Farming and Trade in Amheida/*Trimithis* (Dakhla Oasis, Egypt): New Insights from Archaeobotanical Analysis

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Abstract. This paper presents the results of the first archaeobotanical investigation carried out by the University of Salento archaeological team during the 2015 field season at the site of Amheida/*Trimithis* in Dakhla Oasis, Egypt. The bulk of the recovered material consists of seeds and fruits from midden deposits that lay under the foundation of an upper class fourth century AD house and the adjoining school, and similar deposits beneath streets that flanked the house. Overall, almost 600 seeds were recovered. The archaeobotanical assemblage includes nine species of fruit trees. Among these species, three belong to the local, sub-arid, vegetation of the Dakhla Oasis, such as the date palm (*Phoenix dactylifera* L.), Nile acacia (*Acacia nilotica* (L.) Delile Willd. ex Delile) and Christ's-thorn (*Ziziphus spina-christi* (L.) Desf.), while the rest are allochthonous species that could have been locally grown, or imported as food from other areas of the Mediterranean and the Far East. The olive tree (*Olea europaea* L.), which was introduced to Egypt from the Mediterranean areas of the Levant, is quite abundant at Amheida/*Trimithis*, and its presence suggests that olives were an important source of food between the third-fourth century AD. As we know from the site of Umm Mawagir, in the nearby Kharga Oasis, olives were consumed in the oases already in the late Middle Kingdom (Cappers et al. 2013). Another species, which also comes from the Mediterranean area, is the carob tree (*Ceratonia siliqua* L.) Delile. Findings of carob seeds are recorded at Amheida/*Trimithis*, as well as at the contemporaneous site of Ismant el-Kharab/Kellis, but nowhere else in the New Valley Governorate (South-western Egypt), suggesting that this species was introduced, at the earliest, during the Roman period. The presence of black myrobalan (*Terminalia chebula* Retz.), a species that is native to South Asia, might be indicative of a network of exchanges between Amheida*Trimithis* and localities on the Red Sea coast.

Keywords: Archaeobotany · Amheida/*Trimithis* · Egypt · Farming diet Midden · Trade

Introduction

Food habits, trade and the exchange of exotic goods are among those elements that can be addressed by studying plant remains preserved in archaeological contexts. Analyses of such material have been extensively conducted in Egypt from the end of the nineteenth century AD (Newberry 1889) and, since then, several studies have investigated a wide range of subjects, including the use and processing of plant materials. Due to the extreme environmental conditions in arid and sub-arid areas of Egypt, the preservation of organic material is such that plant parts that usually do not survive charring, such as flowers and fruit pulp, can be found in desiccated form.

The site of Amheida/*Trimithis*, in Dakhla Oasis, is among those sites where plant materials are well preserved, with an abundance of charred remains and desiccated seeds (Thanheiser and Walter 2015). The plant material discussed in this paper consists of charred and desiccated seeds collected from Area 2.1: some seeds were hand-picked from above the floors of fourth century buildings (B1 and B5), and others from beneath floors, where midden deposits were used to flatten the area on which the buildings were constructed in the first half of the fourth century AD. The midden material was intentionally spread on the area in horizontal layers and the waste had been collected from one or more dumps, probably located inside the abandoned *thermae* of the Roman period, which was then partially demolished to make space for these private buildings. Among the new buildings, there is a house (known as the house of Serenos, B1) and a school (B5) (Davoli in press; Ast and Davoli in press). The samples collected in deposits accumulated above the floors in the house of Serenos (B1), in B5, and in the streets (S2 and S3) that flanked the Serenos house are dated between the first phase of occupation (around AD 330) and the abandonment of the area (approximately 370 AD) (Bagnall et al. 2015:86–99).

This new evidence joins a rich array of data from textual sources and archaeobotanical studies on agriculture and diet in Dakhla Oasis (Bagnall 1997; Thanheiser 1999; Walter 2006; Lodwick 2013; Thanheiser and Walter 2015). These sources demonstrate an economy in the Roman period that included higher-value fruit crops, such as grapes for wine, olives largely for olive oil, dates, figs, and other fruits, together with staple cereals and legumes. In addition, it is clear that cotton and pearl millet were cultivated in the summer (Thanheiser et al. 2016) and that olive oil, dates, and cotton were largely exported (Bagnall 1997, 2008a; Gradel et al. 2012).

The Context of Study

Ecological Setting

Kharga and Dakhla Oases occupy part of a great natural depression in the southern section of the Western Desert of Egypt. This area, the New Valley Governorate, also includes the slightly elevated plain (140 m above sea level) between them (Fig. 1). The depression is open towards the south and southeast. The altitude rises gradually to the southwest, reaching 400 m in the direction of Gebel Uweinat. Dakhla Oasis is about 120 km west of Kharga Oasis. Its long axis is in a WNW-ESE direction, while length is

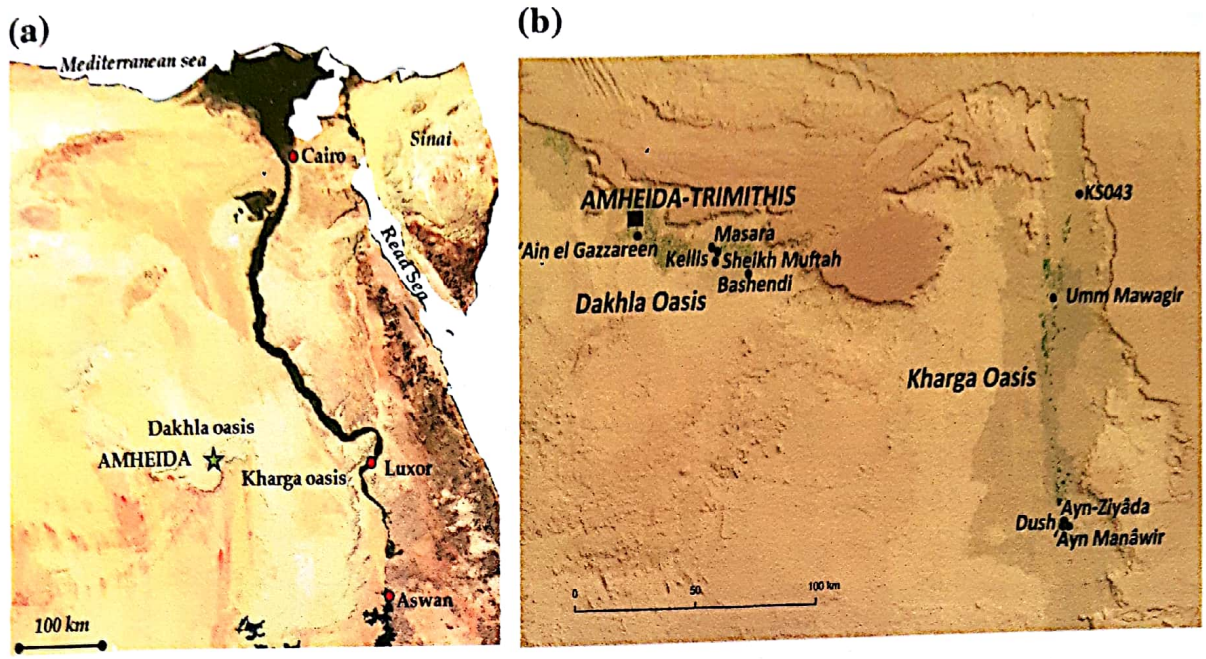

Fig. 1. The site of Amheida\Trimithis. **a** Location of Amheida\Trimithis. **b** Map of Kharga and Dakhla Oases with the archaeological sites cited in the text

about 55 km and width varies between 10 and 20 km. Elevations range between 100 and 400 m above sea level. Dakhla is bounded on the north by a precipitous escarpment running more or less irregularly for at least 250 km eastward to Kharga Oasis. The lowest point of Dakhla Oasis is 100 m above sea level, and surface rises gradually towards the rim (Zahran and Willis 2009).

The Kharga and Dakhla Oases are located in a dry, rainless part of the Great Sahara. Rainfall in recent times is below 5 mm of rain per year, although in the past decade more frequent heavy rains were observed. The temperature ranges from a minimum of 6.0–4.8 °C in winter, to a maximum of 39.2–40 °C in the summer. The water source in both oases is underground (Zahran 2010).

The plant life of the Kharga and Dakhla Oases has been studied by Oliver (1930–1931), Hassib (1951), Täckholm and Drar (1954), Migahid et al. (1960), Shalaby et al. (1975), Ritchie (1999), and Zahran and Willis (2009). Seven vegetation types have been recognized, namely: hydrophytic; reed swamp; halophytic; psammophytic; xerophytic; vegetation of cultivated lands; and vegetation of wastelands (Zahran and Willis 2009).

Hydrophytic vegetation is richly developed in the pools, ditches, wells and irrigation canals of Kharga and Dakhla Oases, which have permanent fresh or brackish waters. Reed swamp vegetation occurs in marshy areas where the water is at the surface and the soil is waterlogged throughout the greater part of the year. This vegetation, thus, occurs around ditches, swampy ground in rice fields, around wells and in pools and in drains and is dominated by *Typha domingensis* Pers. and *Phragmites australis* Adans. Halophytic vegetation is present in the salt marshes where underground water is shallow and dry salt marshes where underground water is deeper. Psammophytic vegetation is the scattered vegetation of the sand plains and the sand dunes. The xerophytic vegetation of the desert ecosystem comprises eleven communities dominated by *Citrullus colocynthis* (L.) Schrad., *Zygophyllum coccineum* L., *Salsola baryosma* Schult., *Chrozophora obliqua*

Adr., *Hyoscyamus muticus* L., *Stipagrostis scoparia* Trin. & Rupr., *Calotropis procera* Aiton, *Lagonychium farctum* Banks & Sol., *Tamarix nilotica* (Ehrenb.) Bunge, *Acacia nilotica* (L.) Delile and *Balanites aegyptiaca* (L.) Delile.

The date palm, which can be considered the dominant fruit tree in the Oases, is grown for its fruits and fibers in the dried leaves, which are used in the manufacture of baskets and other articles. In addition to date palms, the cultivable land in the oases is devoted to cereal cultivation, mainly sorghum, wheat, rice and barley, and horticulture, involving olives, grapes, citrus, pomegranate and apricot. Acacia, another tree cultivated in the oases, produces fruits that are used for tanning, while its wood is valuable for lining wells and, most importantly, it is used as timber.

The most common weeds of winter cultivation in Kharga and Dakhla Oases include *Cynodon dactylon, Melilotus indicus* (L.) All. and *Sonchus oleraceus* L. Less common winter weeds include *Chenopodium murale* (L.) Fuentes, Uotilla & Borsch, *Conyza linifolia* (L.) Less., *Eruca sativa* Mill., *Polygonum equisetiforme* Sm. and *Sorghum virgatum* (Hack.) Stapf. *Cynodon dactylon* is the most frequent weed of summer crops. Common summer weeds include *C. murale, Convolvulus arvensis* L., *Echinochloa colona* (L.) Link and *S. virgatum* (Zahran and Willis 2009). The majority of the vegetation in the oases grows in patches, in proximity to wadis or channels used for irrigation, where water is available on a seasonal basis.

The Archaeological Context

Paola Davoli

The excavation of the house of Serenos (B1), Streets 2 and 3, and building 5 was carried out between 2004 and 2011.[1] The two buildings (B1 and B5) are quite well preserved up to 2.7 m, thanks to a quick covering by sand. The roofs of the rooms, any floor above ground, or terraced roofs are missing. The structures are composed of mud brick and the floors are made of compacted mud. B1 and B5 were built at the same time, around AD 330, as a high status private house and a school of Greek (Cribiore et al. 2008). They were constructed over an imperial period bath complex (*thermae*) abandoned around the end of the third century AD. The bath was contructed in mud and baked brick and remained abandoned for a period during which it was used as a midden. Around AD 330 the area was repurposed for new buildings, and part of the bath was restored and reactivated as a smaller bath (B6) while another section was demolished and its remains leveled using materials that had accumulated inside. Some of its walls were used as foundations for B5, and the baked bricks were reused in several new buildings in the area. Serenos' house and B5 are thus built on the ruins of the *thermae* covered by midden materials and waste of different thickness. The floors of the two streets running east and west of Serenos' house also lie above a thick deposit of waste materials (Ast and Davoli in press).

A few years after the construction of B1 and B5, a natural event damaged both buildings and, as consequence, the house of Serenos was restored and the school

[1] Preliminary reports are available at: http://www.amheida.org.

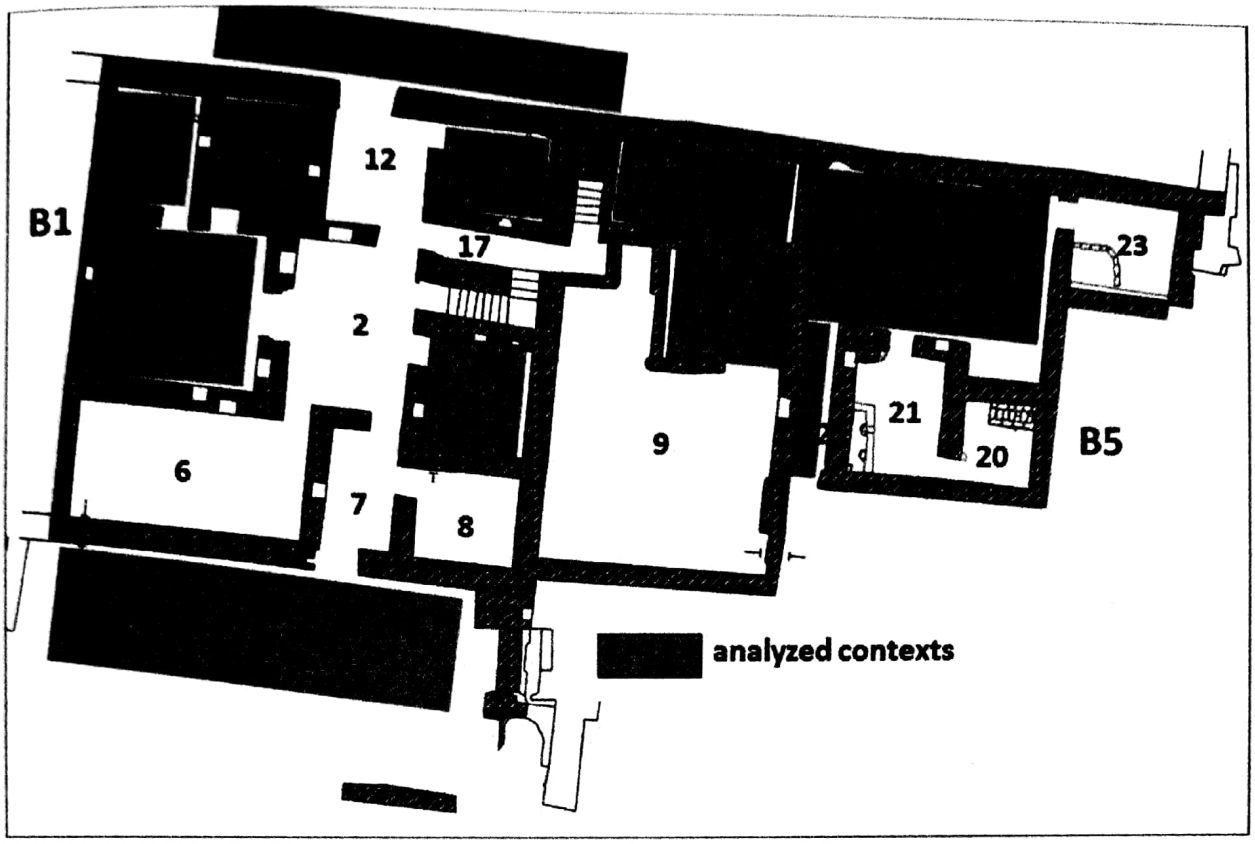

Fig. 2. Area 2.1. Serenos house, B5 and Streets 2 and 3

abandoned. The school was then annexed to the house and transformed into a storage magazine (room 15), and a stable (room 9, 10, 19–23). The last phase of habitation attested by texts (*ostraka*) and coins found in these buildings is around AD 370 (Fig. 2).

The excavation method used was by stratigraphic units: those examined in this paper belong to two main contexts, those related to the life of buildings B1 and B5, i.e., deposits found above floors in which de facto refuse is included; and those found below the floors and belonging to midden materials used to level the surface before the construction of B1 and B5. In addition, some samples were taken from floors and one from the filling of the *stibadium* (a mud-brick dining sofa) found in Street 2 and used for a short period, after which it was dismantled. The inner part of the dining sofa was filled with loose mud brick and debris (DSU 366) (Tables 1 and 2).

Materials and Methods

Macro-botanical materials were handpicked and therefore a bias against the recovery of small seeds is to be expected. The material collected included both burnt and unburnt seeds and charred wood tissue, but for the present paper, only the seeds were analyzed. The perfect state of preservation of the seeds, whether charred or desiccated, allowed an accurate study of morphological traits. The identification was carried out comparing the archaeological material to modern plants of the area with the help of an anatomical atlas (Neef et al. 2012). As result, 590 seeds were identified.

Table 1. Seed remains found above and below the floors in the house of Serenos (B1) and in B5 according to rooms

Room	US	*Acacia nilotica*	*Olea europaea*	*Phoenix dactylifera*	*Vitis vinifera fruit*	*Ziziphus spina-christi*	*Terminalia chebula*	Type of context	Chronology
4	214		1	5	1			Below floor	before ~ 330 AD
1	166			2				Below floor	before ~ 330 AD
	164		1					Below floor	before ~ 330 AD
9	122	2						Above floor	~330–370 AD
	127			4				Below floor	before ~ 330 AD
	128			2				Below floor	before ~ 330 AD
	129			4				Below floor	before ~ 330 AD
	130		1					Below floor	before ~ 330 AD
	132		5	38				Below floor	before ~ 330 AD
	137			1				Below floor	before ~ 330 AD
	151		2	58				Below floor	before ~ 330 AD
	154			1				Below floor	before ~ 330 AD
	180			1				Below floor	

(continued)

Table 1. (*continued*)

Room	US	*Acacia nilotica*	*Olea europaea*	*Phoenix dactylifera*	*Vitis vinifera fruit*	*Ziziphus spina-christi*	*Terminalia chebula*	Type of context	Chronology
									before ~ 330 AD
	196			1				Below floor	before ~ 330 AD
	197			1				Below floor	before ~ 330 AD
	200			1				Below floor	before ~ 330 AD
	210		1	5				Below floor	before ~ 330 AD
	212		6	54			2	Below floor	before ~ 330 AD
	215			5				Below floor	before ~ 330 AD
10	135		4	17				Above floor	~330–370 AD
	142		5	44		2		Below floor	before ~ 330 AD
	144		2	7				Below floor	before ~ 330 AD
	191		3	32				Below floor	before ~ 330 AD
	F106		8	17				floor	~370 AD
	202		1					Below floor	before ~ 330 AD

(*continued*)

Table 1. (*continued*)

Room	US	*Acacia nilotica*	*Olea europaea*	*Phoenix dactylifera*	*Vitis vinifera fruit*	*Ziziphus spina-christi*	*Terminalia chebula*	Type of context	Chronology
11	235			9				Above floor	~330–370 AD
13	207			1				Above floor	~330–370 AD
14	194		2	5				Above floor	~330–370 AD
	221		1		1			Above floor	~330–370 AD
15	157			2				Above floor	~330–370 AD
	145							Above floor	~330–370 AD
	F128			1				floor	~370 AD
19	219		76	2				Below floor	before ~ 330 AD
22	273			2				Above floor	~330–370 AD
Total		2	119	322	2	2	2		

Table 2. Seed remains found above and below the floors in Streets 2 and 3

Street	US	*Ceratonia siliqua*	*Olea europaea*	*Phoenix dactylifera*	*Prunus persica*	Type of context	Chronology
2	350				14	Above floor	~330–370 AD
	364				5	Above floor	~330–370 AD
	366				1	Above floor	~330–370 AD
	371				2	Above floor	~330–370 AD
	372				2	Above floor	~330–370 AD
	F314				3	floor	~330–360 AD
	F326			1		floor	~330–350 AD
3	396	4	18	90		Below floor	before ~ 330 AD
	F347		1			floor	~330–360 AD
Total		4	19	91	27		

Results

The study of the morphological features of recovered seeds and fruits led to the identification of nine arboreal species, a lack of small seeded species, such as staple cereals and legumes, was likely the result of recovery by handpicking during the excavation. Date palm (*Phoenix dactylifera*) and olive (*Olea europaea*) are the most ubiquitous, having been found both in the midden deposit below and above the floors in the house of Serenos, of B5 and in Streets 2 and 3. Peach (*Prunus persica* (L.) Batsch) and carob tree (*Ceratonia siliqua*), were found respectively above Street 2 and below Street 3 (Table 1). The state of preservation could raise questions about the intrusiveness of the peach in the deposit, however the stratigraphic position of the findings, the compactness of layers and the associated cultural materials suggest that the desiccated peach remains were in situ.

The midden deposit that formed the base of the foundation of the upper-class fourth century AD house and adjoining school yielded mainly refuse from edible plants such as date pits and fruits (70%), olive pits (28%), black myrobalan (*Terminalia chebula*) fruits (1%), grape pips (*Vitis vinifera* L.) (0.5%) and Christ's-thorn fruits (*Ziziphus spina-christi*) (0.5%) (Table 1). The sediment above the floor of the house of Serenos contained plenty of date and olive seeds, and a single seed and pod of *Acacia nilotica* (Fig. 3). The botanical material found above the ancient surface of Street 2 is characterized by the predominance of peach, desiccated seeds and fruits. The assemblage, mostly below the floor of Street 3, is made up of dates, olive pits and a few carob seeds (Table 2, Fig. 4).

The data collected so far confirm that a broad spectrum of vegetal products was available to the inhabitants of Amheida/*Trimithis* in the third and early-fourth centuries AD and earlier. Some, such as the date palm, were certainly cultivated, but we can assume that some non-native fruit crops, such us grape, olive, and the plums (*Prunus*

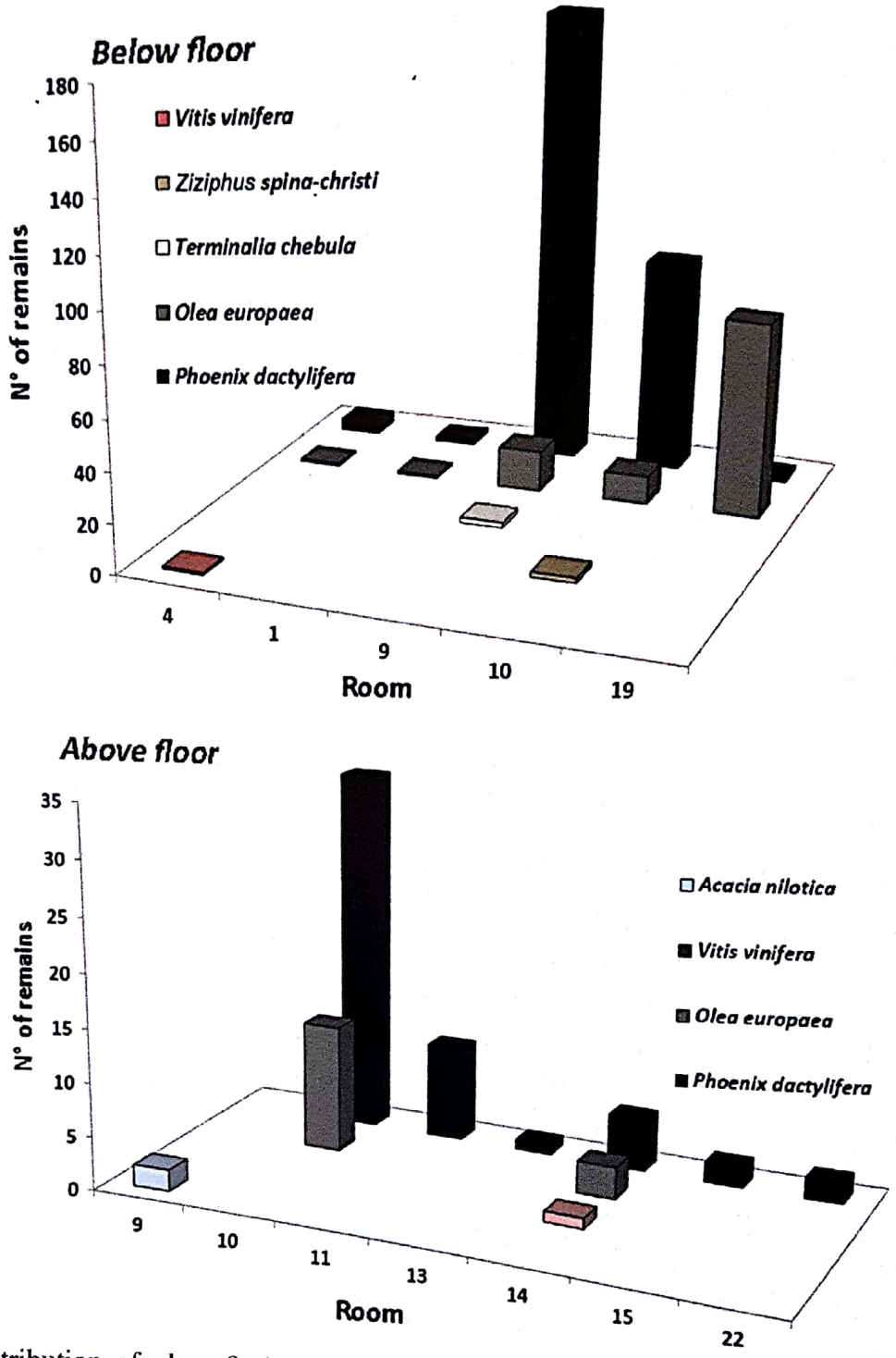

Fig. 3. Distribution of plant finds per phase. The first graph represents the archaeobotanical assemblage below the floors of the house of Serenos and of B5, datable to before the construction of the building (AD 330). The second graph represents assemblages found above the floors of B1 and B5, which accumulated between the construction and abandonment of the building (~330–370 AD)

avium L., *P. domestica/armeniaca*, *P. persica*), were also locally produced. Remains of non-native crops are plentiful in Kellis, a Roman site in Dakhla Oasis (Thanheiser et al. 2002), thus reinforcing the idea that fruit crops were an essential component of the diet of the local community and that 'exotic' plants were introduced to the oases for cultivation before the fourth century AD.

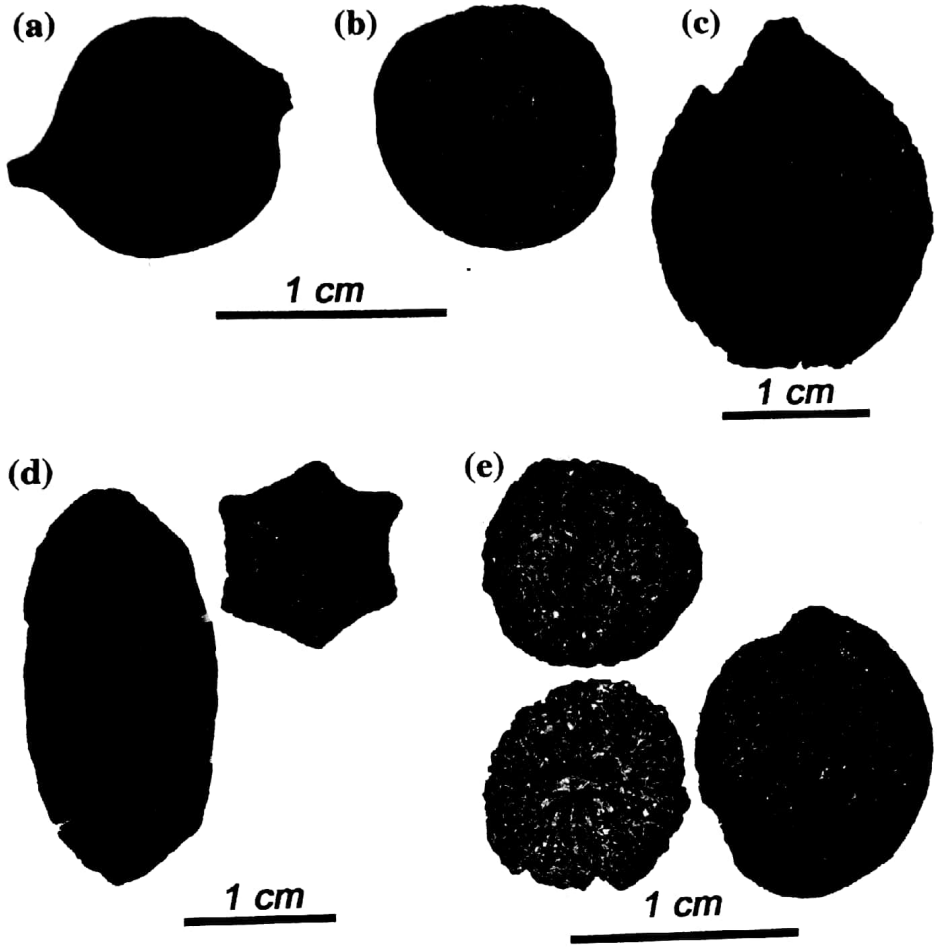

Fig. 4. Images of some species found in Amheida*Trimithis*. **a** *Acacia nilotica* (pod); **b** *Vitis vinifera* (fruit and pip); **c** *Prunus persica* (desiccated stone); **d** *Terminalia chebula* (frontal view of the stone, on the left; view of the top, on the right); **e** *Ziziphus spina-christi* (seeds, on left; fruit, on the right)

Discussion

Previous analyses at Amheida/*Trimithis* revealed the presence of a wide range of edible plants: cereals, mostly barley (*Hordeum sativum* L.) and wheat (*Triticum durum/aestivum*), lentils (*Lens culinaris* Med.) and fruit trees such as olive, grape, date palm, peach, sebesten (*Cordia* sp.) and pine (*Pinus* sp.) (Lodwick 2013). Additional findings are cotton (*Gossypium* sp.), flax (*Linum usitatissimum* L.), coriander (*Coriandrum sativum* L.), rosemary (*Rosmarinus officinalis* L.), black cumin (*Nigella sativa* L.), clover (*Trifolium* sp.), vetch (*Vicia* sp.), medick (*Medicago* sp.) along with mustard (*Brassica* sp.) and mallow (*Malva* sp.) (Thanheiser and Walter 2015). Recent archaeobotanical investigations confirm the presence of date palm, olive tree, grape, but they also identify new species of local and non-local origin (Caracuta et al. 2015; and this study). Christ's thorn, Nile acacia and carob are extensively attested in Dakhla and Kharga Oases, but black myrobalan, to date, is only found at Amheida/*Trimithis*.

The fact that all seeds presented in this study originated from the intentional accumulation of refuse in middens implies that all these remains are of mixed origins. They might have originated from different contexts and were later discarded together.

Since we are unable to assess the provenance of each specimen in relation to its context of use, it makes sense only to examine the provenience of the specimens, and in the case of non-native species, the timing and mode of introduction to the Dakhla and Kharga Oases. The identified species will be divided into 'ecological groups' based on the type of habitat to which they belong, either semi-desert or Mediterranean, and their provenance (see Asian and rare plants).

Semi-desert Vegetation

Acacia nilotica (Nile Acacia)

A native of Africa, Nile acacia is one of the most abundant and useful trees in Egypt. Both the inner bark and pods are used in tanning leather, while the young bark is used as a fiber (Wetterstrom 1984). The shoots and young pods provide forage for herbivores, while the wood makes good fuel and charcoal. In Kharga and Dakhla oases the dried flowers are used for gall bladder trouble and nasal congestion (Osborn 1968:173). The Nile acacia is also a principal source of gum arabic, which was used in making ink, and it is considered to be a very durable timber.

Ancient Egyptians used Nile acacia wood for various purposes including carpentry, dyeing and funeral offerings (Murray 2000). Archaeological remains of Nile acacia are abundant since prehistoric times in Dakhla Oasis. Amongst the earliest finds are those from the prehistoric Masara C, Bashendi A, and Sheikh Muftah sites, and from the Old Kingdom site 'Ain el Gazzareen (Thanheiser 2011). Remains were also found in the late Roman phases at Amheida/*Trimithis* (Thanheiser and Walter 2015). Specimens of *A. nilotica* are usually found associated with other species well adapted to arid and semi-arid environments, such as *Tamarix* sp. and *Z. spina-christi*. In Kharga Oasis these three species were found in the Neolithic site KS043 (Briois et al. 2012) and in the Persian site 'Ayn Manâwir (Newton et al. 2013).

Ziziphus spina-Christi (Christ's Thorn)

Christ's thorn is a tropical evergreen tree of Sudanese origin, which is found in the Sahara along main wadis, where the combination of high temperatures and available soil moisture allow trees similar to *Z. spina-christi* to grow. This species is a typical element of the natural vegetation of Dakhla Oasis, where it grows in association with *Acacia nilotica*, *P. dactylifera* and several species of *Tamarix* (Ritchie 1999).

Ziziphus spina-christi was used in ancient Egypt in Pharaonic times (de Vartavan et al. 2010) and its parts appear to have been in use in 'ancient Egyptian industry' (carpentry), diet, and medicine. The fruits were sometimes made into bread, and Egyptian farmers made similar bread as late as the beginning of the twentieth century AD (Manniche 2006).

The earliest attestation of *Z. spina-christi* in Dakhla comes from charcoal and is dated to the seventh millennium BC from the Neolithic site of Bashendi A, with later evidence found at the Old Kingdom site of 'Ain el Gazzareen and the Roman site of Kellis (Thanheiser et al. 2002; Thanheiser 2011) and *Trimithis* (this study). In the nearby Kharga Oasis, the earliest finds date to the fourth millennium BC (site KS043), while later discoveries date to the Middle Kingdom (Umm Mawagir) (Cappers et al.

2013) and Persian period ('Ayn Manâwir and 'Ayn-Ziyâda) (Newton et al. 2005; Agut-Labordère and Newton 2013).

Phoenix dactylifera (Date Palm)

The date palm ranks among the first fruit trees that were brought into cultivation in the Old World. High temperatures, rainless summers, and very low humidity are particularly important conditions for fruit setting and ripening. Date palms can withstand considerable salinity and they grow well even when watered with brackish water. Date horticulture is therefore centered in the deserts south of the Mediterranean Sea and in the southern fringe of southwest Asia (Zohary and Spiegel-Roy 1975). Date palms thrived in these territories long before the initiation of agriculture. This is attested by the finds of charred fragments of *P. dactylifera* wood retrieved in Israel, at the Epi-Palaeolithic site of Ohalo II (Lipschitz and Nadel 1997). The stones of date palm reported from Egypt, Israel, Iran, and Pakistan, date to the 6th and 5th millennia BC, and probably represent fruits collected from the wild (Zohary et al. 2012).

In Egypt, remains of dates appear rarely in prehistoric sites; nonetheless, evidence of this tree is found in the Late Palaeolithic site of E-75-6 at Nabta Playa (Wasylikowa et al. 2001). Findings of date palm become more common in Pre-Dynastic sites, such as Hierakonpolis and El Omari, and prior to the Middle Kingdom much of the date remains consist of leaves, fiber, and wood, rather than fruits (see References in de Vartavan et al. 2010). Roof logs made of date palm wood were employed in the construction of the necropolis of Saqqara in tombs dated to the Proto-dynastic period (I-II dynasties) and to the Old Kingdom (V dynasty) (Nicholson and Shaw 2000).

At Kharga Oasis remains of date palm appear during the Persian period at 'Ayn Manâwir (Newton et al. 2013), and later in the Roman cemeteries of Douch (Barakat and Baum 1992). In Dakhla Oasis date palm stones are found at the Roman sites of Kellis (Thanheiser et al. 2002) and *Trimithis* (this study and Thanheiser and Walter 2015). According to the *Kellis Agricultural Account Book*, dates were used as payment for rent. Date pulp was compressed and consumed fresh, while date stones, which are also recorded in transactions, were likely crushed and milled into a flour to feed camels (Bagnall 1997).

Mediterranean Plants

Olea europaea (Olive Tree)

The olive tree is a prominent feature of present-day Mediterranean vegetation. This species is adapted to cool winters and warm dry summers, but its cultivation has caused the species to surpass its natural bioclimatic limits. Today, the olive tree is extensively cultivated in northern Egypt, the Fayyum and the western Mediterranean coast and Siwa Oasis.

The distribution of olive finds in Pre-Pottery Neolithic sites indicates that the species was present, in its wild form, in a variety of habitats in the Southern Levant, ranging from the Mediterranean areas of the coast to the sub-arid highlands of the Negev (Liphschitz et al. 1991; Liphschitz 2007). However, the earliest certain evidence for olive cultivation is found in sub-arid areas of Jordan, at the Chalcolithic sites of Teleilat Ghassul and el-Khawarij (Bourke et al. 2004; Lovell et al. 2010).

Traditionally, the beginning of the cultivation of olive in Egypt is dated to the New Kingdom (Meeks 1993). The first representation of the tree on a wall painting appears in the Amarna period (Germer 1985), whereas a branch of olive is carved in a wall-relief discovered at Hermopolis, dating to the XVIIIth dynasty. The latter depicts Akenaton offering the branch to the God Aton (Cooney 1965). Information about olive orchards begin to appear in written documents dating to the XXth dynasty, such as the Harris Papyrus, which records a donation of 2735 hectares of olive orchards to temples by Ramses III (Erichsen 1933). Based on written documents, scholars have identified six major centers for the production of olives in the New Kingdom Period: Thebes, Hermopolis, Amarna, Heliopolis, Alexandria, and Qantir, but the Egyptian olive oil was of a lower quality of that imported from Syria-Palestine or Cyprus (Meeks 1993). Evidence of the import of olives and olive oil in Egypt pre-date by about five hundred years the cultivation of the plant in the countryside. The earliest archaeological remains of olive dates to the Middle Kingdom and they were found at the port-city of Memphis (Giddy and Jeffreys 1991; Murray 1993). Amongst the earliest findings of *O. europaea* in the Nile Valley are desiccated stones from a Middle Kingdom context at Umm Mawagir in Kharga Oasis (Cappers et al. 2013).

Evidence becomes more abundant at Kharga and Dakhla Oases during the Greco-Roman Period as shown by findings from the cemetery of Douch (Barakat and Baum 1992), and the sites of Kellis and *Trimithis* (Thanheiser et al. 2002; Thanheiser and Walter 2015; and this study). The textual references from Kellis point out the importance of olive oil, suggesting that this crop was one of the major products of the oasis (Bagnall 2008b).

***Ceratonia siliqua* (Carob)**

The carob tree is an evergreen species native to the eastern Mediterranean region. In Egypt today it is found along the Mediterranean coastal belt and as a cultivated garden tree (Darby et al. 1977). Carob pods are rich in protein, starch and sugar, and the medical properties of this species are commonly exploited to cure digestive diseases. Carob pods are today also used to make a syrup and sweet gum extract, which is used as a thickening agent and a substitute for coffee and chocolate (Aykroyd et al. 1982). The available archaeobotanical evidence shows that carob was part of the Levantine flora at least since early prehistoric times. The earliest finds of charred carob wood come from the prehistoric site of el-Wad terrace, in Mount Carmel, and they date to ~9500–9000 BC (Caracuta et al. 2016). In a later period, between 8000 and 5500 BC, wood and seeds of carob are found in Neolithic sites such as Nahal Oren and Atlit-Yam (Noy et al. 1973; Galili et al. 1993). Carob remains continue to appear in later Chalcolithic and Bronze Age contexts, yet many of these remains, recovered mostly in Israel, come from Roman period times or later (Zohary et al. 2012). Discoveries of carob seeds among the food offerings of a XIIth dynasty tomb seem to suggest that carob was indeed incorporated in ancient diets in Egypt as well (Täckholm 1961). Textual evidence dating to the Middle Kingdom, such as the Harris Papyrus, demonstrate that carob was included among fruits used as offerings in the oblations of festival offerings instituted by Rameses III. Carob wood was used to make chairs, tables, chests, shrines, chariots and staffs (Breasted 1906). Remains of carob seeds are

attested in the Dakhla Oasis since the third-fourth century AD, as shown by the discoveries in *Trimithis* and Kellis (Thanheiser et al. 2002, and this study).

Asian and Rare Plants

Prunus persica (Peach)

The wild form of peach originated in China, where it was consumed already by the sixth-fifth millennium BC (Weisskopf and Fuller 2014). From the fourth millennium BC the tree spread outside China, first to Japan, and later to India, where it appears in its domesticated form in the third-second millennium BC (D'Andrea 2007; Boivin et al. 2012). Epigraphic sources date its introduction farther west into Persia by the fourth century BC (Hedrick 1919), but the earliest archaeological evidence is from the seventh century BC, at the site of the Heraion on Samos (Zohary et al. 2012). By the first century BC, Romans were cultivating peaches in southern Europe, Israel and Egypt (Bassi and Monet 2008; Bakels and Jacomet 2003; Sadori et al. 2009).

In Egypt, the earliest finds of *P. persica* come from el Hibeh, in the Nile valley, and date to the Late Pharaonic and Ptolemaic periods (Wetterstrom 1984). In the third-fourth centuries AD, this species appears in Dakhla Oasis, with peach being consumed in Kellis (Thanheiser et al. 2002) and *Trimithis* (Thanheiser and Walter 2015).

Terminalia chebula (Black Myrobalan)

Black myrobalan is a tree native to South and Southeast Asia and belongs to the family Combretaceae. The tree is found in forests throughout India. Black myrobalan flowers May–June, the fruits appear between November and January and reach full maturity between January and April. The fruit is 3–5 cm long, has a plum-like shape with six lines or ribs on the outer skin; it is green when unripe and yellowish grey at full maturity.

Black myrobalan is one of the most versatile plants, having a wide spectrum of pharmacological and medicinal uses. This medicinal plant is the unique source of various types of chemical compounds, which act as antioxidants, laxatives, antidiabetics and antimicrobics. The fruit paste, mixed with water, is found to be anti-inflammatory, analgesic and to have a purifying and healing capacity for wounds. Its decoction is used as a gargle to treat oral ulcers and sore throat, while its powder is a good astringent dentifrice for loose gums, bleeding and ulceration in gums (Bag et al. 2013). The fruits of *T. chebula* are rare in ancient Egypt, and prior to the finds at Amheida/*Trimithis*, the only other evidence was recovered from the port of Quseir el Qadim in layers dating to the Islamic period (Van der Veen 2011; Van der Veen and Morales 2015). Textual records report trade of black myrobalan from the Far East through Afghanistan, while medieval epigraphic sources refer to the shipment of myrobalans from India to Africa and Europe where it was used for its medical properties (Goitein and Friedman 2008).

The discovery of black myrobalan seeds in Amheida*Trimithis* in the midden deposit below the Serenos house, dated between the third and fourth century AD, represents the earliest findings of this species in Egypt and pre-dates its appearance during the Roman period, almost one thousand years before the findings of Quseir el Qadim.

Conclusion

The development of Dakhla Oasis in the Roman period is indicated by an increase in the number and extent of inhabited archaeological sites. The flourishing of settlements is likely related to the development of a successful economic system, which generated goods to be exchanged in return for commodities and rare items. A large portion of the oasis economy was probably based on the exploitation of agricultural products. The results presented herein provide insights into the local farming system and natural resources available to the inhabitants of *Trimithis*, in addition to those available through interregional trade of commodities. Species such as Nile acacia, Christ's thorn and date palm suggest that local environmental conditions around *Trimithis* did not differ from those of today, since these trees are still grown in the oasis. Textual evidence suggests that the olive was locally cultivated, and it is likely that olive oil was exported. Carob, another Mediterranean fruit tree, could have also been grown in the area surrounding *Trimithis* thanks to the groundwater system. The presence of peach is interesting, and it could have been imported or locally grown. Black myrobalan most likely was imported for its medical properties from East Asia through the ports on the Red Sea.

These results are not considered exhaustive, but rather provide a preliminary set of data which will be supplemented by further research. Additional excavations and a larger number of samples are required to understand the provenance of the macroremains deposited in the midden below the Serenos' house and adjacent streets.

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