MC/early LC I.

(Tables V.9 to V.12) implies their cultivation and management during the later occupational phases of the site.

It is very probable that part of the area where previously the pine forest grew was from MC onwards occupied by olive groves, as well as orchards where fruit-bearing taxa like *Punica granatum* and *Prunus amygdalus* could grow. The slight increase of hydrophilic taxa like *Quercus* type deciduous, the presence of *Alnus/Corylus*

| Akrotiri - Shaft of New Pillar 35 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Square of the Sacral Horns - LC I** | | | | | | | | | |
| **Context** | Deck 2 - Fill | | | Deck 1 - Fill | | | | | |
| **Layer** | 3 | 4 | | 5 | 7 | | | | |
| **Taxa/Samples** | WF2000 (725) | WF2000 (729) | WF2000 (808) | WF2000 (752) | WF2000 (753) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | 1 | | | | 3 | **4** | **1.02** | **2** | **40** |
| *Juniperus* sp. | 3 | 2 | | 4 | | **9** | **2.28** | **3** | **60** |
| Labiatae | | 1 | | | | **1** | **0.25** | **1** | **20** |
| Maloideae | 1 | | | | | **1** | **0.25** | **1** | **20** |
| *Olea europaea* | 68 | 63 | 6 | 56 | 48 | **241** | **61.17** | **5** | **100** |
| cf. *Olea europaea* | 5 | 4 | 1 | 5 | 3 | **18** | **4.57** | **5** | **100** |
| *Pinus* tp. *nigra/sylvestris* | | | | | 1 | **1** | **0.25** | **1** | **20** |
| *Pistacia* sp. | 1 | | | | | **1** | **0.25** | **1** | **20** |
| *Prunus amygdalus* | 1 | 1 | | 28 | | **30** | **7.61** | **3** | **60** |
| *Prunus* sp. | 4 | | | 3 | | **7** | **1.78** | **2** | **40** |
| cf. *Prunus* sp. | | 2 | | | | **2** | **0.51** | **1** | **20** |
| *Punica granatum* | 7 | 2 | | 3 | | **12** | **3.05** | **3** | **60** |
| cf. *Punica granatum* | 2 | | | | 1 | **3** | **0.76** | **2** | **40** |
| *Quercus* tp. deciduous | | 1 | 1 | 7 | | **9** | **2.28** | **3** | **60** |
| *Quercus* tp. evergreen | | 28 | | 1 | | **29** | **7.36** | **2** | **40** |
| *Quercus* sp. | 1 | 1 | 2 | 2 | | **6** | **1.52** | **4** | **80** |
| *Salix/Populus* | 2 | | | | | **2** | **0.51** | **1** | **20** |
| Angiosperm | 5 | 3 | 2 | 2 | 6 | **18** | **4.57** | **5** | **100** |
| **TOTAL** | 101 | 108 | 12 | 111 | 62 | **394** | **100** | | |
| **Min No of taxa** | **10** | **8** | **3** | **7** | **4** | **13** | | | |

**Table V.11:** Anthracological results from Decks 1 and 2 of the Square of the Sacral Horns, Akrotiri, dated to LC I.

and the reappearance of *Salix/Populus* might give an indication of the location of these orchards. Fruit-bearing taxa, like the species of the Maloideae family, and especially *Punica granatum*, a notably thirsty plant (Intrigliolo et al., 2011), would need regular watering in order to maximize their production of fruit. Thus, it is possible that the inhabitants were planting them close to water sources to minimize the effort of irrigation. In this way, given the regular treatment of these trees (watering, pruning, harvesting), branches of hydrophilic taxa growing nearby could be cut and brought back to the settlement as firewood. Finally, the reduction in the shrubby taxa during LC I might suggest that the inhabitants used areas previously covered with garigue or maquis to plant new orchards.

| Akrotiri - Square of the Cenotaph | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Drainage pipe - LC I | | | | | | | | | Deck of Cenotaph Sq.- North of Sector D - LC I | | | | | |
| **Context** | Dump | | | | | | | | | Fill | | | | | |
| **Taxa/Sample** | E1 | E2 | E3 | E4 | E5 | E93(48)-E2 | E93(51)-E5 | E93(61)-E6 | M29 | E94(026)-E10 | E94(028)-E11 | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | | | | | | | 1 | | | | **1** | **0.66** | **1** | **9.09** |
| Fabaceae | | | | | | | | 1 | | | 1 | **2** | **1.32** | **2** | **18.18** |
| *Juniperus* sp. | | | | | | 1 | | | | | 5 | **6** | **3.97** | **2** | **18.18** |
| *Lonicera* sp. | | | | | 1 | | | | | | | **1** | **0.66** | **1** | **9.09** |
| Maloideae | | | | | | | | 1 | | | | **1** | **0.66** | **1** | **9.09** |
| *Olea europaea* | 2 | | 2 | 7 | 2 | 19 | 4 | 11 | 2 | 10 | 40 | **99** | **65.56** | **10** | **90.91** |
| cf. *Olea europaea* | | | | 1 | 1 | | | 2 | | 4 | | **8** | **5.30** | **4** | **36.36** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | 1 | | | | | **1** | **0.66** | **1** | **9.09** |
| *Prunus amygdalus* | | | | | | 1 | | | | | | **1** | **0.66** | **1** | **9.09** |
| *Prunus* sp. | | | 1 | | 1 | | | 1 | | | | **3** | **1.99** | **3** | **27.27** |
| cf. *Prunus* sp. | | | | | | | | 1 | | | | **1** | **0.66** | **1** | **9.09** |
| *Punica granatum* | | | | | | 2 | | | | | | **2** | **1.32** | **1** | **9.09** |
| cf. *Punica granatum* | | | | | | | | | | | 1 | **1** | **0.66** | **1** | **9.09** |
| *Quercus* tp. evergreen | | | | | 2 | | | | | | 1 | **3** | **1.99** | **2** | **18.18** |
| *Quercus* sp. | | 3 | | | | | | | | | | **3** | **1.99** | **1** | **9.09** |
| cf. *Quercus* sp. | | | | | | | | | | 1 | | **1** | **0.66** | **1** | **9.09** |
| *Rhamnus/Phillyrea* | 4 | | | | | 1 | | | | | | **5** | **3.31** | **2** | **18.18** |
| *Tamarix* sp. | | | | | 1 | | | | | | 2 | **3** | **1.99** | **2** | **18.18** |
| cf. *Tamarix* sp. | | | | | | 1 | | | 1 | | | **2** | **1.32** | **2** | **18.18** |
| Angiosperm | | 1 | | | 1 | 3 | 1 | | | 1 | | **7** | **4.64** | **5** | **45.45** |
| **TOTAL** | **6** | **4** | **3** | **8** | **9** | **28** | **6** | **18** | **3** | **16** | **50** | **151** | **100** | | |
| **Min No of taxa** | **2** | **1** | **2** | **1** | **5** | **6** | **2** | **5** | **2** | **2** | **6** | **14** | | | |

**Table V.12:** Anthracological results from the Deck of the Square of Cenotaph, Akrotiri and the drainage pipe excavated there, dated to LC I.

### 1.2. Discussion

#### 1.2.1. Landscape and tree management during the Bronze Age

The study of the anthracological assemblage of Akrotiri has indicated that during the Bronze Age the island of Thera was far from being bare of trees. During the EC period, the landscape close to the settlements would have been characterized by the presence of pine forest with *Pinus* type *brutia/halepensis*, *Juniperus* sp., *Olea europaea*, and Fabaceae. In areas with fresh water would have grown *Quercus* type deciduous, *Salix/Populus*, *Alnus/Corylus* and *Platanus orientalis*, while closer to the sea there would have existed halophytic communities, where *Tamarix* sp. would thrive.

A major change in the environment surrounding the site is observed in the anthracological diagram during late EC III/early MC: *Pinus* type *brutia/halepensis* loses its dominance in the landscape and its place is taken by *Olea europaea*. This incidence coincides with the abandonment of the chambers cut in the bedrock and their backfilling, after which the inhabitants of the site constructed new buildings on top of them. Unfortunately, the absence of data from buildings of this period means one cannot tell if pines were used as structural timbers. Another cause for the reduction of the pine trees during this phase might be their use in the construction of ships. Already in the EC II period and on through MC, the trade between Akrotiri and Crete, as well as other regions of the Aegean, was intensifying (Doumas, 1983a; Knappett and Nikolakopoulou, 2015), which might well have led to the need for new ships.

Evidence from shipwrecks from this early period does not exist. However, the analysis of wood coming from the Late Bronze Age shipwrecks of Uluburun and Cape Gelidonya has indicated the use of *Cedrus libani* as the main building timber and in the second case, of *Pinus brutia* and *Quercus* sp. for secondary components (Liphschitz and Pulak, 2007). During the Classical and Roman periods, the use of *Pinus brutia* increased, indicating its fitness for shipbuilding. Liphschitz and Pulak (2007) emphasize that the use of specific taxa in a ship is largely related to their availability in the area where the ship is constructed. For example, in the case of the Heracleon-Thonis shipwrecks (Egypt), the main taxon used is *Acacia* sp., although it is hard to work with, probably because acacia forests existed in the area (Fabre and Belov, 2011). Ethnographical studies from Greece also attest to the preference of taxa that grow in close proximity to the site and are thus readily available to the boat-builders (Damianidis, 1991, p. 233). Thus, given that *Pinus* type *brutia/halepensis* is suitable for shipbuilding and that it could be easily collected from the forests of the island, it is probable that it was used for the construction of ships at Akrotiri during the earlier phases. Of course, in order to verify these hypotheses excavations need to be carried out where the harbour of Akrotiri should be.

Finally, the reduction of the pine forest and the domination of *Olea europaea* could be related too to the purposeful propagation of the latter species. This could happen through the clearing of forest to bring new areas into cultivation. The progressive reduction of the pine forest and the increase in the percentages of *Olea europaea* and other fruit-bearing taxa indicate the efficacious use of economically valuable taxa during the later occupational phases of the settlement.

In addition to the pine forest, another component of the landscape of Akrotiri was areas with water-retentive soils. The identification of hydrophilic taxa, like *Quercus* type deciduous, *Alnus/Corylus*, *Salix/Populus*, *Platanus orientalis*, and *Fraxinus* sp. throughout the anthracological diagram affirms the presence of such areas on the island of Thera. These taxa were certainly not imported to the island, as is indicated by the constant presence of *Quercus* type deciduous in the anthracological diagram. In addition, evidence from the study of phytoliths attests to the presence of fresh standing water at Fira Quarry and moist conditions at Mavromatis Quarry (Vlachopoulos and Zorzos, 2014). The litter and damp conditions existing in this forest could sustain troglodytic beetles like *Troglorhynchus cf. anophthalmus* identified by Panagiotakopulu (2000) at the West House, while *Quercus* type deciduous and *Juniperus* sp. could have been utilized as fodder by the inhabitants of the island to grow silkworms, as suggested by Panagiotakopulu et al. (1997). More specifically, in a structure to the east of the House of the Ladies was recovered a cast of a cocoon of the species *Pachypasa otus* (L.). This species of Lepidoptera is native to Greece and it was used during the antiquity as source of "wild silk" (Panagiotakopulu et al., 1997). Last but not least, the microfaunal data argue as well for a forested area on the island prior to the volcanic eruption. According to Papagianni (2012), the identification of rodents of genus *Apodemus,* and specifically *A. sylvaticus* and *A. flavicollis,* whose natural habitats include forests, maquis, and orchards, and who build their nests in wooded areas, argues for the presence of forests of broadleaved taxa on the island. Besides Akrotiri, wood charcoal macroremains of *Quercus* type deciduous and *Salix/Populus* have been also recovered at the archaeological site of Dhaskalio, although *Salix/Populus* is not considered endogenous to the island of Keros (Ntinou, 2013a).

According to the findings of the present study, during the later occupational phases the dominant woody taxa around Akrotiri were olives and other fruit-

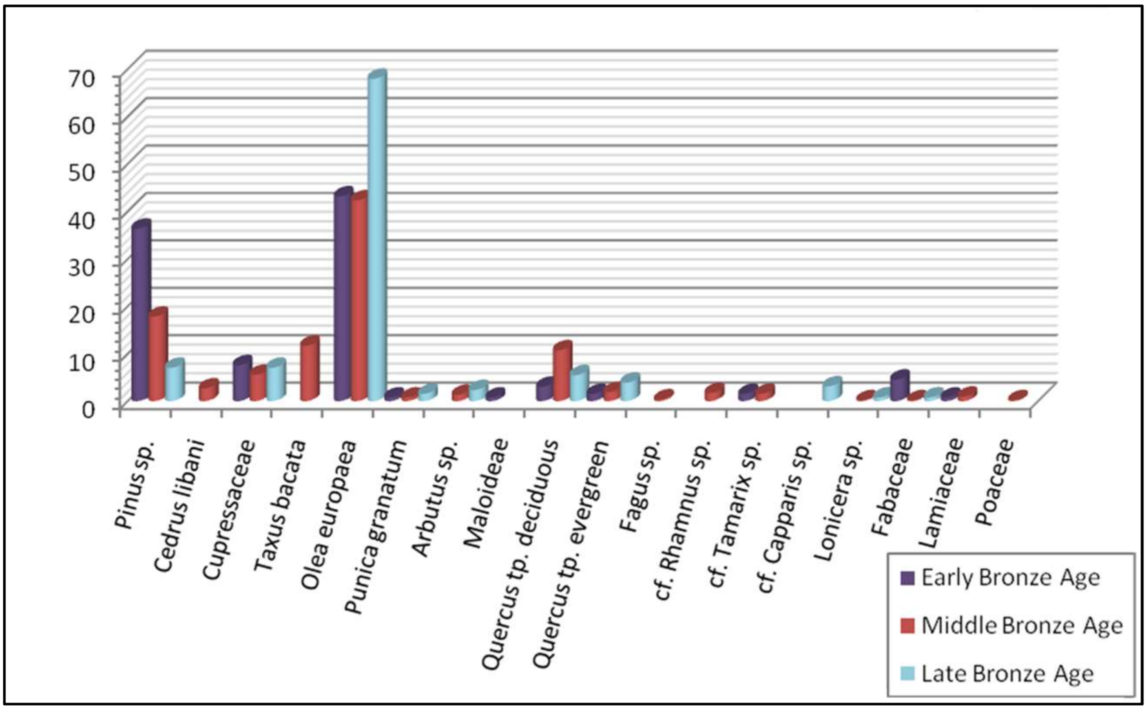



**Figure V.2:** Bar-chart representing the percentage counts of charcoal remains of Pillar 63A, based on Asouti (2003, Table 1).

bearing taxa like pomegranates and almond trees. At the same time maquis and garigue vegetation had established themselves; the inhabitants also took advantage of the hydrophilic taxa growing on water-retentive soils. Generally speaking, the transition from the natural environment towards a more controlled landscape from MC onwards at Akrotiri, as suggested by this study, is in accordance with the study of Asouti (2003), who analysed the anthracological material from the shaft of Pillar 63A. However, a discrepancy is observed in the percentages of *Olea europaea* for the earlier occupational phases of the settlement. According to Asouti (2003), during the EC phase *Olea europaea* was the most exploited species with percentages rising above 40% (Fig. V.2). However, current data coming from assemblages excavated in Pillars 18, 35, and 66Π (Tables V.1 to V.3) suggest that this species, although it was one of the most represented in the assemblage, never rose above 20%. In fact, the visibility of the taxon seems to fall from EC I/EC II to EC III, by almost 5%. This observation along with the absence of growth rings argues that while olive trees were harvested for fuel wood, they were not exploited systematically.

The beginning of such methodical management from the MC period, culminating in the cultivation in the last phases of the settlement, as understood in this study, sits well with the observations of Valamoti et al. (2018). They have pointed out that the increase in seeds and charcoal of *Olea europaea* throughout the Bronze Age period indicates its predominance in the landscape during LC I as a result of cultivation. Further, in their opinion, the main reason for the systematic cultivation of olive trees was most probably the production of olive oil by and for the elite. The recovery of stirrup jars, specifically made for the transportation of oil, as well as mention of olive oil in Linear B texts, adds to this testimony (Valamoti et al., 2018).

For Akrotiri, the above state of affairs is reinforced by the anthracological evidence, as carpological studies likewise suggest the cultivation of *Olea europaea* during the LC I period (Sarpaki, 1987). According to Sarpaki (1987), olive stones recovered from Akrotiri belong to varieties developed for olive-oil production, while the fact that they were found crushed prior to combustion strengthens the case for the production of oil at the site.

The presence of a ruler and his attendant elite, who controlled the production of olive oil (Hamilakis, 1996), is not very likely in the case of Akrotiri, unlike cotemporaneous settlements in Crete (Doumas, 1983b). The society of Akrotiri was composed of wealthy merchants and sailors (Doumas, 1983b), as is evident from the excavation finds, as well as from the urban structure of the settlement in place since the MC (Doumas, 1983b; Palyvou, 1999). Nonetheless, the presence of a central authority, at least from that same period onwards, must be considered as certain: this is indicated by communal works like the drainage system and the construction and maintenance of paved streets (Doumas, 1983b). The production of olive oil could then have been supervised by this central authority, as has been also suggested for the production of wine by Karnava and Nikolakopoulou (2005). This rich community could have either consumed the olive oil for its own religious purposes, adopting the lifestyle of the Minoan elite (Valamoti et al., 2018) or traded it for other goods. In any case, the recovery of stirrup jars at the site from the LC I period (Nikolakopoulou, 2002) and items bearing Linear A inscriptions (THE 11-12) with the logogram characteristic of olive oil (Boulotis, 2008), support the ideas of Valamoti et al. (2018) on the increasingly important role of olive oil in the Bronze Age societies and on its trafficking in the eastern Mediterranean.

In addition to the cultivation of *Olea europaea*, as based on the anthracological diagram, arboriculture in general would have flourished at Akrotiri from the MC period on. Fruit-bearing taxa like *Punica granatum*, *Prunus amygdalus*, *Prunus* sp.

and *Ficus carica* increase their percentages during this phase, while Maloideae are constantly present, albeit in very low quantities. These taxa could have been grown in orchards and gardens close to the site or in areas closer to good water sources: they could be used both for their fruits and as fire wood. In addition to the taxa mentioned, wood charcoal macroremains of *Pyrus amygdaliformis* (pear) were recovered from the area surrounding the West House (Bottema-MacGillavry, 2005). According to Sarpaki (1987), no seeds of almonds, apples or pears were identified in the carpological samples of Akrotiri of the LC I period, though fig seeds were present in the assemblages of the West House. In the case of *Prunus amygdalus* however, imprints of almonds were found in a jar unearthed at the West House (Friedrich et al., 1990), reinforcing belief in their cultivation here. Other evidence for the presence of *Prunus amygdalus* in the West House come from the anthracological samples collected in its interior and also in the vicinity of the building: all in circumstances dated to the LC I period (Bottema-MacGillavry, 2005).

*Punica granatum* is not native to the island of Thera. The wild ancestor of this species is known to grow naturally to the south of the Caspian Sea, in north-eastern Turkey, and in the southern Balkans (Zohary and Hopf, 2000). According to Jacomet et al. (2002), the pomegranate tree was most probably introduced into the Aegean during the 3$^{rd}$ millennium BC from Cyprus by the Phoenicians and their maritime activities. Early carpological evidence of *Punica granatum* comes from Arad (Hopf, 1978) and Jericho (Hopf, 1969), dated to the EB period, while for the LB period evidence exists from Hala Sultan Teke (Cyprus) (Hjelmqvist, 1979), Tiryns (Kroll, 1982) and the shipwreck of Uluburun (Bass, 1989; Ward, 2003). Seeds of the species were recovered at Monastiraki (Sarpaki and Kanta, 2011) and Gournia (Watrous et al., 2015) on Crete, dated to the MB and LB period, respectively. Ward (2003, p. 538) points to the luxurious and/or symbolic character of pomegranates during the Bronze Age in the eastern Mediterranean as the majority of *Punica granatum* fragments or depictions are related to elite contexts (residential areas and tombs). Pomegranates in Minoan and Mycenaean religion are likely to be related to rebirth and fertility (Nigro and Spagnoli, 2018).

At Akrotiri the earliest anthracological evidence of *Punica granatum* is dated to the EC period: from deposits connected to Pillar 63A (Asouti, 2003). The present study recovered pomegranate wood charcoal fragments for the first time in deposits dated to the MC period, peaking during the transitional period between late MC and early LC I. Seeds of *Punica granatum* have not been identified in the LC I deposits of the site studied by Sarpaki (1987). However, the significant percentage of the species in the anthracological diagram, which reaches almost 10% during the later occupation phases, in addition to its representation in ceramic iconography and frescos from the MC period onwards (see below §V.1.2.3), all serve to indicate the importance of its fruits to the inhabitants here.

### 1.2.2 Exogenous taxa

As can be seen in Table V.13, in addition to the taxa growing naturally on the island of Thera, the Akrotiri assemblages dating to MC and onwards yielded also taxa not endemic to the island. These taxa were recovered from samples collected from deposits characterized as dumps. The exogenous taxa so identified in the present study are *Castanea sativa*, *Cedrus libani*, *Cupressus sempervirens*, and *Pinus* type *nigra/sylvestris*, while from Pillar 63A fragments of *Taxus bacata* and *Fagus* sp. were recovered as well (Asouti, 2003). The low number of fragments in addition to their small size does not allow any secure appraisals as to how they were introduced to the site – as wooden objects or as timber. However, here (see §V.2.7) it has been suggested that at least *Cupressus sempervirens* and probably *Castanea sativa* were used as construction timbers in the buildings of Akrotiri (Xeste 3 and the House of the Ladies), without of course excluding the possibility that finished wooden objects made of these taxa were also brought in. The use of *Castanea sativa* as a constructional element is inferred also for the West House by Bottema-MacGillavry (2005). Additionally, Asouti (2003) mentions the possibility that *Cedrus libani* was utilized as timber here, as during antiquity this species was widely used as such. However, in none of the assemblages studied that are related to construction debris – from Xeste 3, the House of the Ladies and the buildings excavated in Pillars 66Π and 67 or the West House (Bottema-MacGillavry, 2005)– was this species identified. Thus, it is very likely that this wood was not favoured for construction timber by the inhabitants of Akrotiri either in public buildings or private ones.

| EXOGENOUS TAXA - AKROTIRI | | | |
|---|---|---|---|
| **Taxon** | **Locality** | **Context** | **Chronology** |
| *Castanea sativa* | NPS 66Π | dump - backfill of MC Room | MC |
| | West House (Bottema-MacGillavry 2005) | fill - exterior area of West House | LC I |
| *Cedrus libani* | NPS 18 | dump | late MC/early LC I |
| | NPS 66Π | dump - backfill of MC Room fill - levelling of natural rock | MC |
| | NPS 63A (Asouti 2003) | fill | MC |
| *Cupressus sempervirens* | NPS 18 | dump | late MC/early LC I |
| | Sq. of the Cenotaph | dump - debris and household refuse | late MC/early LC I |
| *Fagus* sp. | NPS 63A (Asouti 2003) | fill | MC |
| *Pinus* tp. *nigra/sylvestris* | NPS 35 | fill - 1rst Deck of Sq. of Sacral Horns | LC I |
| | Sq. of the Cenotaph | dump - debris and household refuse | late MC/early LC I |
| *Taxus baccata* | NPS 63A (Asouti 2003) | fill | MC |

**Table V.13:** Exogenous taxa identified in charcoal assemblages of Akrotiri. In the table is presented the locality from where each taxon was recovered, the context and the date.

The earliest evidence for the trading/movement of wood in the Cyclades are from Dhaskalio, Keros where, in deposits dated to the EC period, wood charcoal fragments of *Cupressus semprevirens*, *Pinus nigra*, *Fraxinus* sp. and *Salix/Populus* were recovered (Ntinou, 2013a). In the case of Akrotiri, the exogenous taxa identified in the MC and LC I deposits suggest that the inhabitants transported to the island exogenous taxa to cover their needs either for building materials (e.g. *Cupressus sempervirens* at Xeste 3) or as finished wooden objects. The trading activities of the Therans during the Bronze Age period have long been known, mainly through the study of pottery but also they involved stone vases, metal objects, figurines, etc.

(Sotirakopoulou, 2008b). As traders and seafarers, the inhabitants had developed trading inter-connections with Crete, Cyprus, mainland Greece (including Attica, Peloponnese, Euboea, and Boeotia), Asia Minor and the islands of the North and East Aegean (Buchholz, 1980; Knapp, 1990; Sotirakopoulou, 2008b, 2008c). In this way, the source area from where exogenous taxa could have been imported into the island is broad. *Cupressus sempervirens* could have been shipped from Crete or one of the bigger East Aegean islands like Samos and Chios, as well as from Cyprus and Lebanon where its natural habitats occur (Korakis, 2015). Though the natural distribution of *Castanea sativa* is difficult to determine, it is considered to grow naturally in the eastern Mediterranean region at an altitude ranging from 200 m a.s.l. to 1800 m a.s.l. (Korakis, 2015). Following Polunin (1980, Map 37), this species could come from Thessaly, north Euboea or Macedonia. The natural distribution of *Cedrus libani* is limited to the Taurus mountain range in southern Turkey, on Mt. Lebanon and in Cyprus (Gale and Cutler, 2000). Thus, this species could have been introduced to Akrotiri through Cyprus or Lebanon. Finally, *Pinus* type *nigra/sylvestris* occupies the mountainous zones of mainland Greece, with specifically *Pinus nigra* being present in Euboea and the bigger Aegean islands like Lesvos, Thasos and Samos (Korakis, 2015). Consequently, this species could have been introduced from any of the aforementioned areas. Polunin (1980) mentions that in Macedonia *Pinus nigra* grows along with *Fagus* sp. and *Taxus bacata*. The latter taxa were identified in the assemblage of Pillar 63A by Asouti (2003): it is thus likely that these three taxa were imported from the same area(s).

No matter in what form these taxa were transported to the settlement, their presence adds to our knowledge of the goods brought to the islands, as well as of the interconnections the merchants and sailors of Akrotiri had forged with other settlements across eastern Mediterranean. Moreover, these 'luxurious' timbers along with other exotic objects like ivory, ostrich eggs, and semiprecious stones, all indicate the wealth of the citizens of Akrotiri: they had access to almost all the costly objects then existing (Bichta, 2003; Buchholz, 1980). According to Nikolakopoulou (2009, p. 37), at the end of MC period and in the beginning of LC I, the Minoan impact upon the culture of Akrotiri is more obvious, as the citizens of the settlement adopt and adapt new technologies and cultural practices involving, amongst others, patterns of consumption and ritual activities, without losing their connections with other settlements in the central and southeast Aegean. Thus, the increase in the percentages of *Olea europaea* as indicated by the anthracological and carpological data, which most probably suggests olive oil production and the consequent import and use of 'luxurious' timbers and objects at Akrotiri (Colburn, 2008; Warren, 2004), mirrors not only trading connections in between the two islands, but also the tendency of the community at Akrotiri to embrace social and cultural behaviour originating on Crete.

### 1.2.3 Depiction of woody plants on the frescos of Akrotiri

The interior walls of the buildings of Akrotiri were covered with plaster and often were decorated with wall paintings. These decorations included geometric motifs like spirals and rosettes, as well as naturalistic scenes with female and male figures, animals, birds, insects and plants. The artists of Akrotiri selected the landscapes and flora depicted on the wall paintings from the natural environment of the island and/or other areas known to them (Vlachopoulos and Zorzos, 2014), representing the species illustrated in sufficient detail to allow of their identification by their fellow citizens (Georma et al., 2014). Thus, leaving aside the religious character permeating these wall paintings, one can use them to extract information on the physical environment of Thera or of that known to the Therans (see also Sarpaki, 2000; Vlachopoulos and Zorzos, 2014). In this chapter, the plants with woody tissue that are depicted on the frescos of the settlement are presented briefly in an effort to correlate this information with that coming from the analysis of the anthracological samples regarding the natural environment of the island prior to the volcanic eruption.

Woody plants depicted in the murals of Xeste 3 include reeds, olive trees, wild roses, and myrtles. More specifically, reeds are illustrated on the fresco of "The Reeds" (Fig. V.3) occupying the west and south walls of Room 3b of the building, as well as on other smaller surfaces. In this fresco is depicted a marshy habitat with blooming reeds, among which dragonflies and ducks are shown (Vlachopoulos, 2008). According to Sarpaki (2000), these reeds most likely represent *Arundo donax* and not *Phragmites australis* as the former has a very distinct inflorescence which

**Figure V.3:** Part of the fresco called *"The Reeds"* unearthed at Xeste 3. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

differentiates it from the latter. As has been discussed above (§V.1.2.1), there occurred on Thera areas with standing water (Vlachopoulos and Zorzos, 2014) where hydrophilic taxa thrived. In these areas it is very likely that reeds grew too, as Poaceae have been identified in Pillar 63A (Asouti, 2003). Thus, the scenery depicted on the aforementioned fresco probably represents the natural environment of Thera. As to the species of reed represented, it should be mentioned that *Phragmites australis* is native to the Mediterranean. *Arundo donax* is considered native to East Asia, although there is a hypothesis that it has its origins in the Mediterranean area

(Corno et al., 2014; Hardion et al., 2012; Mariani et al., 2010). However, a recent study from Mariani et al. (2010), who used AFLP (amplified fragment length polymorphism) analysis in order to evaluate the genetic similarity of *Arundo donax* and other species of *Arundo*, has verified East Asia as the centre of origin, based on the genetic uniformity presented in the samples examined from the Mediterranean area, explaining it as the result of a bottle neck effect. *Arundo donax* has, then, reached the Mediterranean basin through Asia Minor. According to Hardion et al. (2014), this event could have taken place during the Neolithic period, as there are Sumerian tablets suggesting the transportation of reeds from Mesopotamia to Egypt during this period. Although the reeds referred to the Mesopotamian tablets could have been any species, the broad naturalized distribution of *Arundo donax* indicate its early introduction to the Mediterranean: thus the hypothesis of Sarpaki (2000) on the reed represented in the frescos of Akrotiri cannot be totally ruled out.

**Figure V.4:** Fresco depicting an altar/shrine, from the top of which springs an olive tree. East wall of Lustral Basin, Xeste 3. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

An olive tree (*Olea europaea*) is represented on the east wall of the Lustral Basin, growing on the top of a shrine or altar (Fig. V.4). Attending the altar in some way are the three women ("adorants") depicted on the north wall and over the Lustral Basin itself (Vlachopoulos, 2016). Of these women, the middle one (Fig. V.5), who is shown seated on a rock nursing her bleeding foot, has garlanded her head with a small branch of a tree. This, according to Vlachopoulos (2016, p. 492), is an olive twig most probably cut from the tree on the altar. Other researchers (i.e. Doumas, 1992b; Sarpaki, 2000), however, identify this branch as from a myrtle (*Myrtus communis*) (Fig. V.6). The same figure wears in her headdress a pin with its finial

**Figure V.5:** Part of the fresco called "*The Adorants*". The injured adorant has adorned her hair with a branch of olive tree or myrtle; she is wearing a hair pin whose finial resembles a pomegranate. North wall, over the Lustral Basin, Xeste 3. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

resembling a pomegranate (*Punica granatum*) (Doumas, 1992b). Pomegranates are also depicted in the local ceramic iconography since the Middle Bronze Age (Georma et al., 2014, p. 176). Finally, in the two pairs of mature women painted on the walls


**Figure V.6:** Depiction and photograph of *Myrtus communis* and *Olea europaea* leaves.

of the corridor leading to the auxiliary staircase (Room 8), the one to the left (Fig. V.7) on the north wall holds a bouquet of wild roses (*Rosa* sp.) (Vlachopoulos, 2008). Another fifth woman depicted on the east wall of Room 3 has her snood decorated with a wild rose and a branch of an olive-tree (here the olive-fruits can be seen; Vlachopoulos, 2008). Those plants identified as wild roses by Vlachopoulos (2008, p. 494) could also be rock roses (*Cistus sp.*), as Sarpaki (Sarpaki, 2000, pp. 663, 670) has pointed out. She also observes that ladanum can be extracted from the rock rose, which is used as a fragrance or dye.

**Figure V.7:** Depiction of mature women, decorating the walls of the corridor to the auxiliary staircase (Room 8), Xeste 3. The one to the left holds a bouquet of wild roses or rock roses. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

Anthracological and carpological data have indicated the management of olive trees at Akrotiri for at least the MC period, while the taxon was present on the island since the EC period. Although the anthracological evidence cannot directly suggest the sacred character of this tree, the presence of an olive tree shown on top of the altar, along with the increased importance of olive oil from MC onwards (Valamoti et al., 2018), might indicate the significance olive trees held for the society of Akrotiri. As for the other taxa depicted on the fresco from the Lustral Basin, *Punica granatum* has now been proven to be growing on the island since the EC period (Asouti, 2003), while the present study shows how its importance increased from the MC onwards. Thus, regardless of the semantic value assigned to pomegranates, this species was present on the island and would be a common sight the inhabitants of Akrotiri. *Myrtus communis* is native to the Mediterranean region and could grow on the island of Thera, but it was not identified in the anthracological assemblage. If we accept the sacred nature of these frescos and the restoration as myrtle, then its absence from the anthracological diagram might indicate the very special character of this plant, used exclusively for ceremonial purposes. Finally, *Cistus* sp. belongs to the family of Cistaceae which is one of the shrub families recovered at the anthracological deposits of Akrotiri.

In the West House, woody plants were depicted in the Miniature Frieze in Room 5 on the first floor. The Miniature Frieze was 16 m long, covered an area of 4.80 $m^2$, decorating the upper part of the walls of the aforementioned Room. Here are illustrated palm trees of two distinct types, reeds, pine trees, chaste trees, olive trees, papyri, and possibly mulberry (Sarpaki, 2000; Televantou, 1994). Palm trees of type A as defined by Televantou (1994) had a tall, slim, and black trunk, unlike type B which are shown with a short and thick trunk, with symmetrical indentations in its profile. Both types of palm trees are present in the east wall (East Frieze-Fig. V.8) of the Miniature Frieze, which depicts a landscape with palm trees, papyri (*Cyper-*

**Figure V.8:** Part of landscape depicted in the East Frieze, where palm trees are shown. East wall of Miniature Frieze, Room 5, West House.Courtesy of the Archaeological Society in Athens, Excavations at Thera.

*us papyrus*), chaste trees (*Vitex agnus-castus*) and exotic animals along the banks of a river. Sarpaki (2000) suggests that the palm trees of type A represent most probably *Phoenix dactylifera*, while type B could be young trees of the species mentioned or *P. theophrasti* or *Chamaerops humilis.* Televantou (1994) characterized the landscape depicted here as a semi-tropical one, taking into account in addition to the vegetation the animals illustrated, as well as the presence of the river. On the other hand, Sarpaki (2000) and Warren (1979) believe that the majority of the species presented at it are taxa of the thermo-Mediterranean vegetation zone, and could grow in Greece.

On the south wall of Room 5 (South Frieze), a fleet is illustrated sailing from one town (Town IV-left end) to another (Town V-right end). Above Town IV, a river is depicted on whose banks reeds are growing (Fig. V.9). On the mountains above the

**Figure V.9:** Town IV depicted at the South Frieze. A river and a pine forest are shown above the town. South wall of Miniature Frieze, Room 5, West House. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

river, a pine forest exists – the eleven trees represented have been identified as pines (Sarpaki, 2000; Televantou, 1994). These trees could either be *Pinus pinea* due to their umbrella-like canopy or *P. halepensis,* although Sarpaki (2000, p. 664) finds the last unlikely. Finally, on the north wall of Room 5 (North Frieze) where scenes of warfare and everyday life are depicted, two trees are illustrated at the entrance of a round structure (Fig. V.10) which has been described as fold (Warren, 1979), garden

(Televantou, 1994) or threshing floor (Sarpaki, 2000). These trees seem to be pollarded and they have been identified as fig trees (*Ficus carica*) or mulberry trees (*Morus nigra)*(Sarpaki, 2000, pp. 665–666).

**Figure V.10:** Scenes of everyday life as depicted at the North Frieze. On top, the round structure in front of which are depicted two pollarded trees. North wall of Miniature Frieze, Room 5, West House. Courtesy of the Archaeological Society in Athens, Excavations at Thera.

Starting from the East Frieze, the suggestion by Warren (1979) and Sarpaki (2000) that the taxa illustrated could have been grown in Greece is viable, as many of them are characteristic thermo-Mediterranean taxa. However, none of these taxa were identified in the anthracological assemblage of Akrotiri. This, in addition to the presence of exotic animals at the fresco (Televantou, 1994), makes the possibility that this landscape is that of Thera rather unlikely. Concerning the pine species depicted in the South Frieze, again it has to be mentioned that the anthracological samples of the site have no *Pinus pinea*. If one accepts that their depiction indicates that the artist responsible had actually seen a pine forest, as suggested by Televantou (1994), then the pines are most probably *Pinus* type *brutia/halepensis*, as this taxon is present in the anthracological deposits of Akrotiri from the EC to the LC I period. Finally, *Morus nigra* as referred to by Sarpaki (2000) is most likely the trees shown outside the round structure in the North Frieze. This species is considered to be an introduction to Greece, although the exact time of that is not known (Browicz, 2000). As no wood charcoal fragments from this species were identified at Akrotiri and no anthracological or carpological data exist to verify its presence in the Aegean during the Bronze period, its identification in the North Frieze seems doubtful.

In the rest of the buildings of Akrotiri, the plants depicted are: papyrus plants in Room 1 of the House of the Ladies (Sarpaki, 2000), reeds from Room 6 of Sector Beta (Georma, 2009), myrtle (*Myrtus communis*) in Sector Gamma (Sarpaki, 2000) and Room 6 of Sector Beta (Georma, 2009), the chaste tree (*Vitex agnus-castus*) in Room 17 of Sector Delta, and finally the palm tree from Sector Alpha (Sarpaki, 2000).

## 2. The uses of wood in the buildings: Results and Discussion

The present study from the archaeological site of Akrotiri includes samples from the interior of Xeste 3, the House of the Ladies and construction debris from buildings excavated in Pillars 66Π and 67.

Xeste 3 was a three-storey semi-public building, situated at the southern part of the excavation (Palyvou, 2005). Wood charcoal macroremains analysed from this building are from its ground floor and first storey. The samples were recovered from the fill of the rooms formed during the destruction of the building, comprising parts of the structural elements of the wooden floors, the pier-and-door partitions, the doors, and the infrastructure of the walls. Finally, a few samples analysed came from the content of vessels. In total, from Xeste 3 were analysed 1,206 charcoal fragments representing eighteen taxa. These taxa, in alphabetical order, are: *Arbutus* sp., *Castanea sativa*, Cistaceae, *Cupressus sempervirens*, Fabaceae, *Ficus carica*, *Juniperus* sp., *Lonicera* sp., Maloideae, *Olea europaea*, *Pinus* type *brutia/halepensis*, *Platanus orientalis*, *Prunus* sp., *Prunus amygdalus*, *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, and finally *Tamarix* sp.

The House of the Ladies is another three-storey building, situated to the north of the Square of the Cenotaph (Palyvou, 2005). Samples recovered from this building are from the ground floor, as well as the wooden floors of the first and second storeys, from the wooden frame-work supporting the walls, from a door and from debris filling its rooms. In total there were analysed 741 wood charcoal fragments, which represent sixteen taxa. The taxa identified are: *Arbutus* sp., *Castanea sativa*, Fabaceae, *Ficus carica*, *Juniperus* sp., Labiatae, *Lonicera* sp., Maloideae, *Olea* *europaea*, *Pinus* type *brutia/halepensis*, *Prunus amygdalus*, *Prunus* sp., *Punica granatum*, *Quercus* type deciduous, *Quercus* type evergreen, and *Tamarix* sp.

In Pillar 66Π was excavated a destruction layer (layer 15), which contained parts of a wooden floor belonging to the latest building excavated within it (latest occupational phase). According to the unpublished archaeological report, here were found traces of wooden beams which supported the floor of the second storey (Floor 2-layer 11). This floor was made of wooden beams on top of which, instead of the branch layer, was placed soil mixed with small stones. In addition to the floor, wood charcoal macroremains were also recovered from a window excavated in the third storey in its south exterior wall. The creation of the building is dated to the early LC I period and its destruction caused by the eruption of the volcano. In total from these assemblages, there were analysed 123 wood charcoal fragments, belonging to five taxa, namely *Juniperus* sp., *Olea europaea*, *Prunus amygdalus*, *Quercus* type evergreen, and *Quercus* sp. Additionally, 414 wood charcoal macroremains were retrieved from the two earth floors recovered there, particularly Floor 3 on the ground level and the clay/soil coating of Floor 2 mentioned above. The taxa identified are the following: *Arbutus* sp., *Cupressus sempervirens*, Fabaceae, *Fraxinus* sp., *Juniperus* sp., Maloideae, *Olea europaea*, *Pinus* type *brutia/halepensis*, *Pinus* type *nigra/sylvestris*, *Pistacia* sp., *Prunus amygdalus*, *Prunus* sp., *Punica granatum*, *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, *Salix/Populus*, and *Tamarix* sp.

Finally, in Pillar 67 were unearthed rooms of two superimposed buildings. After the destruction of the settlement dated to late MC/early LC I period, the earlier room (Room 2) here excavated was abandoned, but it was not backfilled (Mairi Tsoulakou, fothcoming). Thus, the deposits excavated within Room 2 comprise constructional debris. The second building, whose Room 1 was excavated, was built on top of the earlier one, using its walls as foundations. This building was in use until the eruption of the volcano. The archaeological layers excavated within Room 1 comprise also construction debris (Mairi Tsoulakou, forthcoming). Additionally, in both rooms were unearthed vessels which contained wood charcoal macroremains. The total number of wood charcoal macroremains analysed from these deposits rises to 156 fragments, representing fourteen taxa in total. The taxa alphabetically are: *Arbutus* sp., *Castanea sativa*, Fabaceae, *Ficus carica*, *Juniperus* sp., *Olea europaea*, *Pinus* type *brutia/halepensis*, *Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Quercus* type deciduous, *Quercus* sp., *Salix/Populus*, and *Tamarix* sp. Additionally, from the two earth floors unearthed at Room 2 were analysed 296 wood charcoal specimens. The taxa identified are: *Arbutus* sp., *Castanea sativa*, Cistaceae, Fabaceae, *Ficus carica*, Maloideae, *Olea europaea*, *Pinus* type *brutia/halepensis*, *Pinus* type *nigra/sylvestris*, cf. *Pistacia* sp., *Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Punica granatum*, *Quercus* type deciduous, *Quercus* type evergreen, and *Tamarix* sp.

Below the results are presented and discussed architectural feature by feature. Thus, first to be described are the wooden floors of the upper storeys, then the infrastructure of the walls, the openings, like doors and pier-and-door partitions, the contents of the fill of the rooms, and finally the assemblages related to the earth floors of the buildings.

## 2.1 Wooden Floors of the upper storey

As described in Chapter II, the floor of the first storey of the buildings at Akrotiri was made of large wooden beams covered first by smaller tree branches and then topped with superimposed layers of beaten soil and clay (Palyvou, 1999). In more detail, and following the description given in the excavation diaries, the samples included in this chapter are divided into two categories. Those described as collected from the destruction layer of the floors were characterized as structural elements, while only those samples which are clearly referred as beams in the diaries were categorized as such (Table V.14). The samples in the structural element category are thought to contain specimens from both the large beams of the first layer of the floors (lower layer), as well as from the second and upper layer made of smaller branches.

### 2.1.1 Main Beams of the Floors (first/lower layer)

Wood charcoal fragments related to the main beams of the floors of the upper storey in Xeste 3 come from Rooms 6, 7, 10, 11, and 14. Related samples from the House of the Ladies are from Rooms 5, 7, 8, and 10. Concerning the samples collected in

| Building | Room | Sample | Excavation Diary | Description |
|---|---|---|---|---|
| Xeste 3 | 6 | Δ5 | 32, p. 19 | Ground floor, SW corner of the Room. Pile of charred wood coming from the floor of the upper storey. |
| | 7 | E81 (6) | 32, p. 347 | Horizontal beam fallen on the ground floor along the west wall of the Room. Width of the hole 0.14m. |
| | | Δ1 | 32, p. 263 | Organic matter collected from a hole of a disintegrated beam |
| | 10 | Δ1 (2) | 32, p. 431 | West end of South wall. Horizontal beam unearthed at the corner formed by two curved stones. Diameter of beam 0.20m |
| | 11 | Δ3 (7) | 32, p. 117 | Excavation trenches 2B, 3B and 4B. Part of the wooden structure (ξυλοδεσιά) of the upper floor. |
| | 14 | M17/L11-12 | 36, p. 243 | Beam of the floor of the upper storey |
| House of the Ladies | 5 | M10 | 41, p. 140 | Excavation trench 19. Part of the floor of the upper storey unearthed along the west wall. |
| | | M24 | 41, p. 174 | Excavation trench 13 and 14. Lower layer of the floor of the upper storey. Burnt matter. |
| | | E87(65) | 41, p. 124 | Sample collected under the clay coating of the floor where the beams of the floor occurred |
| | 7 | M3(3) | 45, p. 105 | Traces of burnt wood under the clay coating of the floor. |
| | 8 | M4 | 39, p. 83 | Wood charcoal fragments from the floor of the upper storey. Layer of the beams. |
| | 10 | M1 | 38, p. 228 | Destruction layer. Layer of the beams of the floor of the upper storey. |

**Table V.14:** Description of the samples characterized as beams at Akrotiri.

Pillars 66Π and 67, the available data coming from the archaeological reports, regarding the rooms excavated within them, do not provide enough information either concerning the exact location where the samples were collected or if they are related to the main beams of the floor and/or the layer of the branches. Thus, it is accepted here that all samples collected from related deposits belong to structural elements category: they will be presented and discussed in the following section.

In Table V.15, the total counts and the frequency of each taxon found in the samples coming from the beams and structural elements of the floors of the first storey of Xeste 3 are presented, as well as the ubiquity and ubiquity percentage

(U%) of the taxa identified in these samples. As is evident from this table, the species most represented and most frequently met with in the samples representing beams is *Olea europaea*– it is present in four out of six samples. Another taxon identified in

| **Akrotiri - Xeste 3 - Floors** | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Structural elements | | | | | | | | Beams | | | | | | | | | |
| **Room** | 7 | 10 | 14 | | | | | | 6 | 7 | | 10 | 11 | 14 | | | | |
| **Taxa/Samples** | (1)/R7 | E81 (13) | M6/L2 | M7/L3 | **N** | **%** | **Ubiquity** | **Ubiquity %** | Δ5 | E81(6) | Δ1 | Δ1 (2) | Δ3 (7) | M17/L11-12 | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | 1 | 1 | | **2** | **1.2** | **2** | **50.0** | | | | | | | | | | |
| *Castanea sativa* | | | | | | | | | | 2 | | | | 1 | **3** | **1.32** | **2** | **33.3** |
| *Cupressus sempervirens* | 3 | | 1 | 1 | **5** | **3** | **3** | **75.0** | | | | | 7 | | **7** | **3.07** | **1** | **16.7** |
| Fabaceae | | | | 1 | **1** | **0.6** | **1** | **25.0** | | | | | | | | | | |
| *Juniperus* sp. | 3 | 2 | 4 | 1 | **10** | **5.9** | **4** | **100** | | | | | | 1 | **1** | **0.44** | **1** | **16.7** |
| Maloideae | | 2 | | | **2** | **1.2** | **1** | **25.0** | | | | | | | | | | |
| *Olea europaea* | 10 | 27 | 31 | 36 | **104** | **62** | **4** | **100** | 50 | 40 | | 21 | | 16 | **127** | **55.70** | **4** | **66.7** |
| cf. *Olea europaea* | 2 | | 1 | | **3** | **1.8** | **2** | **50.0** | | | | | | | | | | |
| *Pinus* tp. *brutia/halepensis* | | 6 | 5 | 1 | **12** | **7.1** | **3** | **75.0** | | 5 | 80 | | | 1 | **86** | **37.72** | **3** | **50.0** |
| *Prunus amygdalus* | | | | 3 | **3** | **1.8** | **1** | **25.0** | | | | | | | | | | |
| cf. *Prunus* sp. | | 1 | | | **1** | **0.6** | **1** | **25.0** | | | | | | | | | | |
| *Quercus* tp. deciduous | | 1 | | | **1** | **0.6** | **1** | **25.0** | | | | | | | | | | |
| *Quercus* tp. evergreen | 1 | 2 | 6 | 6 | **15** | **8.9** | **4** | **100** | | 1 | | | | 1 | **2** | **0.88** | **2** | **33.3** |
| *Quercus* sp. | | 3 | | | **3** | **1.8** | **1** | **25.0** | | | | | | | | | | |
| *Rhamnus/Phillyrea* | | 1 | | | **1** | **0.6** | **1** | **25.0** | | | | | | | | | | |
| *Tamarix* sp. | 1 | 1 | | | **2** | **1.2** | **2** | **50.0** | | 1 | | | | | **1** | **0.44** | **1** | **16.7** |
| Angiosperm | | 3 | 1 | | **4** | **2.4** | **2** | **50.0** | | 1 | | | | | **1** | **0.44** | **1** | **16.7** |
| **TOTAL** | **20** | **50** | **50** | **49** | **169** | **100** | | | **50** | **50** | **80** | **21** | **7** | **20** | **228** | **100** | | |
| **Min No of taxa** | **5** | **10** | **6** | **7** | **12** | | | | **1** | **5** | **1** | **1** | **1** | **5** | **7** | | | |

**Table V.15:** Anthracological results from contexts related to structural elements and beams of the floors of the upper storey, unearthed at Xeste 3, Akrotiri.

half of the cases is *Pinus* type *brutia/halepensis*, while *Castanea sativa* and *Quercus* type evergreen were found in two samples, with *Tamarix* sp., *Cupressus sempervirens*, and *Juniperus* sp. in one sample each. Table V.16 presents the results coming from similar contexts in the House of the Ladies. Again, *Olea europaea* is the most frequently met taxon in the samples characterized as beams – it is present in four out of the six samples studied. Beside *Olea*, *Pinus* type *brutia/halepensis* and *Quercus* type deciduous are also present, the former in two samples and the later in only one.

From the above, it can be suggested that in the majority of the samples related to the big beams of the lower layer of the floors of the upper storey, the one supporting the weight, *Olea europaea* was the species most frequently occurring. The presence of samples clearly related by the excavators to beams, exclusively from

| Akrotiri - House of the Ladies - Floors | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Structural elements | | | | | | | | | | Beams | | | | | | | | | |
| **Room** | 2 | 4 | 5 | | | 7 | | | | | 5 | | | 7 | 8 | 10 | | | | |
| **Taxa/Samples** | M3 | E87 (23) | M26 | M28 | E87 (18) | M2 | **N** | **%** | **Ubiquity** | **Ubiquity %** | M10 | M24 | E87 (65) | M3(3) | M4 | M1 | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | 3 | | | | | **3** | **6.52** | **1** | **16.67** | | | | | | | | | | |
| cf. *Arbutus* sp. | | 1 | | | | | **1** | **2.17** | **1** | **16.67** | | | | | | | | | | |
| Fabaceae | | | | | | 2 | **2** | **4.35** | **1** | **16.67** | | | | | | | | | | |
| cf. Fabaceae | | | | | 1 | 1 | **2** | **4.35** | **2** | **33.33** | | | | | | | | | | |
| *Juniperus* sp. | | | | | | 1 | **1** | **2.17** | **1** | **16.67** | | | | | | | | | | |
| *Olea europaea* | 2 | 5 | 7 | | 3 | 4 | **21** | **45.65** | **5** | **83.33** | 22 | 9 | | 1 | 20 | | **52** | **76.47** | **4** | **66.67** |
| cf. *Olea europaea* | 2 | | | | | 1 | **3** | **6.52** | **2** | **33.33** | | | | | | | | | | |
| *Pinus* tp. *brutia/halepensis* | | | | 1 | | | **1** | **2.17** | **1** | **16.67** | | 1 | 4 | | | | **5** | **7.35** | **2** | **33.33** |
| *Prunus amygdalus* | 1 | | | 1 | | | **2** | **4.35** | **2** | **33.33** | | | | | | | | | | |
| *Prunus* sp. | | | | 2 | | | **2** | **4.35** | **1** | **16.67** | | | | | | | | | | |
| *Quercus* tp. deciduous | | | | | | | | | | | | | | | | 10 | **10** | **14.71** | **1** | **16.67** |
| *Quercus* tp. evergreen | | | | 3 | | | **3** | **6.52** | **1** | **16.67** | | | | | | | | | | |
| *Quercus* sp. | | | | | | | | | | | | | | | | 1 | **1** | **1.47** | **1** | **16.67** |
| *Tamarix* sp. | | | | 2 | | | **2** | **4.35** | **1** | **16.67** | | | | | | | | | | |
| cf. *Tamarix* sp. | | | | 1 | | | **1** | **2.17** | **1** | **16.67** | | | | | | | | | | |
| Angiosperm | | | | 2 | | | **2** | **4.35** | **1** | **16.67** | | | | | | | | | | |
| **TOTAL** | **5** | **9** | **7** | **12** | **4** | **9** | **46** | **100** | | | **22** | **10** | **4** | **1** | **20** | **11** | **68** | **100** | **6** | **100** |
| **Min No of taxa** | **3** | **2** | **1** | **5** | **2** | **3** | **9** | | | | **1** | **2** | **1** | **1** | **1** | **2** | **4** | | | |

**Table V.16:** Anthracological results from contexts related to structural elements and beams of the floors of the upper storey, unearthed in the House of the Ladies, Akrotiri.

this species, indicates the use of *Olea* trunks as structural material. Other taxa systematically found in these contexts were *Pinus* type *brutia/halepensis* and *Quercus* type deciduous.

As can be seen in Figures V.11 and V.12, showing the distribution of the beam samples at Xeste 3 and the House of the Ladies respectively, usually more than one taxon were employed in the construction of the lower layer of the floor. In addition to the description provided by the excavation diaries, the weak curvature of fragments of *Quercus* type deciduous and *Pinus* type *brutia/halepensis* (Fig. V.13 and Fig. V.14), as well as the lack of pith or bark in all occasions (an indication that the fragments were coming from the trunk of the tree and not from smaller branches; Marguerie and Hunot, 2007), reinforce the belief that they were parts of the main beams of the floors. Furthermore, occasionally, like in samples Δ5 of Room 6 (Xeste 3) and Δ1 of Room 7 (Xeste 3), the samples contained a few big fragments of only one taxon, whose dimensions were approximately 0.10x0.07x0.07 $m^2$ or larger, alongside other smaller pieces which as they belonged to the same taxon apparently had become detached from the bigger fragments (Fig. V.15).

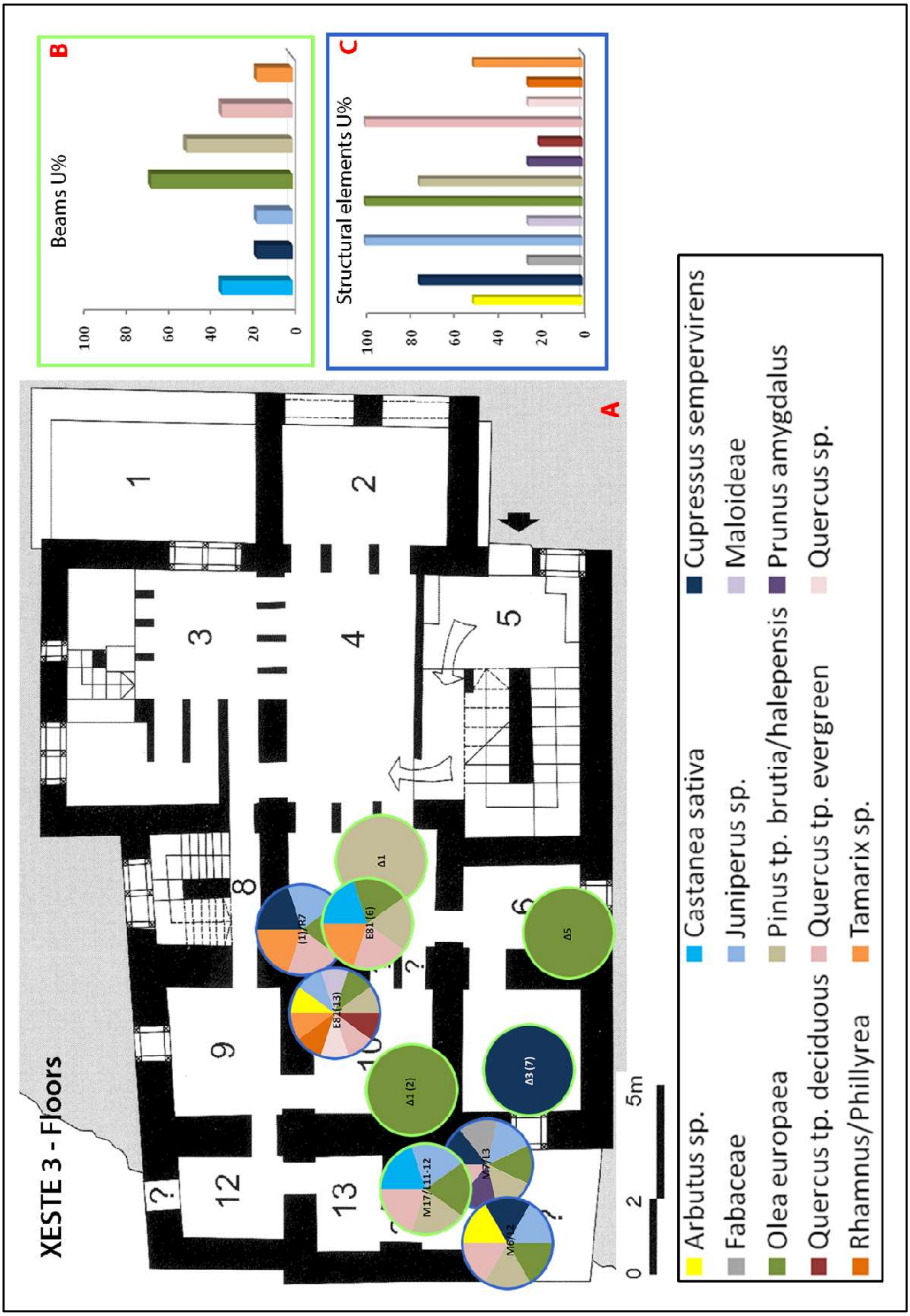



**Figure V.11:** Distribution of the samples characterized as from beams and structural elements of the floors of the upper storey at Xeste 3, Akrotiri. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. On the right, bar charts present the ubiquity percentage (U%) of the taxa identified as (B) beams and (C) structural elements of the floors.

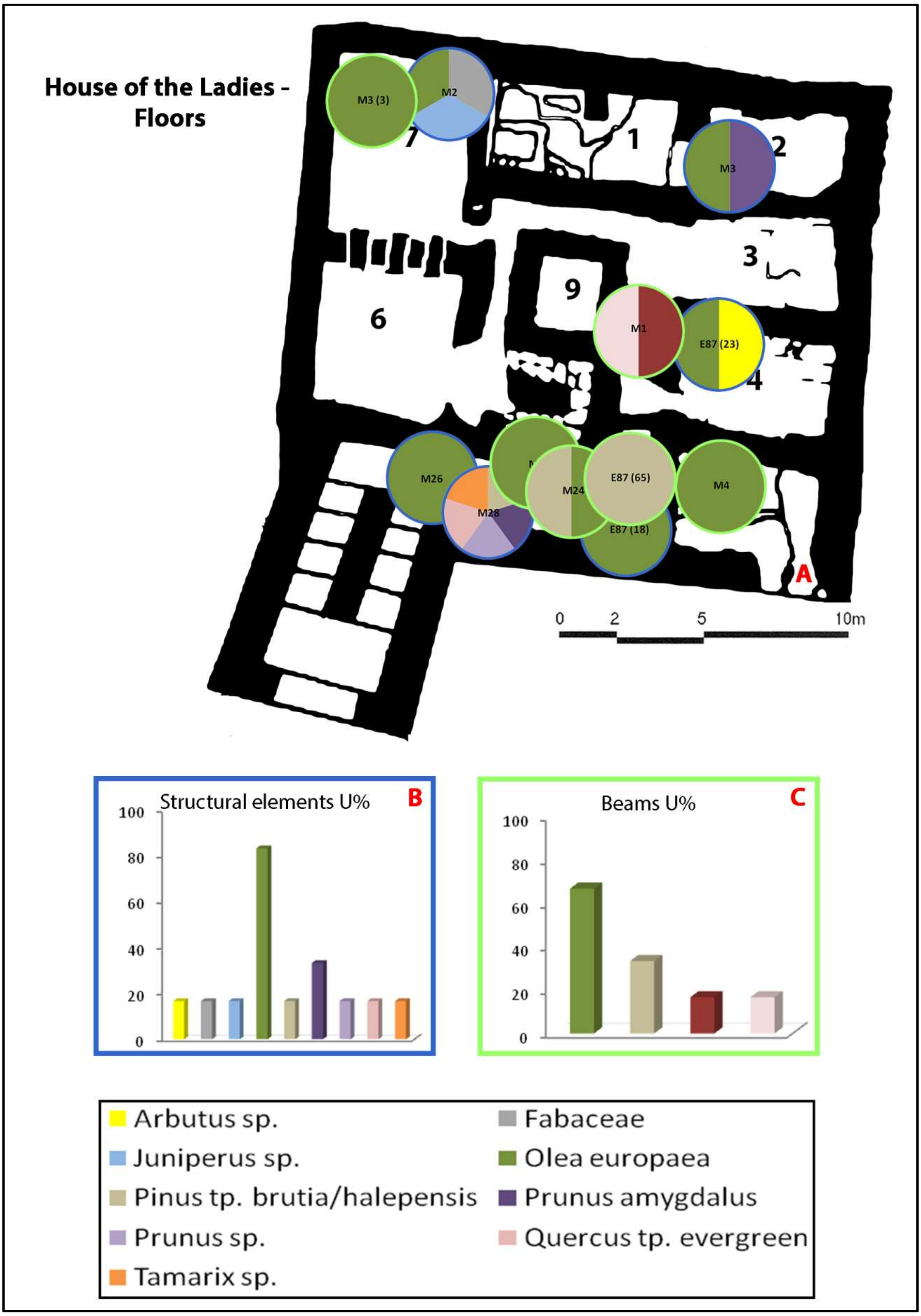



**Figure V.12:** Distribution of the samples characterized as from beams and structural elements of the floors of the upper storey at the House of the Ladies, Akrotiri. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, bar charts present the ubiquity percentage (U%) of the taxa identified as (B) beams and (C) structural elements of the floors.

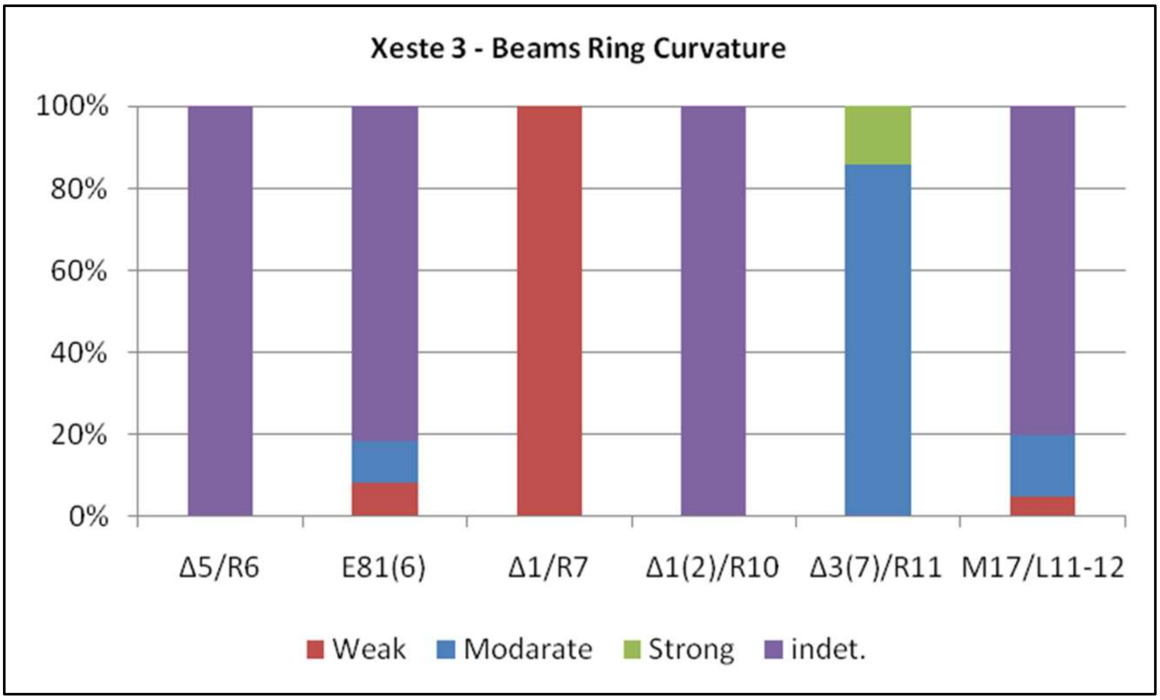



**Figure V.13:** Ring curvature of all fragments recovered at each sample characterized as beams from the floors of the upper storey at Xeste 3, Akrotiri.

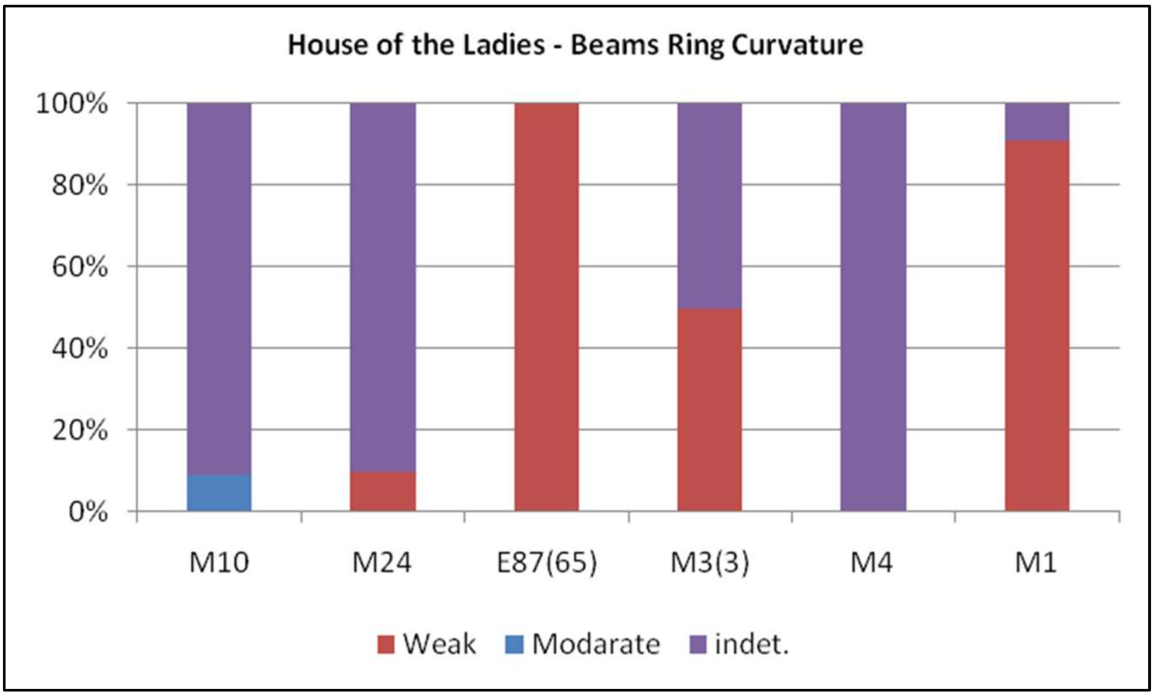



**Figure V.14:** Ring curvature of all fragments recovered at each sample characterized as beams from the floors of the upper storey at the House of the Ladies, Akrotiri.


**Figure V.15:** Part of a wooden beam recovered from Room 6 of Xeste 3 (sample Δ5).

An exception is provided by sample Δ3 (7), collected in Room 11 of Xeste 3: this was characterized by the excavators as a beam, but most probably belongs to the second layer of the floor. This sample was composed exclusively from *Cupressus sempervirens* fragments, whose curvature was either moderate or strong (Fig. V.13). In the excavation diary, it is mentioned that in squares 2b, 3b, and 4b of Room 11, where the sample was collected, there were found cavities belonging to beams, as well as smaller branches set perpendicular to them. Thus, it could be suggested that here *Cupressus sempervirens* comprised one of the smaller branches from the second layer of the floor.

Sample Δ1 (2), collected from Room 10 of Xeste 3, contained exclusively *Olea europaea* fragments. This can be associated with the beam placed under the built bench, holding four embedded pithoi: the bench was set at the west side of the first floor of the room (Fig. V.16). The sample was collected at the point where the beam had broken at the north face of the south wall. According to Palyvou (1999), this reinforcing beam was placed under the bench to support its extra weight. The beam was placed approximately 0.30m out from the face of the west wall of Room 10, and parallel with it: it had an almost rectangular cross-section, 0.20 m wide. The beam supported the structure so that this remained essentially intact, although it had collapsed and sunken by almost 1 m (Palyvou, 1999).

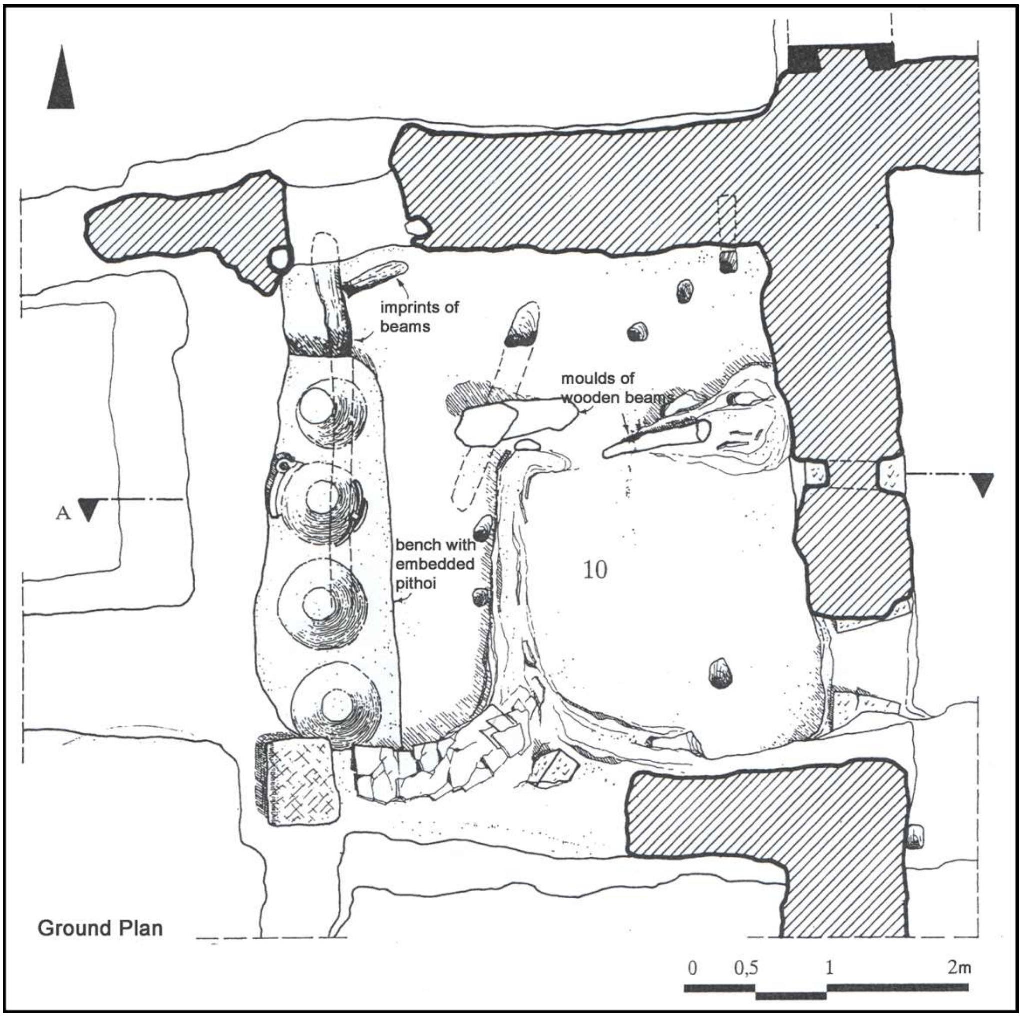



**Figure V.16:** Ground plan of Room 10 of Xeste 3. On the left, the built bench with the embedded pithoi. Sketch by Palyvou 1999, Fig. 103.

Special mention must be made of the presence of *Castanea sativa,* an exogenous species, in assemblages related to the beams at Xeste 3. Of the three fragments of this species identified, only one had a weak curvature. This fragment was one of the two found in sample E81 (6) of Room 7. Although *Castanea sativa* cannot be directly related to a beam, its presence in the destruction layer of the floor might imply its use within the layer of the branches. Of course, the possibility that these fragments belong to a wooden object cannot be totally ruled out either.

Similarly to the case of Xeste 3, in the House of the Ladies samples collected closer to the walls are composed of *Olea*. For example in Room 8, sample M4 was most probably part of the first beam at the west to support the upper storey floor. This sample was from a beam of the floor, unearthed under its upper layer made of soil. In corridor 10, the only sample (M1) collected as related to a beam was composed almost exclusively from *Quercus* type deciduous fragments (one fragment was identified as *Quercus* sp.). This is the only case where *Quercus* type deciduous is clearly related to a beam. Finally, in Room 5 the presence of *Pinus* type *brutia/halepensis* in the east part of the room was observed. According to the excavation diary, to effect the construction of the floor of this room, first horizontal beams were placed on an orientation north-south and at distances of approximately 0.40 m apart. On top of these beams had been placed at least one beam on an east-west orientation, down the centre of the Room; above this were set other and smaller branches. Sample E87 (65), composed exclusively of *Pinus* type *brutia/halepensis* fragments, can be associated with the east-west oriented beam sampled 1 m west of the east wall of the Room, where it comprised the upper part of the aforementioned beam. In this case the preference of *Pinus* type *brutia/halepensis* is most probably connected to the distance between the east and west walls which had to be covered: it was an approximately 6 m-wide gap.

#### 2.1.2 Structural elements of the Floors (first and second layer)

Anthracological samples related to the second layer of the floors of the upper storey are from Rooms 7, 10, and 14 of Xeste 3, Rooms 2, 4, 5 and 7 of the House of the Ladies and finally from deposits excavated at the rooms unearthed in Pillars 66Π and 67.

At Xeste 3, in the four samples characterized as structural elements (Table V.15) there have been identified in total thirteen taxa from which *Olea europaea*, *Juniperus* sp., and *Quercus* type evergreen are met with in all samples studied, while *Cupressus sempervirens* and *Pinus* type *brutia/halepensis* occur in three of them.

Worth noting is the fact the apart from *Olea europaea* the other taxa mentioned scored percentages lower than 10%, although their ubiquity percentage is high. Similarly, samples to do with the second layer of the floors of the House of the Ladies (Table V.16) present a higher diversity of taxa in comparison to those coming from beams alone, although the overall number of fragments identified is rather low. From the nine taxa identified from this kind of contexts, *Olea europaea* is present in all samples but one, while the rest occur in one or two samples each.

Table V.17 presents the results from the analysis of the wood charcoal macroremains recovered from the destruction layer of the three-storey building excavated within NPS 66Π. As it can be seen, *Olea europaea* was the most abundant species, identified in all six samples from this context. From the rest of the taxa found, only *Quercus* type evergreen was found in more than one sample. In the case of Room 1 of Pillar 67 the number of taxa identified from its destruction layer is low, with only five taxa recognized (Table V.18). Here *Olea europaea* has the highest relative ubiquity as it is present in all samples, while *Juniperus* sp. and *Prunus amygdalus* are present in half of them. Of the samples coming from vessels unearthed in this deposit, beside *Olea europaea*, which is present in almost all contexts related to buildings from Akrotiri, these samples contained also Fabaceae, *Quercus* type deciduous, and *Quercus* sp.

| **Akrotiri - Shaft of New Pillar 66Π** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Construction material/Destruction layer - LC I | | | | | | | | | | |
| **Context** | Floor 2 (storey floor) | | | | | | | | | |
| **Layer** | 15 | | | | | | | | | |
| **Taxa/Samples** | WF2000 (992) | WF2000 (996) | WF2000 (998) | WF2001 (1021) | WF2001 (1106) | WF2001 (1120) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Juniperus* sp. | | | | | 1 | | **1** | **0.81** | **1** | **16.67** |
| *Olea europaea* | 4 | 4 | 61 | 2 | 13 | 18 | **102** | **82.93** | **6** | **100** |
| cf. *Olea europaea* | 1 | | | | 2 | 2 | **5** | **4.07** | **3** | **50.00** |
| *Prunus amygdalus* | | 1 | | | | | **1** | **0.81** | **1** | **16.67** |
| *Quercus* tp. evergreen | | | 1 | | 1 | | **2** | **1.63** | **2** | **33.33** |
| *Quercus* sp. | | | | | | 1 | **1** | **0.81** | **1** | **16.67** |
| Angiosperm | 1 | 2 | 4 | | 2 | 2 | **11** | **8.94** | **5** | **83.33** |
| **TOTAL** | **6** | **7** | **66** | **2** | **19** | **23** | **123** | **100** | | |
| **Min No of taxa** | **1** | **2** | **2** | **1** | **3** | **2** | **5** | | | |

**Table V.17:** Anthracological results from the destruction layer of Floor 2 (LC I building) excavated in the new shaft of Pillar 66Π. Akrotiri.

| **Akrotiri - Shaft of New Pillar 67** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROOM 1 - LC I | | | | | | | | | | | | | | |
| **Context** | Construction debris above floor | | | | | | | | Vessels content | | | | | |
| **Layer** | 9 | | 10 | 11 | | | | | 11 | | | | | |
| **Taxa/Sample** | M2/67N024 | WF2000 (821) | M6/67N030 | WF2000 (925) | **N** | % | **Ubiquity** | **Ubiquity %** | WF2000 (940) | WF2000 (942) | **N** | % | **Ubiquity** | **Ubiquity %** |
| Fabaceae | | | | | | | | | | 1 | **1** | **7.69** | **1** | **50.0** |
| *Juniperus* sp. | | | 1 | 1 | **2** | **3.85** | **2** | **50.0** | | | | | | |
| *Olea europaea* | 1 | 32 | 5 | 6 | **44** | **84.62** | **4** | **100** | 1 | 5 | **6** | **46.15** | **2** | **100** |
| cf. *Olea europaea* | | 1 | | 1 | **2** | **3.85** | **2** | **50.0** | | | | | | |
| *Pinus* tp. *brutia/halepensis* | | 1 | | | **1** | **1.92** | **1** | **25.0** | | | | | | |
| *Prunus amygdalus* | | 1 | | 1 | **2** | **3.85** | **2** | **50.0** | | | | | | |
| cf. *Prunus* sp. | | | 1 | | **1** | **1.92** | **1** | **25.0** | | | | | | |
| *Quercus* tp. deciduous | | | | | | | | | 1 | 1 | **2** | **15.38** | **2** | **100** |
| *Quercus* sp. | | | | | | | | | | 1 | **1** | **7.69** | **1** | **50.0** |
| cf. *Quercus* sp. | | | | | | | | | 1 | 1 | **2** | **15.38** | **2** | **100** |
| Angiosperm | | | | | | | | | | 1 | **1** | **7.69** | **1** | **50.0** |
| **TOTAL** | **1** | **35** | **7** | **9** | **52** | **100** | | | **3** | **10** | **13** | **100** | | |
| **Min No of taxa** | **1** | **3** | **3** | **3** | **5** | | | | **2** | **4** | **4** | | | |

**Table V.18:** Anthracological results from the constructional debris of Room 1 and the content of the vessels unearthed just above it, excavated in Pillar 67, Akrotiri.

Overall, the variety of taxa identified as beams is lower than what is encountered in the samples described as structural elements. This diversity of taxa is to be expected in the latter case: the second layer (of branches and similar) can be made up from a greater number of taxa. The size of the branches needed for the construction of this layer makes this possible: according to Palyvou (1999) such had a diameter of approximately 0.05 m and they were up to 0.70 m long. Thus, besides *Olea europaea* as the most frequently met taxon, other taxa present at a high level were *Juniperus* sp. and *Quercus* type evergreen, and to a lesser extent *Pinus* type brutia/halepensis, *Prunus* amygdalus, and in the case of Xeste 3, *Cupressus sempervirens*.

In an effort to differentiate the taxa coming from the layer of the branches from those coming from the beams, in each sample related to structural elements the curvature of each fragment per taxon has been plotted, wherever possible. With *Olea europaea*, the most ubiquitous species, the distribution of its vessels generally did not allow any estimation as to the curvature of the fragments to be made. Only in very few cases were bark or pith present, or growth rings that could be observed, as for example in the sample coming from Room 14 of Xeste 3, where fragments of *Olea europaea* with moderate or strong curvature were identified which also had growth rings. The same circumstances apply also to fragments of *Tamarix* sp. and *Quercus* type evergreen. In the rest of the taxa recovered from the samples of Xeste 3, *Cupressus sempervirens*, *Juniperus* sp., *Pinus* type *brutia/halepensis* and finally *Quercus* type deciduous have both weakly and moderately curved fragments, while *Arbutus* sp., Maloideae, *Rhamnus/Phillyrea*, Fabaceae, and *Prunus amygdalus* are represented almost exclusively by fragments with moderate curvature (Fig. V.17). At

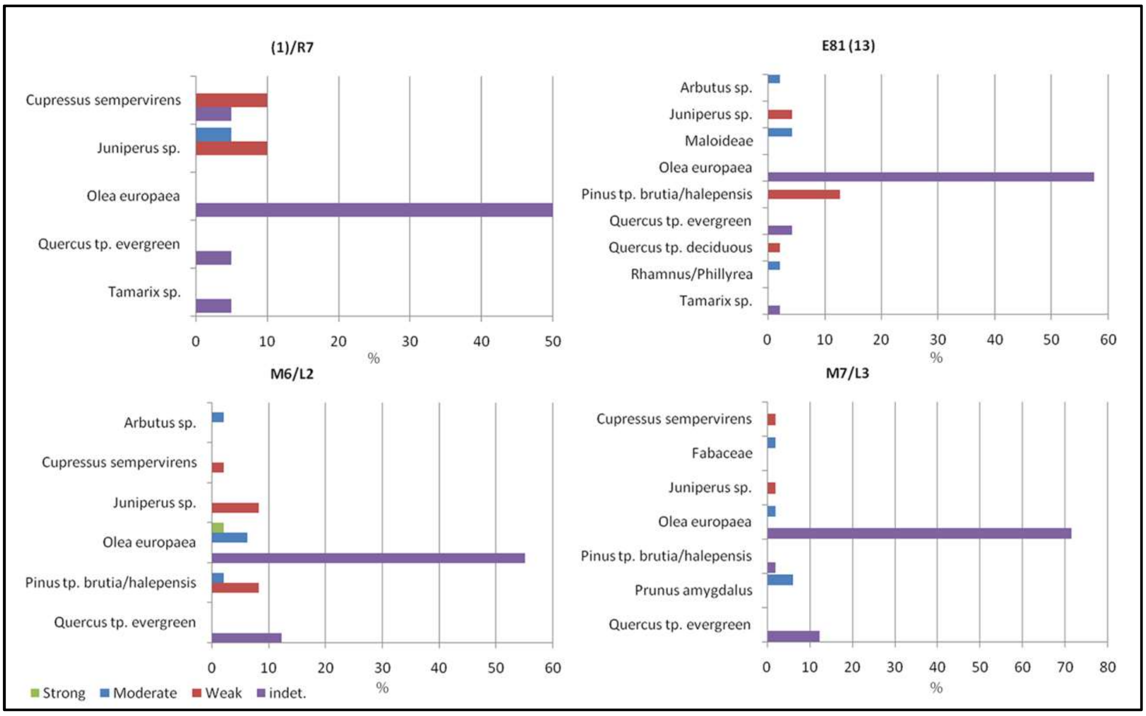



**Figure V.17:** Ring curvature of the fragments recovered in samples characterized as Structural elements from the floors of the upper storey at Xeste 3, Akrotiri. Each sample is presented by a different bar chart.

the House of the Ladies, the preservation of the wood charcoal fragments coming from contexts related to structural elements was poor. Fragments of weak curvature originated from *Pinus* type *brutia/halepensis*, while *Prunus amygdalus*, *Arbutus* sp., *Olea europaea*, and Fabaceae are represented with fragments of moderate curvature (Fig. V.18).

In general, the fragments with weak curvature can be attributed to beams rather than the branches of the second layer. Each room required five or six beams to span the length of the floor. Thus, from observing the content of the samples characterized as structural elements, what was suggested already acquires further verification, namely that in all rooms whence samples were studied, a variety of taxa was used for the construction of the first layer of the floor of the upper storey. For example, in the sample (1)/R7 of Xeste 3, the presence of *Cupressus sempervirens* and *Juniperus* sp. with weak curvature, indicate that these taxa might have also been used as main beams of the floor along with *Olea* (sample E81 (6)). Similarly, in sample M28 of the House of the Ladies, *Pinus* tp. *brutia/halepensis,* and *Tamarix* sp. could both represent beams. As the sample was collected almost from the middle of

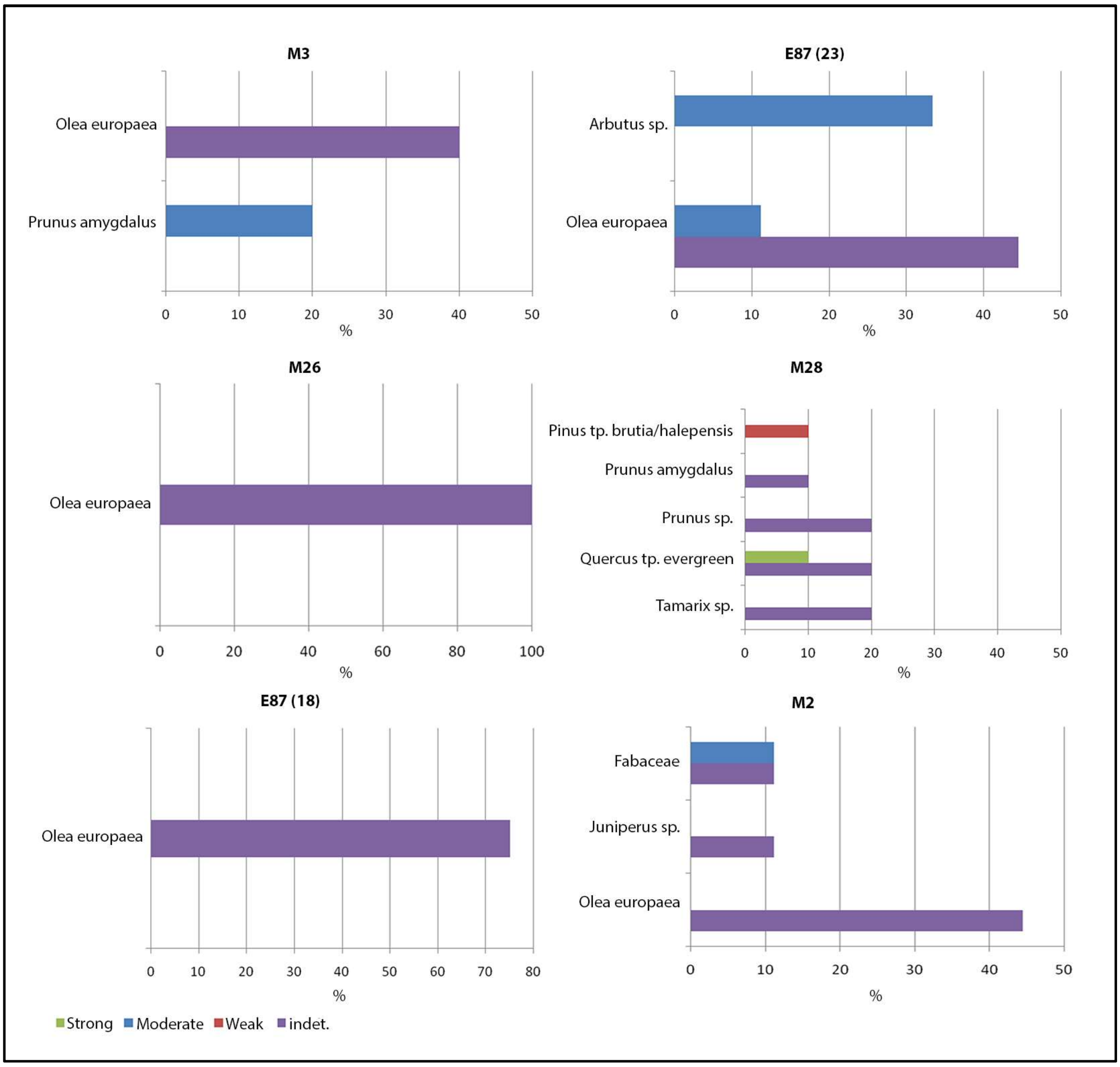



**Figure V.18:** Ring curvature of the fragments recovered in samples characterized as structural elements of the floors of the upper storey at the House of the Ladies, Akrotiri. Each sample is presented by a different bar chart.

Room 5 (see Fig. V.12), *Tamarix* sp. could represent one of the main beams holding up the floor of the first storey and was set on a north-south orientation, while the fragments of *Pinus* type *brutia/halepensis* are most probably part of a beam at right-angles to this, as mentioned above, and oriented east-west.

In Pillar 66Π, by observing the content of each sample as well as the curvature of the fragments analysed, it could be suggested that for Floor 2 of the building excavated there (Table V.17, Fig. V.19), *Juniperus* sp. and possibly *Quercus* type evergreen could have been used as parts of the first layer. Additionally, both the high ubiquity of *Olea*, as well as its high number of fragments, indicates that this species was utilized in the construction of the floor both in its first layer and the second. For example, considering the way the layers of the upper floor were placed and the fact that in a fire event the lower layer would have fallen on top of the floor below, sample WF2000 (998) could be attributed to the first layer of the floor of the upper storey, because it was sampled in the destruction layer of the floor of the first storey, just above the ground floor level. It contains almost exclusively fragments of one species, namely *Olea europaea*. For the second layer of the floor there were most likely used also *Prunus amygdalus*.

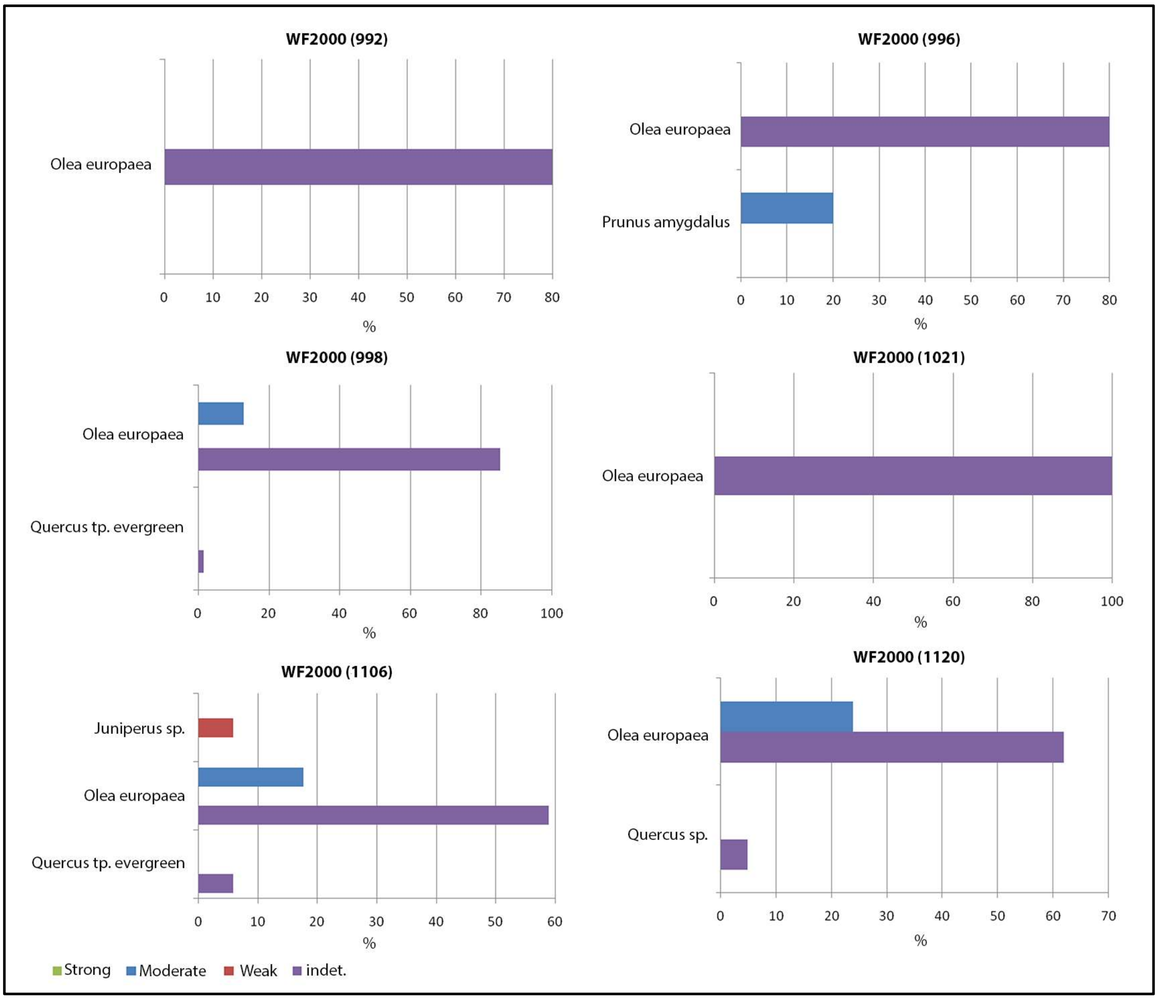



**Figure V.19:** Ring curvature of the fragments recovered in samples related to the destruction layer of Floor 2 (LC I building) from the new shaft of Pillar 66Π, Akrotiri. Each sample is presented by a different bar chart.

From the destruction layer of the first floor of Room 1 excavated in Pillar 67 were collected four samples in total (Table V.18). In this assemblage *Olea europaea* is again the most frequently occurring species. From the total of the taxa identified, only *Prunus amygdalus* had weakly curved fragments which fact could attribute it to the first layer of the floor (Fig. V.20). However, the presence of big fragments of *Olea* in sample M2/67N024 might be an indication that this sample was from a beam. Branches of *Juniperus* sp., *Prunus amygdalus*, and *Olea europaea* could be part of the second layer. The presence of growth rings in some of the *Olea* fragments argue for the use of branches originating from pruned trees.

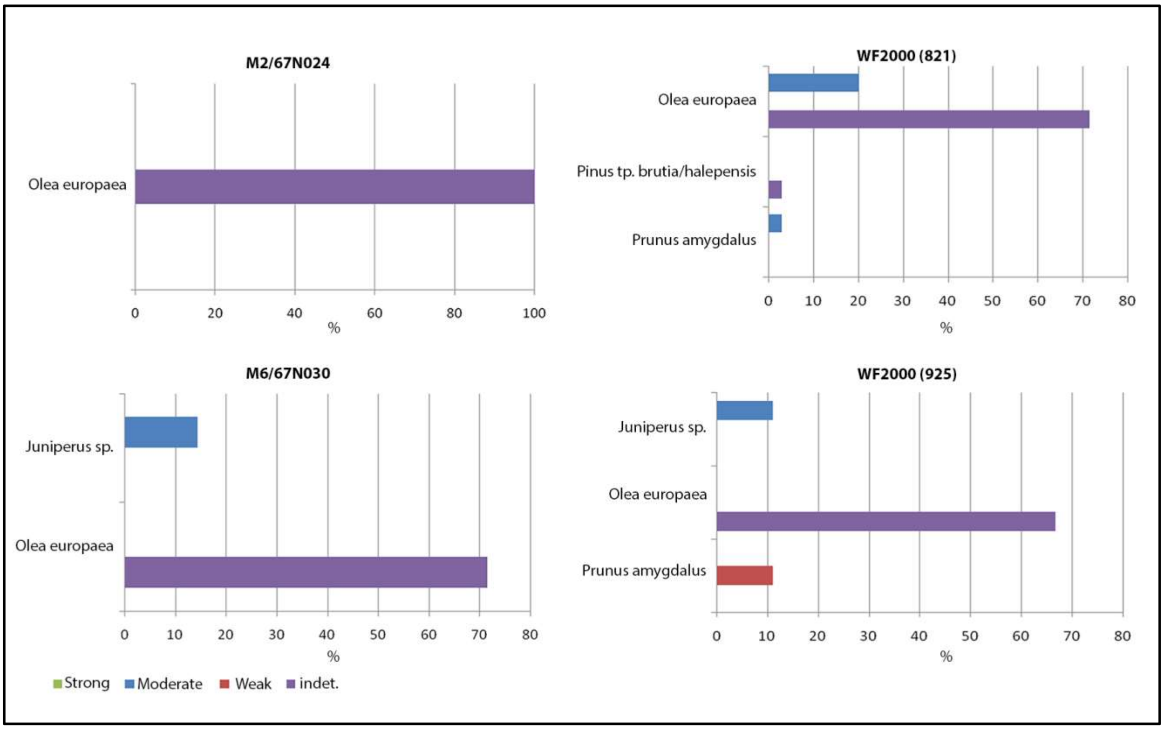



**Figure V.20:** Ring curvature of the fragments recovered in samples related to the destruction layer of Room 1 at the new shaft of Pillar 67, Akrotiri. Each sample is presented by a different bar chart.

Summing up the above, it can be suggested that taxa with a moderate curvature and so attributable to the upper layer of the branches are *Arbutus* sp., *Prunus amygdalus*, Maloideae, *Rhamnus/Phillyrea*, and Fabaceae. With regard to the taxa used for the construction of the beams of the first layer, their utilization again in the construction of the second layer of the floors is quite feasible, as in many samples from relevant contexts fragments of these taxa occur with moderate curvature, although in low quantities. It should be remembered here, according to Dufraisse (2006), that a tree-trunk is formed by successive *cones*, the thickness of each is related to the diameters of its neighbours. Consequently, when a log is burnt, fragments of different diameters are produced in quantities relevant to each other. Thus, it is very probable that fragments with moderate curvature included in samples characterized as structural elements are coming here from the main beams of the floors of the upper storey. In the case of *Olea europaea*, its high ubiquity in all samples of relevant contexts, in addition to the presence of growth rings in some of the fragments, is a strong indication that branches of the species were used too in the second layer of the floors. These branches might have resulted from the pruning of the trees (Rackham, 1972).

### 2.2 Wooden infrastructure of the walls

The walls of the buildings at Akrotiri were reinforced with wooden horizontal grids which were placed in the thickness of the walls in order to prevent them from collapse (Palyvou, 2005, 1999) (for details see Chapter II). Samples from these constructions were collected from the walls of Xeste 3 and the House of the Ladies. In more detail, samples ascribed to the wooden frame of the walls of Xeste 3 were retrieved from the west wall of the ground floor of Room 3, where in the northern part of the wall and at different heights nine samples were collected (Table V.19). At the House of the Ladies relevant samples were recovered from the south wall of the second storey of Room 2 (sample M7), from the north wall of the first storey of Room 3 (sample I2), and from the north (sample 1) and south (samples 2, 3, E92 (6), E92 (25)) walls of the ground floor of Room 8 (Table V.20).

As can be seen in Table V.19, at Xeste 3 seven taxa have been identified in total, although none of the samples contained more than three taxa. The most frequently met with species is *Olea europaea*– present in seven out of nine samples. *Juniperus* sp. and *Pinus* type *brutia/halepensis* are present in two samples, while the ubiquity of all other taxa is lower than 25%, meaning they are present in only one sample apiece. As in the previous cases, in the House of the Ladies (Table V.20), *Olea europaea* is the taxon with the highest ubiquity percentage (85.71%), followed by *Quercus* type deciduous which is present in almost half the samples (42.86%).

| Akrotiri - Xeste 3 - Walls | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Construction debris of walls | | | | | | | | | | | | |
| **Room** | 3 | | | | | | | | | | | | |
| **Taxa/Samples** | M1 | M2 | M3 | M4 | M7 | Δ1 (3) | Δ1 (4) | Δ1 (5) | Δ2 (6) | **N** | % | **Ubiquity** | **Ubiquity %** |
| *Castanea sativa* | 1 | | | | | | | | | **1** | **1.82** | **1** | **11.11** |
| Fabaceae | 2 | | | | | | | | | **2** | **3.64** | **1** | **11.11** |
| *Ficus carica* | | | | | | 1 | | | | **1** | **1.82** | **1** | **11.11** |
| *Juniperus* sp. | | | | | 2 | | 2 | | | **4** | **7.27** | **2** | **22.22** |
| *Olea europaea* | 10 | 3 | 5 | 6 | 8 | | | 1 | 2 | **35** | **63.64** | **7** | **77.78** |
| *Pinus* tp. *brutia/halepensis* | | | | | 7 | | 2 | | | **9** | **16.36** | **2** | **22.22** |
| *Tamarix* sp. | | | | | | 3 | | | | **3** | **5.45** | **1** | **11.11** |
| **TOTAL** | **13** | **3** | **5** | **6** | **17** | **4** | **4** | **1** | **2** | **55** | **100** | | |
| **Min No of taxa** | **3** | **1** | **1** | **1** | **3** | **2** | **2** | **1** | **1** | **7** | | | |

**Table V.19:** Anthracological results from contexts related to constructional debris of walls excavated at Xeste 3, Akrotiri.

| Akrotiri - House of the Ladies - Walls | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Construction debris of walls | | | | | | | | | | |
| **Room** | 2 | 3 | 8 | | | | | | | | |
| **Taxa/Samples** | M7 | I2 | 1 | 2 | 3 | E92 (6) | E92 (25) | **N** | % | **Ubiquity** | **Ubiquity %** |
| *Ficus carica* | 1 | | | | | | | **1** | **0.88** | **1** | **14.29** |
| *Olea europaea* | 12 | 10 | 7 | | 2 | 29 | 34 | **94** | **83.19** | **6** | **85.71** |
| cf. *Olea europaea* | 1 | | | | | 1 | 1 | **3** | **2.65** | **3** | **42.86** |
| *Prunus amygdalus* | 1 | | | | | | | **1** | **0.88** | **1** | **14.29** |
| *Quercus* tp. deciduous | 2 | | | | | 2 | 1 | **5** | **4.42** | **3** | **42.86** |
| *Quercus* tp. evergreen | 1 | | | | | 3 | | **4** | **3.54** | **2** | **28.57** |
| Angiosperm | 1 | | | 1 | | 3 | | **5** | **4.42** | **3** | **42.86** |
| **TOTAL** | **19** | **10** | **7** | **1** | **2** | **38** | **36** | **113** | **100** | | |
| **Min No of taxa** | **5** | **1** | **1** | **0** | **1** | **3** | **2** | **5** | | | |

**Table V.20:** Anthracological results from contexts related to constructional debris of walls excavated in the House of the Ladies, Akrotiri.

Beside these, *Quercus* type evergreen has been found in two samples, and *Ficus carica* and *Prunus amygdalus* in one sample each.

According to Palyvou (1999), to fashion this wooden frame there were usually used logs and branches in their natural form, with the biggest of them having a diameter of 0.12 m. As can be seen in Tables V.19 and V.20, and Figures V.21 and V.22, respectively, *Olea europaea* seems to be the species preferred, although other taxa, which are known from the construction of the floors, are also present, like *Prunus amygdalus*, *Pinus* type *brutia/halepensis,* and *Quercus* type deciduous and evergreen. Interesting here is the presence of *Ficus carica* in both buildings, as this is the first time this taxon has been identified in assemblages coming from the interior of the buildings. Additionally, the presence of *Castanea sativa* at Room 3 of Xeste 3 implies its use in constructions, although this is a rare matter.

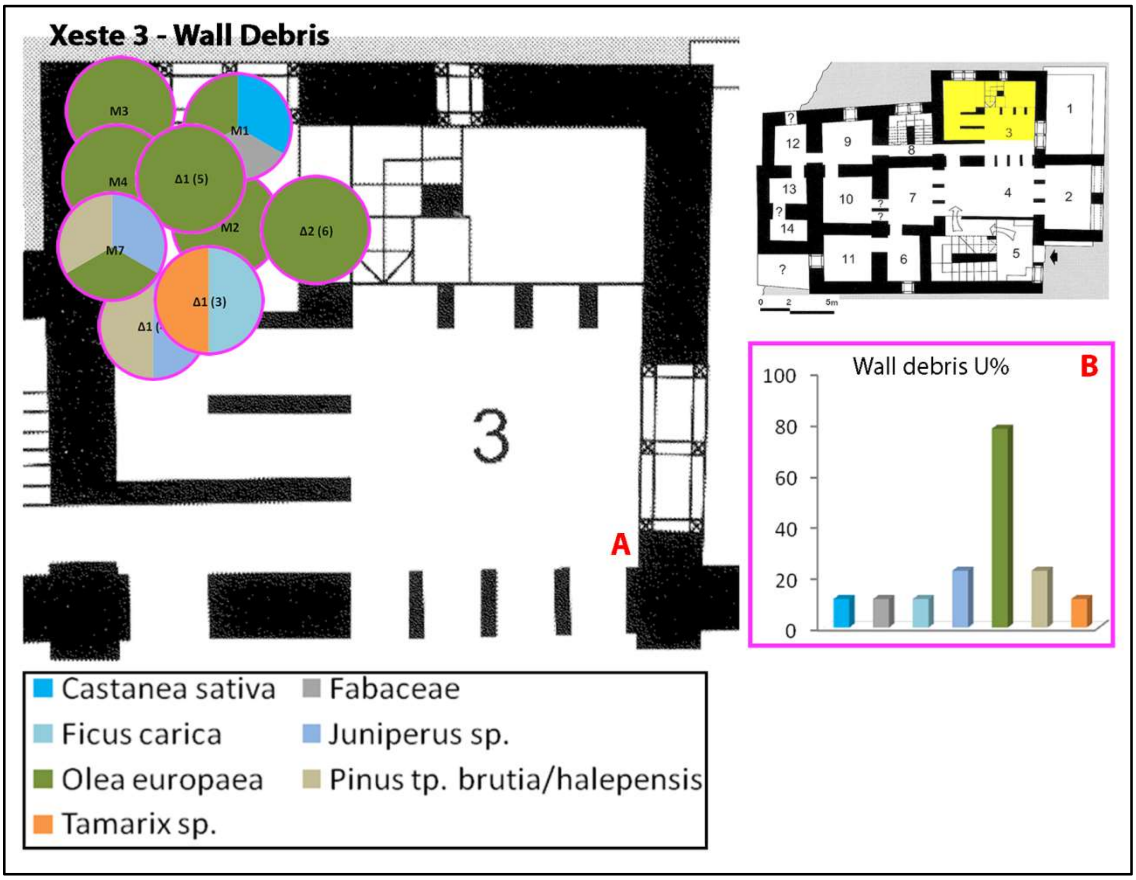



**Figure V.21:** Distribution of the samples characterized as wall debris recovered from Xeste 3, Akrotiri. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. On the right, (B) the bar chart presents the ubiquity percentage (U%) of the taxa of this context.

### 2.3 Openings in the buildings (doors, pier-and-door partitions, windows)

Evidence for the woody taxa used for the construction of the doors and the windows at Akrotiri are scarce. There is only one sample coming from a window, excavated in the LC I building unearthed in Pillar 66Π, three samples related to two interior doors, one from Xeste 3 and one from the House of the Ladies, and finally two samples from a pier-and-door partition from Xeste 3 (Table V.21). In the case of

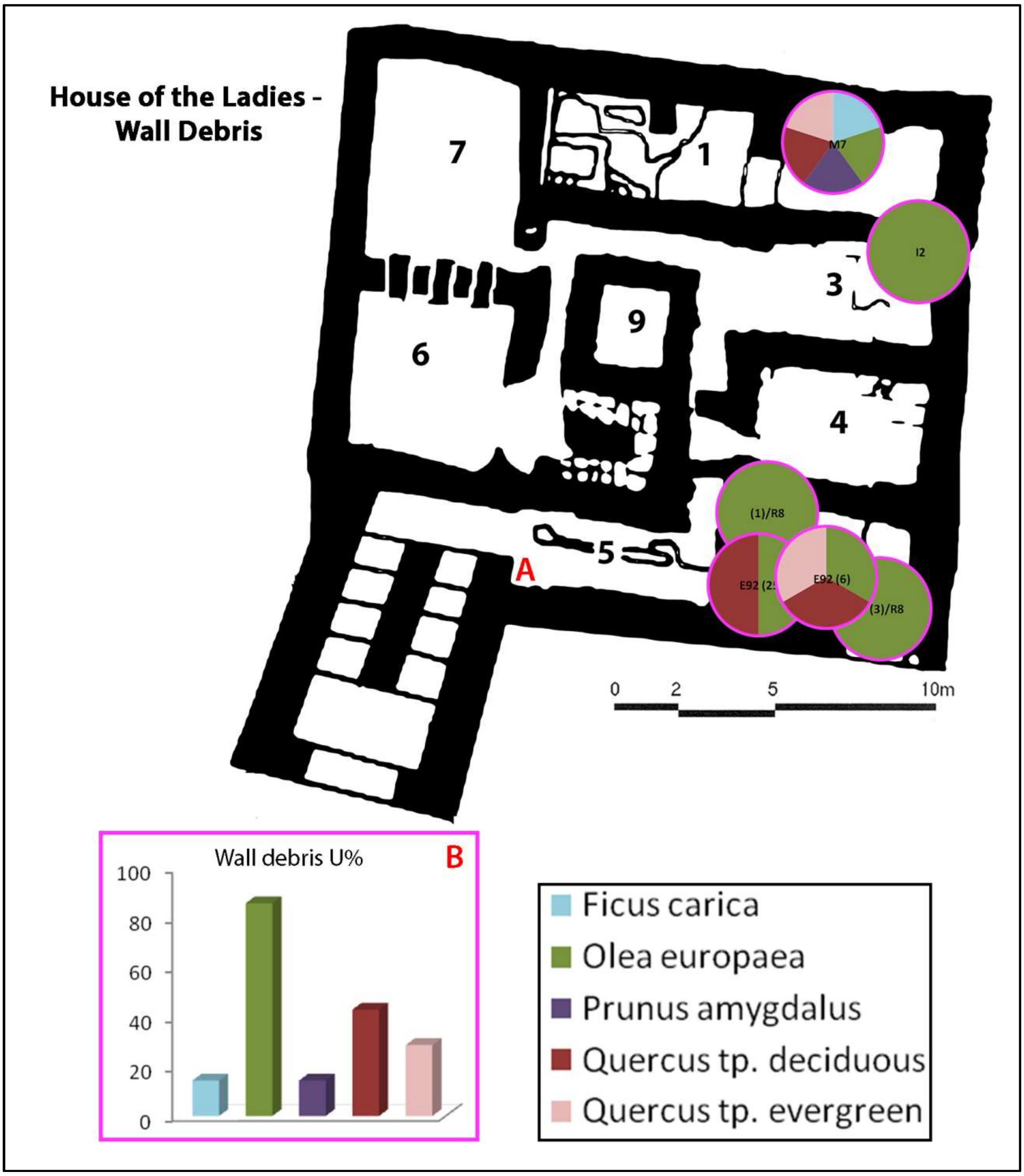



**Figure V.22:** Distribution of the samples characterized as wall debris recovered at the House of the Ladies Akrotiri. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, (B) the bar chart presents the ubiquity percentage (U%) of the taxa of this context.

the sample from the window of the building from Pillar 66Π, this comprised only one fragment of *Juniperus* sp. and thus, no further suggestions can be made. Regarding the doors and the pier-and-door partitions, however, combined information of the architectural and anthracological data provide indications on the preference of specific taxa for the construction of each of the wooden parts of the door and its frame.

| Akrotiri - Openings | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Building** | Xeste 3 | | | | | | | | House of the Ladies | | Pillar 66Π |
| **Context** | Pier-and-door partitions | | Door | | | | | | Door | | Window |
| **Room** | 3 | 7 | 14 | | | | | | 8 | | |
| **Taxa/Samples** | 1 | E81 (5) | M18 (1)/L10 | M19/L8-12 | **N** | % | **Ubiquity** | **Ubiquity %** | E92 (14) | % | |
| Cistaceae | | | 1 | | **1** | **0.67** | **1** | **25.0** | | | |
| *Juniperus* sp. | | 1 | 5 | | **6** | **4.00** | **2** | **50.0** | | | 1 |
| *Olea europaea* | 36 | 37 | 27 | 17 | **117** | **78.00** | **4** | **100** | 18 | **94.74** | |
| *Pinus* tp. *brutia/halepensis* | | 4 | 2 | 5 | **11** | **7.33** | **3** | **75.0** | | | |
| *Quercus* tp. deciduous | | 1 | | | **1** | **0.67** | **1** | **25.0** | 1 | **5.26** | |
| *Quercus* tp. evergreen | | 7 | 1 | | **8** | **5.33** | **2** | **50.0** | | | |
| *Tamarix* sp. | | | 2 | | **2** | **1.33** | **1** | **25.0** | | | |
| Angiosperm | | | 2 | 2 | **4** | **2.67** | **2** | **50.0** | | | |
| **TOTAL** | **36** | **50** | **40** | **24** | **150** | **100** | | | **19** | **100** | **1** |
| **Min No of taxa** | **1** | **5** | **6** | **2** | **7** | | | | 2 | | 1 |

**Table V.21:** Anthracological results from contexts related to doors, pier-and-door partitions and window, excavated in Xeste 3, House of the Ladies, and Pillar 66Π, Akrotiri.

In the single sample recovered from the door connecting Rooms 8 and 4 in the House of the Ladies, the only taxa identified were *Olea europaea* and *Quercus* type deciduous. At Xeste 3, sample 1 of Room 3 was collected from the pier-and-door partition connecting Room 3 to Room 4 on the first floor, while sample E81 (5) was taken from a beam unearthed at the pier-and-door partition connecting Room 7 to Room 4. In the first case, *Olea europaea* was the only taxon identified. However, in the second sample, beside *Olea*, other taxa were also identified, such as *Quercus* type deciduous and evergreen, *Pinus* type *brutia/halepensis* and *Juniperus* sp. Here, the high number of *Olea* fragments might indicate that this timber represented the beam sampled, while the other taxa might be related to other structural elements of the pier-and-door partition, or they could have fallen from the floor make-up of the upper storey. The two samples of Room 14 were both collected during the cleaning of the door connecting Room 14 and Room 13 at the ground floor of the building. *Olea europaea* and *Pinus* type *brutia/halepensis* were identified in both samples from this assemblage, while four more taxa were identified in sample M18 (1). Overall, in this building *Olea* was the most frequently met taxon, being identified in all four samples related to doors, followed by *Pinus* type *brutia/halepensis*, identified in three samples. The only other taxa present in more than one sample were *Quercus* type evergreen and *Juniperus* sp.

Palyvou (1999) has described in her study the construction of the interior doors and pier-and-door partitions of the buildings of Akrotiri in great detail. According to her, and as already mentioned at Chapter II, for the construction of the frame of each door (see Fig. II.5) two pairs of vertical beams were placed in between two transversely positioned beams, which secured them at the height of the threshold and the lintel, respectively. Above the transverse beams of the lintel were also placed two more horizontal beams, which were attached to the wooden framework set in the walls. In between these two horizontal beams were also placed other smaller branches or small slabs of stone to cover the gap, so that the building of the wall could continue from that point up (Palyvou, 1999, pp. 329–330). Consequently, for the construction of a door there were needed six large and long logs and four shorter pieces, which all would have had approximately the same diameter, as well as small branches which went above the lintel of the door.

Studying the taxa present in the samples related to doors from both buildings, as well as the curvature of the fragments (Fig. V.23), it can be suggested that *Olea europaea*, *Pinus* type *brutia/halepensis*, *Quercus* type deciduous and evergreen and probably *Tamarix* sp. were the taxa used for the construction of the beams of the frame of the doors, with *Olea* being the most widely used species. In addition, for the filling of the gap between the two horizontal beams of the lintel were most probably used branches of *Juniperus* sp, Cistaceae, and possibly *Quercus* tp. evergreen, *Pinus* type *brutia/halepensis*, and *Olea europaea*. The variety of taxa identified in samples E81 (95) and M18(1)/L10 (Table V.21) indicates that the frame of each door used more than one taxa. Thus, it seems, that what was important was not the taxon itself, but whether the timber was suitable in terms of its length and diameter to the needs of the builders. As to the composition of the door leaves, the evidence is scarce. Palyvou (1999) suggests that each door had double leaves, whose thickness was approximately 0.025 m, but no further information exists on their construction. Most probably these leaves were constructed from wooden planks, as the total width of the doors was approximately 0.80m, meaning that each door leaf was 0.40 m wide. As to the number of planks used and their individual width, nothing is know but it could be suggested that any of the taxa mentioned above with a weak curvature could have done.

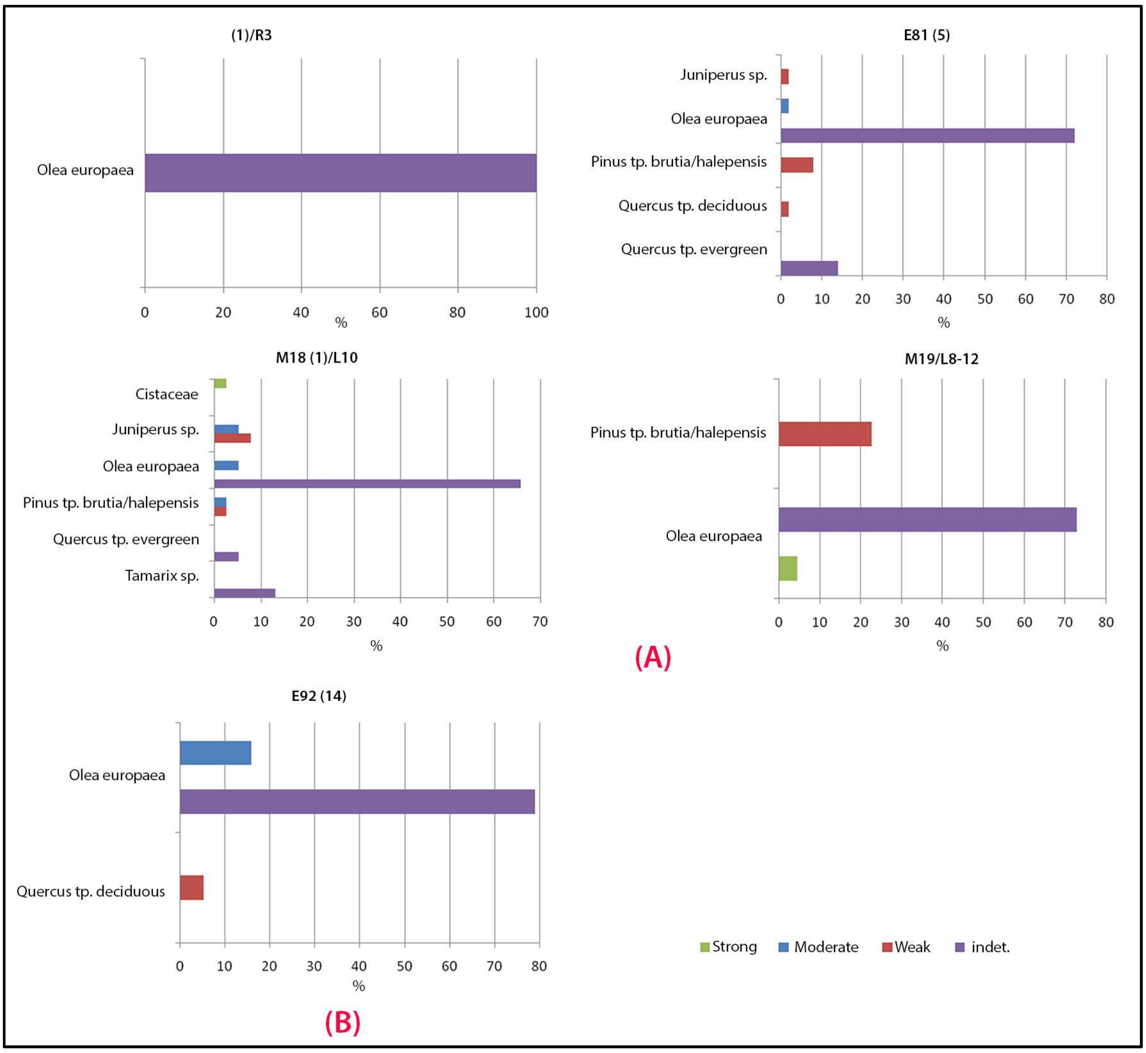



**Figure V.23:** Ring curvature of the fragments recovered from samples related to doors and pier-and-door partitions from (A) Xeste 3 and (B) the House of the Ladies. Each sample is presented by a different bar chart.

## 2.4 Fill of the Rooms

Those samples collected during the excavation of the interior of the rooms are referred to as from the fill of a room. The anthracological material from these deposits comprises construction debris, excavated from the destruction layers of Xeste 3 and the House of the Ladies, which were destroyed during the eruption of the volcano, as well as from the earlier Room unearthed in Pillar 67 (Room 2), which was destroyed during an earthquake during the late MC/early LC I period. In the case of Xeste 3 and the House of the Ladies, samples were collected from both the ground and the first floor of both buildings. In none of the excavation diaries was mentioned either the retrieval of wooden objects (i.e. parts of furniture) or the excavation of cavities caused by their disintegration, but even so the presence of wooden objects in the buildings cannot be excluded. Samples from the first floor of Xeste 3 are from Rooms 4, 10, and 11, and samples from the ground floor were retrieved from Rooms 3, 7, and 14. At the House of the Ladies, samples from the first floor come from Rooms 2 and 5 and from the ground floor from Rooms 3, 4, 5, 7, 8, and 9. Finally, the single sample from Pillar 67 was collected from the deposit covering the west half of the room, immediately above the surface of its ground floor.

Table V.22 presents the results from the charcoal samples collected in the fills of the rooms of Xeste 3. The results from the anthracological samples of the ground level of the building present a high variety of taxa, as 11 such have been recovered. The taxon most usually met with in these samples is *Olea europaea*– present in 82.61% of the samples, followed by *Pinus* type *brutia/halepensis* (47.83%), *Juniperus* sp. (34.78%), *Quercus* type evergreen (30.43%), and *Tamarix* sp. (30.43%). In contrast, in the samples from the first floor of the building, only three taxa have been identified, namely *Olea europaea*, *Pinus* type *brutia/halepensis*, and *Platanus orientalis*. From these, *Olea* is present in all eleven samples analysed from this level, while the other two taxa occur in only one sample each.

Special mention must be made of two samples coming from the first floor of Room 11, both collected at excavation square 2a, namely samples Δ3(3) and Δ4(4). Though the pair was not characterized by the excavators as beams, however both consist solely of one species, *Olea europaea*, and contain large fragments. Additionally, in this excavation trench disintegrated wooden beams were unearthed which most probably belong to the second storey of the room. As these beams were excavated at the same depth as the samples taken, it is very likely that these are also derived from the beams supporting the floor of the second storey.

Concerning the samples recovered from the contents of the vessels unearthed in the first floor of Rooms 10 and 11 (Table V.23), these contained a small number of fragments. As in all previous cases, *Olea europaea* was present in all four vessels, while vessel Π2 contained also one fragment of *Juniperus* sp. and vessel Π4 a fragment of *Prunus amygdalus*.

| Akrotiri - Xeste 3 - Room Fills | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ground Floor | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Room | 3 | | | | | | 7 | | | | 14 | | | | | | | | | | | | | | | | |
| Taxa/Samples | Δ1 (2) | M8 | M9 | E87 (20) | E87 (21) | E87 (22) | 3 | 4 | Δ3 | E81 (9) | E87 (10) | E87 (4) | E87 (41) | E87 (55) | E87 (6) | E87 (8) | E87(45) | M2/L8 | M3/L1 | M5/L11 | M6/L10 | M9/L11 | M9/L5 | N | % | Ubiquity | Ubiquity % |
| *Arbutus* sp. | | | | 1 | | 1 | | | | | | | | | 2 | | | | | | | 1 | | 5 | 1.39 | 4 | 17.39 |
| cf. *Arbutus* sp. | | | | | | 1 | | | | | | | | | | | | | | | | | | 1 | 0.28 | 1 | 4.35 |
| *Cupressus sempervirens* | | | | 1 | | | | | | | | | | | | | | | 1 | | | | | 2 | 0.56 | 2 | 8.70 |
| Fabaceae | | | | | 1 | | | | | | | | | | 1 | | | | | | 1 | | | 3 | 0.83 | 3 | 13.04 |
| *Juniperus* sp. | | | 2 | 2 | | | 1 | | | 2 | | 1 | | | | 1 | | 3 | | | 1 | | | 13 | 3.61 | 8 | 34.78 |
| *Lonicera* sp. | | | | | | 3 | | | | | | | | | | | | | | | | | | 3 | 0.83 | 1 | 4.35 |
| *Olea europaea* | 1 | 2 | 13 | 22 | 28 | 13 | 5 | | | 8 | 1 | 9 | 1 | 8 | 5 | 10 | 1 | 24 | | | 25 | 17 | 27 | 220 | 61.11 | 19 | 82.61 |
| *Pinus* tp. *brutia/halepensis* | | 7 | | 5 | | 1 | | 7 | 1 | 1 | | | | 1 | | | | 4 | | | 1 | 4 | 3 | 35 | 9.72 | 11 | 47.83 |
| *Platanus orientalis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prunus amygdalus* | | | | | | | | | | | | | | | | 1 | | 1 | | | | 1 | | 3 | 0.83 | 3 | 13.04 |
| *Quercus* tp. deciduous | | | | 1 | | | | | | | | | | | | | | | | | | | | 1 | 0.28 | 1 | 4.35 |
| *Quercus* tp. evergreen | | | | | | | 4 | | | | | | 1 | | | | | 1 | | 11 | 1 | 5 | 8 | 31 | 8.61 | 7 | 30.43 |
| *Tamarix* sp. | | | 4 | | | | | | | | 1 | | | | 2 | | | 4 | | | 1 | 21 | 1 | 34 | 9.44 | 7 | 30.43 |
| cf. *Tamarix* sp. | | | | 1 | | | | | | | 1 | | | | | | | | | | | | | 2 | 0.56 | 2 | 8.70 |
| Angiosperm | | | | 2 | 1 | | | | | | | | | | | | | | | | 3 | | 1 | 7 | 1.94 | 4 | 17.39 |
| **TOTAL** | **1** | **9** | **19** | **35** | **30** | **19** | **10** | **7** | **1** | **11** | **3** | **10** | **2** | **9** | **10** | **12** | **1** | **37** | **1** | **11** | **33** | **49** | **40** | **360** | **100** | | |
| **Min No of taxa** | **1** | **2** | **3** | **7** | **2** | **4** | **3** | **1** | **1** | **3** | **2** | **2** | **2** | **2** | **4** | **3** | **1** | **6** | **1** | **1** | **6** | **5** | **4** | **11** | | | |

**Table V.22:** Anthracological results from contexts related to fills of the ground floor and first floor of rooms in Xeste 3, Akrotiri.

| Akrotiri - Xeste 3 - Room Fills (continuation) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First Floor | | | | | | | | | | | | | | |
| Room | 4 | | | 10 | 11 | | | | | | | N | % | Ubiquity | Ubiquity % |
| Taxa/Samples | 1 | 2 | 3 | Δ1 (1) | Δ3 (5) | Δ3 (6) | Δ3 (9) | Δ4 (1) | Δ3(3) | Δ4 (2) | Δ4 (4) | | | | |
| *Arbutus* sp. | | | | | | | | | | | | | | | |
| cf. *Arbutus* sp. | | | | | | | | | | | | | | | |
| *Cupressus sempervirens* | | | | | | | | | | | | | | | |
| Fabaceae | | | | | | | | | | | | | | | |
| *Juniperus* sp. | | | | | | | | | | | | | | | |
| *Lonicera* sp. | | | | | | | | | | | | | | | |
| *Olea europaea* | 10 | 10 | 8 | 20 | 2 | 1 | 7 | 12 | 50 | 11 | 50 | **181** | **97.31** | **11** | **100** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | 1 | | | | **1** | **0.54** | **1** | **9.09** |
| *Platanus orientalis* | | | 4 | | | | | | | | | **4** | **2.15** | **1** | **9.09** |
| *Prunus amygdalus* | | | | | | | | | | | | | | | |
| *Quercus* tp. deciduous | | | | | | | | | | | | | | | |
| *Quercus* tp. evergreen | | | | | | | | | | | | | | | |
| *Tamarix* sp. | | | | | | | | | | | | | | | |
| cf. *Tamarix* sp. | | | | | | | | | | | | | | | |
| Angiosperm | | | | | | | | | | | | | | | |
| **TOTAL** | **10** | **10** | **12** | **20** | **2** | **1** | **7** | **13** | **50** | **11** | **50** | **186** | **100** | | |
| **Min No of taxa** | **1** | **1** | **2** | **1** | **1** | **1** | **1** | **2** | **1** | **1** | **1** | **3** | | | |

**Table V.22 (continuation):** Anthracological results from contexts related to fills of the ground floor and first floor of rooms in Xeste 3, Akrotiri.

| Akrotiri - XESTE 3 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Context** | Vessels content | | | | | | | |
| **Room** | 10 | | | 11 | N | % | Ubiquity | Ubiquity % |
| **Taxa/Samples** | E81 (10) | E81 (12) | E81 (7) | Δ1 (8) | | | | |
| *Juniperus* sp. | 1 | | | | **1** | **1.72** | **1** | **25.0** |
| *Olea europaea* | 5 | 18 | 7 | 23 | **53** | **91.38** | **4** | **100** |
| cf. *Olea europaea* | | | | 2 | **2** | **3.45** | **1** | **25.0** |
| *Prunus amygdalus* | | | 1 | | **1** | **1.72** | **1** | **25.0** |
| Angiosperm | | 1 | | | **1** | **1.72** | **1** | **25.0** |
| **TOTAL** | **6** | **19** | **8** | **25** | **58** | **100** | | |
| **Min No of taxa** | **2** | **1** | **2** | **1** | **3** | | | |

**Table V.23:** Anthracological results from the content of vessels unearthed in Xeste 3.

| Akrotiri - House of the Ladies - Room Fills | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ground Floor | | | | | | | | | | | | | | | | | | | | | | |
| **Room** | 3 | | | 4 | | | | | | | 5 | 7 | | | | 8 | | 9 | | | | | |
| **Taxa/Samples** | I1 | E87 (22) | E87 (23) | E87 (3) | I2 | I6 | M7 | 1 | 2 | 3 | M53 | M3 | M7 | M8 | M10 | 4 | 5 | 1 | E87 (28) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Castanea sativa* | | 3 | | | | | | | | | | | | | | | | | | **3** | **1.21** | **1** | **5.26** |
| cf. *Castanea sativa* | | 1 | | | | | | | | | | | | | | | | | | **1** | **0.40** | **1** | **5.26** |
| Fabaceae | | | 1 | | | | | | | | | | | | | | | | | **1** | **0.40** | **1** | **5.26** |
| *Juniperus* sp. | | 3 | | | | 2 | | | | | | 1 | | | | | 1 | 4 | | **11** | **4.44** | **5** | **26.32** |
| Labiatae | | | | | | 1 | | | | | | | | | | | | | | **1** | **0.40** | **1** | **5.26** |
| *Lonicera* sp. | | | | | | | | | | | | | | | | | | | | | | | |
| Maloideae | | | | | | | | | | | | | | | | | | | 1 | **1** | **0.40** | **1** | **5.26** |
| *Olea europaea* | 7 | 18 | 19 | 2 | 7 | 20 | 2 | 2 | 6 | 10 | 8 | 1 | 3 | 2 | 7 | 20 | 2 | 4 | 12 | **152** | **61.29** | **19** | **100** |
| cf. *Olea europaea* | | | | | | 2 | | | | | | | | | | 1 | | | 1 | **4** | **1.61** | **3** | **15.79** |
| *Pinus* tp. *brutia/halepensis* | | | | | | 2 | | | | | | | | | 1 | 2 | | 4 | | **9** | **3.63** | **4** | **21.05** |
| *Prunus amygdalus* | | | 2 | | | | | | | | | | | | | | | | 1 | **3** | **1.21** | **2** | **10.53** |
| *Quercus* tp. deciduous | | | | | | 2 | | | | | 1 | | | | 17 | 13 | 4 | | | **37** | **14.92** | **5** | **26.32** |
| *Quercus* tp. evergreen | | 1 | | 2 | 1 | | | | | 6 | | | | | | | | 1 | | **11** | **4.44** | **5** | **26.32** |
| *Quercus* sp. | | 2 | 1 | | | | | | | | | | | | | | | 4 | | **7** | **2.82** | **3** | **15.79** |
| Angiosperm | | 2 | | | | | | | | | 1 | | | | | 2 | | 1 | 1 | **7** | **2.82** | **5** | **26.32** |
| **TOTAL** | **7** | **30** | **23** | **4** | **8** | **29** | **2** | **2** | **6** | **16** | **10** | **2** | **3** | **2** | **25** | **38** | **7** | **18** | **16** | **248** | **100** | | |
| **Min No of Taxa** | **1** | **5** | **4** | **2** | **2** | **5** | **1** | **1** | **1** | **2** | **2** | **2** | **1** | **1** | **3** | **3** | **3** | **5** | **3** | **10** | | | |

**Table V.24:** Anthracological results from contexts related to fills of the ground floor and first floor of rooms in the House of the Ladies, Akrotiri.

| Akrotiri - House of the Ladies - Room Fills (continuation) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | First floor | | | | | | | | | | | | |
| Room | 2 | | | | | 5 | | | | N | % | Ubiquity | Ubiquity % |
| Taxa/Samples | I7 | M10 | I1 | M5 | I4 | M2 | M3 | M5 | M20 | | | | |
| *Castanea sativa* | | | | | | | | | | | | | |
| cf. *Castanea sativa* | | | | | | | | | | | | | |
| Fabaceae | | | | | | 11 | | | | **11** | **13.75** | **1** | **8.33** |
| *Juniperus* sp. | | | | | | | | | | | | | |
| Labiatae | | | | | | | | | | | | | |
| *Lonicera* sp. | | | | | | | 1 | | | **1** | **1.25** | **1** | **8.33** |
| Maloideae | | | | | | | | | | | | | |
| *Olea europaea* | 2 | 1 | 23 | 9 | 9 | 1 | 3 | 5 | 1 | **54** | **67.50** | **9** | **75.00** |
| cf. *Olea europaea* | | | | | | | | | | | | | |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | | | | | |
| *Prunus amygdalus* | | | | 1 | | | | | | **1** | **1.25** | **1** | **8.33** |
| *Quercus* tp. deciduous | | | | 1 | | | | | | **1** | **1.25** | **1** | **8.33** |
| *Quercus* tp. evergreen | | | | 7 | | | 2 | | | **9** | **11.25** | **2** | **16.67** |
| *Quercus* sp. | | | | | | | | | | | | | |
| Angiosperm | | | | | | 2 | | 1 | | **3** | **3.75** | **2** | **16.67** |
| **TOTAL** | **2** | **1** | **23** | **18** | **9** | **14** | **6** | **6** | **1** | **80** | **100** | | |
| **Min No of Taxa** | **1** | **1** | **1** | **4** | **1** | **2** | **3** | **1** | **1** | **6** | | | |

**Table V.24 (continuation):** Anthracological results from contexts related to fills of the ground floor and first floor of rooms in the House of the Ladies, Akrotiri.

| Akrotiri - House of the Ladies | | | |
|---|---|---|---|
| Context | Vessel content | | |
| Room | 2 | N | % |
| Taxa/Sample | I10 | | |
| *Olea europaea* | 20 | **20** | **100** |
| **TOTAL** | **20** | | |
| **Min No of taxa** | **1** | **1** | |

**Table V.25:** Anthracological results from the content of a vessel unearthed in the House of the Ladies, Akrotiri.

As it can be seen in Table V.24, the taxa identified from the fills of both floors of the House of the Ladies presents a high level of variety. In both cases *Olea europaea* remained the taxon most frequently seen, being present in all samples. In the samples from the ground floor, other taxa with a high relative ubiquity were *Juniperus* sp., *Quercus* type deciduous, *Quercus* type evergreen, all present in 26.32% of the samples, and *Pinus* type *brutia/halepensis* in 21.05% of them. *Juniperus* sp. and *Pinus* type *brutia/halepensis* were not identified in any samples from the first floor of the building. There, the only other taxa present in more than one sample were *Quercus* type evergreen and *Tamarix* sp. Last but not least, in the only vessel from this building (Table V.25) whence wood charcoal macroremains were studied, *Olea europaea* was the only taxon identified.

Finally, in Pillar 67, only one sample was recovered from the destruction layer (layer 12) of Room 2 (earlier building): it contained five different taxa, from which *Olea* europaea and *Arbutus* sp. achieved the highest number of fragments (Table V.26). In contrast, the contents of the eight vessels studied from this layer yielded a higher variety of taxa. *Olea europaea* was that with the highest relative ubiquity (62.50%), as it was identified in the majority of the samples. Other taxa identified in a notable number of samples include Fabaceae, *Ficus carica*, *Juniperus* sp., *Pinus* type *brutia/halepensis*, and *Tamarix* sp, although the frequency of none of these taxa exceeds 6%.

| **Akrotiri - Shaft of New Pillar 67** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ROOM 2 - late MC/early LC I | | | | | | | | | | | | | |
| **Context** | Debris | Vessels content (floor of Room 2) | | | | | | | | | | | |
| **Layer** | 12 | | | | | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Taxa/Samples** | WF2000 (961) | WF2000 (965) | WF2000 (967) | WF2000 (974) | WF2000 (985) | WF2000 (986) | WF2000 (987) | WF2000 (988) | WF2001 (1020) | | | | |
| *Arbutus* sp. | 12 | | | | | 4 | | | | **4** | **4.35** | **1** | **12.50** |
| cf. *Arbutus* sp. | 2 | | | | | | | | | | | | |
| *Castanea sativa* | | | | | 1 | | | | | **1** | **1.09** | **1** | **12.50** |
| Fabaceae | 3 | | | | | 2 | | 1 | 1 | **4** | **4.35** | **3** | **37.50** |
| cf. Fabaceae | | | | | | | | | 1 | **1** | **1.09** | **1** | **12.50** |
| *Ficus carica* | | | | | 2 | 2 | | | 1 | **5** | **5.43** | **3** | **37.50** |
| *Juniperus* sp. | 3 | 1 | | | 2 | | | | 2 | **5** | **5.43** | **3** | **37.50** |
| *Olea europaea* | 24 | | | 1 | 31 | 6 | 6 | | 5 | **49** | **53.26** | **5** | **62.50** |
| cf. *Olea europaea* | 1 | | 1 | | 4 | 1 | | | | **6** | **6.52** | **3** | **37.50** |
| *Pinus* tp. *brutia/halepensis* | 2 | | | 1 | 2 | | | | 1 | **4** | **4.35** | **3** | **37.50** |
| *Platanus orientalis* | | | | | 1 | | | | | **1** | **1.09** | **1** | **12.50** |
| *Prunus amygdalus* | | | | 1 | | | | | | **1** | **1.09** | **1** | **12.50** |
| *Prunus* sp. | | | | | 1 | 1 | | | | **2** | **2.17** | **2** | **25.00** |
| *Quercus* tp. deciduous | | | | | 2 | | | | 1 | **3** | **3.26** | **2** | **25.00** |
| *Salix/Populus* | | | | | 1 | | | | | **1** | **1.09** | **1** | **12.50** |
| *Tamarix* sp. | | | 1 | | | 1 | | | 1 | **3** | **3.26** | **3** | **37.50** |
| Angiosperm | 1 | | | | 1 | 1 | | | | **2** | **2.17** | **2** | **25.00** |
| **TOTAL** | **48** | **1** | **2** | **3** | **48** | **18** | **6** | **1** | **13** | **92** | **100** | | |
| **Min No of taxa** | **5** | **1** | **2** | **3** | **9** | **6** | **1** | **1** | **7** | **13** | | | |

**Table V.26:** Anthracological results from the constructional debris of Room 2 and the content of the vessels unearthed just above it, excavated in Pillar 67, Akrotiri.

Comparing the samples of the floors (beams and structural elements) with those coming from the fill of the ground level of both Xeste 3 and the House of the Ladies, it can be suggested that both the diversity of taxa identified and their ubiquity are similar in both contexts. This is very likely to be the case because these fills actually contained parts of the collapsed floors. Palyvou (1999) mentions the frequent excavation of rooms, which had the form of shafts. These 'shafts' were formed after the collapse of the floors of the upper storeys under the weight of the volcanic materials entering through the doors and the windows. The damaged floors landed on top of a layer of soft pumice covering the ground level. During the excavation, on many occasions, in order to uncover the floor of the ground level, the layers of the first floor were removed first and then the excavation continued down through the layers of pumice and volcanic material below it (Palyvou, 1999). The majority of the samples related to the ground level fills are exactly from these collapsed higher deposits.

Worth noting is the distribution of the fill samples in the interior of the rooms. As it can be observed from Figures V.24 and V.25, these samples were collected from over a greater area of the rooms in comparison to those related to the floors proper, which mainly came from the corners or were excavated close to the walls. Holes associated with beams or branches were located more in the middle of the rooms, but in most cases they did not contain any wood charcoal fragments (or samples were not collected from there). Thus, it is probable that burnt beams were preserved in better condition closer to the walls and/or that, in some occasions, during the excavation it was not feasible to correlate the archaeobotanical samples taken from the middle of the rooms to the structural features of the floor.

In Room 3 of Xeste 3, no samples related to the floor of the upper storey were recovered, so no comparison can be made. Apart from sample Δ1 (2), which according to the excavation diary is from a burnt piece of wood, all other samples were collected from the deposits covering the north-west area of the Room. The constant presence of *Olea europaea* indicates that this species was used as building materials for the floor of the Room. In the case of taxa like *Juniperus* sp., *Pinus* type *brutia/*halepensis, *Cupressus sempervirens*, and *Quercus* type deciduous, it is very likely that they were used as part of the first layer of the floors of the upper storey. As with Room 3, samples collected from the fills of Room 7 are from the whole extent of the Room, with the only exception being sample Δ3, which was taken from the centre of the room some 0.40 m deeper than the *Pinus* type *brutia/halepensis* beam (samples Δ1 – Table V.15). Overall, the taxa present in the fill samples of the

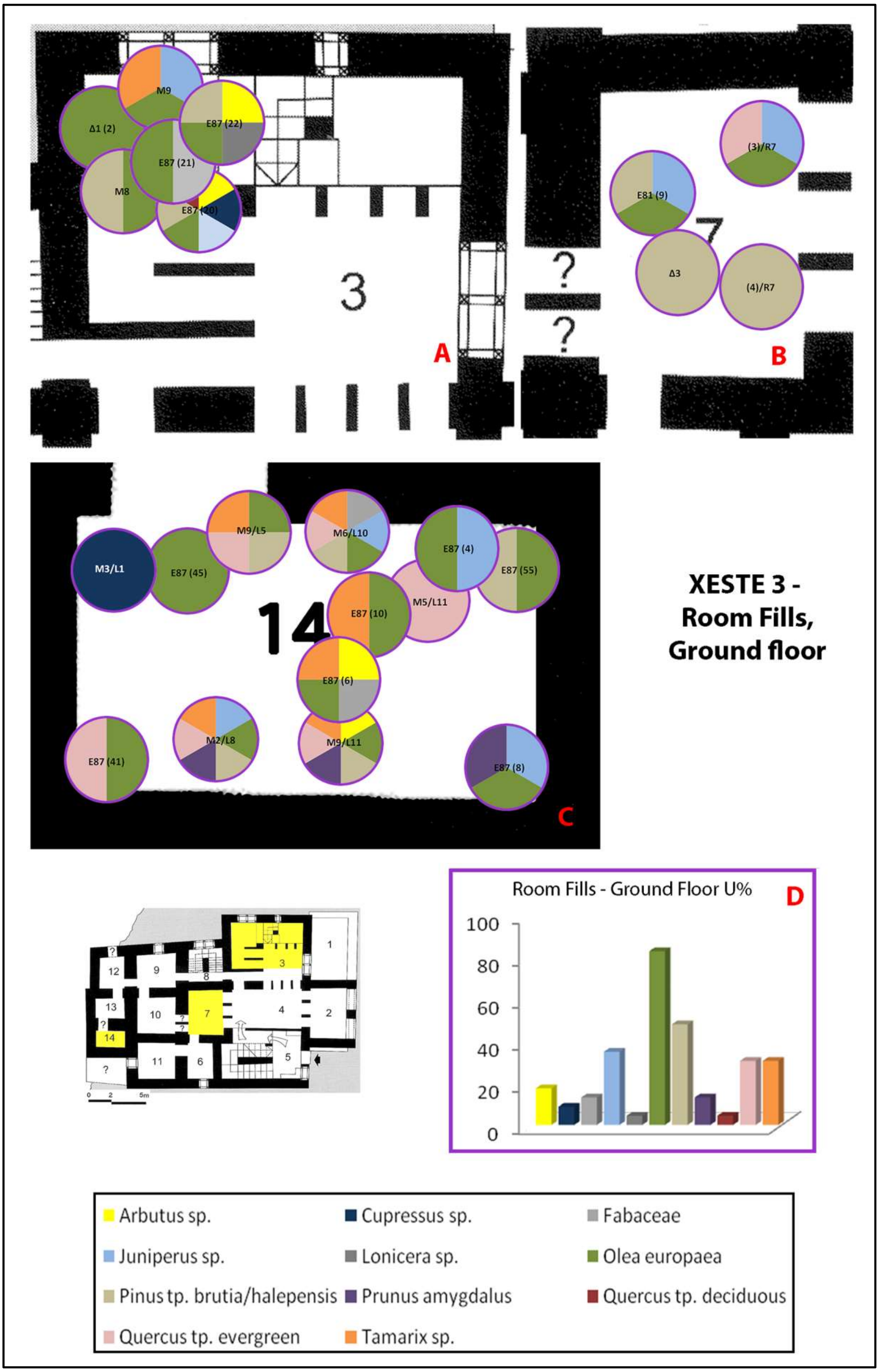



**Figure V.24:** Distribution of the samples characterized as fills recovered from the ground floor of Rooms (A) 3, (B) 7, and (C) 14 at Xeste 3, Akrotiri. The scale of the plan of the rooms is not proportional. Taxa characterized as *confer* are excluded. On the bottom right, (D) the bar chart presents the ubiquity percentage (U%) of the taxa of all three rooms.

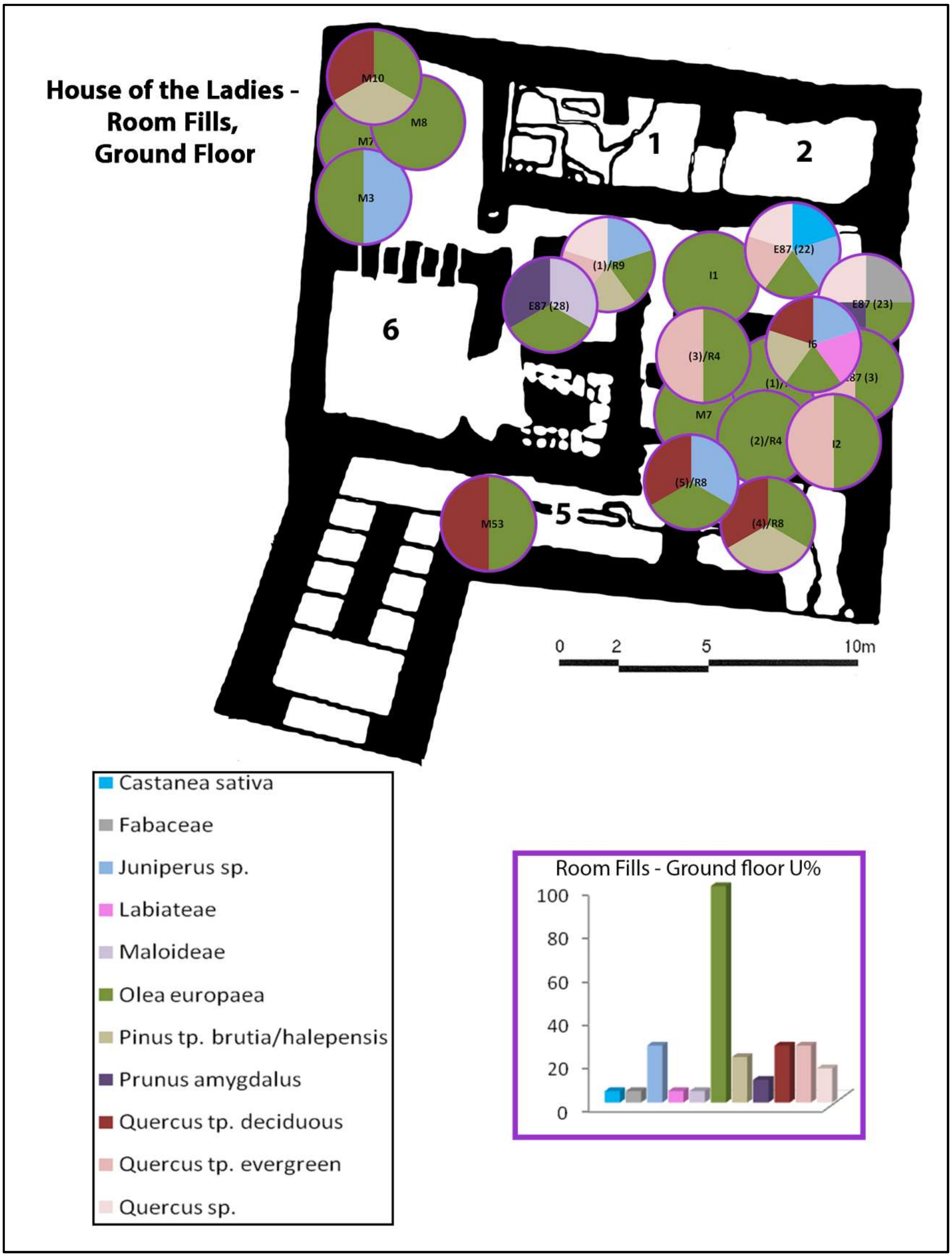



**Figure V.25:** Distribution of the samples characterized as fills recovered from the ground floor of the House of the Ladies, Akrotiri. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, (B) the bar chart presents the ubiquity percentage (U%) of the taxa of all rooms.

Room mirror those of the floor samples, although rare taxa like *Cupressus sempervirens* and *Castanea sativa* are absent. Finally, in Room 14, as in the case of Room 7, the samples coming from the floors and those coming from the fills are analogous. Interesting here is the presence of a high number of fragments of *Tamarix* sp. in sample M9/L11, a species absent from the samples related to the floor of this Room.

In the House of the Ladies, no samples related to the structure of the floor have been recovered from Room 3, however, the fact that *Olea europaea* is present in all samples coming from the fill might be an indication that the species was used too for the construction of its floor. Here, it is worthwhile also noting the presence of *Castanea sativa*, as it is the only time it is identified in relation to construction debris at the House of the Ladies. The identification of weakly curved fragments of this species might suggest its utilization as construction timber, although the very few fragments recovered make this still a little dubious. The high ubiquity of *Olea europaea* in the samples from Room 4 might be an indication of its use in the construction of the upper floor. In fact, the dimensions of *Olea* fragments in sample (2)/R4 are approximately 0.8x0.75x0.7 m, which suggests that they are from a sizeable log. This sample was collected from the centre of the Room, above the floor of the ground level. Consequently, although not stated at the excavation diary, it is very likely that *Olea* in this sample comprises a beam. From the rest of the rooms, worth noting is the presence of weakly curved fragments of *Quercus* type *deciduous* in samples M10 of Room 7, and (4)/R8 of Room 8. Although none of these samples is directly associated with beams, it is once again very likely that these samples represent beams of the aforementioned rooms. In more detail, the sample (4)/R8 was collected from the deposits excavated above the floor of the ground level of Room 8 at the northern end of the room, located just 0.10 m higher than sample M4 which comprised a beam. Thus, it is possible that in this deposit occur other taxa related to beams. Finally, the deposit from where sample M10 of Room 7 was collected was composed of pumice and sand. Its position above the slabbed stones of the floor of the ground level and among the vessels excavated at this level might indicate that the wood charcoal fragments found within it compose part of the construction of the upper floor. Beside sample M10, from the same layer and context come also samples M3, M7, and M8.

Comparing the fill samples of the first floor with those of the ground level in Xeste 3, it is evident that the number of taxa identified in the first case is very low, with only three taxa present (Table V.22). This might be related to the fact that these samples represent for the most part beams of the floor of the second storey or the roof, something which would explain the low number of taxa. According to the excavation diary, the samples at Room 11 were collected from the whole area of the Room, but mainly from excavation trench 2a where a concentration of wood charcoals was recovered. As mentioned above, samples Δ3 (3) and Δ4 (4) contain large fragments of *Olea europaea* which most probably belong to a beam. Thus, it is very probable that at least some of the beams of the second storey of the building were constructed from *Olea europaea* logs. In Room 4 of the same building, the samples recovered are composed of large charcoal fragments of *Olea europaea*, which exceed 0.8x0.75x0.8 m in dimension. According to the excavation diary, these samples were collected from the destruction layer excavated above the floor of the first storey. Consequently, it is likely that these big charcoal fragments are from beams of the roof, as in this area of the building no second floor existed. Exceptional is the recovery of fragments of *Platanus orientalis*, as this is the first time this species is identified in contexts related to buildings at Akrotiri. Although the fragments of *Platanus orientalis* were weakly curved and the species was identified in a sample clearly related to a destruction layer, because of its rare presence it is still not clear if it is related to constructional elements of the roof, or to a wooden object.

In contrast, the samples of the fill of the first floor of the House of the Ladies present a higher variety of taxa, although again *Olea europaea* is the species with the highest ubiquity (Table V.24). In Room 2, samples I7, M10, I1, and I4 were collected on the surface of the floor of the first storey, among vessels found there. These samples contained exclusively fragments of *Olea europaea*. As the floors of the second and the first storeys of this Room were found fallen one on top of the other with only approximately 0.40 m separating them, it is very likely that the charcoal fragments found in between the vessels of the first floor belong to the beams of the floor of the second storey of Room 2. The presence in sample M5 of *Quercus* type evergreen and *Prunus amygdalus*, two taxa which have been found systematically in contexts related to the floors of the buildings of Akrotiri, might suggest that this sample is also related to the aforementioned floor. Finally, in Room 5 the samples of the first floor were collected immediately under the surface-coating of the same floor, where cavities of beams were unearthed and thus, although they are not clearly related to construction elements of the floor at the excavation diary, it is yet most probable that they belong to its wooden skeleton.

Last but not least, in addition to the unique sample collected from the destruction layer of the MC Room, unearthed in Pillar 67 (Table V.26), the contents of eight vessels were also collected and analysed. Concerning the wood charcoal fragments found in the vessels, they are considered to be related to the fills which covered the room after its collapse: they will be discussed here along with the sample from the room. Overall, the samples are characterized by the high ubiquity of *Olea europaea*, which is present in five of the nine samples. This suggests that this species could have been utilized for the construction of the floor of the upper storey as part of the first layer, the second, or both. Other taxa which could have been used for the same end are *Pinus* type *brutia/halepensis*, *Juniperus* sp., *Quercus* type deciduous, and *Tamarix* sp. Exceptional is the recovery in sample WF2000 (961) of a high number of *Arbutus* sp. fragments, which might imply its utilization as a beam, something that was not observed in the samples from the LC I period. However, as the fragments were too small for an estimation of their curvature to take place, no further suggestions can be securely made. Finally, noteworthy here too is the identification of *Salix/Populus*, as this is the first time this taxon has been identified in contexts related to destruction layers of houses. The taxon was recovered from a sample (WF2000 (985)) taken from the interior of an MC closed vessel which also included other rare species like *Castanea sativa* and *Platanus orientalis*, also in very low quantities. These taxa could be part of the house carpentry or parts of wooden objects, as well as structural elements of the floor of the upper storey. In any case, as there is no other evidence from buildings of this period and no clear reference at the excavation diary for the presence of burnt beams, the above observation remains an assumption.

### 2.5 Reconstructing the lower layer of the floors of the upper storeys. The case of Rooms 7 and 14 of Xeste 3 and Room 5 of the House of the Ladies.

In an effort to clarify which taxa were used for the construction of the first layer of the floor of the upper storey of the houses of Akrotiri, the anthracological evidence from rooms 7 and 14 of Xeste 3, and room 5 of the House of the Ladies discussed earlier will be compared with the architectural data. These locations were initially chosen because they represent rooms of different dimensions. Room 7 of Xeste 3 is among the wider of the rooms studied, while Room 14 (Xeste 3) and Room 5 (House of the Ladies) are smaller. Studying samples from these areas is expected to reveal differences in the taxa employed when related to the width of the room to be covered. Secondly, from these rooms a high number of samples spread widely was analysed, which will allow comparisons to take place. To make suggestions on the taxa used, primarily the samples characterized as beams and structural elements will be used and then those samples coming from the fill of the rooms (but only those from a specific area and not throughout the rooms).

According to Palyvou (1999), for the main beams of the floors of the upper storey the builders used logs with diameters of approximately 0.12 m, placed some 0.60 m apart. The beams were positioned parallel to the shorter walls. In Xeste 3, the dimensions of Room 7 are 4 x 3.20 m and those of Room 14 are 3.35 x 1.60 m, approximately. From the above, it may be deduced that for both rooms four beams were needed. Regarding the length of these beams, in the case of Room 7 these should be approximately 3.80 m (as each one was embedded in the walls by almost 0.30 m at each end), while those of Room 14 would not need to exceed 2.20 m.

Starting with the first/lower layer of the floor of the upper storey in Room 7, information on the taxa used for the construction of the main beams based on the anthracological evidence are available for the three of the four beams. As can be seen in Figure V.26, data for the southernmost beam does not exist. The two beams in the middle were most probably made of *Pinus* type *brutia/halepensis* and *Olea europaea*, respectively. The location of sample Δ1, characterized by the excavators as a beam, coincides with the surmised location of the second beam from the south of the room under study. Thus, as this is composed exclusively by weak fragments of pine it is very likely that the beam was constructed of this taxon. The samples collected at the location where the third beam from the south would likely occur contain a greater number of taxa than the previous one. In sample E81(6), characterized as beam with

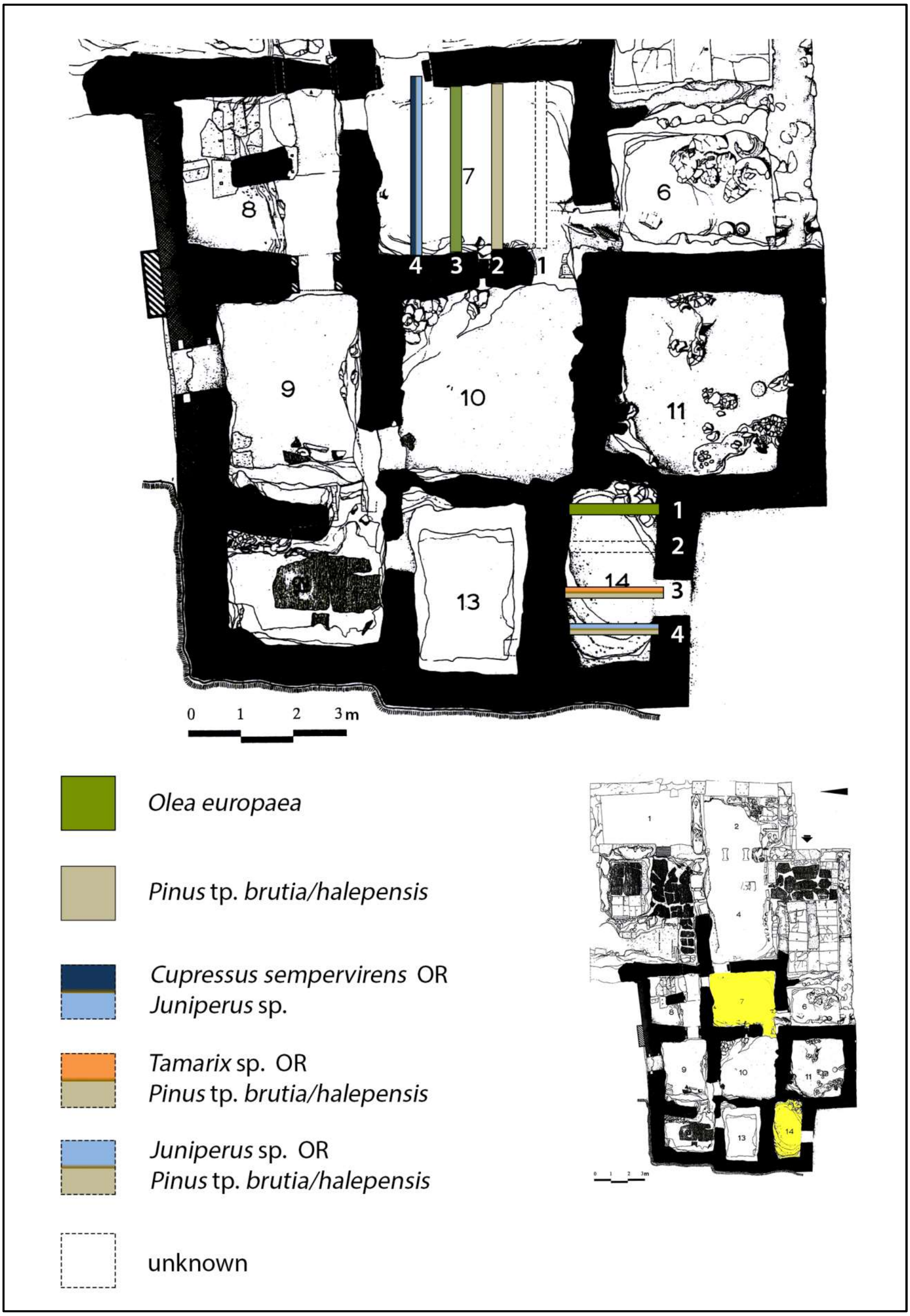



**Figure V.26:** Reconstruction of the beams supporting the upper floor of Rooms 7 and 14 of Xeste 3, based on anthracological and architectural evidence.

diameter of 0.14 m, were identified five taxa, among which are *Castanea sativa*, *Pinus* type *brutia/halepensis*, and *Juniperus* sp. All these trees could be used to provide the beam. However, the majority of these taxa are represented with fragments with moderate curvature (Fig. V.13), which suggests rather that they are from smaller branches. On the other hand, the great number of *Olea* fragments might argue that these are the remains of a bigger log. Toward this same end argues also sample E81(9) (Table V.22, Fig. V.27) which was collected from deeper down, but in the same area. Here the fragments of *Juniperus* sp. and *Pinus* type *brutia/halepensis* identified had also a moderate curvature.

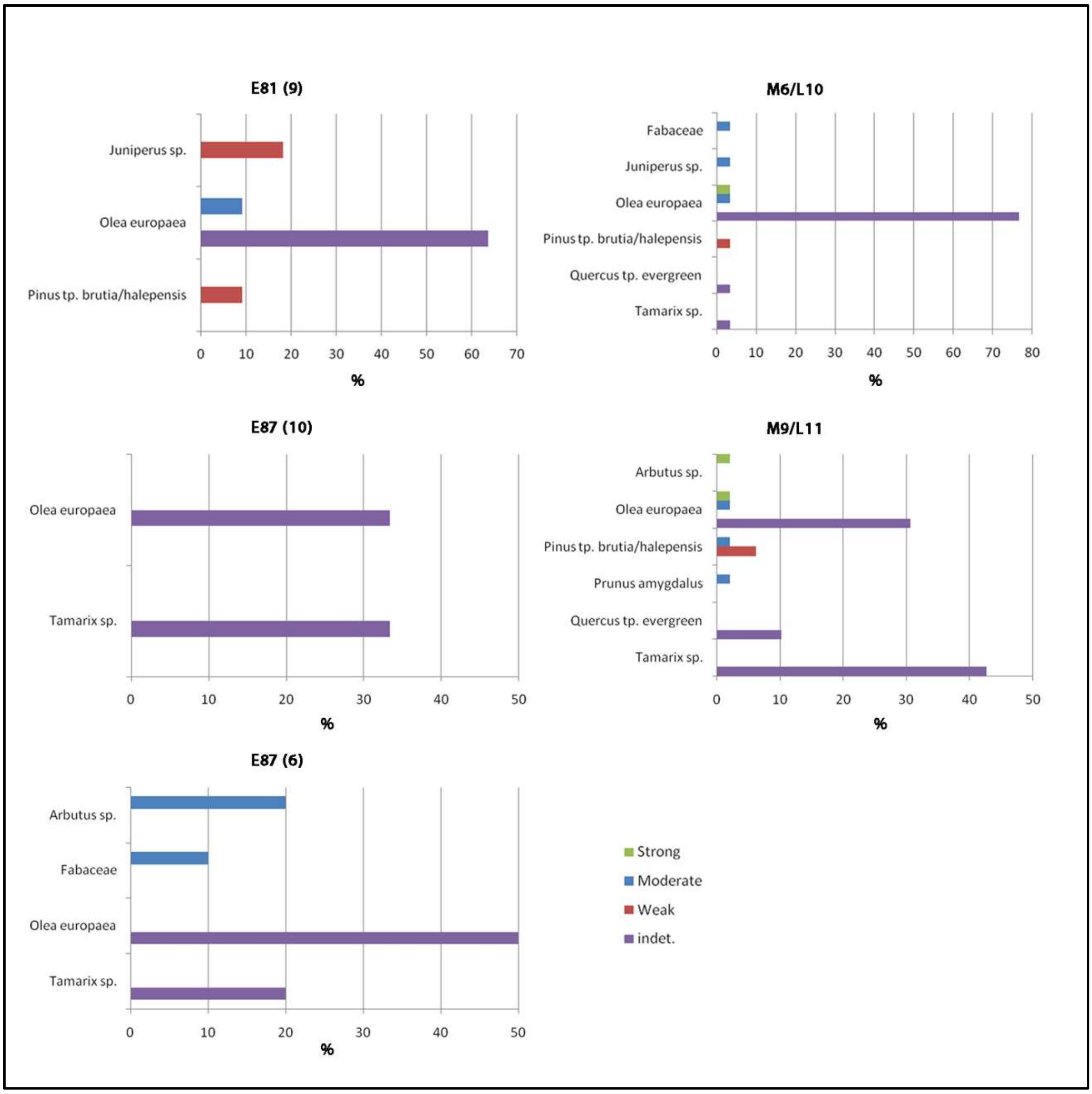



**Figure V.27:** Ring curvature of fragments recovered from samples characterized as fills or structural elements, coming from Rooms 7 and 14 of Xeste 3, Akrotiri

Finally, the northernmost beam could have been constructed from *Cupressus sempervirens* or *Juniperus* sp. At sample (1)/R7 coming from the second layer of the floor, these two taxa were represented by fragments with weak curvature (Fig. V.17). *Cupressus sempervirens* has been identified also in the construction of the second layer of the floor of the upper storey of Room 11, while *Juniperus* sp. was most probably used as a beam with Floor 2 of the house unearthed in Pillar 66Π. In the absence of other evidence, the taxon used for this beam cannot be defined more accurately.

For Room 14 of Xeste 3, only one sample was directly related to a main beam of the floor of the upper storey by the excavators. Sample M17/L11-12 is from the beam situated in the eastern part of the room. In this sample, the only fragment with a weak curvature is identified as *Castanea sativa*. Additionally, in sample M7/L3 from the structural elements of the floor, *Cupressus sempervirens* and *Juniperus* sp. were represented also by one fragment each with a weak curvature (Fig. V.17). The above data might suggest that this beam was of one of the aforementioned taxa, although their low number does not allow of more secure conclusions. Another option is that this beam was constructed by *Olea europaea*: this supposition may be supported first because this is the most represented taxon and secondly because the distance between the walls to be spanned was short, and thus even a pruned olive tree could produce branches of the requisite length.

For the second beam to the west no information is available. In the case of the remaining two beams, information is from samples characterized as structural elements or fills. More specifically, from the area where the third beam should have occurred (Fig. V.24), four samples were collected. Although all of them were characterized as coming from the fills of the room, the study of the curvature of the fragments identified along with their composition allow suggestions to be made in regard to the taxa possibly used for the beam. As can be seen in Figure V.27, the curvature of *Pinus* type *brutia/halepensis* from samples M9/L11 and M6/L10 is weak, which suggests that this taxon could have been used for its construction. Another chance is that *Tamarix* sp. was used for this beam, as this taxon was present in all four samples from this area. Sample M9/L11 contains a high number of *Tamarix* sp. fragments and it was taken from more or less the same depth as sample

M17/L11-12, which represents a beam of the floor. Although *Tamarix* sp. cannot grow as tall as *Pinus* type *brutia/halepensis*, its branches can grow longer than the 2.60 m required to span the distance between the south and north walls of Room 14. Finally, sample M6/L2 was collected in the area where the western beam should be. Although the sample is not related directly to the beam, but to the structural elements of the floor, the presence of weakly curved fragments of *Cupressus sempervirens*, *Juniperus* sp, and *Pinus* type *brutia/halepensis* leave open the chance that one of these taxa could have been used for its construction.

Finally, as has been already mentioned at section §V.2.1.1 for the construction of the upper floor of Room 5 in the House of the Ladies, beams were placed in parallel to the east-west axis of the room and on top of them at least one more beam oriented at right-angles to this axis was positioned. Based on the excavation diary, the beams of the lower layer were placed approximately 0.40 m apart. The dimensions of this room are approximately 6 x 2 m. This suggests that for the lower layer there were required nine beams with a diameter of 0.12 m and length up to 2.60 m. Additionally, following the description provided by Palyvou (1999) for the construction of the floors, for the upper layer there would be needed two beams with a length of up to 6.60 m. As already discussed, one of these two beams was most probably made of *Pinus* type *brutia/halepensis* as sample E87(65) collected where the northern of these beams would occur contained exclusively this taxon. Unfortunately, evidence for the other beam does not exist.

For the beams positioned in parallel to the east-west axis of the room, evidence exists for beams 1, 3, 6, 8 and 9 (see Figure V.28). Samples collected from the destruction of the floor and related to these beams suggest that for the most part they were constructed from *Olea europaea*. In this case, as for Room 14 of Xeste 3, the distance that had to be covered is small, and thus the use of branches of olive trees is possible. An exception is sample M28 which is composed of a greater number of taxa, in which *Pinus* type *brutia/halepensis* is represented by fragments with a weak curvature (see Fig. V.18). Consequently, it is very likely that the third beam from the west was constructed of pine, although *Tamarix* sp. could have been used for the same reason.


**Figure V.28:** Reconstruction of the beams supporting the upper floor of Room 5 of the House of the Ladies, based on anthracological and architectural evidence.

Taking all the above into account, as well as the results from the other samples related to beams from Xeste 3 and the House of the Ladies, it can be suggested that when long beams were required, the preferred taxon was *Pinus* type *brutia/halepensis*, although this was used also for shorter beams. Beside this, *Juniperus* sp., *Quercus* type deciduous, and most probably *Cupressus sempervirens* were also used for longer beams. For the shorter beams, *Olea europaea* was the taxon most used, while in one case from Room 14 of Xeste 3, *Tamarix* sp. was also utilized. *Olea europaea* in a few cases was used also for the construction of longer beams, as with the third beam from the south in Room 7 of Xeste 3, as well as the beam recovered in Room 6 of the same building (see §V.2.1.1).

## 2.6 Earth Floors

In the House of the Ladies, as well as Pillars 66Π and 67, there were excavated floors made of beaten earth. The charcoal fragments recovered in the samples from these contexts must have accumulated during the use of the houses. Additionally, it is very likely that these samples contain also fragments of the structural elements of the buildings or of wooden objects occurring in the houses, which fell on the floor during their destruction. More specifically, in the House of the Ladies were unearthed floors of beaten soil in Rooms 2, 4, 5 and 9. Additionally, under the floor of Room 4 was excavated a cavity which according to the excavation diary might be related to the foundation of the building. In the case of Pillar 66Π, two such floors were excavated. The first, dated to the MC period, comprised the floor of the ground level of the earlier building unearthed there, while the second constituted the clay coating of the floor of the second storey of the later building, da-

| **Akrotiri - House of the Ladies - Earth Floors** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Context** | Floor content | | | | | | | Cavity | | | | | |
| **Room** | 2 | | 4 | | 5 | 9 | | 4 | | | | | |
| **Taxa/Samples** | I13 | I16 | I7 | I8 | M19 | E87 (16) | I1 | E87 (7) | E87 (9) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | | | | 2 | | 1 | | 1 | | **4** | **2.72** | **3** | **33.3** |
| cf. *Arbutus* sp. | 1 | | | | | | | | | **1** | **0.68** | **1** | **11.1** |
| *Castanea sativa* | | | | | | 1 | | | | **1** | **0.68** | **1** | **11.1** |
| Fabaceae | | | 1 | | | 1 | | 1 | 1 | **4** | **2.72** | **4** | **44.4** |
| cf. *Ficus carica* | | | | | | | | | 1 | **1** | **0.68** | **1** | **11.1** |
| *Juniperus* sp. | | | 5 | 3 | | | | 14 | 9 | **31** | **21.1** | **4** | **44.4** |
| Labiatae | | | | | | | | 3 | | **3** | **2.04** | **1** | **11.1** |
| Maloideae | | 6 | | | | | | | | **6** | **4.08** | **1** | **11.1** |
| *Olea europaea* | 4 | 5 | 1 | 20 | | 7 | 1 | 14 | 1 | **53** | **36.1** | **8** | **88.9** |
| cf. *Olea europaea* | 1 | 1 | | | | | | | | **2** | **1.36** | **2** | **22.2** |
| *Pinus* tp. *brutia/halepensis* | | | 1 | | | | | 12 | 3 | **16** | **10.9** | **3** | **33.3** |
| *Prunus* sp. | 4 | | | | | | | | | **4** | **2.72** | **1** | **11.1** |
| cf. *Prunus* sp. | 6 | | | | | | | | | **6** | **4.08** | **1** | **11.1** |
| *Punica granatum* | | | | | | | | 1 | | **1** | **0.68** | **1** | **11.1** |
| *Quercus* tp. deciduous | | | 1 | | | | | 3 | | **4** | **2.72** | **2** | **22.2** |
| *Tamarix* sp. | 1 | | | | 4 | | | | 1 | **6** | **4.08** | **3** | **33.3** |
| Angiosperm | | 2 | | | | | | 1 | | **3** | **2.04** | **2** | **22.2** |
| Monocotyledones | | | | | | | | | 1 | **1** | **0.68** | **1** | **11.1** |
| **TOTAL** | **17** | **14** | **9** | **25** | **4** | **10** | **1** | **50** | **17** | **147** | **100** | | |
| **Min No of Taxa** | **4** | **2** | **5** | **3** | **1** | **4** | **1** | **8** | **6** | **13** | | | |

**Table V.27:** Anthracological results from contexts related to earth floors of the House of the Ladies, Akrotiri, and the content of the cavity unearthed under the floor of the ground level of Room 4 in the same building.

ted to the LC I period. Finally, in Pillar 67 were unearthed two superimposed earth floors, which were separated from each other by a sub-layer. Both floors belong to Room 2, the earlier of the two rooms excavated within this pillar. The earlier (lower) floor is dated to the late MC period, while the later (upper) belongs to late MC/early LC I.

As can be seen in Table V.27, from the House of the Ladies, *Olea europaea* is by far the most ubiquitous species – present in 88.9% of the samples. Other taxa with significant presences are Fabaceae, *Juniperus* sp., and to a lesser extent *Arbutus* sp., *Pinus* type *brutia/halepensis*, and *Tamarix* sp. The total number of taxa identified is rather large; it much resembles the numbers identified in the fills of the ground le-

| **Akrotiri - Shaft of New Pillar 66Π** | | | | | | |
|---|---|---|---|---|---|---|
| Floor of Lower Room - MC | | | | | | |
| **Context** | Floor 3 of beaten soil | | | | | |
| **Layer** | 21 | | | | | |
| **Taxa/Samples** | WF2001 (1047) | WF2001 (1215) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | 4 | | **4** | **1.35** | **1** | **50** |
| Fabaceae | 3 | 1 | **4** | **1.35** | **2** | **100** |
| *Juniperus* sp. | 8 | 11 | **19** | **6.40** | **2** | **100** |
| Maloideae | 2 | | **2** | **0.67** | **1** | **50** |
| *Olea europaea* | 100 | 106 | **206** | **69.36** | **2** | **100** |
| cf. *Olea europaea* | 7 | 4 | **11** | **3.70** | **2** | **100** |
| *Pinus* tp. *brutia/halepensis* | 7 | 4 | **11** | **3.70** | **2** | **100** |
| *Pinus* tp. *nigra/sylvestris* | 2 | | **2** | **0.67** | **1** | **50** |
| *Pistacia* sp. | 1 | | **1** | **0.34** | **1** | **50** |
| *Prunus amygdalus* | 2 | 6 | **8** | **2.69** | **2** | **100** |
| *Prunus* sp. | | 2 | **2** | **0.67** | **1** | **50** |
| cf. *Prunus* sp. | 1 | | **1** | **0.34** | **1** | **50** |
| *Punica granatum* | | 2 | **2** | **0.67** | **1** | **50** |
| *Quercus* tp. deciduous | 1 | 5 | **6** | **2.02** | **2** | **100** |
| *Quercus* tp. evergreen | | 2 | **2** | **0.67** | **1** | **50** |
| cf. *Quercus* sp. | | 1 | **1** | **0.34** | **1** | **50** |
| *Rhamnus/Phillyrea* | | 2 | **2** | **0.67** | **1** | **50** |
| *Salix/Populus* | 1 | | **1** | **0.34** | **1** | **50** |
| *Tamarix* sp. | 2 | 3 | **5** | **1.68** | **2** | **100** |
| Angiosperm | 6 | 1 | **7** | **2.36** | **2** | **100** |
| **TOTAL** | **147** | **150** | **297** | **100** | | |
| **Min No of taxa** | **13** | **11** | **16** | | | |

**Table V.28:** Anthracological results from contexts related to earth Floor 3 (MC building-Lower Room), unearthed in Pillar 66Π, Akrotiri.

| Akrotiri - Shaft of New Pillar 66Π | | | | | | |
|---|---|---|---|---|---|---|
| Floor of later Room - LC I | | | | | | |
| **Context** | Floor 2 of beaten soil | | | | | |
| **Layer** | 11 | | | | | |
| **Taxa/Sample** | WF2000 (908) | WF2001 (1063) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Cupressus sempervirens* | | 1 | **1** | **0.85** | 1 | 50.0 |
| Fabaceae | 1 | | **1** | **0.85** | 1 | 50.0 |
| *Fraxinus* sp. | 1 | | **1** | **0.85** | 1 | 50.0 |
| *Juniperus* sp. | | 3 | **3** | **2.56** | 1 | 50.0 |
| *Olea europaea* | 37 | 37 | **74** | **63.25** | 2 | 100 |
| cf. *Olea europaea* | 6 | 5 | **11** | **9.40** | 2 | 100 |
| *Prunus amygdalus* | 10 | | **10** | **8.55** | 1 | 50.0 |
| cf. *Prunus* sp. | 2 | 2 | **4** | **3.42** | 2 | 100 |
| *Quercus* tp. deciduous | | 1 | **1** | **0.85** | 1 | 50.0 |
| *Quercus* tp. evergreen | | 1 | **1** | **0.85** | 1 | 50.0 |
| *Quercus* sp. | | 1 | **1** | **0.85** | 1 | 50.0 |
| *Rhamnus/Phillyrea* | 1 | | **1** | **0.85** | 1 | 50.0 |
| Angiosperm | 4 | 4 | **8** | **6.84** | 2 | 100 |
| **TOTAL** | **62** | **55** | **117** | **100** | | |
| **Min No of taxa** | **6** | **6** | **10** | | | |

**Table V.29:** Anthracological results from contexts related to earth Floor 2 (LC I building), unearthed in Pillar 66Π, Akrotiri.

vel of the building. Worth noting is the recovery of the exogenous *Castanea sativa* and *Punica granatum*. Both species were identified in the cavity unearthed under the floor of Room 4. Unfortunately, the absence of secure archaeological evidence for the use of this cavity in the foundation process of the building does not allow one to argue that these two species were employed in some kind of ritual. *Castanea sativa* was also found in the fills in the building, and so its presence in the cavity might not be intentional.

In Pillar 66Π, the taxa identified in both samples coming from the earliest floor (Floor 3) (Table V.28) are Fabaceae, *Juniperus* sp., *Olea europaea*, *Pinus* tp. *brutia/halepensis*, *Prunus amygdalus*, *Quercus* type deciduous, and *Tamarix* sp. Apart from *Olea* which comprises 69.36% of the total number of fragments analyzed, only *Juniperus* sp. has a percentage higher than 5%. In this floor were identified also a few rare or exogenous taxa, namely, *Pinus* type *nigra/sylvestris*, *Punica granatum*, and *Salix/Populus*. All these taxa were present in only one of the two samples and their count percentage is lower than 1%. In Floor 2 (Table V.29), dated to the LC I period, the total number of taxa identified is lower, although as in the previous case *Olea europaea* is the dominant species: it is present in both samples and its count percentage is the highest (63.25%). The only other species with a count percentage higher than 5% is *Prunus amygdalus* (8.55%), although it is present only in one sample. In this assemblage, notable is the presence of *Cupressus sempervirens* and *Fraxinus* sp., with one fragment apiece.

| **Akrotiri - Shaft of New Pillar 67** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Floor of Room 2 and sub-layer - late MC/early LC I | | | | | | | | |
| **Context** | Floor of beaten soil | | Sub-layer of floor | | | | | |
| **Layer** | 13 | | 14 | | | | | |
| **Taxa/Sample** | WF2001 (1028) | WF2001 (1041) | WF2001 (1046) | WF2001 (1077) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Arbutus* sp. | 2 | 3 | | | **5** | **1.76** | **2** | **50.0** |
| *Castanea sativa* | | | 1 | | **1** | **0.35** | **1** | **25.0** |
| Cistaceae | 2 | | | | **2** | **0.70** | **1** | **25.0** |
| Fabaceae | 1 | 2 | 2 | 1 | **6** | **2.11** | **4** | **100** |
| *Ficus carica* | | 1 | | 6 | **7** | **2.46** | **2** | **50.0** |
| cf. *Ficus carica* | | 2 | | | **2** | **0.70** | **1** | **25.0** |
| *Juniperus* sp. | 1 | 1 | 1 | | **3** | **1.06** | **3** | **75.0** |
| Maloideae | | 1 | | | **1** | **0.35** | **1** | **25.0** |
| *Olea europaea* | 72 | 46 | 51 | 13 | **182** | **64.08** | **4** | **100** |
| cf. *Olea europaea* | 5 | 4 | 7 | 3 | **19** | **6.69** | **4** | **100** |
| *Pinus* tp. *brutia/halepensis* | | 1 | 4 | 1 | **6** | **2.11** | **3** | **75.0** |
| cf. *Pistacia* sp. | 1 | | | | **1** | **0.35** | **1** | **25.0** |
| *Platanus orientalis* | | 1 | 1 | | **2** | **0.70** | **2** | **50.0** |
| *Prunus amygdalus* | | 2 | 2 | 1 | **5** | **1.76** | **3** | **75.0** |
| *Prunus* sp. | | | 1 | 1 | **2** | **0.70** | **2** | **50.0** |
| *Punica granatum* | 1 | | | | **1** | **0.35** | **1** | **25.0** |
| *Quercus* tp. deciduous | 2 | | | | **2** | **0.70** | **1** | **25.0** |
| *Quercus* tp. evergreen | | | 16 | 1 | **17** | **5.99** | **2** | **50.0** |
| *Tamarix* sp. | | | 1 | | **1** | **0.35** | **1** | **25.0** |
| Angiosperm | 5 | 5 | 5 | 4 | **19** | **6.69** | **4** | **100** |
| **TOTAL** | **92** | **69** | **92** | **31** | **284** | **100** | | |
| **Min No of taxa** | **8** | **9** | **10** | **7** | **17** | | | |

**Table V.30:** Anthracological results from contexts related to the later earth floor of Room 2 (late MC/early LC I) and its sub-layer, unearthed in Pillar 67, Akrotiri.

From the floor of Room 2 (made of beaten soil) unearthed in Pillar 67, the samples taken from the later floor and its sub-layer will be considered together, as this sub-layer lies in between the two floors of Room 2 and the variety of taxa identified within it are similar with those of the floor above it. In the samples coming from the later floor of Room 2 and its sub-layer (Layers 13 and 14) (Table V.30), *Olea europaea* has the highest fragment count, as it comprises 64.08% of the fragments identified, and at the same time is present in all four samples. The only other species with a percentage higher than 5% is *Quercus* type evergreen, although this taxon is present in only two samples. Other taxa present in more than two samples are Fabaceae, *Juniperus* sp., *Pinus* type *brutia/halepensis*, and *Prunus amygdalus*. Exceptional here is the identification of rare taxa, namely *Castanea sativa, Platanus orientalis,* and *Punica granatum*. All these are present in the assemblage in percentages lower than 1%. In the earlier floor (Layer 15) (Table V.31), *Olea europaea* comprises 41.67% of the fragments identified. Beside *Olea*, the only other two taxa identified can be characterized as rare – they are *Pinus* type *nigra/sylvestris* and *Platanus orientalis*. Both species are present with but one fragment each.

| **Akrotiri - Shaft of New Pillar 67** | | | | | | |
|---|---|---|---|---|---|---|
| Earlier floor Room 2 -late MC | | | | | | |
| **Context** | Floor of beaten soil | | | | | |
| **Layer** | 15 | | | | | |
| **Taxa/Sample** | WF2001 (1029) | WF2001 (1060) | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| *Olea europaea* | 5 | | **5** | **41.67** | **1** | **50.0** |
| cf. *Olea europaea* | 2 | | **2** | **16.67** | **1** | **50.0** |
| *Pinus* tp. *nigra/sylvestris* | | 1 | **1** | **8.33** | **1** | **50.0** |
| *Platanus orientalis* | 1 | | **1** | **8.33** | **1** | **50.0** |
| Angiosperm | 2 | 1 | **3** | **25.00** | **2** | **100** |
| **TOTAL** | **10** | **2** | **12** | **100** | | |
| **No of taxa** | **2** | **1** | **3** | 3 | | |

**Table V.31:** Anthracological results from contexts related to the earlier floor made of beaten soil of Room 2 (late MC), unearthed in Pillar 67, Akrotiri.

Overall, the results obtained from samples related to earth floors are comparable with those coming from the interior of the houses. Thus, in those cases where comparisons can be made between the content of the floors and the fill of the rooms, as in the case of the House of the Ladies, Room 2 of Pillar 67, and the second storey of the house at Pillar 66Π, it is observed that in all such assemblages the most ubiquitous taxa are more or less the same, with *Olea europaea* coming first followed by *Juniperus* sp. and *Pinus* type *brutia/halepensis* in the case of the House of the Ladies, by Fabaceae, *Juniperus* sp. and *Pinus* type *brutia/halepensis* in the case of Pillar 67 and in Pillar 66Π by *Juniperus* sp. and *Prunus amygdalus*. In this last case, however, it is to be noted that the total number of taxa identified in the samples from Floor 2 (layer 15 - Table V.31) are less than those recovered from the clay coating of the same floor (layer 11 – Table V.29). This occurrence can be explained by the fact that in the first case the samples were taken from the structural elements of the floor, and thus the taxa represented comprise in their majority construction timbers, while in the second case the samples would also include, as mentioned above, the remains of wooden objects, structural beams of the roof, doors etc. and wood used as fuel.

In the samples recovered from the earth floors of the buildings of Akrotiri, the presence of rare or imported taxa is very frequent. From the floors dated to the mature or late MC period were identified *Castanea sativa*, *Pinus* type *nigra/sylvestris*, *Platanus orientalis*, *Punica granatum*, and *Salix/Populus*, while from the comparable LC I contexts were identified *Castanea sativa*, *Punica granatum*, *Cupressus sempervirens*, and *Fraxinus* sp. Concerning those taxa which are identified as rare but that could nonetheless grow on the island of Thera, like *Platanus orientalis* and *Salix/Populus*, these could have been used both as carpentry timber and as construction timber. Similarly and for the same ends might have been used *Castanea sativa*, *Pinus* type *nigra/sylvestris,* and *Fraxinus* sp, which are imported. *Platanus orientalis* and *Castanea sativa* have been identified already in the House of the Ladies, Xeste 3, and Room 2 of Pillar 67 in contexts related to destruction debris. However, the low number of fragments recovered makes it more likely that these species were parts of wooden objects rather than wooden beams. The low number of fragments of both species identified in the earth floors is in accordance with this hypothesis, as their use as fuel and especially so for *Castanea sativa*, an imported species, is not very probable.

*Pinus* type *nigra/sylvestris* fragments were recovered exclusively in earth floors dated to the mature (Pillar 66Π) or late MC period (Pillar 67). Both *Pinus nigra* and *Pinus sylvestris* provide wood of excellent quality for construction work, valued for its properties since antiquity (Gale and Cutler, 2000). However, the very low number of fragments identified does not justify the use of the taxon here for construction. The same applies to *Fraxinus* sp., which was identified in Floor 2 of the upper storey of the building of Pillar 66Π, dated to the LC I period. This is the only fragment identified in the assemblages coming from Akrotiri, and most likely it belongs to some wooden object rather than to fuelwood or construction timber. Lastly, *Cupressus sempervirens* identified at the same context as *Fraxinus* sp. might be part either of a wooden object, or it might be related to construction timber, as in the case of Xeste 3.

As mentioned already, the presence of wooden objects in the interior of the buildings studied is not testified to in the excavation diaries. However, the presence of wooden furniture and objects at the houses of the site is well known in other cases. During the excavation, plaster was used to fill imprints of wooden objects left after their disintegration in the volcanic ash (Palyvou, 2005). For example, thus were recovered the well-known bed found in situ in sector Delta-East, as well as the three beds found in an exterior area north of building IΓ, and a sculptured wooden table (Palyvou, 2005). Furthermore some of the daggers made of copper/bronze found in the West House seem to have had wooden hafts (Michailidou, 2007). In addition, imprints and remains of wooden baskets have been identified in the aforementioned building, as well as in some of the pillars excavated more recently and in other buildings on the site (Mpelogianni, 2008; Tzahili, 2007).

Evidence for the taxa used for the manufacture of these wooden items is scarce in Greece, as the environmental conditions rarely favor their preservation. An unusual example comes from Grave V of Circle A at Mycenae, where two tripod tables were recovered made of cypress (Muhly, 1996). A little information is also provided by the Pylos inscriptions in Linear B, dated to the later LB period. According to them the production of tables employed ebony (*Diospyros* sp.), yew (*Taxus bacata*), and boxwood (*Buxus* sp.) (Krzyszkowska, 1996).

### 2.7 Explaining the preference for specific taxa

The builders of Akrotiri incorporated a vast amount of wood in the infrastructure of the buildings to prevent them from collapsing. Additionally, as Palyvou (2005) mentions, the presence and manner of use of this amount of wood in the buildings of the site might well be related to the adaptation of construction techniques from Crete, where timber was easier to hand. Of course, as has been discussed earlier in this study (see §V.1.2) and as has been indicated in other previous anthracological (Asouti, 2003; Mavromati, 2017) and phytolith (Vlachopoulos and Zorzos, 2014) studies, the island of Thera was far from being bare of trees during the Bronze Age and thus the Therans took advantage of/developed construction techniques drawing largely on the raw materials they could find locally. As demonstrated repeatedly above, *Olea europaea* was the most widely used species in all contexts related to the construction of the buildings under study. In addition, *Pinus* type *brutia/halepensis*, *Juniperus* sp., *Quercus* type evergreen and deciduous, and *Prunus amygdalus* are frequently found in such assemblages.

*Olea europaea* has a high quality timber, as it is very tough and strong (Gale and Cutler, 2000) and it has a great strength in absorbing the stresses of bending and crushing, which makes it suitable building material. As was described in Chapter IV, the modulus of rupture and the crushing strength of *Olea* are actually greater than those of other species which are considered as good quality wood, such as varieties of the *Quercus* type deciduous, as well as *Cupressus sempervirens*, *Pinus* type *brutia/halepensis* and *P.* type *nigra/sylvestris*, and *Cedrus libani* (Elaieb et al., 2017; Guller, 2007; Meier, 2017; Voulgaridis and Passialis, 1995). Besides being strong, the wood of *Olea* is also resistant to insect attacks (Gale and Cutler, 2000), something that is considered a benefit when used as a structural element.

In Akrotiri, though, the systematic use of *Olea* in constructions must not be considered only as a result of its great quality, but mostly as the result of its abundant presence in the surroundings of the site. As was shown in Chapter V.1, *Olea* gradually replaced the *Pinus* forest existing on the island during the EC period and by the LC I period it predominated. Of course, this proliferation was a consequence of human actions, who favoured fruit-bearing taxa during these periods. Considering that for the construction of the floors of the upper storey there were needed long and thick logs, exceeding in some cases 4 m, which would have to come from mature trees, the presence of *Olea europaea* in relevant contexts might give an indication of how these were pruned in order to produce the long branches suitable for this purpose. For the beams used for the construction of the infrastructure of the walls, as well as in the door and pier-and-door partition frames, shorter beams and branches were employed which did not exceed 1.5 m in length (Palyvou, 1999).

The way olive trees were pruned in prehistory is not known, but the fact that during the LB period *Olea* trees were grown mainly for the production of oil (Valamoti et al., 2018) might give a hint on how they were treated. Fooks (2002) suggests that in those cases where no mechanical means are available for the gathering of the olives, then the trees must be pruned short so as to give the gatherers access to the branches. The practice of cutting the olive trees low and pruning them in a way so as give them maximum exposure to sunlight and ventilation is documented by Theophrastus (CP 3.7.4, 7), who lived during the late 4$^{th}$ – early 3$^{rd}$ centuries BCE. Today, olive trees are pruned with the view to increase the production of olives and to reduce the non-productive period. Usually, the cultivators cut the young trees (yearlings) off at the height of 0.60 to 0.80 metres or even lower at 0.30 to 0.40 metres above ground level so as to stimulate the growth of side shoots. After the tree has developed well, three to five shoots are chosen and the rest are removed. In that way the tree finally acquires an almost spherical shape (Petropoulou, 2014). Another way is to leave the tree to fully develop over the first five to six years, and only then to prune away any shoots that exceed 3 m in height, as well as any out-of-place branches (Petropoulou, 2014). Beside this general rule, however, nowadays there are cultivars which are left to grow to a greater height, like *Olea europaea var. craneomorpha* which is common on Corfu, where it can reach 20 m, and again *O. europaea var. rotunda* which grows in Amfissa, Arta, Pelion, and elsewhere and can reach 10 m. Other cultivars which can reach a height of over 10 m, if left undisturbed, are *O. europaea var. mastoids* which grows in the Peloponnese, Crete, Samos and Ikaria, and *O. europaea var. mamilaris* which grows in areas of Crete and the Peloponnese (Fooks, 2002).

Ethnographical data from Israel suggest the use of *Olea* timber as constructional material during the 19$^{th}$ century AD, in areas where a high number of olive orchards existed (Liphschitz et al., 1991). In fact, the authors link this use of the tree to its high presence in the surroundings of Galilee because of cultivation (Liphschitz et al., 1991, p. 448). Furthermore, Rackham and Moody (1996) attest to the use of the wood of *Olea* in modern-time Crete for house-carpentry, when other resources were lacking. Anthracological evidence from the broader area of the

Aegean comes from Crete, the Peloponnese, the Cycladic islands, and the Near East. In more detail, evidence from Crete comes from the EB settlement of Myrtos, where *Olea* branches and poles were identified in contexts related to the construction of roofs (Rackham, 1972). According to Rackham (1972), the presence of "degenerated" olive branches in the assemblage indicated the use of wood coming from pruned trees. To the same period are dated anthracological data coming from eight sites excavated at Israel, which also indicate the use of olive wood as timber (Liphschitz et al., 1991), while evidence from the same period from Dhaskalio, Keros indicate the use of branches of *Olea europaea* for the construction of the second layer of the roofs of the stone-built houses of the settlement (Ntinou, 2013a). Additionally, to the LB period are dated anthracological remains of *Olea* coming from Mochlos, which are also related to roof and wall destruction debris (Schoch and Ntinou, 2004). Finally, the shorter poles from the roof of Room 10 in the Lower Citadel of Tiryns, dated to the LB period, were most probably made of *Olea europaea* branches (Vetters et al., 2016).

Overall, then, in the majority of the studies mentioned above only the smaller parts of olive trees are present, such as branches and short poles, which might result from the regular pruning of trees after the collection of its fruits. The use only of branches and not of bigger logs is reasonable, especially considering the economic value of *Olea* during the LC period, when the species was highly valued for the extraction of oil (Margaritis, 2013; Valamoti et al., 2018). In view of all the above, the presence of long beams, even though but few, of *Olea europaea* wood at Xeste 3 and the House of the Ladies is worth noting. The use of *Olea* beams is only verified for the two buildings mentioned, as the excavation diaries do not provide precise evidence for such use for the rooms uncovered within Pillars 66Π and 67, while at the West House the fragments of *Olea europaea* identified were largely from branches, whose morphology linked them to coppiced or pruned trees (Bottema-MacGillavry, 2005) and not to beams. These beams in question might, of course, have been cut from wild olives, which would be present on the island, or derive from (parts of) unproductive trees. Another possibility to consider is that the use of *Olea* beams in the two buildings of Akrotiri studied here is linked to the fact that they were rebuilt after the catastrophic earthquake of the late MC/LC I period. According to Doumas (1983a), the inhabitants of Akrotiri rebuilt or repaired their houses rapidly after the destructive event, and so it may have seemed reasonable to them to use trees readily available. In any case, the use of large branches, even those exceeding 4 m in length, does not necessarily suggest the felling of a whole tree: olive trees are capable of producing branches of that size and with diameters analogous to those excavated at Akrotiri.

In conclusion, the use of sizeable olive branches mainly for the floors, but also in the wall and door frames of two buildings at Akrotiri, might reflect the low availability of other suitable taxa. In some cases, though, its use seems purposeful: e.g. the beam recovered at the base of the construction holding four pithoi on the first floor of Room 10 of Xeste 3, where *Olea* was most probably selected to take advantage of its properties. Finally, the presence of moderately curved olive fragments, some of which had also growth rings, in all buildings examined in this study, as well as the West House, indicates the use of pruned branches in the construction of the second layer of the floors. This fits with the use of olive wood in the other sites discussed above and reinforces the suggestion of Sarpaki (1987) that during the LC period olives were cultivated at Akrotiri.

Another broadleaf taxon used for the construction of floor beams and frames at Akrotiri is *Quercus* type deciduous. The values given in Chapter IV show that this taxon produces a great quality wood, durable and able to withstand great static and dynamic forces (see also: Gale and Cutler, 2000; Marguerie and Hunot, 2007). Additionally, its great height and its straight trunk makes it suitable for roofing timber. Usefully too, tyloses present in the heartwood of the taxon impedes the growth of fungi and contributes to the good preservation of the wood (Gale and Cutler, 2000; Marguerie and Hunot, 2007). The fact that in almost all fragments coming from the beam of Room 10 in the House of the Ladies tyloses was observed, suggests that the beam was cut from the heartwood of the tree.

At Akrotiri, the low presence of the taxon in assemblages related to the buildings of the settlement must be considered to reflect its general low occurrence in the environment of the island, given the dry conditions prevailing. In fact, the highest concentration of fragments of this taxon has been identified in the House of the Ladies, in contexts related to the construction of the floors, the walls, and the door of Room 8. In Xeste 3, the presence of the taxon is very low, while it is totally absent from the West House (Bottema-MacGillavry, 2005) and the rooms unearthed in Pillars 66Π and 67. Indications as to the use of this taxon for construction timber come from the LB settlement of Mochlos (LMIII) at Crete (Ntinou, 2011b), while the taxon might have also been used in a similar fashion in the EB site of Dhaskalio, Keros (Ntinou, 2013a). Finally, *Quercus* type deciduous was the main taxon utilized for the construction of the wooden frames of the houses in the latest phases of the settlement of Assiros Toumba in northern Greece (LHIII - phases 6 to 9) (Mavromati, 2010).

The quality of the wood of both *Pinus brutia* and *P. halepensis* is poorer than that of the broadleaf taxa described above, as their crushing strength and modulus of rupture are lower than those of *Olea europaea* and *Quercus* sp. (see Chapter IV). However, their abundance in the Mediterranean environments during antiquity led to their utilization for the construction of buildings and ships (Gale and Cutler, 2000). Besides being plentiful, their great height, which can exceed 25 m, and the fact that their trunks grow almost straight, make them suitable for construction work. Last but not least, the resin in *Pinus* deters fungi and insect attacks which could infect the tree (Phillips and Croteau, 1999) and so increases its quality as a timber.

*Pinus* type *brutia/halepensis* is present in all the buildings and rooms of Akrotiri studied here, although the highest occurrence is observed in Xeste 3, where it comes second after *Olea europaea* in terms of ubiquity. In the same building were excavated beams clearly made of this taxon, while it is also present in the samples coming from the door of Room 14 and the pier-and-door-partition of Room 7. Beams of *Pinus* type *brutia/halepensis* were recovered from the House of the Ladies too. At the West House, *Pinus* type *brutia/halepensis* is absent from the interior of the house, but it was identified in samples coming from the sewer (Bottema-MacGillavry, 2005). The rather low frequency of the taxon at the buildings of the site compared to its ubiquity is most probably related to the fact that it was mainly used for the construction of beams. Had it been systematically used for the construction of the second layer of the floor of the upper storeys, where the poles are thickly laid, then most likely more fragments would have survived. This preference for utilizing it for load-bearing, long beams is of course correlated to the great height pine trees can reach: they can easily span the distance between the walls at the buildings of Akrotiri, exceeding 4 m. The low availability of the taxon during the late MC and LC I periods, as indicated by the anthracological diagram, would force the builders of the houses to use it sparingly. Unfortunately the absence of evidence from earlier buildings does not allow comparison in regard to the extent of its use then.

The identification of moderately curved fragments of the taxon from the second layer of the floors of Xeste 3 and the House of the Ladies suggests the use of its branches at this layer. These smaller branches would be generated in the trimming down of the trunk after felling, in preparing the main beams. Evidence from Crete for the use of *Pinus* type *brutia/halepensis* as structural material comes from the archaeological site of Myrtos, where it was used also as a roof timber (Rackham, 1972), as well as from Mochlos where it was most probably used for the same purpose (Ntinou, 2011b).

Next to the taxa identified in contexts securely related to samples coming from beams, there are also taxa which were identified in samples coming from the second layer of the floor, as well as from the fill of the rooms. At times they might also comprise part of the lower beam layer of the floors. These taxa are *Quercus* type evergreen, *Juniperus* sp., and *Tamarix* sp. Additionally, rare taxa like *Cupressus sempervirens*, *Castanea sativa,* and *Platanus orientalis* were identified in contexts related to the structural elements of the houses: they will be discussed below. Finally, branches of *Prunus amygdalus* were used systematically in the second layer of the floors of Xeste 3 and the House of the Ladies.

The two evergreen types of *Quercus* which are very likely to be present at Akrotiri are *Q. coccifera* and *Q. ilex*. Of these two taxa, *Quercus coccifera* can grow up to 6 m in optimal conditions, although today it usually only manages 2 m. In contrast, *Q. ilex* can reach 28 m in height. The wood of the taxon is hard and dense (see Chapter IV): considering that the length of the beams at the houses of Akrotiri was more or less 4 m, both taxa referred to above could have been used. Fragments of evergreen oak were identified at Xeste 3, the House of the Ladies, and Pillar 66Π, but they were absent from the room excavated in Pillar 67, as well as the West House (Bottema-MacGillavry, 2005). At Myrtos, Crete the taxon was used along with *Olea europaea* for the construction of the poles of the buildings (Rackham, 1972).

*Juniperus sp.* is a high quality timber, hard, and durable, with a straight trunk, resistant to rot. At Akrotiri, the taxon has been identified in all buildings under study, as well as in the first floor of the West House (Bottema-MacGillavry, 2005).

Although it was not directly related to samples coming from beams in any of the buildings, the high percentage of weakly curved fragments identified in contexts related to the second layer of the floors, as well as the fill of the rooms, indicates that beams could have been fashioned from this. The utilization of the taxon for such has been suggested at the archaeological site of Dhaskalio, where most likely it comprised the main beams of the roof (Ntinou, 2013a). Additionally, in the case of Akrotiri, it is worth noting that *Juniperus* sp. occurred in almost all samples coming from contexts related to doors and windows. The taxon is present in one of the two doors studied here, as well as from the pier-and-door partition of Room 7 of Xeste 3, and finally it was the only taxon identified in relation to the window excavated at Pillar 66Π. Moreover, the taxon was also identified in the wall debris of Xeste 3. Considering that the wooden infrastructure in the walls was placed horizontally and that branches of the taxon were most probably used to fill the gap between the two horizontal beams of the lintel of the door referred above, then it is possible that the choice of the taxon for these positions was deliberate, being related to the high amount of force needed to break it.

*Tamarix* sp. and *Prunus amygdalus* are two taxa with a significant presence in the samples coming from the buildings. *Prunus amygdalus* was found in all buildings whence samples were analysed, as well as from the first floor of the West House, although there it is characterized as firewood (Bottema-MacGillavry, 2005). The species was identified in contexts related to the second layer of the floors, room fills, and the structural debris of walls. This, in addition to the presence of moderately curved fragments belonging to the species, might imply the use of pruned branches during the construction of the floors. The cultivation of *Prunus amygdalus* trees, at least during the Late Cycladic period at Akrotiri, is reinforced by the present results (§ V.1.1), as well as by the recovery of imprints of its fruit in a jar at the West House (Friedrich et al., 1990). Finally, *Tamarix* sp. was identified in contexts similar to the former species, but it was not present in the rooms excavated in Pillars 66Π and 67. The taxon could have been utilized for the construction of the second layer of the floor, as well as the wooden infrastructure of the walls; it may also be that some main beams were made from it.

Exceptional in the assemblages coming from the construction debris of the buildings is the recovery of *Cupressus sempervirens*, *Castanea sativa,* and *Platanus* *orientalis*. Starting with *Cupressus sempervirens,* it can be suggested that this taxon is not native to Akrotiri. *Cupressus sempervirens,* identified in the structural remains of Xeste 3, is considered a high quality timber. Additionally, its great height and its resistance to fungi and insect attacks make it an excellent building material. In this particular case, the presence of the taxon in a context characterized as a beam by the excavators (sample Δ3(7)/R11), as well as other cases where the fragments might belong to beams, hint at the importing of the taxon for use as a structural element.

*Castanea sativa* is another species which comprises good quality building material, mainly because it grows tall and it is resistant to fungi and insect attacks. The species was identified in contexts related to structural material in Xeste 3, the House of the Ladies, and the West House (Bottema-MacGillavry, 2005). However, the very few fragments identified in Xeste 3 and the House of the Ladies might show that these pieces belonged to wooden objects and were not derived from structural timbers. Unfortunately, comparison with the relevant data from the West House is not possible as neither a specific fragments count is given there, nor details on the contexts whence the specimens were recovered.

Finally, another exceptional discovery was that of fragments of *Platanus orientalis* in Xeste 3. The presence of the species in only one sample and in such low numbers might well be an indication that a wooden object is their source and not some structural member. This species could have been imported from Crete, mainland Greece or many other areas with which the Therans had commercial relations. It is also very likely that *Platanus orientalis* grew on the island of Thera in areas with fresh standing water, in formations with *Quercus* type deciduous, *Alnus* sp., and *Salix/Populus* (see §V.1.1).

One of the main characteristic all the aforementioned taxa have in common is that they are resistant to insects and fungi attacks, either by containing tyloses (Gale and Cutler, 2000; Marguerie and Hunot, 2007), suberin (Shigo, 1984), resin (Phillips and Croteau, 1999; Schweingruber et al., 2006) or phenol compounds (Del Río et al., 2000; Del Río et al., 2003). The percentage of infected fragments at Xeste 3 is only 3.8% of the total fragments recovered from the interior of the building, though in the House of the Ladies this rises to 8.62%. Those specimens infected by fungi were characterized where the presence of fungal filaments or cell-wall collapse could be observed, while in the only three occasions where insect degradation was detected, the fragments had tunnel-like openings caused by wood-boring insects. Although the origin of an infected wood in an anthracological assemblage cannot be known (Moskal-del Hoyo et al., 2010), the overall low percentages of infected fragments from Akrotiri suggest the use of healthy trees for the construction of the wooden parts of the buildings, which would ensure the longevity of the structure.

Last but not least, special attention must be paid to the importation of exogenous taxa on the island in the form of timber destined for construction. In order to verify this proposition, the size and the capacity of the ships, potentially transferring the logs, must be considered. The only evidence on such aspects comes from two shipwrecks, namely those of Uluburum and Cape Gelidonya in Turkey, both dated to the later LB period (Liphschitz and Pulak, 2007). The ship found at Uluburun had a length of approximately 15 m and capacity of 20 metric tons, while that found at Cape Gelidonya was smaller with length of 11.5 to 12.5 m and capacity of 10 metric tons (Monroe, 2007). Thus, taking into account the length of the ships and the fact that all exogenous taxa identified in this study can exceed 30 metres in height (see Chapter IV), it is obvious that these might have had to be cut at least in half in order to be transportable. Of course, as discussed previously, the length of the floor beams needed to cover the distance between the walls of the rooms did not exceed 5 m, meaning that any log longer than that would be appropriate for use. However, one must keep in mind that in neither of the two shipwrecks mentioned above were tree logs as raw material identified. This circumstance might be related to the perishable nature of wood in sea water. In Akrotiri the only exogenous species securely located as coming from a floor is that of *Cupressus sempervirens* (Room 11, Xeste 3), whose moderately curved fragments here suggest the use of a smaller branch and not a large log. However, the presence of weakly curved specimens of the same species in related contexts might indicate the import of large timber (logs) for building purposes. All told then, the import of timber, although it is possible, would benefit from further supporting evidence before being securely accepted.

# VI. Landscape, tree management, and uses of wood at Heraion, Samos

## 1. Landscape and tree management: Results and Discussion

At the archaeological site of Heraion, wood charcoal macroremains which could be used for the evaluation of the vegetation surrounding the settlement were recovered from deposits dated to the Chalcolithic, Early, and Middle Bronze periods, as well as to the Archaic and Roman periods.

Samples were collected from all three sectors excavated recently at Heraion, North of the Sacred Road. In total, there were analysed 940 wood charcoal macroremains coming from fill and dump deposits, representing 20 taxa. From the total of fragments analysed, 160 came from the sample recovered from the only Ch deposit (a dumped fill), 320 belong to assemblages dated to the EB period, 137 were recovered from the archaeological phases of the MB period, 23 from a sample collected from a fill dated to the Archaic period, and finally 300 wood charcoal fragments are coming from deposits of the Roman period. The taxa identified are: *Arbutus* sp., *Cupressus sempervirens*, *Erica* sp., Fabaceae, *Ficus carica*, *Fraxinus* sp., *Juniperus* sp., Maloideae, *Olea europaea*, *Pinus* tp. *brutia/halepensis*, *Pinus* tp. *nigra/sylvestris*, *Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Quercus* sp., *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, *Salix/Populus*, *Ulmus* sp., and *Ulmus/Celtis*.

### 1.1. The anthracological diagram

The anthracological diagram of Heraion is presented in Figure VI.1. As indicated in the Methodology chapter (Chapter III) the only anthracological assemblages with a sufficient number of fragments, from which palaeovegetation information can be extracted, are those dated to the EB, MB, and Roman periods. The number of wood charcoal macroremains dated to the Ch period (Table VI.1) could be characterized as sufficient, as the effort-return curve saturates before the first 50 fragments were analysed (see Fig. III.15). However, because these fragments came from only the one sample, the circumstances do not allow for any general extrapolation from what is there. Thus, with regard to the anthracological data from

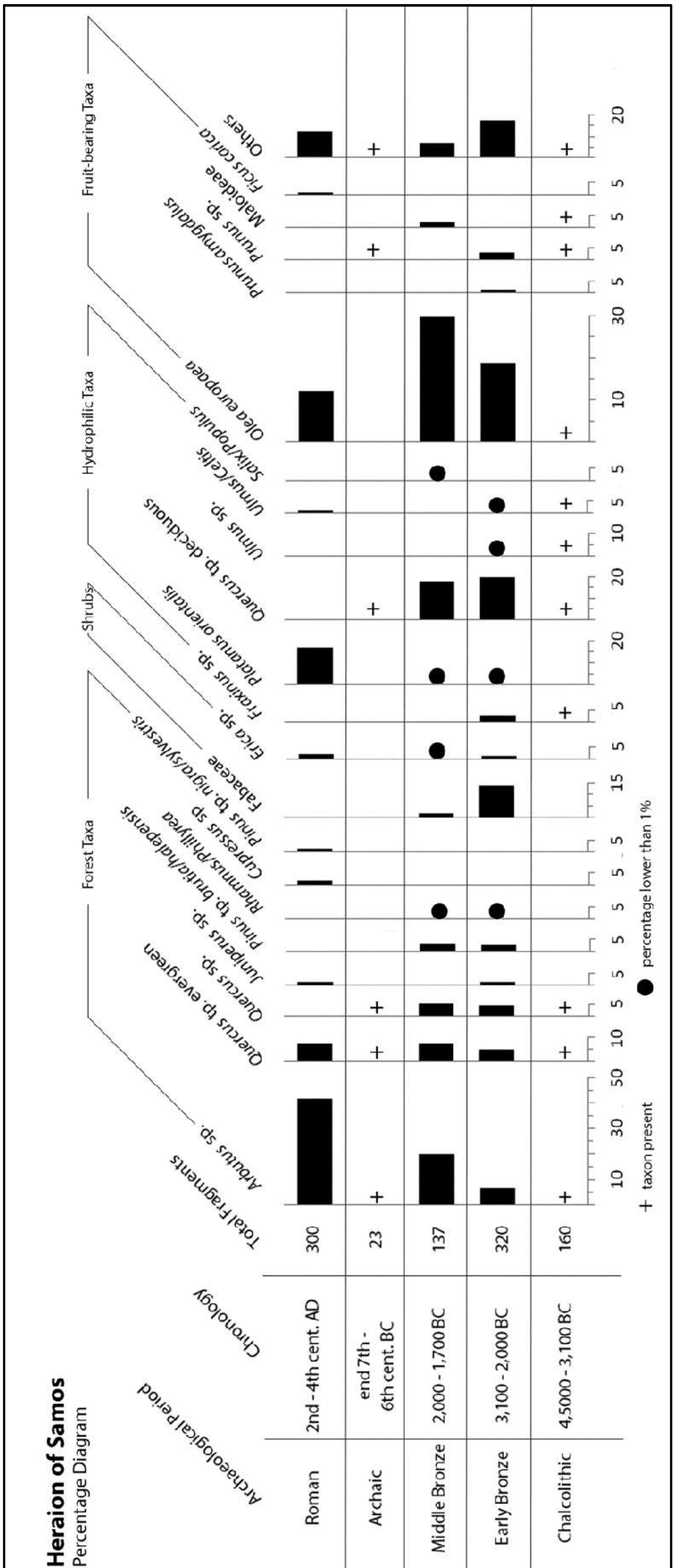



**Figure VI.1:** Anthracological diagram of Heraion. Taxa with percentage lower than 1% are presented with a dot. The taxa identified at the assemblages of Chalcolithic and Archaic period are marked with a cross, indicating which taxa were present.

| Heraion - Chalcolithic deposit | | |
|---|---|---|
| Cultural Period | Ch | |
| Sector | South | |
| Context | Dump | |
| Stratigr. Unit/Excav. Year | 58/11 | % |
| Taxa/Samples | 32164 | |
| *Arbutus* sp. | 3 | **1.91** |
| *Fraxinus* sp. | 21 | **13.38** |
| cf. *Fraxinus* sp. | 4 | **2.55** |
| Maloideae | 3 | **1.91** |
| *Olea europaea* | 76 | **48.41** |
| cf. *Olea europaea* | 9 | **5.73** |
| *Prunus* sp. | 2 | **1.27** |
| cf. *Prunus* sp. | 1 | **0.64** |
| *Quercus* tp. deciduous | 9 | **5.73** |
| *Quercus* tp. evergreen | 2 | **1.27** |
| *Quercus* sp. | 2 | **1.27** |
| cf. *Quercus* sp. | 1 | **0.64** |
| *Ulmus* sp. | 13 | **8.28** |
| *Ulmus/Celtis* | 7 | **4.46** |
| cf. *Ulmus/Celtis* | 2 | **1.27** |
| Angiosperm | 2 | **1.27** |
| **TOTAL** | **157** | **100** |
| **Min No of taxa** | **9** | |

**Table VI.1:** Anthracological results from the Chalcolithic deposit, excavated in the South Sector of the excavation at Heraion.

| Heraion - Archaic deposit | | |
|---|---|---|
| Cultural Period | Archaic | |
| Sector | Central | |
| Context | Deposit above HS12:86 & 12:102 - Fill | |
| Stratigr. Unit/Excav. Year | 29/12 | % |
| Taxa/Samples | 39058 | |
| *Arbutus* sp. | 7 | **77.78** |
| cf. *Arbutus* sp. | 2 | **22.22** |
| cf. *Olea europaea* | 2 | **22.22** |
| *Prunus* sp. | 1 | **11.11** |
| *Quercus* tp. deciduous | 3 | **33.33** |
| *Quercus* tp. evergreen | 1 | **11.11** |
| *Quercus* sp. | 3 | **33.33** |
| Angiosperm | 1 | **11.11** |
| **TOTAL** | **20** | **222** |
| **No of taxa** | **5** | |

**Table VI.2:** Anthracological results from the Archaic deposit, excavated in the Central Sector of the excavation at Heraion.

the aforementioned period as well as from the Archaic period where only 23 fragments were recovered (Table VI.2), whilst the results will be examined in the discussion, they cannot be considered conclusive.

The anthracological assemblage dated to the EB period (Table VI.3) contained the highest number of taxa when compared to the other periods studied here. During this phase, the dominant taxon is *Quercus* type deciduous, attaining percentages close to 20%, followed very closely by *Olea europaea*. The difference between these two taxa is less than 1%. The third co-dominant taxon is Fabaceae with its percentage getting up to 13.74%. During the MB period (Table VI.4), *Olea europaea* almost doubled its presence to 29.63%. At the same time, *Arbutus* sp.

| Heraion - Early Bronze Age deposits | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cultural Period** | EB II (EB1) | | | | | | | EB II (EB2/3) | EB II (EB3) | EB II (EB3/4) | | EB III | | | | | | | | | | |
| **Sector** | South | | | | | | | | | | | Central | | | | | | | | | | |
| **Context** | Open space between HS09:61 and HS09:66 | | | | | | | Foundation layer HS10:07 | Pavement SE of HS10:51 | Open space S of HS10:51 | | S of HS13:30 | | Open space W of HS13:30 | | | | | N | % | Ubiquity | Ubiquity % |
| **Stratigr. Unit/Excav. Year** | 73/09 | | | | 94/09 | 98/09 | 102/09 | 86/10 | 98/10 | 115/10 | | 69/13 | | 60/13 | 66/13 | | | | | | | |
| **Taxa/Samples** | 35 | 36 | 37 | 39 | 42 | 48 | 49 | 25249 | 25831 | 26080 | 26081 | 48127 | 48149 | 46884 | 47601 | 47603 | 47456 | 47482 | | | | |
| *Arbutus* sp. | | | | | | | | | | | | 2 | 7 | | 1 | 4 | 6 | | **20** | **6.39** | **5** | **27.78** |
| *Erica* sp. | | | | | | | | | | | | 1 | | | 1 | 1 | | 1 | **4** | **1.28** | **4** | **22.22** |
| cf. *Erica* sp. | | | | | | | | | | | | | | | 1 | | | | **1** | **0.32** | **1** | **5.56** |
| Fabaceae | | | | | | | | 1 | | | | 11 | 14 | | 6 | 9 | 2 | | **43** | **13.74** | **6** | **33.33** |
| cf. Fabaceae | | | | | | | | | | | | | 1 | | 1 | 1 | | | **3** | **0.96** | **3** | **16.67** |
| *Fraxinus* sp. | | | | | 1 | | | | | 3 | 3 | 1 | | | | | | 1 | **9** | **2.88** | **5** | **27.78** |
| cf. *Fraxinus* sp. | | | | | | | | | | | | | | 1 | | | | | **1** | **0.32** | **1** | **5.56** |
| *Juniperus* sp. | | | | | | | 1 | | | | | 1 | 1 | | | | 1 | | **4** | **1.28** | **4** | **22.22** |
| *Olea europaea* | | | 1 | 1 | | | | 4 | 1 | 5 | | | 4 | 2 | 7 | 13 | 8 | 13 | **59** | **18.85** | **11** | **61.11** |
| cf. *Olea europaea* | | | | | 1 | | 1 | 1 | | | | | 1 | | 1 | 2 | 2 | 1 | **10** | **3.19** | **8** | **44.44** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | | | | | | | 2 | 6 | | | **8** | **2.56** | **2** | **11.11** |
| *Platanus orientalis* | | | | | 1 | | | | | | | | | | | | | | **1** | **0.32** | **1** | **5.56** |
| *Prunus amygdalus* | | | | 1 | | | | | | | | | 1 | | | 2 | | | **4** | **1.28** | **3** | **16.67** |
| *Prunus* sp. | | | | | 1 | | | | | | | 4 | 1 | | 2 | | | 2 | **10** | **3.19** | **5** | **27.78** |
| cf. *Prunus* sp. | 1 | | | | | | | 8 | | | | | | | | 1 | | | **10** | **3.19** | **3** | **16.67** |
| *Quercus* tp. deciduous | | | | | | | | | | | 2 | 7 | 36 | 1 | 2 | 4 | 8 | 2 | **62** | **19.81** | **8** | **44.44** |
| *Quercus* tp. evergreen | | | | 1 | | | | | | | | 1 | 5 | 1 | 1 | 4 | 2 | | **15** | **4.79** | **7** | **38.89** |
| *Quercus* sp. | | | | | | | | 2 | | 1 | 1 | 2 | 2 | 2 | 2 | 1 | | | **13** | **4.15** | **8** | **44.44** |
| cf. *Quercus* sp. | | | | 1 | | | | | | | | | | | 1 | 2 | | 1 | **5** | **1.60** | **4** | **22.22** |
| *Rhamnus/Phillyrea* | | | | | | | | 1 | | | | 1 | | | | | | | **2** | **0.64** | **2** | **11.11** |
| *Ulmus* sp. | | | | | | | | | | | | | | | | | 1 | | **1** | **0.32** | **1** | **5.56** |
| cf. *Ulmus* sp. | | | | 1 | | | | | | | | | | | | | | | **1** | **0.32** | **1** | **5.56** |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | 3 | | | **3** | **0.96** | **1** | **5.56** |
| Angiosperm | | 1 | | | | 1 | | 3 | | | 1 | 1 | 5 | | | 8 | 3 | 1 | **24** | **7.67** | **9** | **50.00** |
| **TOTAL** | **1** | **1** | **1** | **5** | **4** | **1** | **2** | **20** | **1** | **9** | **7** | **32** | **78** | **7** | **28** | **61** | **33** | **22** | **313** | **100** | | |
| **Min No of taxa** | **1** | **0** | **1** | **4** | **4** | **0** | **2** | **5** | **1** | **3** | **3** | **9** | **8** | **4** | **8** | **10** | **7** | **5** | **15** | | | |

**Table VI.3:** Anthracological results from Early Bronze Age deposits, excavated in the South and Central Sectors of the excavation at Heraion.

| Heraion- Middle Bronze Age deposits | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cultural period** | MB1a | | | | MB3/4 | | MB final | | | MB | | | | |
| **Sector** | North | North | | | North | | Central | | | North | | | | |
| **Context** | Along HS11:47 - concentration of stones | HS11:47 - Fill of the curvilinear construction | | | Foundation of HS12:62 - Fill | Beneath Foundation of HS12:62 - Fill | Beneath Foundation of HS13:10 - Fill | HS13:10 - Beneath unit 29 - Fill | | HS12:87 - Beneath unit 89 - Fill | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/ Excav. Year** | 34/12 | 27/12 | | | 81/12 | 83/12 | 29/13 | 34/13 | | 100/12 | | | | |
| **Taxa/Samples** | 39056 | 39530 | 39652 | 41180 | 40496 | 40654 | 44900 | 45165 | 45227 | 41572 | | | | |
| *Arbutus* sp. | | 1 | 1 | 3 | | 5 | | 1 | | 16 | **27** | **20.00** | **6** | **60.00** |
| cf. *Arbutus* sp. | | | | | | | | 1 | | | **1** | **0.74** | **1** | **10.00** |
| *Erica* sp. | | | | | 1 | | | | | | **1** | **0.74** | **1** | **10.00** |
| Fabaceae | | | | | | | | | | 2 | **2** | **1.48** | **1** | **10.00** |
| Maloideae | | | | | | | | | | 3 | **3** | **2.22** | **1** | **10.00** |
| cf. Maloideae | | | | | | | | | | 1 | **1** | **0.74** | **1** | **10.00** |
| *Olea europaea* | | | 3 | 6 | | | 11 | 7 | 7 | 6 | **40** | **29.63** | **6** | **60.00** |
| cf. *Olea europaea* | | | | | | | | 2 | | | **2** | **1.48** | **1** | **10.00** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | 3 | 1 | **4** | **2.96** | **2** | **20.00** |
| *Platanus orientalis* | | | | | | | | | | 1 | **1** | **0.74** | **1** | **10.00** |
| *Quercus* tp. deciduous | 1 | | 1 | 1 | | | | 7 | 6 | 8 | **24** | **17.78** | **6** | **60.00** |
| *Quercus* tp. evergreen | | | | 1 | 2 | 1 | | 3 | 2 | 1 | **10** | **7.41** | **6** | **60.00** |
| *Quercus* sp. | | | | | | 1 | | 3 | 2 | 1 | **7** | **5.19** | **4** | **40.00** |
| cf. *Quercus* sp. | | | | 1 | | | | 1 | 2 | | **4** | **2.96** | **3** | **30.00** |
| *Rhamnus/Philyrea* | | | | | | | | | 1 | | **1** | **0.74** | **1** | **10.00** |
| *Salix/Populus* | | | | | | | | | | 2 | **2** | **1.48** | **1** | **10.00** |
| cf. *Salix/Populus* | | | | | | | | | | 1 | **1** | **0.74** | **1** | **10.00** |
| Angiosperm | 1 | | | | | | 1 | 2 | | | **4** | **2.96** | **3** | **30.00** |
| **TOTAL** | **2** | **1** | **5** | **12** | **3** | **7** | **12** | **27** | **23** | **43** | **135** | **100** | | |
| **Min No of taxa** | **1** | **1** | **3** | **4** | **2** | **3** | **1** | **4** | **5** | **9** | **11** | | | |

**Table VI.4:** Anthracological results from Middle Bronze Age deposits, excavated in the North and Central Sectors of the excavation at Heraion.

(20%) increased and it became the co-dominant taxon, along with *Quercus* type deciduous whose percentages fell slightly.

During the EB and MB periods, the inhabitants of Heraion were exploring the diverse vegetation in the surroundings of the site to cover their need for fuel. The presence of *Quercus* type deciduous in high quantities, along with other moisture demanding taxa, is indicative of the vegetation prevailing by the banks of the Imvrassos River. *Fraxinus* sp., *Ulmus* sp., and *Quercus* type deciduous would form a mixed riparian forest close to the banks of the river, as these broadleaf riparian taxa prefer deeper soil but they cannot withstand long periods of flooding. Moreover, *Platanus orientalis* and *Salix/Populus* would occupy the areas even closer to the banks of the river, where looser gravelly sediments would occur (Dafis, 2010).

The recovery of wood charcoal fragments of *Quercus* type evergreen and *Pinus* type *brutia/halepensis* would suggest the presence of mixed evergreen woodland in proximity to the site, probably at the lacustrine deposits to its west (Institute of Geological and Mining Research, 1979). *Arbutus* sp., *Juniperus* sp., *Prunus* sp., Maloideae, *Rhamnus/Phillyrea*, Fabaceae, and *Erica* sp. could also be part of this latter formation. In fact the identification of heliophilous taxa like *Rhamnus/Phillyrea*, Maloideae, Fabaceae, and *Prunus* sp. imply an openness to this woodland. The low percentages of *Pinus* type *brutia/halepensis* might be an indication of how few in number were these trees in the vegetation close to the site, or it might be related to selection criteria exercised by the community.

*Olea europaea*, *Prunus amygdalus*, and Maloideae were the fruit-bearing taxa identified in the anthracological assemblage of the EB period. Concerning *Olea*, its recovery in the Ch deposit (Table VI.1) suggests that the species was present on the island from an early period. The significant percentage of the species during EB and MB periods, along with the recording of growth rings, attests to the management of these trees. The increase in the percentage of *Olea* during the MB period indicates a concomitant intensification of its use. The increase in percentages of *Arbutus* sp. and *Quercus* type evergreen suggests the opening up too of the mixed woodland. For the rest of the fruit-bearing taxa, the low percentage might indicate that they were not regularly managed, but they were exploited periodically as firewood and probably for their fruits.

The Roman period sees a reduction in the number of taxa identified, compared to the earlier phases of the site (Table VI.5). As the anthracological diagram reveals, the variety of fruit-bearing and hydrophilic taxa is very limited - with but two and three identified, respectively. In contrast, the forest taxa enjoy a greater variety. During this period *Arbutus* sp. dominates the assemblage, while *Platanus orientalis* and *Olea europaea* could be characterised as co-dominant with percentages close to 15%. Additionally, from this deposit there was recovered *Pinus* type *nigra/sylvestris* in very low percentage. *Cupressus sempervirens* is identified for the first time at the assemblages of the site, although in percentage lower than 5%.

| Heraion - Roman deposits | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cultural Period** | Roman | | | | | | | | | |
| **Sector** | North | | | North | North | | | | | |
| **Context** | Fills North of HS10:25 | | | Fill South of HS10:62 | Fills under foundation of HS10:25 & HS10:38 | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/Excav. Year** | 35/10 | 100/10 | 108/10 | 94/10 | 34/11 | 17/11 | | | | |
| **Taxa/Samples** | 23453 | 25836 | 25951 | 25279 | 30870 | 30509 | | | | |
| *Arbutus* sp. | 40 | 4 | 1 | 5 | 12 | 60 | **122** | **41.92** | **6** | **100** |
| cf. *Arbutus* sp. | 1 | 2 | | | | 1 | **4** | **1.37** | **3** | **50.00** |
| *Cupressus sempervirens* | 3 | | 1 | | | 1 | **5** | **1.72** | **3** | **50.00** |
| *Erica* sp. | | | | | | 6 | **6** | **2.06** | **1** | **16.67** |
| *Ficus carica* | 2 | | | 1 | | | **3** | **1.03** | **2** | **33.33** |
| cf. *Ficus carica* | 2 | | | | | | **2** | **0.69** | **1** | **16.67** |
| *Fraxinus* sp. | | | | 1 | | | **1** | **0.34** | **1** | **16.67** |
| *Juniperus* sp. | | 3 | | 1 | | | **4** | **1.37** | **2** | **33.33** |
| *Olea europaea* | 25 | | | 6 | 1 | 3 | **35** | **12.03** | **4** | **66.67** |
| cf. *Olea europaea* | 8 | | | | | | **8** | **2.75** | **1** | **16.67** |
| *Pinus* tp. *nigra/sylvestris* | | | 2 | | | 2 | **4** | **1.37** | **2** | **33.33** |
| *Platanus orientalis* | 40 | 1 | | 5 | | 3 | **49** | **16.84** | **4** | **66.67** |
| cf. *Platanus orientalis* | 3 | 1 | | | | | **4** | **1.37** | **2** | **33.33** |
| *Quercus* tp. evergreen | 2 | 4 | 12 | 4 | | | **22** | **7.56** | **4** | **66.67** |
| *Quercus* sp. | 1 | 1 | | | | | **2** | **0.69** | **2** | **33.33** |
| cf. *Quercus* sp. | | 1 | 2 | | | | **3** | **1.03** | **2** | **33.33** |
| *Ulmus/Celtis* | 1 | 1 | | | | 1 | **3** | **1.03** | **3** | **50.00** |
| Angiosperm | 8 | 3 | | | | 3 | **14** | **4.81** | **3** | **50.00** |
| **TOTAL** | **136** | **21** | **18** | **23** | **13** | **80** | **291** | **100** | | |
| **No of taxa** | **8** | **6** | **4** | **7** | **2** | **7** | **12** | | | |

**Table VI.5:** Anthracological results from Roman deposits, excavated in the North Sector of the excavation at Heraion.

During this Roman period, the mixed woodland must have been degraded to maquis vegetation: this is implied by the significant percentage of *Arbutus* sp. and the rise in the presence of *Quercus* type evergreen and *Erica* sp. All the above taxa are pyrophytes (Houérou Le, 1974) and the increase in their percentages might suggest purposeful repeated fire events. The tactic of clearing forested areas through fire in order to obtain new grazing lands or areas of cultivation was well established during the antiquity (Hughes, 2014). Thus, their predominance in the assemblage could be related to the formation of pasturelands for the animals of the settlement.

At the same time, the variety of hydrophilic taxa growing by the banks of the river Imvrassos is significantly reduced. The most represented species among them during this period is *Platanus orientalis*, while the percentages of *Fraxinus* sp. and *Ulmus/Celtis* are close to 1%. The ability of *Platanus orientalis* to occupy gravelly sediments and loose alluvial deposits, which are unsuitable for farming (Dafis, 2010), might justify its predominance during this period. *Fraxinus* sp. and *Ulmus* sp., which prefer deeper silty-clay soils, might have been reduced as a result of anthropogenic pressure, as the soils they occupy are considered fertile and highly suitable for cultivation (Dafis, 2010). Another possibility is that the regular flooding by the Imvrassos River led to the erosion of the alluvial formation in areas close to the site. This would favor the expansion of *Platanus orientalis*, which as mentioned can occupy gravelly sediments. The erosion could have taken place after the cutting down of the *Quercus* type deciduous trees which had occupied the deposits since the EB period, as this species is totally absent from the Roman assemblage.

Finally, the significant presence of *Platanus orientalis* might be related to the esthetic value it was accorded during the Roman period, being considered an ornamental tree (Bosi et al., 2017; Moser et al., 2013). *Cupressus sempervirens* might have been also as an ornamental tree at the site now. This taxon is considered native to the island of Samos: it could grow along with *Pinus* type *brutia/halepensis* and *Juniperus* sp. (Caudullo and de Rigo, 2016). However, the fact that it was not recovered from any of the deposits of the earlier phases of the settlement, not even in those coming from close contexts, like architectural debris, indicates that either *Cupressus sempervirens* did not grow in proximity to the site or that it was not used by the inhabitants of the settlement due to some cultural prejudice during these early phases. Finally, *Pinus* type *nigra/sylvestris* was identified in very low quantities in the Roman deposits. This taxon could grow on the higher levels of the island, as happens today (Christodoulakis and Georgiadis, 1990), but not in the surroundings of the site. Its presence implies the exploitation of higher terrain, either for fuelwood or timber suitable for carpentry. The first option does not seem very likely: it was a long way to go for fire-wood.

Last but not least, the significant percentage of *Olea europaea* in the anthracological diagram of Heraion implies its cultivation on Samos during this period, although there were not observed any growth rings in the specimens of this period which would securely verify it.

Overall, the presence of animal herds and the cultivation of *Olea europaea* are indicators for the agropastoral economy of the settlement during the Roman period. These features, along with the degradation of *Quercus* type deciduous forest, were the main elements of the cultural landscape prevailing in the Heraion surroundings at this time.

### 1.2. Discussion

The analysis of wood charcoal macroremains from Heraion on Samos has illustrated the main characteristics of the landscape surrounding the site during the Bronze Age and the Roman periods. In general, it is observable that the inhabitants were utilizing the diverse vegetation growing near the site to cover their need in fire wood in all periods under study. Additionally, a development towards a more controlled landscape can be detected even in the EB period, with the management of *Olea europaea*. This situation peaked during the Roman period, when animal husbandry and probably cultivation led to the deterioration of the woody vegetation growing in the various formations close to the settlement.

*Olea europaea* was utilized as fuel wood by the inhabitants of Heraion from the earliest occupational phases of the site down until the Roman period, as is indicated by the presence of olive wood charcoal macro remains even in the Ch period. The species was not identified at the deposit of the Archaic period: but as in this period only one sample was recovered, with a low number of specimens, this apparent absence is not solid evidence for its actual non-existence in the surroundings of the site.

The earliest evidence for the presence of *Olea europaea* charcoal fragments in the Aegean comes from the island of Youra in the northern Sporades: it is dated to the Late Neolithic period (Ntinou, 2011a). In western Anatolia, early evidence of wood charcoal fragments of the species are known in the archaeological site of Kumtepe B, dated to the Final Neolithic (Riehl and Marinova, 2008). Additionally, olive pits were recovered from Troy (Riehl and Marinova, 2016) and Çukuriçi Höyük (Horejs et al., 2011) in assemblages dated to the Late Chalcolithic and EB periods. Finally, pollen evidence from Lesvos Island suggests the presence of *Olea* there from as early as MIS 3 (58.32-24 ka BP) (Margari et al., 2009).

Samos, which is situated bellow latitude 39°N, lies within the natural distribution range of *Olea europaea* (Carrión et al., 2010). This in addition to the identification of wood charcoal macroremains of the species from Ch deposits, indicates that *Olea* could be growing at the mixed woodland formations near the site. Unfortunately, the lack of a sufficient number of anthracological samples from this period does not allow estimations on the abundance of *Olea* on the environment during the earlier occupational phase of the site.

The recovery of olive stones from assemblages where occur mortars and pounders indicates, according to Margaritis (2013) the production of olive oil at the site from as early as EB II-early. This is further reinforced by the anthracological data, as 7.95% of the specimens of *Olea europaea* recovered from the buildings of the site dated to the EB period were observed to have growth rings, which suggests management of the tree in the form of pruning or pollarding (Rackham, 1972). As mentioned in the discussion of Akrotiri (Ch. V.1.2.1), the cultivation of olive trees and the subsequent increase in the percentages of olive stones and wood charcoal macroremains detected during the Bronze period in the Aegean is all to do with the production of olive oil (Valamoti et al., 2018). Olive oil as a luxury item would be consumed by the elites of the stratified societies emerged during this period and also employed in rituals. Additionally, the importance of olive oil is underlined by the recovery of stirrup jars specifically manufactured for the transport of liquids (Valamoti et al., 2018). In the case of Heraion, the anthracological and archaeobotanical data exists alongside the presence of a stratified society (as mirrored by the existence of communal buildings; Kouka, 2015), where stirrup jars have been retrieved (Kouka and Menelaou, 2018). This series of circumstances can arguably be used to validate the postulated link between the management of *Olea europaea* and the existence of hierarchical societies at the Aegean during the Bronze Age, as proposed by Valamoti et al. (2018).

During the Roman period the cultivation of olives expanded in the Mediterranean basin (Loumou and Giourga, 2003), as olive oil was utilized not only as food, but also as lighting fuel and for the production of soaps and perfumes (Mattingly, 1988). The expansion of the olive is also attested in east Aegean from pollen records which suggest its cultivation along with other fruit-bearing taxa during the Roman period (Knipping et al., 2008). The anthracological data from Heraion seem to verify the cultivation on the island, irrespective of the absence of growth rings at the specimens. However, the study of more charcoal fragments coming from Roman deposits and the completion of the ongoing carpological investigation are needed to confirm the above.

In addition to *Olea europaea* the inhabitants of prehistoric Heraion exploited other fruit-bearing taxa, such as *Prunus* sp., *Prunus amygdalus*, Maloideae, and *Ficus carica*. Anthracological evidence suggests the presence in the local environment of *Prunus* sp. and Maloideae since the Ch era, *Prunus amygdalus* during the EB period and *Ficus carica* since the EB period. The consumption of the seeds of *Prunus amygdalus* and *Ficus carica* during the EB period is verified by the carpological data on the site (Evi Margaritis personal communication). Although *Ficus carica* wood charcoal fragments were not identified in fill deposits, their presence in close contexts of the EB period suggests that fig trees were present around the settlement. These trees could have been on the banks of the Imvrassos River, where the inhabitants of the settlement could go and harvest the fruits. *Prunus amygdalus* and *Ficus carica* are also reported in the carpological record of Çukuriçi Höyük recovered from closed contexts dated to the Ch and EB periods (Horejs et al., 2011). Finally, the fruits of Maloideae family could also have been consumed already since the Ch period by the inhabitants of Heraion. But the low number of wood charcoal macroremains along with their absence from the carpological record of the site, do not allow a firm conclusion here.

Last but not least, there existed another taxon which could have been managed during the prehistoric phases of Heraion: namely *Quercus* type deciduous. During the identification process, it was observed that for 12.9% of fragments of this taxon recovered from open spaces in the EB period, and for 8.1% of those coming from buildings the same period, there existed narrow annual rings. Similarly, narrow annual rings were observed in 5.2% of those fragments coming from fills of the MB period. The presence of narrow annual rings in ring-porous taxa, like *Quercus* type deciduous, is indicative of pollarding and pruning (Schweingruber et al., 2006). Thus, this taxon besides being harvested in the nearby riparian forest for fuel wood and timber, could also have been utilized as animal fodder (Halstead, 1998). Although this proposition is very likely, it must be remembered that narrow annual rings can be also caused by the lack of water or the fact that the tree was growing in the shade (Schweingruber et al., 2006). Consequently, the acceptance of the above hypothesis must be made cautiously.

For the EB period, Kouka (2016, 2002) has pointed to the presence of a cultural *koine* between the settlements of Western Anatolia and those of the East Aegean islands, which is expressed through similarities in technologies, like those used for the production of ceramics, similar settlement patterns, with the presence of communal buildings and strong fortifications as well as common symbolisms. This exchange in ideas and technologies occurred because of the intensive trade that took place during this period between the two geographical areas (Kouka, 2016). Concerning tree management techniques and trading in tree species between Heraion and the area of western Anatolian littoral and/or the rest of the east Aegean islands, it should be pointed out that indications of *Olea europaea* cultivation are present also in EB site of Troy. This data is matched by pollen records from Lake Iznik, that demonstrate an increase in the percentage of the species during this period (Langgut et al., 2019). Additionally, *Quercus* type deciduous was used as fodder in the Troad during this period (Riehl and Marinova, 2008), in a similar way as to what is implied by the presence of narrow annual ring at a significant percentage of *Quercus* type deciduous specimens identified in Heraion. To verify the above possibility for Heraion, zooarchaeological data need to be discussed alongside the anthracological record. Whatever the case, there are observable similarities in the management of taxa between Troy and Heraion. Finally, according to Riehl and Marinova (2008), in deposits dated to the EB period from Troy (Troy I/II) there were identified wood charcoal fragments of *Abies* sp., which is considered not native to the area. In contrast, at Heraion, no exogenous taxa were detected, suggesting that during prehistory the inhabitants of the site were relying on local sources.

## 2. The uses of wood in the buildings: Results and Discussion

At Heraion, anthracological samples coming from deposits related to destruction layers were collected from the interior of the houses that were unearthed in all three sectors excavated, namely South, Central, and North. These buildings, which were destroyed by fire, are dated to the Chalcolithic, Early Bronze, and Middle Bronze periods.

The buildings of Heraion, both during the Ch and the Bronze periods, had walls made of stone at their lower part and mudbricks above. The anthracological material recovered from the houses of the site represents mainly the taxa used for the construction of the roofs and to a lesser extent wooden objects that might have been inside. With the exception of *Communal Building I* dated to the EB II period, in no other building were features discovered which could be ascribe to wooden construction elements, like floors or doors and window-frames. Thus, the discussion will focus on the taxa used for the construction of the first and the second layer comprising the roof. At the same time an effort will be made to recognise patterns in the use of taxa over time. It is believed that the taxa from the destruction layers contain parts of both the first, and lower, layer of the roof (beams) and of the second layer (branches). Unfortunately, due to the small size of the charcoal fragments and the bad state of preservation in most (especially those of the earlier phases) observations on the curvature of the fragments were very limited. Thus they proved unsuitable to provide sufficient information on the size of the beams and branches used.

Remains of three buildings dated to the Ch period were excavated at the South Sector of the site (Table VI.6). From these assemblages were analysed 280 fragments representing thirteen taxa, namely *Arbutus* sp., *Celtis* sp., *Erica* sp., Fabaceae, *Fraxinus* sp., *Olea europaea*, *Pinus* type *brutia/halepensis*, *Prunus amygdalus*, *Prunus* sp., *Quercus* type deciduous, *Quercus* type evergreen, *Ulmus* sp., and *Ulmus/Celtis*.

From the six houses dated to the EB period, five were excavated at the South Sector and one at the Central (Table VI.7, Fig. II.17). Additionally, in the South Sector there was also excavated *Communal Building I*, which was utilized most probably as a storeroom (Table VI.8, Fig. II.17). In total 1,028 wood charcoal fragments were analysed, from which 300 come from *Communal Building I*. The sixteen taxa represented are the following: *Arbutus* sp., *Celtis* sp., *Erica* sp., Fabaceae, *Ficus carica*, *Fraxinus* sp., *Juniperus* sp., *Olea europaea*, *Pinus* type *brutia/halepensis*, *Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, and *Ulmus* sp.

Five houses, dated to the MB period, were recovered: four at the North sector and one at the Central (Table VI.9, Fig. II.17). The number of wood charcoal fragments here amounted to 594. There are represented eighteen taxa, namely *Arbutus* sp., *Celtis* sp., *Erica* sp., Fabaceae, *Fraxinus* sp., Maloideae, *Olea europaea*, *Pinus* type *brutia/halepensis*, *Pinus* type *nigra/sylvestris, Platanus orientalis*, *Prunus amygdalus*, *Prunus* sp., *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, *Salix/Populus,* cf. *Tamarix* sp., and *Ulmus* sp.

Finally, from the houses, and in addition to the samples of the destruction episodes, there were recovered samples from two hearths, one threshold-block and two earth floors (Table VI.10, Fig. II.17). In more detail, these comprise: one sample from an earth floor from the Ch house, and recovered from under the foundation of wall HS11:33. From the EB house situated to the north of wall HS10:73, one sample from the soil floor and two more from its sub-layer were collected. Additionally, from the same building two samples from a hearth were also taken. Two more samples were gathered from another hearth in the MB house founded west of wall HS13:12. Finally, two samples were recovered from the threshold at the building situated north of wall HS10:51 and east of wall HS10:70, dated to the EB period. From these assemblages were recovered 117 wood charcoal fragments, representing the following eleven taxa: *Arbutus* sp., Fabaceae, *Fraxinus* sp., *Olea europaea*, *Prunus amygdalus*, *Prunus* sp., *Quercus* type deciduous, *Quercus* type evergreen, *Rhamnus/Phillyrea*, *Ulmus* sp., and *Ulmus/Celtis*.

In the following sections the results are discussed by feature and by archaeological period. The first group to be discussed is the construction of the roofs and then the assemblages related to the earth floors, the hearths, and the threshold.

## 2.1. Wooden Roofs

For the buildings in all three period under study, the roofs were most probably flat and they were made of wood. Similarly to those of Akrotiri, these flat roofs had a lower layer made of bigger poles, above which were placed smaller tree branches. These layers were then covered in turn by superimposed coats of clay, on top of which in many cases were placed slabs of stone (see Chapter II). Unfortunately, during the excavation it was not possible to distinguish which samples belonged exclusively to beams (first layer) and which to the layer of the branches (second layer). Hence, all samples examined are categorised merely as structural elements of the roofs: they likely contain pieces from both features.

### 2.1.1. Chalcolithic period

From the three buildings dated to the Ch period (Table VI.6, Fig. VI.2), the house unearthed under the foundation of the EBA wall HS11:33 had two distinct architectural phases. More specifically, the pebble floor, along with deposits immediately above it, belong to the earlier phase, while the later phase is characterized by the presence of a slab floor and destruction deposits atop it. From the older phase of the house under wall HS11:33 were recovered two samples (34016, 34017), which show great homogeneity in terms of the taxa represented. It should be mentioned that these are two of the richest samples in regard to the number of wood charcoal fragments included. From the taxa identified there, the most well represented is *Olea europaea* (35.88%), followed by *Fraxinus* sp. (17.56%), and *Ulmus* sp. (16.79%). In contrast, from the three samples of the later phase, two, namely samples 33873 and 33998, included a very low number of wood charcoal fragments (below ten in number). Here, *Fraxinus* sp. is the only taxon found in all three samples, while *Olea europaea*, *Quercus* sp., and *Ulmus* sp. are present in two. Taking into account all five samples coming from this house, *Fraxinus* sp. is the most frequently occurring, being present in all of them, followed by *Olea europaea* and *Ulmus* sp. which are present in the 80% of the samples.

| Heraion of Samos - Chalcolithic - Buildings | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | House under the foundation of HS11:33 | | | | | | | | | House deposits SE of HS10:51 | | | | | | West part of South Sector | | | | | |
| **Sector** | South | | | | | | | | | South | | | | | | South | | | | | |
| **Context** | Deposits above Slab Floor | | | Above Pebble Floor-older phase | | **N** | % | **Ubiquity** | **Ubiquity %** | Roof deposits | | **N** | % | **Ubiquity** | **Ubiquity %** | House deposits | | **N** | % | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/Excav. Year** | 85/11 | 89/11 | 90/11 | 91/11 | | | | | | 19/11 | | | | | | 37/11 | | | | | |
| **Taxa/Samples** | 33627 | 33873 | 33998 | 34016 | 34017 | | | | | 30240 | 30506 | | | | | 31099 | 31247 | | | | |
| *Arbutus* sp. | | | | | | | | | | 1 | | **1** | **2.78** | **1** | **50.0** | | | | | | |
| *Celtis* sp. | | | | | | | | | | | 2 | **2** | **5.56** | **1** | **50.0** | | | | | | |
| *Erica* sp. | 1 | | | | | **1** | **0.43** | **1** | **20.0** | | | | | | | | | | | | |
| cf. *Erica* sp. | 1 | | | | | **1** | **0.43** | **1** | **20.0** | | | | | | | | | | | | |
| Fabaceae | | | | | | | | | | 1 | 2 | **3** | **8.33** | **2** | **100** | | | | | | |
| *Fraxinus* sp. | 6 | 3 | 1 | 16 | 7 | **33** | **14.29** | **5** | **100** | 1 | 1 | **2** | **5.56** | **2** | **100** | 1 | 2 | **3** | **27.27** | **2** | **100** |
| cf. *Fraxinus* sp. | | | 1 | 2 | 1 | **4** | **1.73** | **3** | **60.0** | | | | | | | 1 | 1 | **2** | **18.18** | **2** | **100** |
| *Olea europaea* | 20 | | 2 | 34 | 13 | **69** | **29.87** | **4** | **80.0** | 1 | | **1** | **2.78** | **1** | **50.0** | 1 | | **1** | **9.09** | **1** | **50.0** |
| cf. *Olea europaea* | 4 | | | 1 | 3 | **8** | **3.46** | **3** | **60.0** | 1 | 1 | **2** | **5.56** | **2** | **100** | | 1 | **1** | **9.09** | **1** | **50.0** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | | 1 | | **1** | **2.78** | **1** | **50.0** | | | | | | |
| *Prunus amygdalus* | 7 | | | | | **7** | **3.03** | **1** | **20.0** | | | | | | | | | | | | |
| *Prunus* sp. | 2 | | | | | **2** | **0.87** | **1** | **20.0** | 1 | | **1** | **2.78** | **1** | **50.0** | | | | | | |
| cf. *Prunus* sp. | 1 | | | | | **1** | **0.43** | **1** | **20.0** | | | | | | | | | | | | |
| *Quercus* tp. deciduous | 16 | | | | | **16** | **6.93** | **1** | **20.0** | 3 | 5 | **8** | **22.22** | **2** | **100** | | | | | | |
| *Quercus* tp. evergreen | 9 | | | 8 | 1 | **18** | **7.79** | **3** | **60.0** | | 3 | **3** | **8.33** | **1** | **50.0** | | | | | | |
| *Quercus* sp. | 3 | | 1 | | 2 | **6** | **2.60** | **3** | **60.0** | 2 | 2 | **4** | **11.11** | **2** | **100** | | | | | | |
| cf. *Quercus* sp. | 2 | | | | 1 | **3** | **1.30** | **2** | **40.0** | | | | | | | | | | | | |
| *Ulmus* sp. | 10 | | 1 | 17 | 5 | **33** | **14.29** | **4** | **80.0** | 2 | | **2** | **5.56** | **1** | **50.0** | | | | | | |
| *Ulmus/Celtis* | | | | 1 | 1 | **2** | **0.87** | **2** | **40.0** | 4 | | **4** | **11.11** | **1** | **50.0** | | | | | | |
| cf. *Ulmus/Celtis* | | | | 4 | 3 | **7** | **3.03** | **2** | **40.0** | 1 | | **1** | **2.78** | **1** | **50.0** | 1 | | **1** | **9.09** | **1** | **50.0** |
| Angiosperm | 9 | | | 7 | 4 | **20** | **8.66** | **3** | **60.0** | | 1 | **1** | **2.78** | **1** | **50.0** | 3 | | **3** | **27.27** | **1** | **50.0** |
| **TOTAL** | **91** | **3** | **6** | **90** | **41** | **231** | **100** | | | **19** | **17** | **36** | **100** | | | **7** | **4** | **11** | **100** | | |
| **Min No of taxa** | **8** | **1** | **4** | **5** | **6** | **9** | | | | **10** | **6** | **11** | | | | **3** | **2** | **3** | | | |

**Table VI.6:** Anthracological results from contexts related to the houses dated to the Chalcolithic period at Heraion.

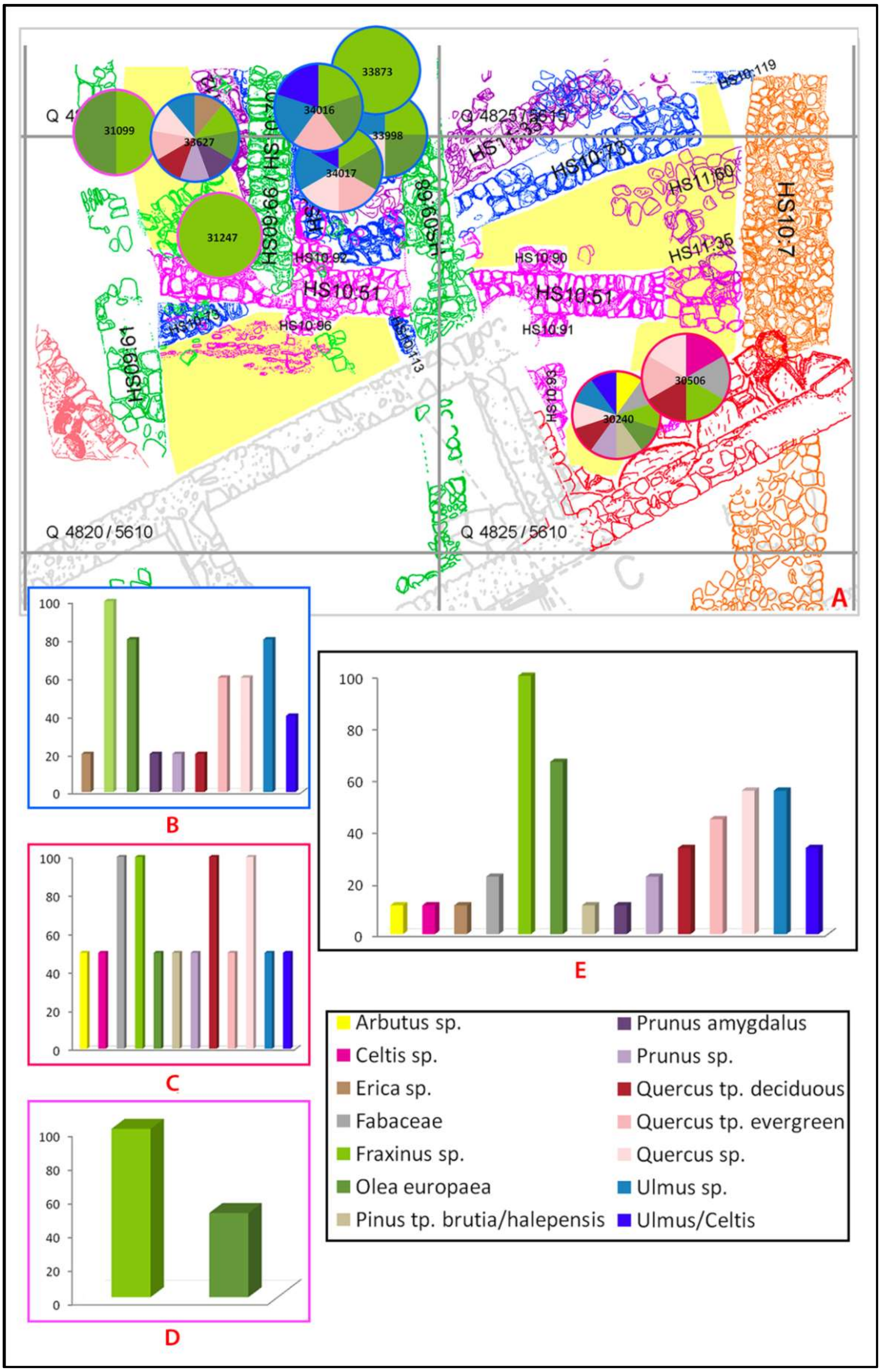



**Figure VI.2:** Distribution of the samples collected from the houses of Heraion, dated to the Chalcolithic period. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, bar charts present the ubiquity percentage (U%) of the taxa recovered from (B) the house under the foundation of HS11:33, (C) the house south-east of HS10:51, and (D) the house to the west part of the South Sector. The ubiquity percentage (U%) of the taxa from all three houses is presented at (E).

From the house to the southeast of the EB wall HS10:51 were retrieved two samples, contributing 37 charcoal fragments in total. Despite the low number of fragments, these samples included a high variety of taxa, with 12 taxa recognized. From them, *Fraxinus* sp., Fabaceae, cf. *Olea europaea*, *Quercus* type deciduous, and *Quercus* sp. are present in both samples. Finally, the deposits belonging to the interior of a Ch house excavated at the west part of the South sector are represented by two samples. The total number of fragments recovered is 11. From this context were identified three taxa: *Fraxinus* sp. was present in both samples, while *Olea europaea* and cf. *Ulmus/Celtis* were retrieved only in sample 31099.

The constant presence of *Fraxinus* sp. in all samples from all three houses examined suggests that this was one of the main taxa used for the construction of the roofs during that period. Beside *Fraxinus* sp., the only other species found in all three houses (but not in all samples) is *Olea europaea*. However, *Fraxinus* sp. enjoys the highest frequency only at the house excavated in the west part of the south sector. In the other two houses, *Olea europaea* (house under HS11:33) and *Quercus* type deciduous (house southeast of HS10:51) dominate, respectively. Additionally, *Quercus* sp., *Ulmus* sp., and *Quercus* type evergreen were recovered in more than half of the samples collected at the house under the foundation of wall HS11:33 and that to the southeast of wall HS10:51. Taking into account both the ubiquity and the frequency count of the taxa identified, it could be suggested that *Fraxinus* sp., along with *Quercus* type deciduous and *Ulmus* sp., were most probably utilized for the construction of the main beams of the roof, which took the weight of the construction. *Pinus* type *brutia/halepensis* and *Celtis* sp. would also have so served, although the low number of fragments of these taxa identified and their low ubiquity do not provide strong evidence for this idea.

*Olea europaea* along with *Quercus* type evergreen could have been used in both layers of the roof. However the high percentage count of *Olea*, at least at the house unearthed under the foundation of wall HS11:33, is an indication that the species was used most probably at the second layer. A layer of branches when burnt would produce a higher amount of charcoal fragments than a beam. Along with *Olea*, other taxa which could have been used for the formation of the second layer are *Arbutus* sp., *Erica* sp., *Prunus amygdalus*, and *Prunus* sp., as well as branches of the taxa used for the main beams. Unfortunately, the bad preservation of the buildings of this period and the scattering of the samples does not allow one to estimate the exact location of the beams, the distance between them or any other useful information related to the architecture of the roofs.

### 2.1.2. Early Bronze period

#### 2.1.2.1. Private Buildings

From the six houses dated to the EB period (Table VI.7, Fig. VI.3), the destruction layer of that situated to the west of wall HS10:112, dated to EBII-early, produced only one charcoal fragment, of *Olea europaea*. From the deposits of the East Room of the house to the north of HS10:73, dated to the same period, were recovered three samples containing in total 30 fragments of wood charcoal. Among the seven taxa identified here, *Olea europaea* was the most frequently met with, being present in all three samples; it was followed by *Quercus* type evergreen in two samples. Beside *Olea europaea* (44.44%) as the most represented taxon, another taxon appearing at a high frequency is cf. *Olea europaea* (14.81%), while the percentages of each of *Ficus carica, Quercus* type evergreen, and *Quercus sp.* rise to 7.41%.

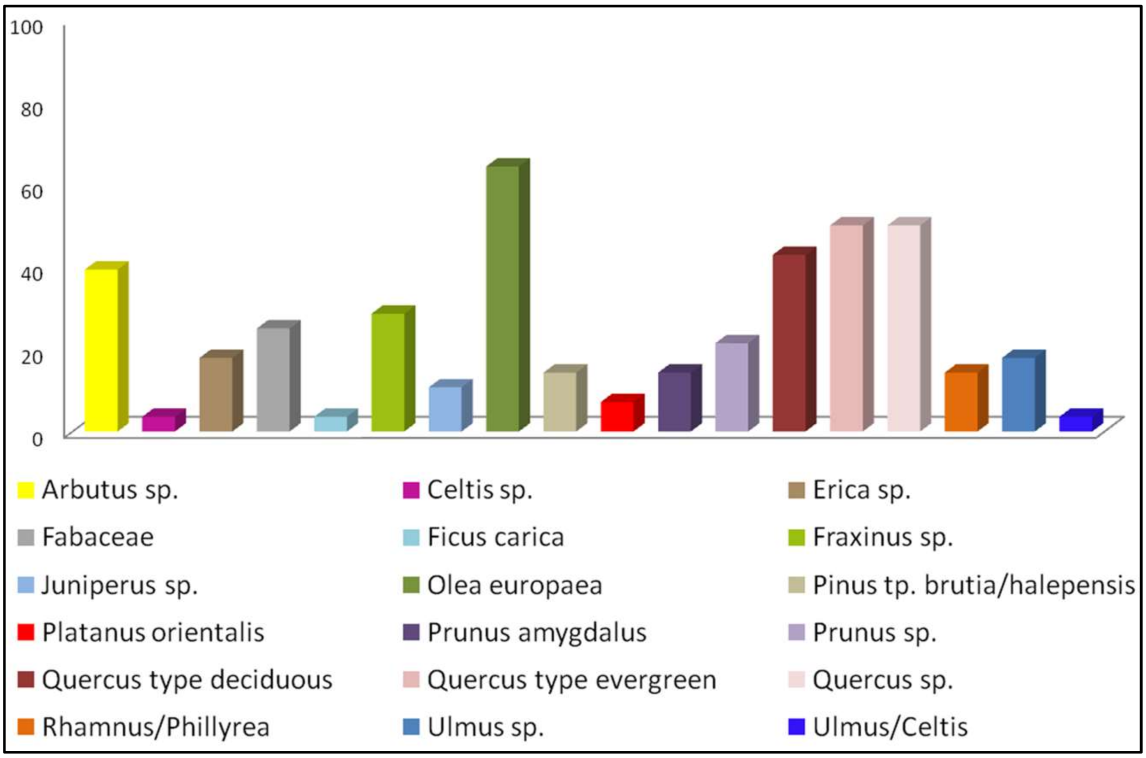



**Figure VI.3:** Bar chart showing the ubiquity percentage (U%) of the taxa identified in the samples recovered from the houses of the Early Bronze period at Heraion, Samos.

| Heraion of Samos - Early Bronze Age - Buildings | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | House W of HS10:112 EBII (EB4) | House N of HS10:73- East Room EB I/II (EB4) | | | | | | | House N of HS10:51 and E of HS10:70 EB II-early (EB3) | | | | | | | | | | | | | |
| **Sector** | South | South | | | | | | | South | | | | | | | | | | | | | |
| **Context** | Destruction layer | Destruction layers HS10:73 | | | **N** | **%** | **Ubiquity** | **Ubiquity %** | Destruction layer above floor | | | | | | | | Destruction layer of HS10:51 | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/ Excav. Year** | 70/11 | 105/10 | 76/10 | | | | | | 58/10 | | | | | | | | 9/11 | | | | | |
| **Taxa/Sample** | 32924 | 25914 | 25682 | 25721 | | | | | 24010 | 24019 | 24080 | 24189 | 24184 | 24194 | 24220 | 24273 | 30282 | 30012 | | | | |
| *Arbutus* sp. | | 1 | | | **1** | **3.70** | **1** | **33.33** | 2 | | | | | | 2 | | 1 | | **5** | **3.94** | **3** | **30.00** |
| cf. *Arbutus* sp. | | | | | | | | | | | | 1 | | | 2 | | | | **3** | **2.36** | **2** | **20.00** |
| *Celtis* sp. | | | | | | | | | | | | | | | | | | 2 | **2** | **1.57** | **1** | **10.00** |
| *Erica* sp. | | | | | | | | | 2 | | | | | | | | | | **2** | **1.57** | **1** | **10.00** |
| cf. *Erica* sp. | | | | | | | | | | | | | | | | | | | | | | |
| Fabaceae | | | | | | | | | | 2 | | | | | | | 2 | | **4** | **3.15** | **2** | **20.00** |
| cf. Fabaceae | | | | | | | | | | | | | | | | | | | | | | |
| *Ficus carica* | | 2 | | | **2** | **7.41** | **1** | **33.33** | | | | | | | | | | | | | | |
| *Fraxinus* sp. | | | | | | | | | | 2 | | | | | | | | 1 | **3** | **2.36** | **2** | **20.00** |
| cf. *Fraxinus* sp. | | | | | | | | | | | 1 | | | | | | | | **1** | **0.79** | **1** | **10.00** |
| *Juniperus* sp. | | | | | | | | | | | | | | | | | | | | | | |
| *Olea europaea* | **1** | 4 | 6 | 2 | **12** | **44.44** | **3** | **100** | | 4 | 30 | | | | | | 2 | 3 | **39** | **30.71** | **4** | **40.00** |
| cf. *Olea europaea* | | 4 | | | **4** | **14.81** | **1** | **33.33** | | 1 | 2 | | 1 | | | | | 1 | **5** | **3.94** | **4** | **40.00** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | | | | | | | | | | | | | | |
| *Platanus orientalis* | | | | | | | | | | | | | | | | | | | | | | |
| cf. *Platanus orientalis* | | 1 | | | **1** | **3.70** | **1** | **33.33** | | | | | | | | | | | | | | |
| *Prunus amygdalus* | | | | | | | | | | | | | | | 1 | | | | **1** | **0.79** | **1** | **10.00** |
| *Prunus* sp. | | | | | | | | | | 1 | 2 | | | | | | 3 | | **6** | **4.72** | **3** | **30.00** |
| cf. *Prunus* sp. | | | | | | | | | | | | | | | | | | | | | | |
| *Quercus* type deciduous | | 1 | | | **1** | **3.70** | **1** | **33.33** | | | 9 | | | 1 | | | 1 | 1 | **12** | **9.45** | **4** | **40.00** |
| *Quercus* type evergreen | | 1 | | 1 | **2** | **7.41** | **2** | **66.67** | | 1 | | | 1 | | 7 | | 2 | | **11** | **8.66** | **4** | **40.00** |
| *Quercus* sp. | | 2 | | | **2** | **7.41** | **1** | **33.33** | | 1 | 4 | | 1 | 3 | | 3 | 1 | 1 | **14** | **11.02** | **7** | **70.00** |
| cf. *Quercus* sp. | | | | | | | | | | | 1 | 1 | | | | | 1 | | **3** | **2.36** | **3** | **30.00** |
| *Rhamnus/Phillyrea* | | | | | | | | | | | | | | | | | | | | | | |
| *Ulmus* sp. | | | | | | | | | | | | | | | | | | | | | | |
| cf. *Ulmus* sp. | | | | | | | | | | | | | | | | | | | | | | |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | | | | | | | |
| Angiosperm | | 2 | | | **2** | **7.41** | **1** | **33.33** | 2 | 3 | 6 | | 2 | | 2 | 1 | | | **16** | **12.60** | **6** | **60.00** |
| **TOTAL** | **1** | **18** | **6** | **3** | **27** | **100** | | | **6** | **15** | **55** | **2** | **5** | **4** | **14** | **4** | **13** | **9** | **127** | **100** | | |
| **Min No of taxa** | **1** | **6** | **1** | **2** | **6** | | | | **2** | **6** | **5** | **2** | **3** | **2** | **3** | **1** | **6** | **5** | **10** | | | |

**Table VI.7:** Anthracological results from contexts related to the houses dated to the Early Bronze period at Heraion.

| Heraion of Samos - Early Bronze Age - Buildings (continuation) | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | House N of HS10:51 & W of HS10:70 EB II-early (EB3) | | | | | | | | House between HS09:66 and HS09:68 EB II-early (EB1) | | | | | | | | | | House close to Fortification Wall HS13:30 EB II late-EB III | | | | | | | | |
| **Sector** | South | | | | | | | | South | | | | | | | | | | Central | | | | | | | | |
| **Context** | Deposits | | Superstructure of HS10:51 | | **N** | **%** | **Ubiquity** | **Ubiquity %** | East Room - above floor | | | West Room above earlier floor | | **N** | **%** | **Ubiquity** | **Ubiquity %** | House deposits | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/ Excav. Year** | 5/11 | | 54/10 | | | | | | 75/09 | | 76/09 | 82/09 | | | | | | 39/13 | 44/13 | | | 47/13 | | | | |
| **Taxa/Sample** | 30016 | 30022 | 24011 | 24012 | | | | | 38 | 43 | 31 | 40 | 47 | | | | | 46075 | 45701 | 45979 | 45986 | 46028 | | | | |
| *Arbutus* sp. | | | | 3 | **3** | **5.26** | **1** | **25.0** | | | | 1 | | **1** | **7.14** | **1** | **20.0** | 8 | 8 | 1 | 4 | 2 | **23** | **4.84** | **5** | **100** |
| cf. *Arbutus* sp. | | | 2 | | **2** | **3.51** | **1** | **25.0** | | | | | | | | | | 3 | | 1 | 1 | 2 | **7** | **1.47** | **4** | **80** |
| *Celtis* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Erica* sp. | | | | | | | | | | 1 | | | | **1** | **7.14** | **1** | **20.0** | 16 | | 3 | 2 | | **21** | **4.42** | **3** | **60** |
| cf. *Erica* sp. | | | | | | | | | | | | | | | | | | 1 | | 1 | | | **2** | **0.42** | **2** | **40** |
| Fabaceae | | | | | | | | | | | | | 1 | **1** | **7.14** | **1** | **20.0** | 14 | 3 | 23 | 6 | | **46** | **9.68** | **4** | **80** |
| cf. Fabaceae | | | | | | | | | | | | | | | | | | | | 2 | | | **2** | **0.42** | **1** | **20** |
| *Ficus carica* | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Fraxinus* sp. | | 1 | | | **1** | **1.75** | **1** | **25.0** | | | | 1 | | **1** | **7.14** | **1** | **20.0** | 5 | | 4 | 4 | 1 | **14** | **2.95** | **4** | **80** |
| cf. *Fraxinus* sp. | | 2 | | | **2** | **3.51** | **1** | **25.0** | | | | | | | | | | 2 | 1 | 1 | | 2 | **6** | **1.26** | **4** | **80** |
| *Juniperus* sp. | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | | **3** | **0.63** | **3** | **60** |
| *Olea europaea* | | 4 | | 5 | **9** | **15.79** | **2** | **50.0** | 1 | | 1 | | 1 | **3** | **21.43** | **3** | **60.0** | 33 | 6 | 37 | 17 | 13 | **106** | **22.32** | **5** | **100** |
| cf. *Olea europaea* | | 4 | | | **4** | **7.02** | **1** | **25.0** | | | | 1 | | **1** | **7.14** | **1** | **20.0** | 1 | | 5 | 5 | 1 | **12** | **2.53** | **4** | **80** |
| *Pinus* tp. *brutia/halepensis* | | | | | | | | | | | | | | | | | | 8 | 1 | 1 | 2 | | **12** | **2.53** | **4** | **80** |
| *Platanus orientalis* | | | 1 | | **1** | **1.75** | **1** | **25.0** | | | | | 1 | **1** | **7.14** | **1** | **20.0** | | | | | | | | | |
| cf. *Platanus orientalis* | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prunus amygdalus* | | | | | | | | | | | | | | | | | | 1 | | 1 | 4 | | **6** | **1.26** | **3** | **60** |
| *Prunus* sp. | | | | | | | | | | | | | | | | | | 9 | | 1 | | 1 | **11** | **2.32** | **3** | **60** |
| cf. *Prunus* sp. | | | | | | | | | | | | | | | | | | | | | | 1 | **1** | **0.21** | **1** | **20** |
| *Quercus* tp. deciduous | 3 | 8 | | | **11** | **19.30** | **2** | **50.0** | | | | | | | | | | 17 | 5 | 24 | 7 | 12 | **65** | **13.68** | **5** | **100** |
| *Quercus* tp. evergreen | 5 | 4 | | 1 | **10** | **17.54** | **3** | **75.0** | | | | | | | | | | 4 | 4 | 16 | 5 | 5 | **34** | **7.16** | **5** | **100** |
| *Quercus* sp. | 2 | 6 | | | **8** | **14.04** | **2** | **50.0** | | 1 | | | | **1** | **7.14** | **1** | **20.0** | 3 | | 3 | 1 | | **7** | **1.47** | **3** | **60** |
| cf. *Quercus* sp. | 1 | | | | **1** | **1.75** | **1** | **25.0** | | | | | | | | | | 1 | | 1 | 2 | | **4** | **0.84** | **3** | **60** |
| *Rhamnus/Phillyrea* | | | | | | | | | | | | | | | | | | 2 | | 6 | 3 | 1 | **12** | **2.53** | **4** | **80** |
| *Ulmus* sp. | | | | | | | | | | | | 2 | | **2** | **14.29** | **1** | **20.0** | 3 | 21 | 3 | 9 | | **36** | **7.58** | **4** | **80** |
| cf. *Ulmus* sp. | 1 | | | | **1** | **1.75** | **1** | **25.0** | | | | 1 | | **1** | **7.14** | **1** | **20.0** | 2 | | 5 | 6 | | **13** | **2.74** | **3** | **60** |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | | | 1 | | | | | **1** | **0.21** | **1** | **20** |
| Angiosperm | | | 2 | 2 | **4** | **7.02** | **2** | **50.0** | | 1 | | | | **1** | **7.14** | **1** | **20.0** | 4 | 4 | 10 | 10 | 3 | **31** | **6.53** | **5** | **100** |
| **TOTAL** | **12** | **29** | **5** | **11** | **57** | **100** | | | **1** | **3** | **1** | **6** | **3** | **14** | **100** | | | **138** | **54** | **150** | **89** | **44** | **475** | **100** | **5** | **100** |
| **Min No of taxa** | **3** | **4** | **2** | **3** | **7** | | | | **1** | **2** | **1** | **4** | **3** | **8** | | | | **13** | **9** | **13** | **12** | **7** | **14** | | | |

**Table VI.7 (continuation):** Anthracological results from contexts related to the houses dated to the Early Bronze period at Heraion.

The assemblage of the house situated to the north of the wall HS10:51 and to the east of the wall HS10:70 was the richest excavated in the south sector, both in regard to the number of charcoal fragments recovered, as well as the number of taxa represented. Considering the ubiquity of the taxa identified, *Quercus* sp. was the taxon most frequently occurring, present in seven of the ten samples from this deposit. Other taxa with significant presence were *Olea europaea,* cf. *Olea europaea,* and *Quercus* type deciduous and evergreen. However, as can be seen in Table VI.7, the taxon with the highest frequency of all was *Olea europaea* (30.71%), while *Quercus* sp. came second with a percentage of 11.02%. Worth mentioning is that the majority of the fragments of *Olea europaea* identified in this deposit came from sample 24080 (58/10), where 30 of the 39 fragments of this species occurred. Such a high concentration of fragments of this species in one sample might indicate that it was from a disintegrated beam.

From the house situated to the north of wall HS10:51 and to the west of wall HS10:70, 64 wood charcoal fragments were recovered. *Quercus* type evergreen is met with in three out of four samples from this context. However, *Quercus* type deciduous has a slightly higher percentage, as its frequency scores 19.30%. This taxon along with *Olea europaea* and *Quercus* sp. are present in half the samples.

Finally, very few charcoal fragments, namely 14, were included in the five samples collected from the deposits of the house situated between walls HS09:66 and HS09:68. *Olea europaea* is present in three samples and it enjoys the highest frequency percentage, 21.43%. All other taxa are present in only one of the samples.

As mentioned above, just one house dated to EB period was excavated in the Central Sector. From this house, in close proximity to defensive wall HS13:30, five samples containing in total 489 fragments were collected. The deposits from this house, besides being the richest of all the houses from this period as to the number of wood charcoal fragments recovered in total, are also the richest in terms of taxa representation - there were 14 identified. As it can be seen in Table VI.7, *Olea europaea* predominates at 22.32%, followed by *Quercus* type deciduous (13.68%), and Fabaceae (9.68%). Other taxa present with percentages greater than 5% are *Ulmus* sp. (7.58%) and *Quercus* type evergreen (7.16%). With regard to the ubiquity of the taxa identified, *Arbutus* sp., *Olea europaea*, and *Quercus* type deciduous and evergreen are present in all five samples, while Fabaceae, *Fraxinus* sp., *Pinus* type *brutia/halepensis*, *Rhamnus/Phillyrea*, and *Ulmus* sp. are present in four of them.

In the EB houses, when compared to the Ch buildings, there is to be observed a reduction in the ubiquity and frequency count of *Fraxinus* sp. and *Ulmus* sp. At the same time, the corresponding values of *Olea europaea* remain stable or rise, while those of *Quercus* type deciduous and evergreen, *Quercus* sp., Fabaceae, and *Arbutus* sp. rise.

In more detail, although *Fraxinus* sp. is identified in the majority of the houses, its presence is restricted to but one sample per house; only at the house close to fortification wall HS13:30 is it present in four of the five samples. Additionally, the fragment count of the taxon is very low: on no occasion does it surpass 4%. In the case of *Ulmus* sp., the taxon is present in two houses. At the house close to fortification wall HS13:30, the high ubiquity of the taxon (80%), along with the high concentration of fragments at sample 45701, might indicate the presence of a beam of the wood. Given that stratigraphical unit 44/13, whence sample 45701 is derived, is clearly related to the destruction layer of the house, the existence of a beam made of *Ulmus* sp. is very likely indeed.

The taxa preferred for the construction of the roof of the houses during the EB period were *Olea europaea*, *Quercus* type deciduous and evergreen and, to a lesser degree, *Arbutus* sp. and Fabaceae. The change in the taxa utilized for the main beams of the roofs might be related to selection criteria. Another option is that the inhabitants of the site changed the location where they cut their timber wood: during the EB period they preferred the oak woodland more than the vegetation growing by the banks of the river Imvrassos. Unfortunately, the lack of sufficient evidence on the vegetation prevailing during the Ch period prevents comparisons from being made concerning any changes in the populations of *Fraxinus* sp. and *Ulmus* sp. in the immediate environment of the site. The current data points toward their low presence in the landscape surrounding the site during the EB period (see Chapter VI.1.1). Keeping in mind that *Fraxinus* sp. and *Ulmus* sp. prefer fertile alluvial deposits, those suitable for the cultivation of cereals and pulses, their low visibility in the assemblage of EB period might imply the deliberate eradication of these taxa by the inhabitants to exploit these areas better for cultivation. This hypothesis will be verified, or not, with the publication of the carpological results of the site.

With regard to *Olea*, Fabaceae, and *Arbutus* sp., branches of these taxa could have been used at the second layer of the roofs. In the case of *Olea*, the systematic pruning of the trees to encourage an increase in the yield of fruits for the production of oil, even on a limited scale (Margaritis, 2013), would have resulted in the ready availability of a great volume of branches to be used in making the second roofing layer.

Finally, when one compares the assemblages of the two houses of the EB period which contained more than 100 charcoal fragments apiece (Table VI.7, Fig. VI.4) - namely the house situated north of wall HS10:51 and east of wall HS10:70 (South Sector), dated to the EB II-early period, and the house founded close to the Fortification Wall HS13:30 (Central Sector), dated to EB II-late/III, it can be suggested that throughout the EB period the same taxa were favoured in the construction of the buildings. As it can be seen in Table VI.7 the dominant taxa, namely *Olea europaea*, *Quercus* type deciduous and *Quercus* evergreen retain their high fragment count, although their frequency of occurrence is higher during the later phase.

Notable are the cases of Fabaceae and *Quercus* sp.: in the house dated to the EB II-early period, Fabaceae scores low in both frequency (3.15%) and ubiquity percentage (20.0%), but during the later architectural phase these values increase significantly to 9.68% and 80%, respectively. The low frequency in the EB II houses and the high frequency in the house situated at the Central Sector dated to EB III period are in accordance with the relevant percentages of the taxon observed at the scattered wood charcoal macroremains from each phase (Tables VI.3 and VI.7). Concerning *Quercus* sp., its frequency percentage declines to 1.47% in the house close to fortification wall HS13:30 (Central Sector), a considerable drop from 11.02% recorded in the house situated at the South Sector. The high frequency and ubiquity of *Quercus* sp. in the house occurring north of wall HS10:51 and east of wall HS10:70 (South Sector) when compared to those of *Quercus* type deciduous and evergreen in the same house (as well as with those of *Quercus* sp. at the house at the

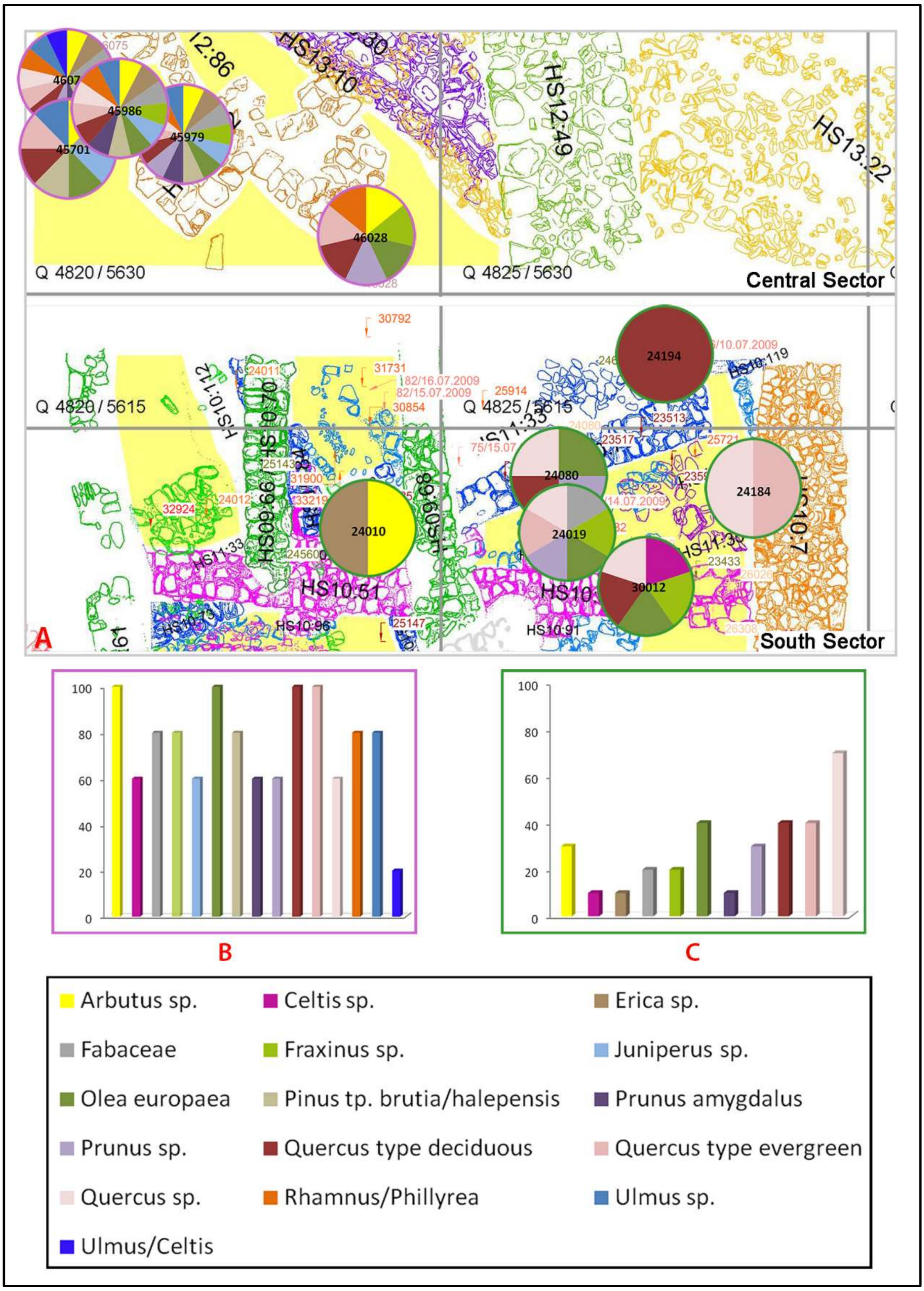



**Figure VI.4:** Distribution of the samples collected from the houses of Heraion dated to the Early Bronze period, which contained more than 100 fragments. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, bar charts present the ubiquity percentage (U%) of the taxa recovered from (B) the house situated close to fortification wall HS13:30, and (C) the house north of HS10:51 and east of HS10:70. The coordinates of samples 24220, 24273, and 30282 of the first house were missing, thus these samples are not depicted on the excavation plan.

Central Sector) might have to do with post-depositional factors. Although geomorphological studies are needed to verify this hypothesis, it is possible that fluctuations in the height of the water table might have occurred over time (currently the earlier architectural phases of Heraion remain under the water table). This could have led to an increased percentage of small specimens, not exceeding 2 mm, in these deposits (which in turn hinders their more precise identification see: Théry-Parisot et al., 2010). The effect of this lack of larger specimens is evident not only from the high percentage of *Quercus* sp. fragments that could not be categorized as either deciduous or evergreen, but also from the high frequency count of fragments characterized as only of *cf.* status in at least three of the five houses dated to the EB II period (see Table VI.7).

#### 2.1.2.2. Communal Building I

In addition to the six houses, *Communal Building I* is also dated to the EB period (Table VI.8, Fig. VI.5). According to the excavator, this building, constructed during the EB2-EB2/3 architectural phase of the settlement (EB II-early), served most probably as a storage space (Kouka, 2015). Apart from its considerable dimensions, compared to the rest of the buildings of this period, *Communal Building I* also had a second storey in the form of a loft (Kouka 2010, unpublished archaeological report). During the excavation, anthracological samples recovered from the layers of the flat roof of the building were able to be distinguished from those related to its upper storey. Thus, the destruction layer excavated immediately above the ground floor and beneath the fallen roof beams is most probably related to the aforementioned upper storey. As it can be seen in Table VI.8, *Olea europaea* is present in five of the six samples related to the construction of the upper storey and in addition it is the most represented taxon (37.10%). A few other taxa are present in two samples, such as *Arbutus* sp., *Pinus* type *brutia/halepensis*, *Quercus* type evergreen, and *Salix/Populus*. From these taxa only *Quercus* type evergreen (17.74%) has a significant percentage, while *Arbutus* sp. (4.48%) and *Salix/Populus* (4.84%) have percentages just below 5%. From the assemblage related to the roof construction, the diversity of taxa present is higher. Here are to be seen 15 taxa, from which *Arbutus* sp. is present in four of the six samples recovered, while *Fraxinus* sp., *Olea europaea*, and *Quercus* type deciduous are present in half of them.

| Heraion of Samos - Early Bronze Age - Communal Building I | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cultural Period** | EB II - early (EB2-EB2/3) | | | | | | | | | | | | | | | | | | | | |
| **Sector** | South | | | | | | | | | | | | | | | | | | | | |
| **Context** | Roof beams | | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** | Destruction layer above floor | | | | | | | **N** | **%** | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/Excav. Year** | 45/10 | | | | 53/10 | | | | | | 13/10 | | 53/10 | | 78/10 | | | | | | |
| **Taxa/Samples** | 23513 | 23517 | 23533 | 23590 | 25147 | 24025 | | | | | 22305 | 23433 | 24560 | 25143 | 24638 | 24639 | 24811 | | | | |
| *Arbutus* sp. | | 5 | | 1 | 55 | 4 | **65** | **28.76** | **4** | **66.67** | | | | 2 | 1 | | | **3** | **4.84** | **2** | **28.57** |
| cf. *Arbutus* sp. | | 5 | | 1 | 2 | | **8** | **3.54** | **3** | **50.00** | | | | | | | | | | | |
| *Erica* sp. | | | 1 | | | | **1** | **0.44** | **1** | **16.67** | | | | | | | | | | | |
| Fabaceae | | | | | 3 | | **3** | **1.33** | **1** | **16.67** | | | | | 2 | | | **2** | **3.23** | **1** | **14.29** |
| *Fraxinus* sp. | | | 10 | 1 | 32 | | **43** | **19.03** | **3** | **50.00** | | | | | | | | | | | |
| cf. *Fraxinus* sp. | | | | | 6 | | **6** | **2.65** | **1** | **16.67** | | | | | | | | | | | |
| *Ficus carica* | | | | | 1 | | **1** | **0.44** | **1** | **16.67** | | | | | | | | | | | |
| *Olea europaea* | 10 | 4 | | 2 | | | **16** | **7.08** | **3** | **50.00** | | | 2 | 5 | 4 | 10 | 2 | **23** | **37.10** | **5** | **71.43** |
| cf. *Olea europaea* | | 1 | | 1 | | | **2** | **0.88** | **2** | **33.33** | | | | | 2 | | 1 | **3** | **4.84** | **2** | **28.57** |
| *Pinus* tp. *brutia/halepensis* | | 1 | | | | | **1** | **0.44** | **1** | **16.67** | 1 | 1 | | | | | | **2** | **3.23** | **2** | **28.57** |
| *Platanus orientalis* | | | | | | | | | | | | | | | | 1 | | **1** | **1.61** | **1** | **14.29** |
| *Prunus amygdalus* | | | | | 1 | | **1** | **0.44** | **1** | **16.67** | | | | | | | | | | | |
| *Prunus* sp. | | 2 | | | | | **2** | **0.88** | **1** | **16.67** | | | | | | | | | | | |
| *Quercus* tp. deciduous | | | 4 | | 22 | 1 | **27** | **11.95** | **3** | **50.00** | | | | | 1 | | | **1** | **1.61** | **1** | **14.29** |
| *Quercus* tp. evergreen | | | | | 1 | | **1** | **0.44** | **1** | **16.67** | | | | 10 | | 1 | | **11** | **17.74** | **2** | **28.57** |
| *Quercus* sp. | | | | | 9 | | **9** | **3.98** | **1** | **16.67** | | | | | 1 | | 1 | **2** | **3.23** | **2** | **28.57** |
| cf. *Quercus* sp. | | 1 | | | 8 | | **9** | **3.98** | **2** | **33.33** | | | | | | | | | | | |
| *Rhamnus/Phillyrea* | | | | 1 | | | **1** | **0.44** | **1** | **16.67** | | | | | | | | | | | |
| *Salix/Populus* | | | | | 1 | 2 | **3** | **1.33** | **2** | **33.33** | | | | 1 | | 2 | | **3** | **4.84** | **2** | **28.57** |
| cf. *Salix/Populus* | | | | | | | | | | | | | | | | 1 | 1 | **2** | **3.23** | **2** | **28.57** |
| *Ulmus* sp. | | | | | 10 | | **10** | **4.42** | **1** | **16.67** | | | | | | | | | | | |
| cf. *Ulmus* sp. | | | | | 1 | | **1** | **0.44** | **1** | **16.67** | | | | | | | | | | | |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | 2 | | **2** | **3.23** | **1** | **14.29** |
| Angiosperm | 1 | 4 | | 1 | 9 | 1 | **16** | **7.08** | **5** | **83.33** | | | 1 | 1 | 1 | 2 | 2 | **7** | **11.29** | **5** | **71.43** |
| **TOTAL** | **11** | **23** | **15** | **8** | **161** | **8** | **226** | **100** | | | **1** | **1** | **3** | **19** | **12** | **19** | **7** | **62** | **100** | | |
| **Min No of taxa** | **1** | **5** | **3** | **4** | **9** | **3** | **14** | | | | **1** | **1** | **1** | **4** | **5** | **5** | **3** | **9** | | | |

**Table VI.8:** Anthracological results from contexts related to the roof beams and the destruction layer above the floor of *Communal Building I*, Heraion, dated to the Early Bronze II-early period.

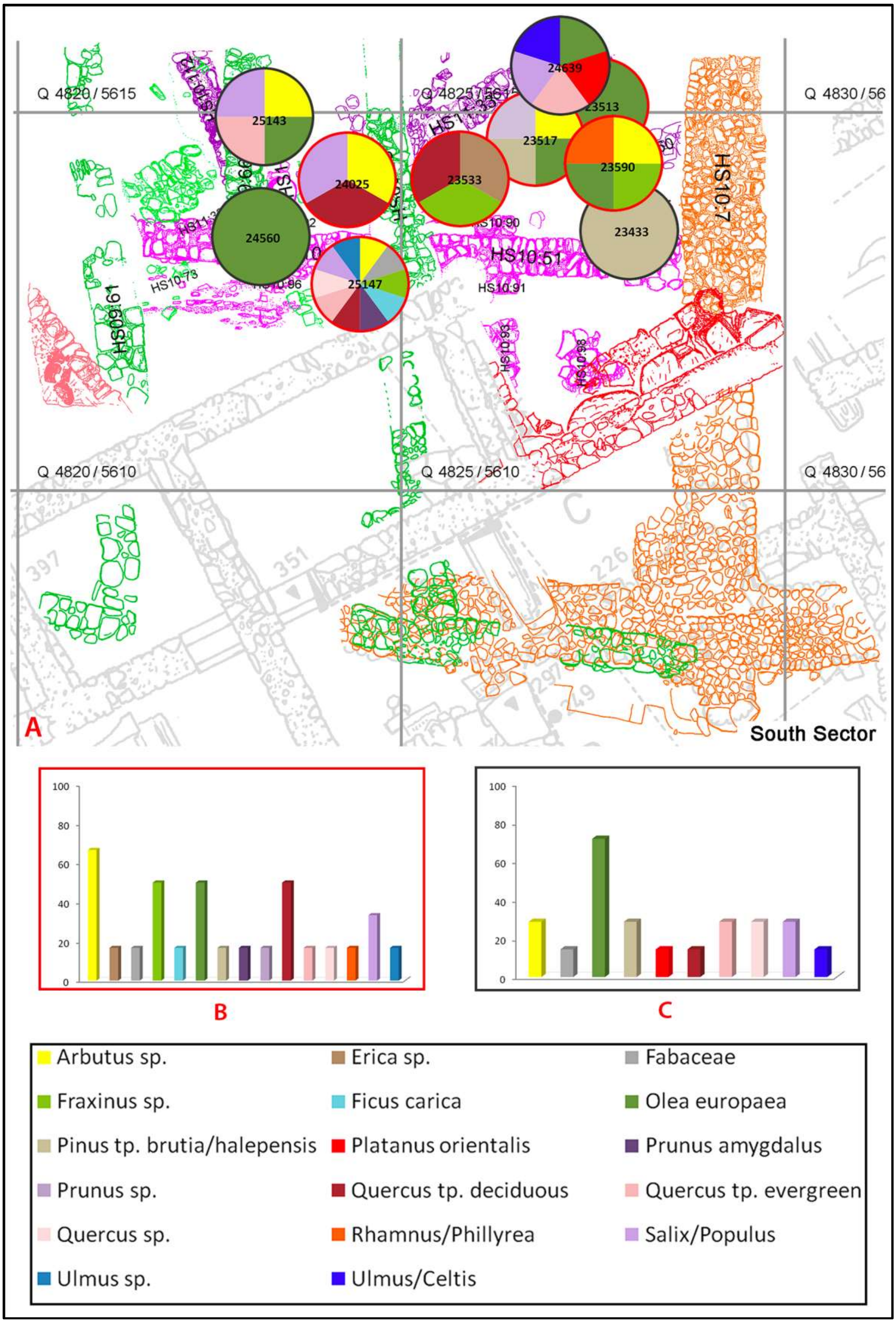



**Figure VI.5:** Distribution of the samples coming from *Communal Building I*, dated to the Early Bronze II-early period. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, bar charts present the ubiquity percentage (U%) of the taxa related to (B) the roof beams of the building and (C) to the destruction layer of its upper floor. The coordinates of samples 22305, 24638, and 24811 of last category were missing, thus these samples are not depicted on the excavation plan.

Contrary to what was observed in the samples related to the construction of the storey, where *Olea europaea* and *Quercus* type evergreen were the predominant taxa, the most represented taxon at this context is *Arbutus* sp. (28.76%), followed by *Fraxinus* sp. (19.03%), *Quercus* type deciduous (11.95%), and *Olea europaea* (7.08%). Worth noting is the high frequency percentage of *Fraxinus* sp., which resembles more the pattern seen in the Ch houses than that coming from the houses contemporary with *Communal Building I*. Additionally, it should be mentioned that sample 25147 (53/10) was that with the highest number of fragments, as well as the one including the most taxa. In fact, six of the ten taxa identified in this sample are present in no other sample from this context. According to the excavator, this sample was collected in an area where roof beams were unearthed. Thus, the high number of fragments of *Fraxinus* sp., *Quercus* type deciduous, and *Ulmus* sp. might indicate the presence of large beams made of these taxa.

Comparing the results of the samples coming from the two houses (north of wall HS10:51) used during the same period as *Communal Building I* with those coming from that same building (Fig. VI.6), it is to be observed first that for *Communal Building I* the variety of taxa used for the construction of the two lower layers of the roof is far greater than in the cases of

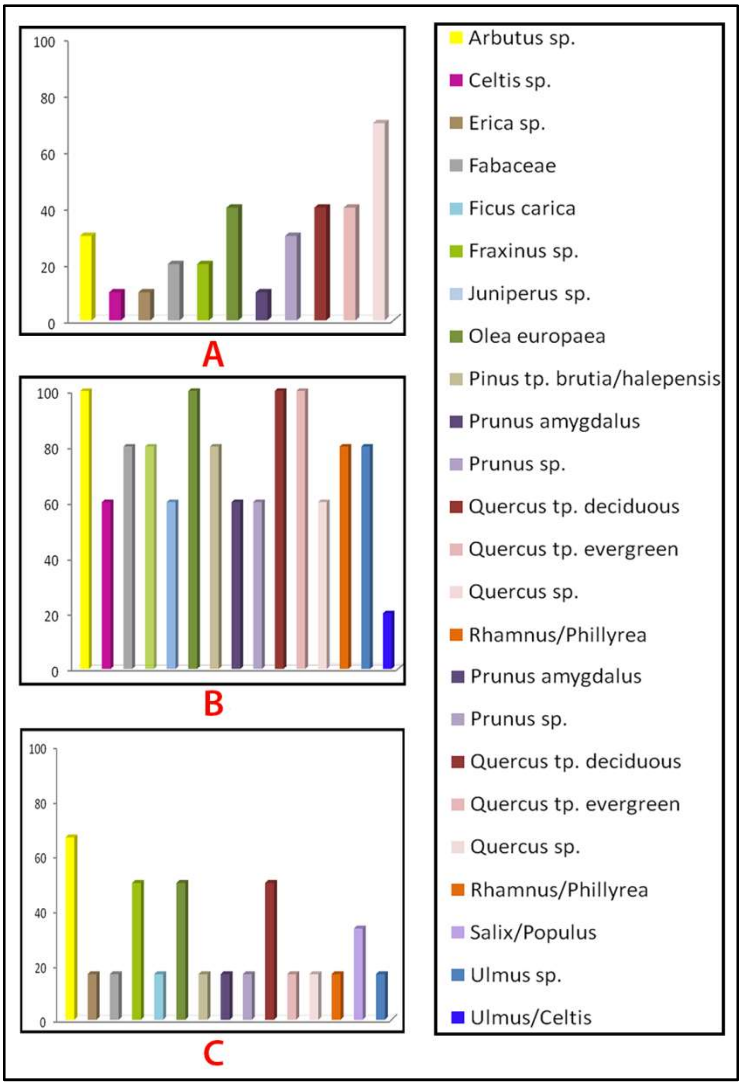



**Figure VI.6:** Bar charts showing the ubiquity percentage (U%) of the taxa recovered from (A) the house north of HS10:51 and east of HS10:70, (B) the house situated close to fortification wall HS13:30 and (C) the roof beams of *Communal Building I*. Taxa characterized as *confer* are excluded.

the two houses. Secondly, beside the difference in the use of *Fraxinus* sp. mentioned above, significant differences in the use of taxa are also noticed in the case of *Olea europaea*, *Arbutus* sp., and *Quercus* type deciduous and evergreen. In more detail, the percentage count of *Olea europaea* and *Quercus* type evergreen is significantly lower in *Communal Building I* than in the two houses, although ubiquity percentage of *Olea* is almost the same. On the contrary, the ubiquity percentage of *Quercus* type evergreen is lower than 20% in *Communal Building I*. The presence of *Arbutus* sp., at the two houses dated to the EB II-early is very low, while at *Communal Building I* this is the predominant taxon. Finally, the ubiquity percentage of *Quercus* type deciduous is almost the same in the three buildings, although the count percentage presents differences, as in the house north of wall HS10:51, and west of wall HS10:70 it rose to 19.30%.

The preference for specific taxa in the roof of *Communal Building I*, like *Fraxinus* sp. and *Quercus* type evergreen, is most likely related to the great width that had to be covered. For the same reason taxa like *Pinus* type *brutia/halepensis*, *Salix/Populus* and *Ulmus* sp. were employed, as they also produce long trunks. They are absent, however, from the houses of the same architectural phase. For the construction of the second layer of the roof, where shorter and more thickly laid branches are needed, primarily *Arbutus* sp. would have been used, and then *Olea europaea,* as well as other taxa like Fabaceae, *Quercus* sp., *Prunus amygdalus,* etc.

In contrast to the samples just discussed and coming from the roof of *Communal Building I*, the samples related to the second storey of the building tell a totally different story. Taxa like *Quercus* type deciduous, *Fraxinus* sp. and *Ulmus* sp. either have a very low presence or they are totally absent. On the other hand, *Olea europaea* and *Quercus* type evergreen have a significant presence. The predominance of these two taxa over others which produce longer trunks might have to do with the length of the upper storey: this, according to the excavator, most probably did not cover the whole extent of the building (Kouka 2010, unpublished archaeological report). In this case, the main beams could have been placed in parallel with the long walls of the building. *Quercus* type evergreen could thus have comprised the main taxon used for the beams of the lower layer of the floor, while *Olea europaea* (with its higher frequency count) could have been used in the second layer of the same. Taxa like *Pinus* type *brutia/halepensis*, *Platanus orientalis*, and

*Salix/Populus* could have been also used to make the first layer of the floor or as pillars to support it.

### 2.1.3 Middle Bronze period

The remains of five houses were unearthed in deposits of the MB period (Table VI.9, Fig. VI.7). From these, the number of wood charcoal fragments recovered from three of the four houses at the North Sector is very sparse. More specifically, the deposits of the house to the west of wall HS12:62 and that of the house to the west of wall HS12:74 yielded a very low number of charcoal fragments, with the first containing only two fragments of *Olea europaea* and the second just one fragment of *Quercus* type evergreen. A slightly higher number of charcoal fragments were recovered from the house defined by wall HS12:87. From the sixteen fragments found in the only sample from this building, five belonged to *Olea europaea*, three to *Quercus* type deciduous, and two to *Quercus* sp. Maloideae, *Pinus* type *brutia/halepensis*, *Quercus* type evergreen, and *Prunus amygdalus* are present with but a single fragment each.

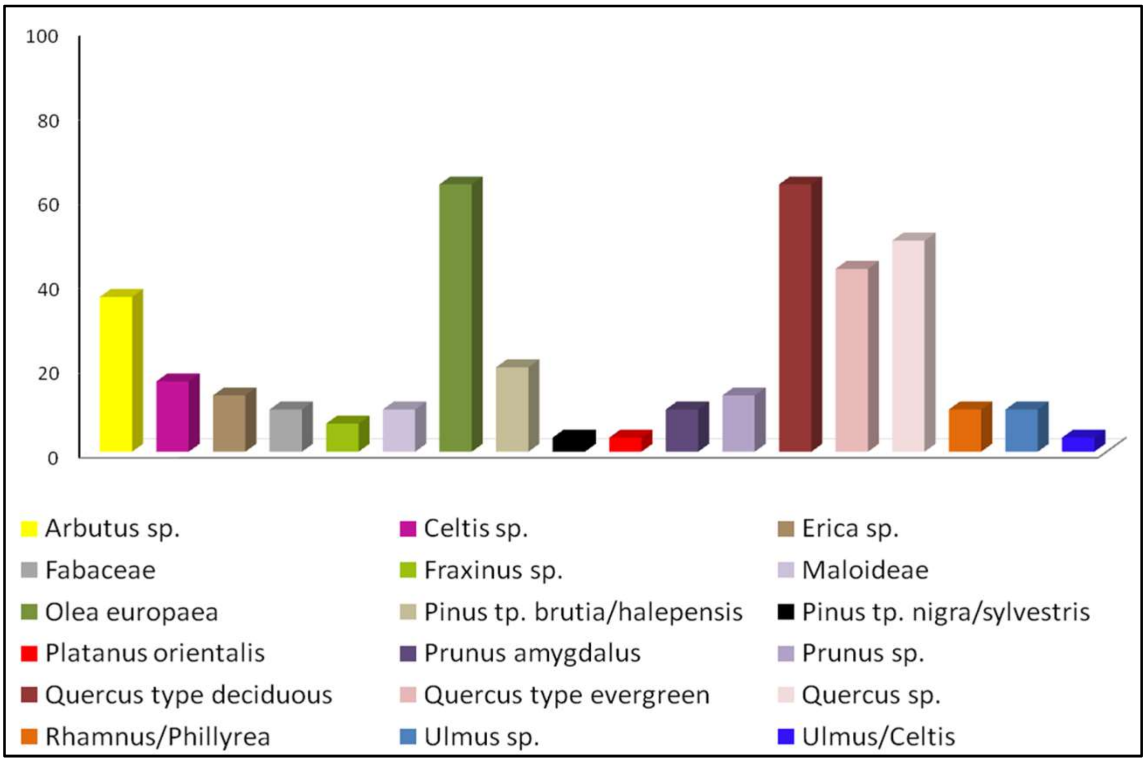



**Figure VI.7:** Bar chart showing the ubiquity percentage (U%) of the taxa identified in the samples recovered from the houses of the Middle Bronze period, at Heraion, Samos.

| Heraion of Samos - Middle Bronze Age - Buildings | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | House MBA3, W of | House MBA4, W of HS12:74 | House MBA5, East of HS12:65 | | | | | | | | | | | | | | | | | | |
| **Sector** | North | North | North | | | | | | | | | | | | | | | | | | |
| **Context** | Along West side of HS12:62 | Destruction layer W of HS12:74 | Thick Destruction layer | Thick destruction layer- Roof clay | | Thick layer of ash under roof clay and above floor | | | | | | | | | Burnt roof clay | | Ashy deposit among the stones of the floor | **N** | % | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/Excav. Year** | 70/12 | 73/12 | 56/12 | 64/12 | | 67/12 | | | | | | | | | 78/12 | | 90/12 | | | | |
| **Taxa/Samples** | 39911 | 40231 | 39106 | 39166 | 39167 | 39997 | 40205 | 40224 | 40277 | 40489 | 40492 | 40494 | 40533 | 40655 | 40270 | 40271 | 41140 | | | | |
| *Arbutus* sp. | | | | | | | 2 | | | | 1 | | 1 | 1 | | | | **5** | **2.60** | **4** | **26.7** |
| cf. *Arbutus* sp. | | | | | | | | | | | | | | 1 | | | | **1** | **0.52** | **1** | **6.67** |
| *Celtis* sp. | | | | | | | | | | | | | | | | | | | | | |
| *Erica* sp. | | | 1 | | | | | | | | | 1 | 1 | | | | | **3** | **1.56** | **3** | **20** |
| cf. *Erica* sp. | | | | | | | | | | | | | 1 | | | 1 | | **2** | **1.04** | **2** | **13.3** |
| Fabaceae | | | | | | | | | | | | 1 | | | | | | **1** | **0.52** | **1** | **6.67** |
| *Fraxinus* sp. | | | | | | | | | | | | | | | | | | | | | |
| cf. *Fraxinus* sp. | | | | | | | | | | | | | | | | | | | | | |
| Maloideae | | | | | | | | | | | | | | | | | 4 | **4** | **2.08** | **1** | **6.67** |
| cf. Maloideae | | | | | | | | | | | | | | | | | | | | | |
| *Olea europaea* | 2 | | 2 | | | | 2 | | | 1 | 1 | 2 | 93 | 3 | 3 | | 2 | **##** | **56.77** | **9** | **60** |
| cf. *Olea europaea* | | | | | 1 | | 1 | | 1 | | | | | 1 | | | | **4** | **2.08** | **4** | **26.7** |
| *Pinus* type *brutia/halepensis* | | | 1 | | | 1 | | | | | | | | | | | | **2** | **1.04** | **2** | **13.3** |
| *Pinus* type *nigra/sylvestris* | | | | | | | | 3 | | | | | | | | | | **3** | **1.56** | **1** | **6.67** |
| *Platanus orientalis* | | | | | | 1 | | | | | | | | | | | | **1** | **0.52** | **1** | **6.67** |
| *Prunus amygdalus* | | | | | | | | | | | | | | | | | 1 | **1** | **0.52** | **1** | **6.67** |
| *Prunus* sp. | | | 1 | | | | | | | | | | | | | | | **1** | **0.52** | **1** | **6.67** |
| cf. *Prunus* sp. | | | | | | 1 | | | | | | | | | | | | **1** | **0.52** | **1** | **6.67** |
| *Quercus* type deciduous | | 1 | | | 3 | 2 | 1 | | 2 | 3 | | 2 | 5 | | | | | **18** | **9.38** | **7** | **46.7** |
| *Quercus* type evergreen | | | | | | | 1 | | 1 | 2 | | | 7 | 2 | 1 | | 1 | **15** | **7.81** | **7** | **46.7** |
| *Quercus* sp. | | | 2 | | | 1 | 1 | | | 2 | | | 2 | 1 | | | | **9** | **4.69** | **6** | **40** |
| cf. *Quercus* sp. | | | | | | | | | | | | | | | | | | | | | |
| *Rhamnus/Phillyrea* | | | | | | | | | | 1 | | | | | | 1 | | **2** | **1.04** | **2** | **13.3** |
| cf. *Rhamnus/Phillyrea* | | | | | | | | | | | | | | | | | | | | | |
| cf. *Tamarix* sp. | | | | | | | | | | | | | | | | | | | | | |
| *Ulmus* sp. | | | 2 | | | | | | | | | | | | | | | **2** | **1.04** | **1** | **6.67** |
| *Ulmus/Celtis* | | | 1 | | | | | | | | | | | | | | | **1** | **0.52** | **1** | **6.67** |
| Angiosperm | | | 1 | | | 1 | | | | | 1 | 1 | | | | | | **4** | **2.08** | **4** | **26.7** |
| Monocotyledones | | | | 1 | | | | | | 1 | | | | 1 | | | | **3** | **1.56** | **3** | **20** |
| **TOTAL** | **2** | **1** | **11** | **1** | **4** | **7** | **8** | **3** | **4** | **10** | **3** | **7** | **110** | **10** | **4** | **2** | **8** | **##** | **100** | | |
| **Min No of taxa** | **1** | **1** | **7** | **0** | **2** | **5** | **4** | **1** | **3** | **4** | **2** | **4** | **5** | **4** | **2** | **2** | **4** | **15** | | | |

**Table VI.9:** Anthracological results from contexts related to the houses dated to the Middle Bronze period at Heraion, Samos.

| Heraion of Samos - Middle Bronze Age - Buildings (continuation) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | House MBA6, | | House MBA to the West of HS13:10 | | | | | | | | | | | | | | | |
| **Sector** | North | | Central | | | | | | | | | | | | | | | |
| **Context** | Burnt roof clay | | Deposits of the interior of the house | | | | | | | | | | | | | | | |
| **Stratigr. Unit/Excav. Year** | 89/12 | % | 6/13 | | | 11/13 | | | 28/13 | | | 31/13 | 48/13 | | N | % | Ubiquity | Ubiquity % |
| **Taxa/Samples** | 41146 | | 44116 | 44118 | 44119 | 43472 | 43528 | 43552 | 45067 | 45261 | 45288 | 44994 | 46044 | 48050 | | | | |
| *Arbutus* sp. | | | | | | | 39 | 2 | | 1 | 2 | 11 | 1 | 9 | **65** | **17.81** | **7** | **58.3** |
| cf. *Arbutus* sp. | | | | | | | 1 | | | | | 2 | 1 | 2 | **6** | **1.64** | **4** | **33.3** |
| *Celtis* sp. | | | | | | | | | | | | 1 | | | **1** | **0.27** | **1** | **8.3** |
| *Erica* sp. | | | | | | | 2 | | | | | | | | **2** | **0.55** | **1** | **8.3** |
| cf. *Erica* sp. | | | | | | | | | | | | | | | | | | |
| Fabaceae | | | | | | | | | | | | | 1 | 2 | **3** | **0.82** | **2** | **16.7** |
| *Fraxinus* sp. | | | 1 | | | | | | | | | | | 1 | **2** | **0.55** | **2** | **16.7** |
| cf. *Fraxinus* sp. | | | | | | | | 1 | | | | | | 1 | **2** | **0.55** | **2** | **16.7** |
| Maloideae | 1 | **6.67** | | | | | | | | | 1 | | | | **1** | **0.27** | **1** | **8.3** |
| cf. Maloideae | 1 | **6.67** | | | | | | | | | | | | | | | | |
| *Olea europaea* | 5 | **33.33** | | | 1 | 1 | 12 | 1 | | 16 | | 28 | 30 | 15 | **104** | **28.49** | **8** | **66.7** |
| cf. *Olea europaea* | | | | | | | | | | | 2 | 5 | 4 | 4 | **15** | **4.11** | **4** | **33.3** |
| *Pinus* tp. *brutia/halepensis* | 1 | **6.67** | | | | | 3 | | | | | 3 | | 2 | **8** | **2.19** | **3** | **25.0** |
| *Pinus* tp. *nigra/sylvestris* | | | | | | | | | | | | | | | | | | |
| *Platanus orientalis* | | | | | | | | | | | | | | | | | | |
| *Prunus amygdalus* | 1 | **6.67** | | | | | | | | 2 | | | | | **2** | **0.55** | **1** | **8.3** |
| *Prunus* sp. | | | | | | | | | | 2 | 1 | 1 | | | **4** | **1.10** | **3** | **25.0** |
| cf. *Prunus* sp. | | | | | | | | | | | | | | | | | | |
| *Quercus* tp. deciduous | 3 | **20.00** | 3 | 2 | 2 | 1 | 12 | 1 | | 2 | 2 | 6 | 11 | 5 | **47** | **12.88** | **11** | **91.7** |
| *Quercus* tp. evergreen | 1 | **6.67** | | | 9 | | 5 | | | | | 2 | 7 | 23 | **46** | **12.60** | **5** | **41.7** |
| *Quercus* sp. | 2 | **13.33** | | | 4 | | 4 | 2 | 1 | | 1 | 2 | 6 | 4 | **24** | **6.58** | **8** | **66.7** |
| cf. *Quercus* sp. | | | | 1 | | 1 | | | | | | 2 | 2 | | **6** | **1.64** | **4** | **33.3** |
| *Rhamnus/Phillyrea* | | | | | | | | | | | | | | 3 | **3** | **0.82** | **1** | **8.3** |
| cf. *Rhamnus/Phillyrea* | | | | | | | | | | | | | 1 | | **1** | **0.27** | **1** | **8.3** |
| cf. *Tamarix* sp. | | | | | | 1 | | | | | | | | | **1** | **0.27** | **1** | **8.3** |
| *Ulmus* sp. | | | | 1 | | | | | | | | | | 1 | **2** | **0.55** | **2** | **16.7** |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | | | |
| Angiosperm | | | | 1 | | | 2 | | | 1 | 2 | | 7 | 7 | **20** | **5.48** | **6** | **50.0** |
| Monocotyledones | | | | | | | | | | | | | | | | | | |
| **TOTAL** | **15** | **100** | **4** | **5** | **16** | **4** | **80** | **7** | **1** | **24** | **11** | **63** | **71** | **79** | **365** | **100** | | |
| **Min No of taxa** | **6** | | **2** | **3** | **3** | **4** | **6** | **5** | **1** | **5** | **6** | **7** | **6** | **9** | **15** | | | |

**Table VI.9 (continuation):** Anthracological results from contexts related to the houses dated to the Middle Bronze period at Heraion, Samos.

The fifteen samples collected from the destruction layers of the house to the east of wall HS12:65 included a total of 193 wood charcoal fragments. *Olea europaea* was the taxon with the highest ubiquity, identified in nine of the samples, while at the same time it was the one with the highest frequency (56.77%). *Quercus* type deciduous and *Quercus* type evergreen were found in seven samples each and their frequency percentages reached 9.38% and 7.81%, respectively. Finally, *Quercus* sp. was present in six samples and *Arbutus* sp. in four; however the frequency of these taxa remained below 5%.

Finally, from the house to the west of wall HS13:10 were recovered 382 wood charcoal fragments: they represent in total 15 taxa. From these taxa, *Quercus* type deciduous is that found in the most samples, as it was present in the 91.7% of them. *Olea europaea* and *Quercus* sp. were present in eight samples (66.7%), while *Arbutus* sp. and *Quercus* type evergreen were found at seven and five samples, respectively. However, the most represented taxon of this assemblage is *Olea europaea* with a percentage of 28.49%. Second comes *Arbutus* sp., while *Quercus* type deciduous is only third (12.88%), followed closely by *Quercus* type evergreen (12.60%). The only other taxon with a percentage above 5% is *Quercus* sp. (6.58%).

Overall, during the MB period, the taxa most frequently met with in the assemblages from the houses were *Quercus* type deciduous, *Olea europaea*, *Quercus* sp. and *Quercus* evergreen, followed closely by *Arbutus* sp. and lastly by *Pinus* type *brutia/halepensis*. These taxa had also had a significant presence during the previous period, along with other taxa like Fabaceae, *Fraxinus* sp., and *Prunus* sp. However, the later set scored very low ubiquity percentages during the MB period.

In the two houses (i.e. house east of wall HS12:65-North Sector and house west of wall HS13:10-Cental Sector) the fragments count exceeded 100 specimens (Fig. VI.8), the dominant species was *Olea europaea*. However, in the house at the North Sector there is observed a concentration of *Olea* wood charcoal fragments in sample 40533 (67/12), which takes the overall count percentage of the species to above 55%. Unfortunately, there is not enough information on the context of the sample to explain the presence of so many fragments of *Olea*, as the archaeobotanical form could not be located in the archives of the excavation. As the sample was collected from under the roof clay and above the floor, it is very likely that *Olea* frag-

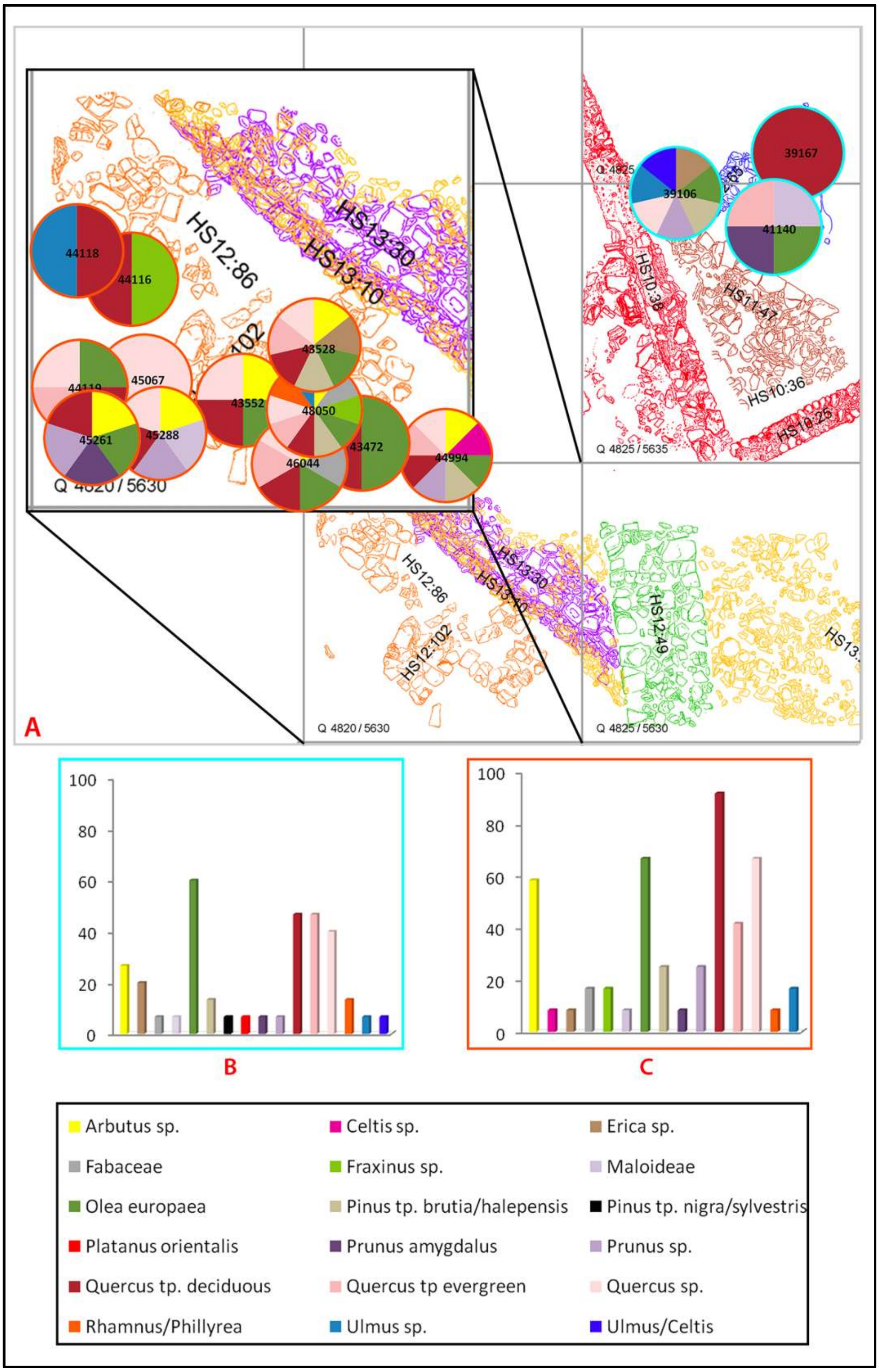



**Figure VI.8:** Distribution of the samples coming from the houses of Heraion dated to the Middle Bronze period, which contained more than 100 fragments. (A) Pie charts depict the taxa included in each sample. Taxa characterized as *confer* are excluded. At the bottom, bar charts present the ubiquity percentage (U%) of the taxa recovered from (B) the house situated to the east of HS12:65, and (C) the house to the west of HS13:10. The coordinates of samples 39997, 40205, 40224, 40277, 40489, 40492, 40494, 40533, 40655, 40270, and 40271 of the first house were missing, thus these samples are not depicted on the excavation plan.

ments correspond to a beam or big branch, although the possibility they result from the burning of a wooden object cannot be excluded.

Along with *Olea*, other taxa with strong presence at these two houses are *Quercus* type deciduous and *Quercus* type evergreen, while at the house west of wall HS13:10, *Arbutus* sp. has both high frequency percentage and ubiquity percentage. Consequently, it is reasonable to suggest that during the MB period the main taxon used for the construction of the main beam of the roof was *Quercus* type deciduous, while in the second layer were primarily used *Olea europaea* and *Quercus* type evergreen as well as *Arbutus* sp. Other taxa which could have been used for the construction of the first layer of the roofs, as they produce long trunks, are *Fraxinus* sp., *Celtis* sp., *Pinus* type *brutia/halepensis*, *Platanus orientalis*, *Salix/Populus,* and *Ulmus* sp. However, as was the case of the EB period, their presence is too limited to allow of secure suggestions. Exceptional is the presence of *Pinus* type *nigra/sylvestris* in the house situated east of wall HS12:65, as this is the only time this taxon is identified at the site in relation to buildings. Although, it is possible that *Pinus nigra* and/or *Pinus sylvestris* could grow on the highest tops of the mountains of the island as it is the case today, the absence of the taxon from any other context indicates that the inhabitants of Heraion preferred to use those taxa in the construction of their houses which were available close to the settlement. The fact that *Pinus* type *nigra/sylvestris* was identified in only one sample and in very low quantity (three fragments) makes it likely that their source was a wooden object that got burnt during the destruction of the house, rather than a beam.

### 2.2. Earth Floors, Hearths, and Threshold

Overall, the total number of charcoal fragments recovered from floors was low (Table VI.10). From the slab floor of the Ch house unearthed under wall HS11:33, eleven fragments were recovered. In these, *Olea europaea* (36.36%) is the most frequent species, followed by *Fraxinus* sp. (18.18%) and *Quercus* type evergreen (18.18%). The samples collected from the floor and its sub-layer at the east room of the house to the north of wall HS10:73, dated to the EB period, present a higher variety of taxa. The dominant taxon from this assemblage is *Quercus* type deciduous (22.8%), followed by *Arbutus* sp., *Olea europaea*, and *Prunus* sp. which are

| Heraion of Samos - Building Features | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chalcolithic period | | | | | | Early Bronze period | | | | | | | | | | | | | | | | | | | Middle Bronze period | | | | | |
| | Chalcolithic House under the foundation of HS11:33 | | | | | | House N of HS10:73- East Room EB I/II (EB4) | | | | | | | | | | | | | House N of HS10:51 and E of HS10:70 EB II-early (EB3) | | | | | | House MBA to the West of HS13:10 | | | | | |
| **Sector** | South | | | | | | South | | | | | | | | | | | | | South | | | | | | Central | | | | | |
| **Context** | Slab floor | | **N** | % | **Ubiquity** | **Ubiquity %** | Hearth | | **N** | % | **Ubiquity** | **Ubiquity %** | Floor | Floor Substrata | | **N** | % | **Ubiquity** | **Ubiquity %** | Threshold | | **N** | % | **Ubiquity** | **Ubiquity %** | Hearth | | **N** | % | **Ubiquity** | **Ubiquity %** |
| **Stratigr. Unit/Excav. Year** | 84/11 | | | | | | 32/11 | | | | | | 81/11 | 44/11 | | | | | | 68/10 | 111/10 | | | | | 36/13 | | | | | |
| **Taxa/Samples** | 33460 | 33473 | | | | | 30792 | 30854 | | | | | 33219 | 31731 | 31900 | | | | | 26026 | 26308 | | | | | 43379 | 45301 | | | | |
| *Arbutus* sp. | | | | | | | 2 | | **2** | **9.52** | 1 | **50** | 1 | 4 | 1 | **6** | **10.53** | **3** | **100** | | 1 | **1** | **20.0** | 1 | **50.0** | | | | | | |
| cf. *Arbutus* sp. | | | | | | | | | | | | | | | 1 | **1** | **1.75** | **1** | **33.33** | | | | | | | | | | | | |
| Fabaceae | | | | | | | | | | | | | 2 | 1 | | **3** | **5.26** | **2** | **66.67** | | | | | | | | | | | | |
| cf. Fabaceae | | | | | | | | | | | | | 3 | | | **3** | **5.26** | **1** | **33.33** | | | | | | | | | | | | |
| *Fraxinus* sp. | 1 | 1 | **2** | **18.18** | **2** | **100** | | | | | | | | | | | | | | | | | | | | | | | | | |
| cf. *Fraxinus* sp. | 1 | | **1** | **9.09** | **1** | **50.0** | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Olea europaea* | 4 | | **4** | **36.36** | **1** | **50.0** | | 2 | **2** | **9.52** | 1 | **50** | 6 | | | **6** | **10.53** | **1** | **33.33** | | 1 | **1** | **20.0** | 1 | **50.0** | 1 | 5 | **6** | **31.58** | **2** | **100** |
| cf. *Olea europaea* | | | | | | | 1 | 1 | **2** | **9.52** | **2** | **100** | 1 | | | **1** | **1.75** | **1** | **33.33** | | | | | | | | | | | | |
| *Prunus amygdalus* | | | | | | | 1 | | **1** | **4.76** | 1 | **50** | | 1 | | **1** | **1.75** | **1** | **33.33** | | | | | | | | | | | | |
| *Prunus* sp. | | | | | | | 1 | | **1** | **4.76** | 1 | **50** | | 6 | | **6** | **10.53** | **1** | **33.33** | | | | | | | | 1 | **1** | **5.26** | **1** | **50** |
| cf. *Prunus* sp. | | | | | | | | | | | | | | 1 | | **1** | **1.75** | **1** | **33.33** | | | | | | | | 1 | **1** | **5.26** | **1** | **50** |
| *Quercus* tp. deciduous | 1 | | **1** | **9.09** | **1** | **50.0** | | | | | | | 4 | 1 | 8 | **13** | **22.81** | **3** | **100** | | 1 | **1** | **20.0** | 1 | **50.0** | | | | | | |
| *Quercus* tp. evergreen | 1 | 1 | **2** | **18.18** | **2** | **100** | | 6 | **6** | **28.57** | 1 | **50** | 1 | | 1 | **2** | **3.51** | **2** | **66.67** | | | | | | | | | | | | |
| *Quercus* sp. | | | | | | | 1 | 2 | **3** | **14.29** | **2** | **100** | 1 | 1 | | **2** | **3.51** | **2** | **66.67** | | | | | | | | | | | | |
| cf. *Quercus* sp. | | | | | | | | | | | | | | | | | | | | 1 | | **1** | **20.0** | 1 | **50.0** | | | | | | |
| *Rhamnus/Phillyrea* | | | | | | | | | | | | | 1 | | | **1** | **1.75** | **1** | **33.33** | | | | | | | 10 | | **10** | **52.63** | **1** | **50** |
| *Ulmus* sp. | | | | | | | 1 | | **1** | **4.76** | 1 | **50** | 2 | | | **2** | **3.51** | **1** | **33.33** | | | | | | | | | | | | |
| *Ulmus/Celtis* | | | | | | | | | | | | | | | | | | | | 1 | | **1** | **20.0** | 1 | **50.0** | | | | | | |
| cf. *Ulmus/Celtis* | 1 | | **1** | **9.09** | **1** | **50.0** | | | | | | | | | | | | | | | | | | | | | | | | | |
| Angiosperm | | | | | | | 1 | 2 | **3** | **14.29** | **2** | **100** | 3 | 6 | | **9** | **15.79** | **2** | **66.67** | | | | | | | | 1 | **1** | **5.26** | **1** | **50** |
| **TOTAL** | **9** | **2** | **11** | **100** | | | **8** | **13** | **21** | **100** | | | **25** | **21** | **11** | **57** | **100** | | | **2** | **3** | **5** | **100** | | | **11** | **8** | **19** | **100** | | |
| **Min No of taxa** | **5** | **2** | **5** | | | | **6** | **3** | **7** | | | | **7** | **6** | **3** | **9** | | | | **2** | **3** | **5** | | | | **2** | **2** | **3** | | | |

**Table VI.10:** Anthracological results from contexts related to features of the houses of Heraion of Samos, dated to the Chalcolithic, Early Bronze, and Middle Bronze periods.

all present with the same number of fragments. The only other taxon with percentage higher than 5% is Fabaceae (5.26%).

The wood charcoal fragments found within the slab floor and the soil floor in the Ch and EB houses respectively could have been accumulated during their last occupational phase, or they could be part of the collapsed roof of the building or even some wooden objects which got burn during the destruction of the house. The fragments recovered from the slab floor of the Ch house were very few, but all in all they belong to the taxa most represented at the samples recovered on top of this floor (these were judged to be part of the collapsed roof). Thus, it is very probable that the fragments recovered from the slab floor were also part of the wooden timber of the roof. The floor and its sub-layer excavated in the EB house present a higher variety of taxa and a larger number of fragments in comparison to those coming from the destruction layer of the house (see Tables VI.7 and VI.10). Additionally, it is observed that *Quercus* type deciduous has a greater percentage in the samples coming from the floor and its sub-layer, while *Olea europaea* and *Quercus* type evergreen are presented with a lower percentage. This might suggest that some of the fragments found at the floor-level belong to wooden objects which got burnt or that at this area was used to store fuel wood destined to be used at the nearby hearth.

The hearth of the house to the north of wall HS10:73 contained a rather small number of fragments, less than 25. These belong to seven taxa from which *Quercus* evergreen (28.57%) was the best represented, followed by *Quercus* sp. (14.28%), *Arbutus* sp. (9.52%), and *Olea europaea* (9.52%). As it can be seen in Table VI.10, the taxa identified in the hearth samples are almost the same as those coming from the floor samples, with only Fabaceae, *Quercus* type deciduous and *Rhamnus/Phillyrea* missing. The samples from the hearth are also in good accordance with those coming from the charcoal macroremains found scattered in the fills of the EB II period, with the taxa present remaining more or less the same. The high percentage of *Quercus* type evergreen in the hearth can be explained by the fact that samples coming from hearths represent the last fire event (Badal, 1992, 1990; Chabal, 1992, 1988) and thus it is likely that *Quercus* type evergreen was one of the taxa used during this event.

From the hearth found in the MB house situated to the west of HS13:10 were identified three taxa, of which the one with the highest percentage is *Rhamnus/Phillyrea* (52.63%), which is otherwise absent from the samples coming from the fills of this period, while *Olea europaea* (31.58%) which is the dominant taxon in the fill samples comes second. Again, this situation can be clarified by the fact that the samples coming from the hearth mirror the last fire event: they cannot be assumed to be representative of the taxa used overall as fuel wood.

Finally, only a very few charcoal fragments were retrieved from the threshold excavated at the east end of wall HS10:51. This threshold was constructed of slabs made of limestone (Kouka 2010, unpublished archaeological report). During the latest architectural phase of the building, to the north and south (either side) of the threshold there existed, according to the excavator, two lines of limestone slabs set at a higher level, which most probably composed the foundation of a wooden threshold there. The two samples analysed are from the part above the slab stones where fragments of burnt wood were found. The samples contained in total five fragments - one from each taxon; *Arbutus* sp., *Olea europaea*, *Quercus* type deciduous, cf. *Quercus* sp., and *Ulmus/Celtis*. The overall number of fragments identified at this threshold is too low to suggest they were actually part of the wood used either for the construction of the threshold itself or for the wooden door that likely existed there. Further, the fact that all five specimens represent a different taxon probably further argues that the woods are not all likely to belong exclusively to the threshold. Consequently, some of these taxa might be related to the threshold, other to the door-leaf and some even to the lintel and jambs of the door.

### 2.3. Explaining the preference for specific taxa

The houses of Heraion were constructed following the methods used on the Western Anatolia littoral during the Ch and the Bronze period, where wooden architectural elements were employed for the construction of the flat roofs of the buildings (Erkanal, 2011). The inhabitants of Heraion in constructing the wooden parts of the roofs took full advantage of the vegetation prevailing in close proximity to the site, seemingly choosing to ignore other woody vegetation types that likely existed in the higher areas of the island, which would have provided large timber for construction material, like *Pinus nigra* and *Pinus sylvestris*. Although an example of this last taxon was recovered from the interior of a MB house, it is more probably related to a wooden object and not a structural timber. During the EB and the MB periods, they used basically the same taxa: mainly *Olea europaea*, *Quercus* type deciduous and *Quercus* evergreen. In the Ch houses a significant role was played, along with the taxa mentioned above, by *Fraxinus* sp. and *Ulmus* sp. The drop in the presence of these two taxa during the later periods might be related to the reduction of the taxa in the environment, or to a change in the selection criteria, prioritizing now the taxa in the mixed woodland formations close to the site, rather than those growing by the banks of the nearby river.

The properties of the wood of *Olea europaea*, *Quercus* type deciduous and *Quercus* type evergreen as well as evidence collected in other excavations where these taxa were recovered from destruction debris, have been already discussed in detail in the relevant chapter of Akrotiri (Chapter V.2.7). Here, a shorter reference to the earlier discussion is all that is required: only the manner how these taxa were utilized at the buildings of Heraion will be presented in some detail.

*Olea europaea* is one of the species with a constant presence in the buildings of Heraion throughout all the habitation phases of the settlement. The species provides timber of great quality, eminently suitable for construction-work (Gale and Cutler, 2000). However, unlike Akrotiri, at Heraion the species was most probably utilized only for the second layer of the roofs, where smaller branches are needed. As large charcoal fragments related to buildings were not recovered, the existence of a large beam from this species can only be argued for convincingly at the house east of wall HS12:65, dated to the MB period, where sample 40533 with a high concentration of fragments of the species was recovered from a context associated to the construction of the roof. The use of olive in the EB and MB period houses can be hypothesized by its significant presence in the surroundings of the settlement, in consequence of the manipulation of the species for the production of olive oil (Margaritis, 2013)(see Chapter VI.1.2), which most probably led to its proliferation. The use of branches cut from controlled and cultured trees is indicated by the presence of growth rings in 7.95% of *Olea* fragments identified in samples coming from the houses of the EB period, and 3.2% of those coming from the same sorts of contexts of the MB period.

Unfortunately, evidence for the use of *Olea europaea* as construction timber at sites of the northeast Aegean is absent. However, the presence of *Olea europaea* fragments from contexts related to destruction layers of houses at two settlements situated in islands of southern Aegean dated to the EB period, indicate the utilization of branches of the species for constructions there at least. In more detail, at Myrtos-Fournou Korifi, Crete (Rackham, 1972) and Dhaskalio, Keros (Ntinou, 2013a) branches of *Olea* were used for the vegetal layer covering the main beams of the roof of houses.

Other taxa, with significant presence at the assemblages of the houses of Heraion, were *Quercus* type deciduous and evergreen. The impressive quality of the timber of *Quercus* type deciduous and its great trunk height (see Chapter IV), along with its resistance to fungi and insect attacks, makes it very suitable for constructions (Gale and Cutler, 2000; Marguerie and Hunot, 2007). Furthermore, in the case of Heraion, the existence of oak woodland in the vicinity of the site gave the inhabitants easy access to good class timber, which fulfilled their need for tall and straight poles in constructing the main beams of the roofs of their houses. Thus is explained the large amount of the taxon in the assemblages of Heraion, as well as its great ubiquity.

Two of the three evergreen oaks which could grow on the island, namely *Quercus aucheri* and *Quercus coccifera,* do not reach any great heights, as their trunks do not exceed 6 m tall. On the other hand, the third of the evergreen oaks probably present on the island, *Quercus ilex*, can reach height of over 20 m. In this way from all three species could be produced beams suitable for the first layer of the roofs, which did not exceed 4.5 m in width, as well as for the upper floor of *Communal Building I*, which is believed to have had the form of a loft. Additionally, the smaller branches of the taxon could have been used at the second layer of the roofs of the buildings. Evidence for the use of *Quercus* sp. as construction material in the northeast Aegean is forthcoming from the EB period settlement of Yenibademli (Imbros, Turkey) (Yaman, 2011), while *Quercus* type deciduous have been recovered from relevant contexts at Dhaskalio, Keros, dated to the same period (Ntinou, 2013a).

At Heraion were also used timbers coming from taxa growing in the nearby riverine forest, like *Fraxinus* sp., *Ulmus* sp., *Celtis* sp. and *Salix/Populus*. The preference for these taxa must be attributed to the ease of collection, as much as for the excellence of their timber. All these taxa produce straight and tall trunks suitable for making the long beams of the lower layer of the roofs, while their branches could have been utilized again in the second layer. *Ulmus* sp. and *Celtis* sp. are tough and resistant to water decay, although *Ulmus* sp. is perishable in dry conditions (Gale and Cutler, 2000). *Fraxinus* sp. has a greater "modulus of rupture", which makes it more resilient and resistant in comparison to the other taxa. It is thus more suitable to withstand the weight of the roof.

Last but not least a short observation must be made on *Pinus* type *brutia/halepensis* and *Arbutus* sp., which could both grow on the mixed woodland that most probably existed near the site. *Arbutus* sp. is not considered suitable for construction (despite its significant crushing strength) because of the distorted shape of its trunks. Its increasing presence in the samples must be mainly related to its use in the second layer of the roofs, were no need for straight branches existed. On the other hand, the wood of *Pinus* type *brutia/halepensis* was used systematically in the Mediterranean during the antiquity (Gale and Cutler, 2000): this mainly due to its resistance to fungal attacks due to the presence of resin (Phillips and Croteau, 1999), as well as the great height its trunk could attain. However, the presence of this taxon is very low in the buildings at Heraion, which is commensurate with its low scores in the samples coming from the fills of the Early and Middle Bronze period.

# VII. Conclusion

This thesis has focused on the analysis of wood charcoal macroremains from the archaeological sites of Akrotiri on Thera and Heraion on Samos. The main objectives of this study were three. The first was to investigate the vegetation surrounding the two sites throughout their occupation and how the inhabitants transformed the landscape to gain access to useful resources. The second was to study the progress in arboriculture and the cultivation of species and how these affected the economy of the settlements. Finally, the third objective was to study the taxa used in the construction of the buildings of the settlements, identify differences in the taxa used between private and public buildings, and finally examine the reason for the preference on specific taxa over others.

It has been demonstrated that the inhabitants of both sites exploited the vegetation in close proximity to their settlements to harvest fuel wood, as well as to collect timber for the construction of their houses. From the MB period onwards in both cases there is observed a modification towards a more controlled landscape: this is expressed both as an increase in profitable taxa, like *Olea europaea,* and as changes in the vegetation related to human actions, mirroring the economy of the Bronze Age societies living there. Concerning the buildings on the sites, differences between the taxa used in various features of structures (doors, roofs, floors, etc.) were able to be recorded. Overall, the selection of specific taxa as construction timber is mostly related to their availability in the environment, although it has been demonstrated that the builders had a good understanding of the properties of the taxa used.

In the case of Akrotiri, the present study has enriched the number of endogenous and exogenous taxa already known from previous studies and verified the hitherto obscure presence of some taxa like *Juniperus* sp. and *Tamarix* sp. (Asouti, 2003). Also, it attested to the presence of a pine forest on the island with the major component being *Pinus* type *brutia/*halepensis. Additionally, it verified the import of structural timbers from other areas of the Aegean. In the case of Heraion, this work constituted not only the first anthracological study at the island of Samos, but also the first conducted in the

North Aegean islands. This analysis hopefully will provide a base-line for further fruitful discussions regarding the past vegetation of the area and the uses of wood.

In more detail, in Akrotiri samples from fills and dumps, suitable for the evaluation of the surrounding vegetation of the site, came from Pillars 18, 35, 66Π, and 67, as well as from the area of the Square of the Cenotaph. These samples cover the time span between EC II/EC III and the final occupational phase of the settlement, destroyed by the volcanic eruption during LC I. Additionally, samples from the interior of Xeste 3, the House of the Ladies and three rooms of houses unearthed in Pillars 66Π and 67 were used to study the uses of wood made in construction.

The interpretation of the anthracological diagram of Akrotiri suggests that during the EC period an open pine forest existed on the island, with the main component being *Pinus* type *brutia/halepensis*, and with *Juniperus* sp., *Olea europaea*, and Fabaceae as co-dominant taxa. Additionally, there existed areas where hydrophilic taxa like *Quercus* type deciduous, *Salix/Populus*, and *Alnus/Corylus* could grow. The above anthracological evidence is also supported by both phytolith studies (Vlachopoulos and Zorzos, 2014) which suggest the presence of water-retaining soils, as well as from microfaunal (Papagianni, 2012) and entomological analyses (Panagiotakopulu, 2000) which also indicate the occurrence of forested areas on the island prior to the eruption.

From the MC period onwards is observed a change in the economy of the settlement. From this period, the presence of *Olea europaea*, *Punica granatum*, *Prunus amygdalus*, and other fruit-bearing taxa increased significantly, at the same time that *Pinus* type *brutia/halepensis* is reduced and heliophilous taxa appear. This indicates that the inhabitants favoured economically valuable taxa, whose products could be consumed at the settlement or used for trade. The landscape would have been characterized by the presence of olive groves, while closer to water sources, and in addition to the wild hydrophilic taxa, would have existed orchards where fruit-bearing taxa grew. The anthracological evidence, with its increased percentages of *Olea europaea* and the presence of growth rings on the same, attests to the cultivation of this species, most probably ongoing since the MC period. Carpological evidence dated to the LC I affirms the cultivation of olive trees and production of olive oil during this period at the settlement (Sarpaki, 1987). This increase in the presence of *Olea europaea* and other fruit-bearing taxa, seen as an indication of their management, coincides with pollen records from Crete and mainland Greece (see among others: Bottema, 1994; Bottema and Worldring, 1990; Kotthoff et al., 2008; Triantaphyllou et al., 2010). Additionally, one more aspect of the economic life of the Therans could have been the production of silk fabrics, as the native silkworm of *Pachypasa otus* (L.) identified by Panagiotakopulu et al. (1997) can feed on *Quercus* type deciduous and *Juniperus* sp., which trees existed in close proximity to the settlement.

Along with the flora growing on the island, in the MC and LC I assemblages of Akrotiri were identified exogenous taxa like *Cupressus sempervirens*, *Pinus* type *nigra/sylvestris*, *Castanea sativa,* and *Cedrus libani*. The presence of these taxa affirms the importation of luxurious wooden objects and probably timber into the settlement. These taxa attest also to trading connections of the Therans with – potentially – Crete, mainland Greece, Cyprus, Asia Minor, and the islands of North and East Aegean.

As to the buildings of the final phase of the settlement, it can be said that no differences were observed in the taxa used in private and in public buildings. The builders of Thera took full advantage of the woody vegetation growing on the island to gain the structural material they needed for the wooden floors, doors, windows, and for the wooden framing of the walls of their buildings. For the taxa used in the beams supporting the upper storey, where long and thick poles were needed, *Pinus* type *brutia/halepensis* and possibly *Juniperus* sp., and to a lesser extend *Cupressus sempervirens* and *Quercus* type deciduous were used. Additionally, the presence of *Olea* beams in contexts related to the main layer of the floors argues for the existence on the island of these trees with long branches, which could yield the timber needed to cover the distance between the walls of the buildings. The use of this species for the construction of large beams is remarkable: first because this is one of the few such cases known from the Cyclades and Crete, but mainly because of the implied economic sacrifice that the taking of such timbers implies. It should though be remembered here that the presence of olive beams does not necessarily demand the felling of the whole tree. Such a use of this specific species is most probably related to its abundance in the landscape of the island, at least during the LB period. For the second layer of these floors a greater variety of taxa was used, which could be recovered from the vegetation growing in close proximity to the settlement, like *Juniperus* sp., *Quercus* type evergreen, and *Prunus amygdalus*.

In a similar way, the variety of taxa used for the construction of the other features of the buildings, like pier-and-door partitions, the infrastructure of the walls, and so on, was great (e.g. Fabaceae, Cistaceae, *Ficus carica*, *Quercus* type deciduous and evergreen, *Tamarix* sp.), with *Olea europaea* being the most ubiquitous species. Finally, the identification of *Cupressus sempervirens* and *Castanea sativa* in contexts related to destruction debris suggests a strong indication for the importation of structural timbers and not only wooden objects made of exogenous taxa.

Overall, the cultivation of *Olea europaea* and fruit-bearing taxa, among which *Punica granatum* stands out as an introduced species, the importing of luxurious timbers, and the construction of buildings decorated with lavish frescos are indicators of the high level of economic well-being the inhabitants of Akrotiri enjoyed. The cultivation of olive trees for the production of olive oil is related to the presence of a stratified society in the settlement, something which is observed all over the Aegean during the LC period (Valamoti et al., 2018). Additionally, the ability of the inhabitants to import and possess luxurious objects, some of which were made of wood, mirrors their trading connections with areas across the Aegean and their consequent wealth. As the influence of Crete increases from late MC onwards, Therans adopt new techniques in the material world, and cultural and social behaviours too (Nikolakopoulou, 2009). However, they do not abandon their connections with other settlements of the Aegean, as is indicated by the potential provenances of the exogenous taxa identified.

For the future, further anthracological analyses from deposits in the interior of houses could shed light on the use of the exogenous taxa as timbers or as wooden objects, or indeed as both. Additionally, more precise sampling from areas where doors and windows occurred would add further information on the taxa used for their construction. Last but not least, the study of anthracological samples coming from houses dated to the MB period will allow comparison on the taxa preferred during different architectural phases of the site.

The anthracological investigation at the site of Heraion encountered a few difficulties, mainly due to the generally small size of the fragments, exacerbated by the low number of wood charcoal fragments recovered from the Ch and Archaic deposits, which naturally has hindered the understanding of the vegetation existing during these periods.

Concerning the prehistoric phases of the settlement, information on the palaeoenvironment is drawn mainly from the EB Age. Thus, the anthracological record suggests the presence of a riparian forest where *Quercus* type deciduous was dominant and *Fraxinus* sp., *Ulmus* sp., and *Platanus orientalis* were also present. Additionally, in close proximity to the site a mixed open woodland also existed, with *Arbutus* sp. and *Quercus* type evergreen, which would be also the natural habitat of *Olea europaea* present already since the Ch period. The inhabitants of Heraion relied exclusively on the tree taxa they could find in proximity to the site to cover their need in fire wood. No exogenous taxa were identified during the Bronze Age period.

Very important here is the recovery of wood charcoal fragments of *Olea* with growth rings, which imply the management of the tree since the EB Age times. This, in addition to the recovery of olive stones from contexts related to oil production (Kouka, 2015; Margaritis, 2013) and the presence of jars suitable for oil transport dated to the same period (Kouka and Menelaou, 2018) attest to the regular and purposeful management of *Olea europaea* at the site from as early as EB II. In addition to *Olea*, *Prunus amygdalus* and *Ficus carica* were also exploited for their fruits during the Bronze Age period, as is suggested by both the anthracological and carpological records. Finally, there is a great possibility that the inhabitants of Heraion were pollarding *Quercus* type deciduous in order to gain fodder for their animals: this is suggested by the presence of narrow rings in the specimens of this taxon.

During the Roman period a turn towards a more controlled landscape is observed at Heraion, mirroring the results of anthropogenic pressure upon it. The openness of the canopy of the mixed woodland formations in proximity to the site must have been greater than in the prehistoric period. The pyrophilous taxa, namely *Arbutus* sp., *Quercus* type evergreen and *Erica* sp. that prevailed in the assemblage, indicate fire events which were most probably deliberate, related to the formation of grazing lands and/or areas for cultivation (Houérou Le, 1974). Additionally, the vegetation of the riparian forest was most probably now degraded, as is indicated by the increase in the percentages of *Platanus orientalis*, which is the only species among the hydrophilic taxa identified which can grow in gravely soils (Dafis, 2010). This situation may have come about from the erosion of the alluvial deposits in areas close to the site, after the eradication of the *Quercus* type deciduous forest which had grown there since the EB. Of course, another cause for the increase of *Platanus orientalis* is that of culturally-prompted behaviour – the species could have been valued as ornamental at the settlement. The high percentages of *Olea europaea* most probably reflect its cultivation during this period. Finally, during this period were recovered fragments of *Pinus* type *nigra/sylvestris*, a taxon which today grows on the higher tops of the island. Its presence indicates the exploitation of the mountainous areas of the island for the collection of fire wood or timber appropriate for carpentry items or construction.

Deposits suitable for the estimation of the taxa used in the making of the flat roofs for the buildings at Heraion are to be found in the Ch, EB, and MB periods. In general, changes are observed in the preferred taxa from period to period, as well as between the private and communal buildings dated to the EB II occupation.

During the Ch period, the taxa preferred were gathered in the riparian formations close to the site, with the main taxon used being *Fraxinus* sp., with *Olea europaea* and *Quercus* type evergreen present in a significant number of samples. During the next two phases, the presence of hydrophilic taxa is reduced, whilst only the *Quercus* type deciduous increases. At the same time the visibility of taxa growing in open and mixed formations, like *Quercus* type evergreen, Fabaceae, *Arbutus* sp., and *Olea europaea*, is on the rise. In fact during both periods *Olea europaea* is the most frequently met taxon in the samples under study. The increase in the ubiquity and frequency percentages of *Olea europaea* in the buildings is most probably related to its management, which has been under way from the EB period, as more branches would thus be readily available for use during the construction of the roofs.

The difference observed between the taxa used for the private houses of EB II period and those for *Communal Building I* indicates how the inhabitants of the site adapted their preferences based on the area they had to roof. As the *Communal Building I* was far larger than the ordinary houses, the use of taxa with long trunks, like *Fraxinus* sp., *Salix/Populus*, and *Ulmus* sp., was essential. On the other hand, for the second storey in the form of a loft, they used mainly *Olea europaea* and *Quercus* type evergreen, just as in the private houses.

Future excavation of the Chalcolithic layers of Heraion and the study of the anthracological material so recovered are deemed necessary for a better understanding of the taxa prevailing in the landscape during the earlier occupational phases of the site. Similarly, the study of anthracological material from better assemblages of the Archaic period will help to evaluate further how the inhabitants affected the environment surrounding the site over time. Finally, house deposits from the Archaic and the Roman period will allow the detection if and how the preference for structural timbers changed over time, and if any such is to be related to their availability in the landscape or to a better appraisal of their specific properties.

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