Finding Millet in the Roman World

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Abstract

Examining the evidence for millet in the Roman empire, during the period, *circa* 753BC-610AD, presents a number of challenges: a handful of scant mentions in the ancient surviving agrarian texts, only a few fortuitous preserved archaeological finds and limited archaeobotanical and isotopic evidence. Ancient agrarian texts note millet's ecological preferences and multiple uses. Recent archaeobotanical and isotopic evidence has shown that millet was being used throughout the Roman period. The compiled data suggests that millet consumption was a more complex issue than the ancient sources alone would lead one to believe. Using the recent archaeobotanical study of Insula VI.I from the city of Pompeii, as a case study, the status and role of millet in the Roman world is examined and placed within its economic, cultural and social background across time and space in the Roman world.

Millet, Roman, Pompeii, Diet

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"If you want to waste your time, scatter millet and pick it up again" (*moram si quaeres, sparge miliu[m] et collige*) (Jashemski et al. 2002, 137).

A proverb scratched on a column in the peristyle of the House of *M. Holconius Rufus* (VIII.4.4) at Pompeii

Introduction

This study seeks to examine the record of 'millet', which includes both *Setaria italia* (L.) P. Beauv. and *Panicum miliaceum* L., in the published archaeobotanical and archaeological literature to date on Roman sites. The label 'Roman' is based upon the archaeological assessment and interpretation as it is reported in the literature which falls within the time period of *circa* 753BC-610AD. No spatial restrictions were placed upon the study rather this paper has attempted to group the known archaeobotanical data by time periods corresponding to the major chronological periods in Roman history: Roman Republic (753BC-27BC), Roman Empire (27BC-395AD), and Empire (395AD-610AD). The use of the un-capitalized word 'empire' refers to Rome's geographical boundaries and capitalized 'Empire' refers to the chronological period in Roman history (Boatwright 2012, xiv). When no specific dates or time ranges were provided in the reported literature the sites were simply classified as 'Roman'.

Classifications

Ancient Greek and Roman writers often refer to *panicum* and *milium* together as if they were different varieties of the same plant species (Smith, Wayte, and Marindin, 1890). However, based upon botanical and textual evidence we know that the ancients were referring to two different plant species. Confusingly, common millet's (also known as broomcorn millet or proso millet) Latin name is *Panicum miliaceum* L. It was called ἔλυμος or μελίνη by the Greeks (Smith, Wayte, and Marindin, 1890), *Milium* by the Romans (Meyer 1988, 205) and *Melinen* by other ancient peoples. *Setaria italica* (L.) P. Beauv. (common name Italian millet or sometimes foxtail millet) corresponds to the description of *kenchros, κέγχρος* by the Greeks (Jashemski 2002, 137; Smith, Wayte, and Marindin, 1890;

Theophrastus (Hist. pl. 1.II.2); Dioscorides (2.119)). Its Latin name was *panicum* or *panic* by the Romans (Dioscorides, 2.131-132; Jashemski *et al*. 2002, 162).

In other taxa it may be problematic to attribute botanical species to ancient Greek and Latin names as it is difficult to trace the ancient version of the plant to modern times. However, this is not the case with millet. *Panicum miliaceum* has been recovered dating back to the end of the 3rd millennium BC onwards on European archaeological sites (Dalby 2003, 99). *Setaria italic* has been cultivated since the Bronze Age *circa* 2000 BC in Europe (Jashemski *et al*. 2002, 162). The wild progenitor of foxtail millet, *S. viridis* (L.) P. Beauv, is well identified and shows clear morphological affinities with, and can interbreed with domesticated *S. italic* (L.) P. Beauv. (Zohary and Hopf 2012, 71). Specific descriptive references in the ancient sources describe *Panicum miliaceum* and *Setaria italica* very clearly. For example, Pliny (XVIII.x) tells us that "[i]n millet the hairs embracing the seed curve over with a fringed tuft. There are also varieties of panic, for instance the full-breasted kind, clustered with small tufts growing out of the ear, and with a double point". Whereas panic is named after its panicles or tuffs which droops according to Pliny (XVIII.x). The Romans were aware of the very distinctive appearance and could differentiate both species of millet as illustrated in an ancient wall painting from Pompeii (Figure 1). With their continued cultivation as domesticates in the Mediterranean today it is clear that these ancient terms apply to the modern taxa of *Panicum miliaceum* L. and *Setaria italica* (L.) P. Beauv.

Figure 1: Wall painting of common millet (left) and Italian millet (right) being eaten by two quails (NM inv. No. 8750) from Pompeii, Italy (Photo by S. Jashemski p. 137 in Natural History of Pompeii). NB: It is possible to distinguish the two plant species and their similarity to modern species of common millet and Italian millet.

Uncovering the evidence for *Milium* and *Panicum* (henceforth referred to as common millet and Italian millet respectively) in the Roman world, *circa* 753BC-610AD, presents a number of challenges: there are only a few brief mentions in the ancient surviving agrarian texts, one or two fortuitous, exceptional archaeological finds and more recently, limited archaeobotanical and isotopic evidence. All these lines of evidence are problematic in terms of their representativeness but together they offer a more complete glimpse into the growing understanding of millet and its use and importance in the Roman world.

Agrarian and Medicinal Literary Sources

In terms of ancient literary sources several ancient Greek writers mention millet including the philosopher Aristotle (384-322 BCE), his successor, Theophrastus (371-c.287 BC) at the Peripatetic school, often considered the father of botany based upon his work on plants, Xenophon (c.430-354 BC), particularly in his most famous work *Anabasis* and Dioscorides (c.40-90AD), a Roman physician, pharmacologist and botanist of Greek origin who wrote the 5-volume *De Materia Medica* (Spurr 1986, 92). No contemporary or near contemporary written records on agricultural development exist for the first six centuries (800-200BC) of Roman history. The earliest classical Roman agronomist, *Marcus Porcius Cato*, better known as Cato the Elder (BC 234-149) wrote *De Agri Cultura* in the middle of the 2nd century BC. It was the first agricultural work written in Latin and was largely concerned with issues involving `investment farming´. *Marcus Terentius Varro* (BC 116-28) wrote *De Re Rustica* which was published in 37 BC. *Lucius Junius Moderatus Columella* (fl. BC 4- AD 65) wrote his twelve volume work *De Re Rustica*, which is arguably the best preserved ancient source on Roman agriculture (White 1970, 15). *Gaius Plinius Secundus*, or Pliny the Elder (AD 23-79), cited by many as the father of the discipline of botany, is considered the best Roman source on ancient plants (Meyer 1980, 403). *De re conquinaria* (On Cooking) by *Apicius*, is the earliest cookery book to survive, which was only directed at a `favoured few´ (Goody 1982, 103; Strong 2002, 22). The above mentioned ancient texts were typically biased towards elite audiences with large-scale agricultural farms, the majority of which were found in the Po valley, the plains surrounding Rome, and the fertile regions of Campania (MacKinnon 2004, 16).

Gaps in the literary sources exist from the 2nd century BC and during the 2nd and 3rd centuries AD for which no agricultural manuals or writings have been found. As ancient agronomists often borrowed material and ideas from earlier, often ancient Greek authors, it is uncertain whether what is described in the ancient agrarian texts reflects current Roman practices in agriculture or established traditions from earlier times, likely based upon earlier Greek writings (MacKinnon 2004, 16). Indeed, the Roman author Varro (*R. R*. 1.1.7 foll.) was able to mention over fifty Greek writers who had written on agricultural science (Smith, Wayte and Marindin 1890). It is likely that these agricultural writings were based to some extent on practical farming experience or observations and thus provide invaluable insight into Roman values and attitudes towards agriculture (Meyer 1980, 403; White 1970, 15).

Ancient Literary Biases

Archaeological evidence has revealed disparities with the ancient literary sources regarding agrarian

issues and the villa culture. The literary sources listed above tend to focus on specialist crops such as vines, olives and fruits and rarely mention cereal or pulse cultivation (Lomas 1993, 121; 1995, 5). Lomas (1993, 121) attributes this literary bias to several factors: the importance placed upon viticulture, oleoculture and other fruit cultivation which were regarded as elite activities for the production of 'luxury' items; and a disinterest in holistic accounts of agricultural production. During the Republican period Cato cultivated vines and olives on his estates near Monte Cassino and Venafro in northern Campania (White 1970, 27). Thus, Lomas (1993, 199) cautions against using these texts as evidence of economic specialization.

Although farmers planted a wide range of cereals, based upon regional variations suitable for certain areas, two varieties of wheat, naked wheat and husked emmer, which still has protective glumes that enclose the grain, have received the majority of attention from historians (White 1995, 38-39). Emmer (*Triticum dicoccum* L.) was the most widely cultivated husked wheat in Roman Italy for over 300 years, into the Imperial period, until at least the 5th and 4th century AD (Bruan 1995, 34-6; Meyer 1988, 215; Spurr 1986, 13). Modern examples of this bias are found in White's (1970, 27) seminal work, *Roman Farming*, in which he dismisses "the treatment of the cereals and legumes in Book II is a straightforward resume, reflecting the decreased importance of this type of husbandry in central Italy in Columella's day".

Modern agricultural practice

Modern common millet is "a warm-season crop which stands up well to intense heat, poor soils and severe droughts, completing its life cycle in a very short time (60-90 days) and succeeding in areas with short rainy seasons" (Zohary, Hopf and Weiss 2012, 69). The ancient sources, such as Vergil (G. 1.216), were aware of its ecological preferences. Columella (II.ix.17) observed that both common millet and Italian millet "cannot be sown before spring, for they are fond of warm weather above all; but they are intrusted to the earth to best advantage in the latter part of March". Pliny (XVIII.x.60-xi) noted that "millet [common and Italian] ripen within 40 days of blossoming, although with considerable variation due to soil and weather". Common and Italian millet's short growing season may have filled an important niche in the Roman agricultural calendar.

Ancient sources advocated growing millet in areas not suitable for wheat, in sandy or wet soil and

foggy areas (Spurr 1986, 89). Columella (II.9.17) informs that “both millet and panic require a light, loose soil, and thrive not only in gravelly ground but also in sand, if only the climate is moist or the ground well watered; for they have a great dread of dry and chalky ground”. Strabo (5.1.12) remarked that millet produces an “exceptional” yield in well-watered soil. However, Pliny (XVIII.x.60-xi) disagrees stating that “[a]ll the other kinds of summer corn flourish even better in land watered by streams than in rainy districts, but millet and panic are not at all fond of water, as it makes them run to leaves”. Pliny (XVIII.xxv) advises against “growing [millets] among vines or fruit trees, as they believe that this is crop impoverishes the soil”. Therefore, in theory, based upon this insight into the ancients' understanding of millet's ecological preferences and adaptability it would appear that millet was not in competition with other cereals, vines or orchards for prime agricultural land. As millet is very resistant to drought conditions, grows in areas of poor fertility and requires less rainfall than other cereals it is possible that in ancient times common and Italian millet could have been grown in less desirable agricultural fields and acted as a supplement to the diet if the autumn cereals failed (Spurr 1986, 89).

Millet is commonly known in ancient times as being used for fodder for animals. Once the feast for the Oxen was performed Cato (*De Agri Cultura* 132) advised men to˝sow broomcorn millet, foxtail millet, garlic, lentil˝. Columella (VI.III.3) and Pliny (X.III.300) both noted that the most highly-esteemed chaff for oxen was from millet and Cato (54.5) listed foxtail millet as one of the preferred spring green forage crops (Spurr 1986, 95). Millet was also used as birdseed by farmers and excess could be sold at market for profit (Spurr 1983, 102). Significantly, Columella (II.ix.18) wrote that millet "do not burden the farmer's budget with a heavy expense, as about four sesiarii are enough for a iugerum". Despite its many uses and affordability millet" demands repeated hoeing and weeding to make them free of weeds" (Columella II.ix.18). Hence, although cheap to buy millet seeds represent a large labour investment in terms of human hours to cultivate.

Hesiod (Shield 395) wrote that "when the beard grows upon the millet" they were ready to harvest when "men sow in summer". Columella (II.ix.18) counsels that millet be harvested "[w]hen they have formed their heads, before the seeds crack open with the heat, they are gathered by hand, hung in the sun, and stored away after they have dried; and when stored in this fashion they keep longer than other grains". Pliny (XVIII.x.60-xi) instructs the reader "that common and Italian millet cannot be freed of husk until they have been dried, and consequently these grains are sown unthreshed, with their husks on". Thus, although a great deal of human labour is required for cultivating, harvesting and processing

millet it may have acted as an important security against crop failure as it could be stored in its husks for long periods of time.

Millet, which is non-glutinous, makes a heavy flat bread in contrast with cereal grains. Dalby (2003, 218) makes the broad generalisation that according to some ancient sources millet was not a favourite crop of the Romans in the Mediterranean. However, a closer examination of the ancient sources reveals a more nuanced perspective. Celsus (2.18.4) listed types of bread in order of *firmitas*, (firmness) placing wheat bread first, followed by bread made from millet and then barley bread. Mixed with wine-must millet could be used as leaven for bread (Pliny XVIII.xxvi). Pliny (XVIII.xxiv) noted that an excellent bread is made from millet. Columella (II.ix.19), less enthusiastically, agrees with Pliny "[b]read is made of millet, and it may be eaten without distaste before it cools". According to Dioscorides (Bk II, p.131) after *milium* is made into bread and eaten "it stops the belly and moves urine". Later sources were not as favourable towards bread made from millet. "On occasion bread is made from these [common millet and panic], whenever there occurs a shortage of those grains useful for food which have already been written about, but it provides little nourishment and is cold, and it is clear that it is friable and crumbling, so naturally it dries a moist stomach" (Oribasius I.15.1). These passages would hint at the fact that although millet was not the first choice in ground flours for bread-making it was not rejected by the Romans, particularly in times of need.

Indeed, one distinct advantage of millet is the fact that "there is no grain heavier in weight or that swells more in baking; they get sixty pounds of bread out of a peck, and a peck of porridge out of three-sixteenths of a peck soaked in water" (Pliny XVIII.I). Millet is rich in carbohydrates but poorer in digestible proteins than other cereals making it an excellent appetite satisfier to fend off hunger (Spurr 1986). The ancient writers were aware of this useful fact. Dioscorides (BK II, pp. 131-132) wrote that *Panicum miliaceum* was less nourishing than other grains and that *Setaria italica* was even less nourishing than *Milium* but also less binding. Thus, common and Italian millet could be used in place of other cereal grains to make and/or bulk up breads and porridges, particularly in times of food shortages to swell a starving stomach.

Millet was also made into porridge. Pliny (XVIII.XXIV) noted that “[m]illet is used to prepare a very white *puls* [or porridge]”. And “[p]anic, when ground and freed from bran, and millet as well, makes a porridge which, especially with milk, is not to be despised even in time of plenty" (Columella II.ix.19).

From the writing of Philotimus, we know that the preparation of millet involves being "pounded when raw, ground finely and, after some water has been poured on, it is pounded once again, strained, boiled". Philotimus continues that "[i]n the countryside people boil meal made from millet and then eat it after mixing in lard or olive-oil. The people in the country sometimes eat millet meal after boiling it with milk just like wheat-meal; and it is clear that this food is better to eat, insofar as milk is intended for an excellent healthy state of the humours and all the other things" (Oribasius I.15.2). Although Oribasius (IV.10.2) goes on to warn that "[o]n the other hand, when it is boiled whole, just as people are accustomed to do, it is more difficult to digest". These passages would suggest that people were accustom to boiling millet whole, which would adversely affect its archaeological preservation.

It would appear that there was a difference of opinions regarding which is better in terms of taste, common millet or Italian millet amongst the ancient sources. Pliny (XVIII.i.xii) opines that panic "produces the same results in terms of cooking as common millet". According to Pliny (XXII.LXIII) Italian millet was called by the physician Diocles the honey of cereals. Whereas Oribasius (I.15.3) posits that "millet is better than panic in every respect: for it is more pleasant in taste, not so difficult to digest, constipates the stomach less, and is more nutritious". The mixed reviews regarding common millet and Italian millet's cooking properties and taste may be due to cultural preferences.

Although the Roman citizen farmer was the ideal citizen throughout this period, who owned and cultivated his land to meet his family's dietary needs, grain production was becoming an increasingly unprofitable venture. Roman law required grain to be sold at cost or distributed free of charge while the raising of livestock was a more profitable activity. In the 301 AD Edict of Diocletian (1.4.5) which set a maximum price for all three major cereals, millet is listed among other food grains (notably as either pounded or whole, which suggests that it could also be purchased in the form of flour), at a price slightly lower than barley or rye and at half the price of wheat (Killgrove and Tykot 2013; Spurr 1983). Therefore, it would not be unreasonable to conclude that it carried some economic importance within the Roman world. Dupont (2000, 127) proposes the unlikely theory that the Romans preferred vegetables to wheat which was largely eaten during food shortages. Dupont (2000) argues that only those of considerable wealth and belonging to the property hierarchy were able to raise wheat; with the vegetable and fruit garden being the `poor man's farm´. However, this theory contradicts the archaeobotanical evidence to date which shows a strong and consistent presence of cereals including barley, emmer, free-threshing wheats and millets throughout the Roman period, including parts of the

city of Pompeii (Meyer 1994, 1988, 1980; Murphy 2010; Murphy *et al.* 2012; Robinson 1999, 2002; Sadori and Susanna 2005) (For millets see **Error! Reference source not found.**, **Error! Reference source not found.**).

Ancient sources Columella (II.x.18) and Pliny (XVIII.XXIII) report that Campanian fields with their fertile volcanic soils were sown twice a year, in the autumn and spring with emmer and once with millet (Spurr 1986, 11). Although there is some evidence of cultivated oats it is relatively clear that in the Roman period oats were better known in their wild form as a weed (Spurr 1986, 61). It is thought that oats were only cultivated as a distinct crop from the beginning of the 1st century AD and then most likely as a replacement for millet (White 1970, 38). The emphasis placed on tradition and conservation in the Roman countryside can lead one to underestimate the dynamic and changing nature of Roman agriculture (Dyson 2003, 105). Based upon his study of the ancient agrarian texts, Kron (2000, 277) suggests that Roman farming was more sophisticated and productive than is generally thought by Romanists. Indeed, we know that the Roman agronomists were cognisant of the fact that different farming conditions required different approaches to cultivation (Morley 1996, 144).

Medicinal Uses

Millet, according to numerous ancient sources, had multiple medicinal uses, particularly for regulating the digestive system. Boiled millet is “difficult to digest and sometimes makes the bowels more relaxed and produces a change in the stools which is not excessive, even if it should be rather glutinous, it distributes sweet juice with an astringent effect” (Oribasius, Book IV Medicine p. 247). Pliny (XXII.LXIII) counsels that roasted common millet checks looseness of the bowels and removes gripings. And Hippocrates (Part 2) recommends that after an operation for piles "[t]he patient should once a day take a draught from flour or millet, or bran, and drink water". Pliny (XVIII.i.xii) advocated the use of common millet meal and liquid pitch applied to wounds inflicted by snakes and multipedes.

To ease aches and pains of the sinews Aretaeus, Pliny (XVIII.I.xii) and Hippocrates (Acut. 7) all endorsed putting "salts or toasted millet in woolen bags [which] are excellent for forming a dry fomentation, for the millet is light and soothing" (Dioscorides Book II, p.131). Pliny (XXII.LXII) declares that "[n]o other application is more useful, for it is very light, very soothing and very retentive of heat. Accordingly it is much used in all cases where the application of heat is lightly to prove beneficial". Millet was even useful for psychological disorders as “[r]oasted common millet, ground up with honey, oil, and linseed, was even recommended as a treatment for hypochondria” (Aretaeus

Chapter 1). Although less well reference in terms of medicinal use Pliny (XXII.LXIII) noted that the physician Diocles stated that "panic taken in wine is good for dysentery".

Millet use by Non-Romans

Pliny (XVIII.xxiv) specifically singles out the fact that “[m]illet flourishes in Campania..." and also observed that millet was also used in "parts of Italy on the banks of the Po, who added it to beans without water" (Pliny XVIII.xxv). The ancient sources also comment upon of the abundance of common and Italian millet in other parts of the ancient world. Polybius (2.15) exclaims that “[t]he quantity of panic and millet produced [in Cisalpine Gaul] is extraordinary". Strabo (4.13) wrote that the "[m]ountains of the Cevennes the entire of the remaining country produces an abundance corn, millet, acorns, and mast of all kinds". Xenophon (Anab. 1.2.22) describes Cilicia as a "large and beautiful plain, well-watered and full of trees of all sorts and vines; it produces an abundance of sesame, millet, panic, wheat and barley". Herodotus (1. 193) writes that in Assyria "[a]s for millet and sesame, I will not say to what an astonishing size they grow, though I know well enough; but I also know that people who have not been to Babylonia have refused to believe even what I have said already about its fertility”.

Common and Italian millet were important food to other people beside the Romans including the Gauls in Pontus, in Sarmatia, and in Ethiopia (Cat. 6; Col. 2.9.17; Plin. Nat. XVIII.xxiv, Plin. Nat. XVIII.x.xx; Pallad. 4.3; Geopon. 2.38; Theophr. C, P, ii, 17, H.P. 8.3; Dioscor. 2.119; Smith, Wayte, and Marindin, 1890). Columella (II.ix.17) declares in his *de re Rustica* that "[p]anic and millet also should be counted among grain crops, even though I have already listed them among the legumes, for in many countries the peasants subsist on food made from them". Indeed, Pliny (XVIII.xxvi) states that "[t]he Tartars still employ millet as one of their principal articles of food. They also extract a kind of wine from it". Herodotus (3.117) records that five tribes: the Chorasmians, the Hyrcanians, the Parthians, the Sarangians, and the Thamanaceans as having grown millet and used the river water when they are sowing their millet and sesame in the summer. Herodotus (4.17) observes that "[b]oth [the Alizones and the Callipidae] resemble the Scythians in their way of life, and also grow grain for food, as well as onions, leeks, lentils, and millet”. In more extreme examples “[t]he Sarmatian tribes live chiefly on millet porridge, and even on the raw meal, mixed with mare's milk or with blood taken from the veins in a horse's leg” (Pliny XVIII.x.xxiv). According to Pliny (XVIII.xxv) “[t]he races of the Black Sea prefer panic to any other food". Pliny (XVIII.xxiv) also claims that millet and barley were

the only grains known to the Ethiopians. It would appear that it was not just the use of common and Italian millet but a culture's reliance upon, and preference for that defined its societies' diet and agriculture in relation to the Romans.

Archaeobotanical Evidence

One early exceptional find of Roman millet was from a dolium (large ceramic storage container) reportedly filled with millet discovered at the v*illa suburbana*, Pisanella Villa near Boscoreale, a large agricultural Roman luxury residence located just outside the city gates. A similar discovery of millet was also made at the Roman villa site of Matrice in Molise, dating to 200BC-AD 400 (Spurr 1983, 94). Significantly, these relatively early archaeobotanical discoveries of millet were from large deposits of well-preserved millet and hence were more readily identified and recorded in the archaeological record. It is suspected that the vast majority of previously uncovered millet, if present, went unrecorded and unnoticed due to millet's small size. A large quantity of common millet was recovered from the cesspit from the House of Hercules' Wedding (VII.ix.47) dating to the 4th to mid-2nd century BC by Ciaraldi (2001, 152). Millet has also been discovered from the House of Amarantus (I.IX.xii) from the 1st century, the House of Hercules' Wedding (VII.ix.47) and the city of Herculaneum. The recent data from some Alpine burnt-offering places (*Brandopferplätze*) and other sacred areas in northeastern Italy in the Iron Age and Roman period show a prevailing use of cereals, especially millets, with "bread". The moderate frequency of millets recovered as offerings from Roman cremations in northern Italy suggests that millet also served as a sacred component within the religious life of Roman society (Rottoli and Castiglioni 2011, 501-502).

It must be acknowledged that the geographical boundaries of the Roman empire during this long time period were both expanding and contracting in certain parts of the world. The fact that the majority of common and Italian millet evidence is present in Europe may speak to the number of archaeological excavations carried out in Europe with archaeobotanical collection in contrast to other parts of the world.

Case Study: Pompeii, Insula VI.i

The results from this archaeobotanical case study were generated over the course of twelve years from the excavation of *Regione* VI, *insula* I by the Anglo-American Project in Pompeii (AAPP). The study of this one city block, *Regione* VI, *insula* I (Figure 2), was a unique opportunity to examine the

preserved plant material both across contemporaneous households, from a variety of domestic and commercial contexts, and diachronically, over the three hundred years for which suitable data has been excavated. Due to a lack of information on the preservation, deposits of interest and density of ecofacts within this section of Pompeii, a complete blanket sampling strategy was employed in which all contexts from earlier phases, up to and including the Roman horizon, were collected and examined (Bon *et al.* 1997, 153; Richardson, Thompson and Genovese 1997, 88).

Figure 2: Insula VI.I (the House of the Surgeon highlighted) (AAPP 2005 Resource Book),

● *Location of House of Hercules' Wedding (VII.ix.47)* ★ *House of Amarantus (I.IX.xii)*

Millet has been recovered from every property within *Insula* VI.I, aside from the Bar of Pheobus (Figure 2, Figure 4, Figure 5). It has also been recovered from larger domestic residences including the House of Amarantus (I.ix.11-12), the House of the Surgeon (VI.I.vii) and the House of Hercules' Wedding (VII.ix.47). It was also recovered from the Inn Bar, Bar of Acisculus and Vestals Bar within Insula VI.I. In contrast to the House of Hercules' Wedding (VII.ix.47), there is almost a complete absence of millet from deposits dating to a later time period, from the mid-2nd century BC to AD 79,

from the House of the Vestals (VI.I.vii) located within Insula VI.i. Ciaraldi and Richardson (2000, 75) suggest that this may indicate disparate levels of wealth between the House of Hercules' Wedding (VII.ix.47) located to the south of Insula VI.i (Figure 2), from which millet was recovered and other domestic properties at different times in their development. The presence or absence of millet may reflect broader economic issues for the city of Pompeii. This shift in the presence of millet could also be interpreted as differences in household tastes or a general decline in the economic importance of common millet over time within the city of Pompeii.

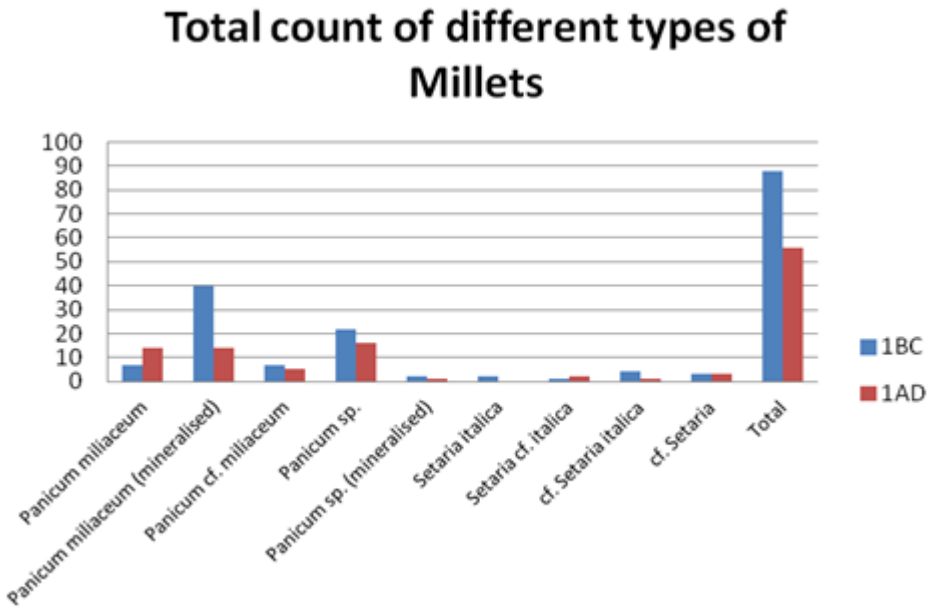

Figure 3: Total count of Millet from Insula VI.I by time period

Setaria italic L. was also present in the archaeobotanical assemblage from Insula VI.I but in smaller quantities than *Panicum miliaceum* (Figure 3) including from the Soap Factory, the Triclinium, the House of the Surgeon (VI.I.x) and the Shrine (Figure 2). Italian millet has been identified from the House of Amarantus (I.IX.xii), the House of the Vestals (VI.I.vii) and the House of Hercules' Wedding (VII.IX.xlvii) by Ciaraldi (2001), I.IX.viii, I.IX.xv and from the Pompeii Museum.

Shifts in grain preference are difficult to ascertain as relatively few cereal grains were recovered and no statistically valid conclusions could be reached. However, it does appear that emmer, barley, and millet, persisted into the 1st century AD within most of the properties of *Insula* VI.I. No evidence of oats was discovered from this study. Oats were likely not cultivated as a distinct crop until the beginning of the 1st century AD, possibly as a replacement for millet.

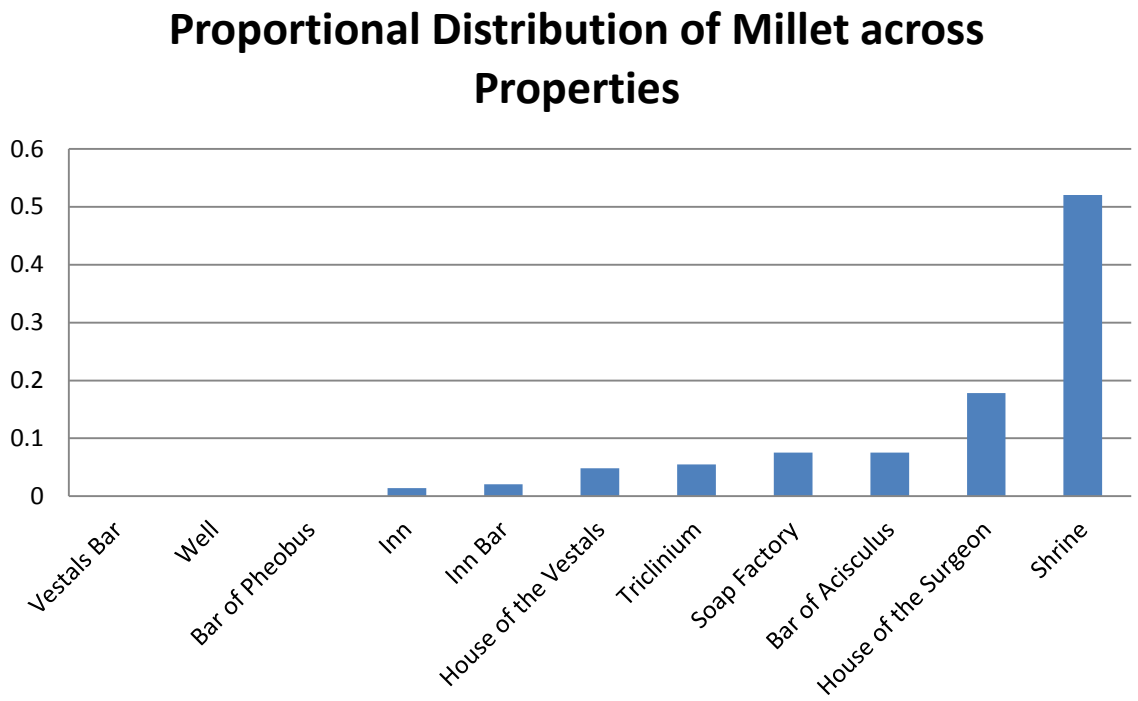

Figure 4: Proportional Distribution of Millet across the properties of Insula VI.I

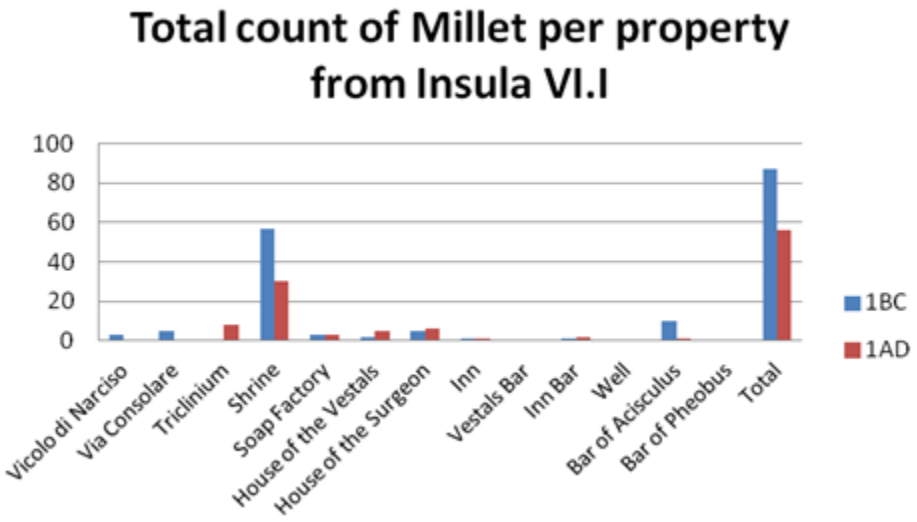

Figure 5: Total count of Millet from Insula VI.I

The majority of millet recovered from Insula VI.I was mineralised *Panicum miliaceum* L., dating to the 1st century BC from the Shrine (Figure 3). Millets are often recovered in a mineralised state due to the fact that during dehusking some grains of millet may retain part or their entire seed coat or lemna. Being so tiny, millet grains with their intact pericarp can pass through the human gastrointestinal tract and facilitate the mineralisation process. Millet was also found at a low frequency within both commercial and domestic properties within the Insula VI.I (Figure 4, Figure 5).

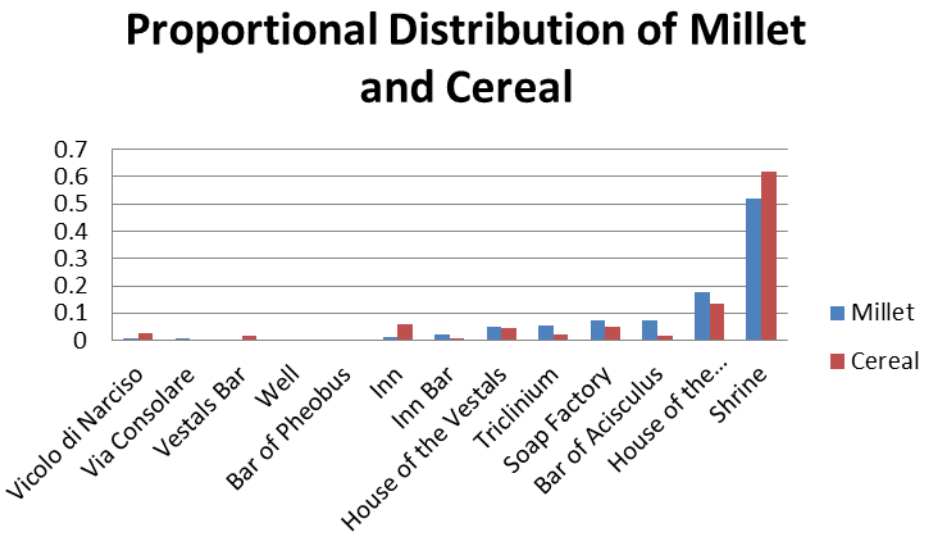

Figure 6: Proportional Distribution of Millet and Cereal across the properties of Insula VI.I

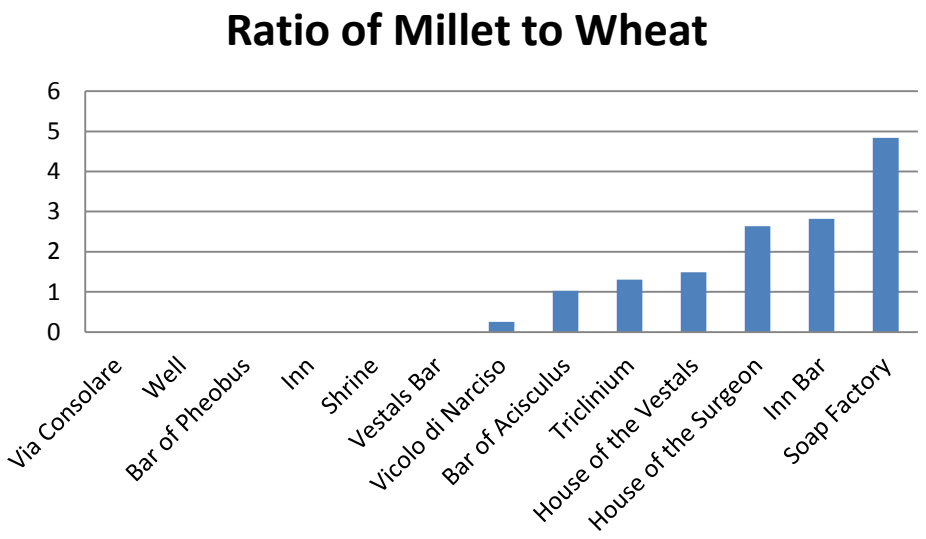

Figure 7: Ratio of Millet to Wheat across the properties of Insula VI.I

A strong correlation exists between the distribution of millets and cereals across the different properties of Insula VI.I (Figure 6, Figure 7). Hence, where cereal is present, millet was also recovered from Insula VI.I. This likely can be attributed to similar taphonomic processes that could have preserved both millet and cereals and their similar usefulness as both food and as material for sacrifice. Although, again, the smaller size of millet must be taken into account in terms of recovery and identification. The shrine has the highest proportion of cereals along with millet (Figure 6). This large proportion of millet and cereal suggests that the preservational conditions, such as burnt offerings, facilitated its preservation over commercial and domestic properties.

Isotopic Studies

The historical record is hazy about millet's status and uses, especially human consumption of millet. It is likely that both modern and ancient perceptions of millet, as a substandard grain, have clouded the discussion and have contributed to the assumption that it was not often consumed by humans aside from in times of famine and scarcity. As millet is one of the few C_4 pathway plants in the Roman food assemblage stable isotope analysis can be employed to critically evaluate this assumption regarding the Romans' consumption of millet.

Although outside the temporal scope of the present paper stable carbon and nitrogen isotope analysis on human and animal bones from four inland Early and Middle Bronze Age sites in Northern and Southern Italy by Tafuri *et al*. (2009) has revealed early evidence for the presence of millet in Northern Italy. Both the human and faunal material from two of the sites in Northern Italy were significantly enriched in 13C, suggesting the possible consumption of domestic millets (*Panicum miliaceum* and/or *Setaria italica*). Individuals from the two Bronze Age sites in Southern Italy were significantly depleted in 13C, compared to those from the north, suggesting the possibility of a greater reliance on C3 pathway plants. This study provides evidence for the early presence and consumption of millet in Northern Italy, following its introduction from across the Alps into Central Europe.

In terms of Roman sites, recent stable C_4 isotopic study by Killgrove and Tykot (2013, 29) from two Imperial-period sites located just outside the city walls of Rome: the *suburbium* cemetery of *Casal Bertone* (36 individuals) and *periurban* cemetery of *Castellaccio Europarco* (12 individuals) from what were believed to be lower status burials, based upon the associated archaeology, suggested that the bodies from the suburban cemetery of *Castellaccio Europarco* made greater use of millet, based on C_4 values, when compared with the individuals from the *periurban* cemetery of *Casal Bertone*, who lived closer to Rome and likely relied more heavily on aquatic resources. The samples from *Casal Bertone* showed a similar pattern to the samples from the St. Callixtus cemetery, radiocarbon dated to the mid-3rd to early 5th century AD, located on the Appian Way in Rome (Rutgers *et al*. 2009). The isotopic results from the two Imperial period cemeteries led Killgrove and Tykot (2013, 36) to conclude that differential use of millet may in fact have been influenced by the individual's socio-economic standing.

Further afield, isotopic analysis carried out in England revealed that one individual from late Roman Britain in Kent either consumed C_4 protein or alternatively migrated from somewhere else (Pollard *et al*. 2011, 446). In contrast, neither legumes nor C_4 plants appear to have been important sources of

protein for the inhabitants of Leptiminus, a Roman port town in Tunisia (Keenleyside *et al*. 2009, 60). Thus, recent isotopic evidence does provide new evidence that C_4 plants, possibly millet, was being consumed in some parts of the Roman empire (Faas 2005; Keenleyside 2009, 53).

It should be noted that C_4 values can also be attributed to the C_4 pathway African crop plant sorghum. The Romans were active traders and importers of exotic plants throughout the world. It is unlike but not impossible, that they were growing sorghum in the Roman empire and that it has contributed to some degree to the C4 values. It must be noted that all these studies are based on relatively small sample sizes and therefore possible consumption of C_4 plants has only been established in a few isolated individuals within the Roman empire. These collagen isotopic studies have shown that millet was not consistently consumed throughout the Roman world. These investigated studies of C_4 consumption show a sporadic geographical distribution which suggests that millet may have been used, possibly by the lower classes based upon the very limited associated funerary and archaeological evidence, where it was ecologically favourable to grow as a possible secondary and/or security crop against famine.

Culturally constructed values towards food

Millet, as an agricultural crop and utilized food source, was embedded within the Roman world view of food as both a necessity and a commodity. Hence, millets' status had a large impact upon its bearing on its value and the values associated with it as both a food and crop. Ancient Roman recipes were written to provide a base upon which set practices could be further elaborated in the kitchens of the very wealthy as illustrated by *De re conquinaria* (On Cooking) by *Apicius*, likely compiled in the late 4th to 5th century AD (Goody 1982, 103; Strong 2002, 22). Within Roman society the virtues associated with foods were not constant or intrinsic to that food but rather could be altered by artificial means, including its associated environment, preparation, and culinary transformations. The huge variety of food items mentioned by ancient Greek and Roman historians and writers (753BC-610AD) could even be extended by dividing these items into finer distinctions including geographic provenance, climate, and cultivation methods (Mazzini 2000, 145).

In reality, food had no place in the moral discourses of the majority of the poor of the Roman empire, *circa* 753BC-610AD, people who did not see the great quantities of luxury foods described by ancient authors. On the other hand, no detailed description of a `standard´ Roman meal is recorded in the

surviving ancient sources (Gowers 1992, 2). The diet of the Roman middling and lower classes, aside from local variations, was most likely heavily concentrated upon cereals, along with olives and grapes and other less important crops such as millets, oats, and rye (Bruan 1995, 25; Garnsey 1999, 13, 15; White 1995, 38-39). Supplementing this diet would have been dried or fresh vegetables and fruits, honey, a variety of nuts including walnuts, almonds, hazelnuts, pinenuts, and chestnuts, and animal protein from milk, cheese, meat, and fish (Corbier 2000, 129).

Aside from (biased) literary and artistic ideological representations, the so-called food of the others was not an issue for the Romans, whose diet was largely free of taboos. Throughout the empire, the tables of elite Romans displayed varieties of local and foreign food items (Longo 2000, 160). The transformation of the regional food of peasants with the addition of exotic items characterises high cuisine throughout a number of cultures. Roman elites do not appear to have distained plebeian meals. Rather, they created distinct dishes with the same ingredients as the peasants but with different methods of preparation and rules of eating the dish. "When they ate broad beans, for example, they added a costly, refined sauce that completely disguised the beans' taste" (Corbier 2000, 135). This may be one reason why exotic and/or expensive food items were not found within the elite properties from Insula VI.I, including the House of the Surgeon and the House of the Vestals due to their preparation in costly sauces and used in preservatives. In addition, the regularity of its consumption and location of its storage, preparation and finally disposal would also influence its final preservation.

Indeed, the presence of millet within the majority of properties with Insula VI.I and other elite houses within Pompeii suggests that millet may have been consumed by the wealthy Roman owners but altered in ways that their slaves, who may have prepared these dishes for their masters, didn't have regular access to for themselves. It is possible that slaves may have cooked their own food in the main kitchens of these elite houses and the millet recovered was prepared for their meals. However, there is also archaeological evidence that slaves and/or servants had their own limited cooking facilities. Roman high cuisine was largely based upon the subtle art of complexity and transformation of regional foods with exotic luxury foods (Garnsey 1999, 19; Goody 1982, 191).

Ancient Roman literary sources are filled with descriptions of the powerful role of food in projecting an individual's moral and cultural values (Gowers 1992, 4). Gastronomy became a socio-political metaphor within Roman society, reflecting certain tensions in Roman society that are documented from the early 2nd century BC onwards. Diametrically opposed views arose from the conflict between the

newly created folk myth during the reign of Augustus of traditional Roman values of archaic frugality and conservative pride in native Italic [Roman Imperial period] agrarian roots and emerging new attitudes open towards foreign modes of living and thought which took hold during the expansion of Roman power (Garnsey 1999, 10; Strong 2002, 18). This presented for the Roman elite a dichotomy between conservative ancestral values and the increasing reality of the multicultural ways of life within Roman society (Bober 1999, 176).

The use of culinary practices to mark social distinction increased in the 3rd century BC in tandem with a decline in subsistence farming. Influences from the Greek colonies in *Magna Graecia* from southern Italy, now under tighter Roman control, increased. This tension was illustrated by the general approval by the Roman people of the sack of Syracuse in 212 BC, as both Sicily and southern Italy represented to the Romans the gastronomic flesh-pots of Hellenistic culture and the all corrupting influences associated with this metaphor (Bober 1999, 169). These cultural and gastronomic pressures surged with the continued absorption and increasing contact with other foreign cultures over the course of the Imperial conquest and domination of other people during the late Republic and Roman Empire. Roman society was being transformed by these processes including the growing cash economy and the increasing wealth and expenditure of privileged groups. Romans generally regarded the growing disparity in terms of their traditional status hierarchies, even if, paradoxically they were aware that these newly created hierarchies of consumption were destroying not only the rules on which their civilization was based but also their own self-image as a Roman people (Corbier 2000, 138). Therefore, one may ask: where did millet fit within these conflicting political, economic and social morals of Roman society?

Traditional Roman foods may be considered ones that the small farmer could grow cheaply on their small plots of land to sustain their families which included millets, pulses, and vegetables. Millets were grown in Bronze Age Europe and possessed a hardy nature, capable of growing when other crops failed. These intrinsic attributes of common and Italian millet's nature tie-in with traditional Roman values, connecting Romans with their perceived past as a conservative, hardy agrarian people living off the land. Based upon limited ritual evidence common and Italian millet were likely traditional Roman foods that continued to be offered to the gods. Thus, common and Italian millet appear to fit into the model of the conflicted Roman psyche of traditional agrarian values and the reality of expanding new frontiers and increasing influx of foreign foods and ideas within the empire.

Conclusions

Despite their many known uses in the Roman world the importance of common and Italian millet is often overlooked by the ancient agrarian authors and modern scholars alike (Rottoli and Castiglioni 2011, 501; Spurr 1986, 14). Indeed, based upon common and Italian millet's increasing recovery from Roman sites throughout the Roman empire it would appear that their role in agrarian societies has been underestimated (**Error! Reference source not found.**). It still remains difficult to ascertain whether common and Italian millet use was stigmatized as a poverty crop, consumed by ordinary free Romans only in times of need. Perhaps what distinguished common and Italian millet as a crop of low status was the extent of one's dependence upon it as a food source. According to the ancient sources and limited archaeobotanical evidence other peoples of the Roman empire grew and relied upon it more extensively than Roman society.

The examined evidence from Pompeian properties suggests that millet was never abandoned as a food in the Roman diet. Its recovery from recent archaeobotanical analyses from Insula VI.I and other areas of Pompeii suggest that its presence within the Roman diet may have been underestimated due to its limited recovery, likely due to its very small size and the fact that millet was normally processed by boiling and thus would be unlikely to be preserved in the archaeological record. It should be acknowledged that this study presents a bias view towards more recent archaeobotanical work at Pompeii and Europe. However, as more rigorous methods of recovery are employed and with more accurate assessments of types of millets used, additional evidence for the presence and use of millets in the Roman world will hopefully become available.

Practically, millet filled a very useful niche, as it was cheap to purchase and easy to grow in less desirable area, in helping to hedge against famine in terms of its ecological adaptability in an unpredictable world which was quickly exhausting its agricultural farmland (Fraser and Rimas 2010). As Strabo (5.1.12) advised "millet is the greatest preventive of famine, since it withstands every unfavourable weather, and can never fail, even though there be scarcity of every other grain". And Vergil (G.1.204) wrote "Receive, and millet's annual care returns".

Thus, it is unlikely that the Romans distained millets. They likely occupied a useful place in the Roman agricultural, culinary and medicinal repertoire. The integration of these lines of evidence has shown that millet consumption was a more complex issue than any single line of evidence would suggest and

closely intertwined with Roman social, economic and cultural values (Killgrove and Tyot 2013, 36). What is clear from the present, albeit limited archaeobotanical and isotopic evidence to date, is that millet was part of the Roman dietary assemblage, to varying degrees, throughout the Roman empire. As archaeobotanical and isotopic analyses become increasingly commonplace and more data is collected it is suspected that common and Italian millets' reputation and usefulness in the ancient world will be elucidated further and millets will move beyond being regarded simply as animal fodder.

Acknowledgement

ERC ComPAg pathways project (Grant no. 323842). Anglo-American Project in Pompeii (AAPP) directors, Dr. Rick Jones and Dr. Damian Robinson for the use of Insula VI.1 images and archaeological information. AAPP environmental specialists staff including Dr. Andrew Jones, Dr. Jane Richardson, and Dr. Robyn Veal, project manager Dr. Hillary Cool, coin specialist Dr. Richard Hobbs, and field director Dr. Michael Anderson. Thanks to Pietro Giovanni Guzzo (*Soprintendente*), Antonio D'Ambrosio, the helpful *custodi* and laboratory staff of the *Soprintendenza Archeologica di Pompei*, particularly the late Annamaria Ciarallo for the kind use of the laboratory facilities over the course of the AAPP field seasons in Pompeii. Finally, anonymous review for helpful comments.

Bibliography

Apicus. *The Roman Cookery Book, a Critical Translation of the Art of Cooking by Apicus for Use in the Study and the Kitchen*. Trans. by Barbara Flower and Elisabeth Rosenbaum. London, Toronto, Wellington, Sydney: George G. Harrap & Co. Ltd, 1958.

Aretaeus, 1972. *The Extant Works of Aretaeus, The Cappadocian*, Boston: Milford House Inc.

Boatwright, M.T., 2012. *Peoples of the Roman World*, Cambridge: Cambridge University Press.

Bober, P. P., 1999. *Art, Culture, and Cuisine: Ancient and Medieval Gastronomy*. Chicago, London: The University of Chicago Press.

Bon, S. E. and Jones, R. (eds.), 1997. *Sequence and Space in Pompeii*. Oxford: Oxbow Books.

Bruan, T., 1995. Barley cakes and emmer bread. In: J. Wilkins, D. Harvey, and M. Dobson (eds.), *Food in Antiquity*. Exeter: University of Exeter Press, 25-37.

Cato, Marcus Porcius. *Cato, the Censor, on farming (De agri cultura).* Trans.by Ernest Brehaut, New York: Columbia University Press, 1933.

Celsus. *De Medicina* Republication of the 1935 edition, Cambridge, Massachusetts: Harvard University Press, 1971.

Ciaraldi, M. R. A., 2001. *Food and Fodder, Religion and Medicine at Pompeii*. Unpublished PhD thesis, Department of Archaeological Sciences, University of Bradford.

Ciaraldi, M. R. A. and Richardson, J. 2000. Food, ritual and rubbish in the making of Pompeii. In: G. Fincham, G. Harrison, R. R. Holland and L. Revel (eds.), *TRAC 99, Proceedings of the Ninth annual Theoretical Roman Archaeology Conference Durham*, *April 1999*. Oxford: Oxbow Books, 74-82.

Columella, L.J.M. *On Agriculture I-IV*, Cambridge, Massachusetts, London, England: Harvard University Press, 1911.

Corbier, M., 2000. The broad bean and the moray: social hierarchies and food in Rome. In: J. L. Flandrin and M. Montanari (eds.), *Food, a culinary history from antiquity to the present*. New York: Penguin Books, 128-140.

Dalby, Andrew. *Food in the Ancient World, from A to Z*. London: Routledge, 2003.

Dioscorides, 1934. *The Greek Herbal of Dioscorides* , Oxford: Oxford University Press.

Dupont, F., 2000. The grammar of Roman dining. In: J. L. Flandrin and M. Montanari (eds.), *Food, a Culinary History from Antiquity to Present*. New York: Penguin Books, 113-127.

Dyson, S.L., 2003. *The Roman Countryside*. London: Duckworth.

Faas, P., 2005. *Around the Roman Table*. Trans. by Whiteside, S. London and Oxford: MacMillan.

Flandrin and M. Montanari (eds.), *Food, a culinary history from antiquity to the present*. New York:

Penguin Books, 128-140.

Fraser, Evans, D.G. and Andrew Rimas. 2010. *Empires of Food: Feast, Famine, and the Rise and Fall of Civilzations*. New York: Free Press.

Garnsey, P., 1999. *Food and Society in Classical Antiquity*. Cambridge, New York: Cambridge University Press.

Goody, J., 1982. *Cooking, Cuisine, and Class: a* Study *in Comparative Sociology*. Cambridge: Cambridge University Press.

Gowers, E., 1992. *The Loaded Table: Representations of Food in Roman Literature*. Oxford: Clarendon Press.

Herodotus, *The Histories*. Trans. by A. D. Godley. Cambridge, MA: Harvard University Press, 1920.

Hesiod, *Shield of Heracles*. Trans.by Hugh G. Evelyn-White. Cambridge, MA: Harvard University Press, London: William Heinemann Ltd., 1914.

Hippocrates. 1868. *The Genuine Works of Hippocrates*. Charles Darwin Adams. New York. Dover.

Hughes, D. J., 1994. *Pan's Travail: Environmental Problems of the Ancient Greeks and Romans*. Baltimore, Md., London: Johns Hopkins University Press.

Jashemski, W. F., 2002b. The Vesuvian Sites before A.D 79: The archaeological, literary, and epigraphical evidence. In: W. F Jashemski, and F. G. Meyer (eds.), *The Natural History of Pompeii*. Cambridge: Cambridge University Press, chap. 2, 6-28.

Jashemski, W. F., 1979a. Pompeii and Mount Vesuvius, A.D. 79. In: P. D. Sheets and D. K. Grayson (eds.), *Volcanic Activity and Human Ecology*. New York, London: Academic Press, 587-622.

Jashemski, W. F., 1979b. *The gardens of Pompeii, Herculaneum and the villas destroyed by Vesuvius*. New Rochelle, N.Y: Caratzas Brothers.

Jones, R., 2003a. Voices from the ashes (Pompeii archaeology). *Archaeology* 56/4, 28-31.

Jones, R., 2003b. The Urbanisation of Insula VI.I at Pompeii. *Rivista di Studi Pompeiani*, 139-146.

Jones, R., 2008. The Urbanisation of Insula VI 1 at Pompeii. In *Nuove Richerche Archeologiche nell'area Vesuviana (Scavi 2003-2006)*. Roma: «L'ERMA» di BRETSCHNEIDER, pp. 139–146.

Jones, R. and Robinson, D., 2004. The making of an elite house: the House of the Vestals at Pompeii. *Journal of Roman Archaeology* 17, 107-130.

Jones, R. and Robinson, D., 2005a. *Anglo-American Project in Pompeii 2005 Resource Book*. Unpublished work.

Jones, R. and Robinson, D., 2005b. Water, wealth, and social status at Pompeii: The House of the Vestals in the first century. *American Journal of Archaeology* 109/4, 695-710.

Jones, R. and Robinson, D. 2006. The Development of Inequality in Pompeii: The Evidence from the

Northern End of Insula VI.I. In: C. C. Mattusch, A. A. Donohue, and A. Brauer, (eds.), *Common Ground: Archaeology, Art, Science and the Humanities. Proc. of the XVI International Congress of Classical Archaeology*, Boston. Oxford: Oxbow Books, 498-502.

Jones, R. and Robinson, D., 2007. Intensification, heterogeneity and power in the development of insula VI.I. In: J. J. Dobbins and P. W. Foss (eds.), The World of Pompeii. London: Routledge, chap. 25, 389-406.

Killgrove, K. and R.H Tykot, 2013. Food for Rome: A stable isotope investigation of diet in the Imperial period (1st-3rd centuries AD). *Journal of Anthropological Archaeology* 32:28-38.

Keenleyside, A., Schwarcz, H., Stirling, L. and N.B. Lazreg. 2009. Stable isotopic evidence for diet in a Roman and Late Roman population from Leptiminus, Tunisia. *Journal of Archaeological Science* 36:51-63.

Kron, G., 2000. Roman ley-farming. *Journal of Roman Archaeology* 13, 277-287.

Lomas, K., 1993. *Rome and the western Greeks, 350BC-AD200: conquest and acculturation in southern Italy*. London, New York: Routledge.

Lomas, K., 1995. Introduction. In: T. J. Cornell and K. Lomas (eds.), *Urban Society in Roman Italy*. London: UCL Press, 1-7.

Longo, O., 2000. The food of others. In: J. L. Flandrin and M. Montanari (eds.), *Food, a culinary history from antiquity to the present*. New York: Penguin Books, 153-162.

MacKinnon, M., 2004. *Production and consumption of animals in Roman Italy: integrating the zooarchaeological and textual evidence*. Portsmouth, R.I: Journal of Roman Archaeology, supplementary series no. 54.

Mazzini, I., 2000. *Diet and medicine in the ancient world*. In: J. L. Flandrin and M. Montanari (eds.), Food, a culinary history from antiquity to the present. New York: Penguin Books, 141-152.

Mennell, S., Murcott, A., and van Otterloo, A. H., 1992. *The Sociology of Food: eating, diet and culture*. London: SAGE.

Meyer, F. G., 1994. Evidence of food plants of ancient Pompeii and other Vesuvian sites. In: D. Moe, J. H. Dickson, and P. M. Jorgensen (eds.), *Garden history: garden plants, species, forms and varieties from Pompeii to 1800: symposium held at the European Univeristy Centre for Cultural Heritage*, Ravello, June, 1991. Belgium: Council of Europe, 19-23.

Meyer, F. G., 1988. Food plants identified from carbonized remains at Pompeii and other Vesuvian Sites. In: R. I. Curtis (ed.), *Studia Pompeiana and classica in honor of Wilhelmina F. Jashemski*. New Rochelle, N.Y: Caratzas, vol. 1, 183-230.

Meyer, F. G., 1980. Carbonized food plants of Pompeii, Herculaneum, and the Villa at Torre Annunziata. *Economic Botany* 34/4, 401-437.

Morley, N., 1996. *Metropolis and hinterland: The city of Rome and the Italian economy 200 B.C.-A.D.*

200. Cambridge: Cambridge University Press.

Murphy, C., 2010. *Pompeii, a Changing City: the Archaeobotanical Assemblage of Regione VI, insula I.* Unpublished PhD thesis. London: University College London.

Murphy, C., Thompson, G., Fuller, Dorian, Q. November 2012. Roman food refuse: Urban Archaeobotany in Pompeii, Regio VI, insula I. *Vegetation History and Archaeobotany*.

Oribasius, 1997. *Dieting for an emperor : a translation of books 1 and 4 of Oribasius' Medical compilations* , Leiden: Brill.

"*Perseus Digital Library*." Editor-in-Chief, Gregory R. Crane. Tufts University. Accessed on July 7, 2014. http://www.perseus.tufts.edu/hopper/.

Pliny, *Natural History*, London, Cambridge, MA: Harvard University Press.

Pollard AM, Ditchfield P, McCullagh JS, Allen TG, Gibson M, Boston C, Clough S, Marquez-Grant N, Nicholson RA. 2011 "These boots were made for walking": the isotopic analysis of a C(4) Roman inhumation from Gravesend, Kent, UK." *American Journal of Physical Anthropology* 146(3):446-56.

Polybius. *Histories*. Evelyn S. Shuckburgh. translator. London, New York. Macmillan. 1889. Reprint Bloomington 1962.

Prowse, Tracy L., Henry P. Schwarcz, Shelley R. Saunders, Roberto Macchiarelli, and Luca Bondioli. 2005. "Isotopic Evidence for Age-Related Variation in Diet From Isola Sacra, Italy." *American Journal of Physical Anthropology* 128: 2-13.

Richardson, J., Thompson, G., and Genovese, A., 1997. New directions in economic and environmental research at Pompeii. In: S. E. Bon and R. Jones (eds.), *Sequences and Space in Pompeii*. Oxford: Oxbow books, 88-101.

Robinson, M. A., 1999. The macroscopic plant remains. In: Fulford, M. and Wallace-Hadrill, A. (eds.), Towards a history of pre-Roman Pompeii: excavations beneath the House of Amarantus (I.9.11-12). *Papers of the British School at Rome* 67, 95-102, and 139-44.

Robinson, M. A., 2002. Domestic burnt offerings and sacrifices at Roman and pre-Roman Pompeii, Italy. *Vegetation History and Archaeobotany* 11/1-2, 93-99.

Rottoli, M., and Castiglioni, E., 2011. Plant offerings from Roman cremations in northern Italy: a review. *Vegetation History and Archaeobotany* 20:495-506.

Rutgers, L.V., van Strydonck, M., Boudin, M. and C. van der Linde (2009) Stable isotope data from the early Christian catacombs of ancient Rome: new insights into the dietary habits of Rome's early Christians. *Journal of Archaeological Science* 36: 1127-1134.

Sadori, L. and Susanna, F., 2005. Hints of economic change during the late Roman Empire period in central Italy: a study of charred plant remains from "*La Fontanaccia*", near Rome. *Vegetation History and Archaeobotany* 14/4, 386-393.

Smith, W., Wayte, W. & Marindin, G.E., 1890. *A Dictionary of Greek and Roman Antiquities*, Albemarle Street, London: John Murray.

Spurr, M. S., 1983. The cultivation of millet in Roman Italy. *Papers of the British School at Rome*. London: British School at Rome, 1-15.

Spurr, M. S., 1986. *Arable cultivation in Roman Italy c.200BC-c.AD 100*. *Journal of Roman studies*, monograph no. 3. London: Society for the Promotion of Roman Studies.

Strabo. *The Geography of Strabo*. Edited by H. L. Jones Cambridge, MA: Harvard University Press, London: William Heinemann, Ltd., 1924.

Strong, R., 2002. *Feast, a History of Grand Eating*. Orlando, Florida: Harcourt.

Tafuri, M, Craig, O.E. and A. Canci. 2009. Stable Isotope Evidence for the Consumption of Millet and Other Plants in Bronze Age Italy. *American Journal of Physical Anthropology* 139: 146-153.

Theophrastus, 2012. *Aeneas of Gaza with Zacharias of Mytilene Ammonius*, London: Bristol Classical.

van der Veen, M., 2003. When is food a luxury? *World Archaeology* 34/31, 405-427.

Varro, M.T., 1934. *De Re Rustica*, Boston, MA: Loeb Classical Library.

Varro, M.T., 1912. *Varro on farming*, London: G. Bell and Sons, ltd.

Vergil, 2008. *Georgics*. Edited by Katharina Volk. Oxford: Oxford University Press.

White, K. D., 1995. Cereals, bread and milling in the Roman world. In: J. Wilken, D. Harvey, and M. Dobson (eds.), *Food in Antiquity*. Exeter: Exeter University Press, 38-43.

White, K. D., 1970. *Roman Farming: Aspects of Greek and Roman Life*. Great Britain: Camelot Press.

Wilcox, G., H., 1977. Exotic Plants from Roman Waterlogged Sites in London. *Journal of Archaeological Science* 4, 269-282

Xenophon. *Xenophon in Seven Volumes*. Edited by Carleton L. Brownson. Cambridge, MA: Harvard University Press, London: William Heinemann Ltd., 1922.

Zohary, D., Hopf, M. and Weiss, E., 2012. *Domestication of plants in the Old World: The origin and spread of cultivated plants in west Asia, Europe and the Nile Valley*. (4th edition). Oxford: Oxford University Press.