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Ancient floras, vegetational reconstruction and man-plant relationships: case studies from archaeological sites

Abstract

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Archaeobotany provides information on the ancient floras, the vegetation that surrounded the archaeological sites, and the interaction between human populations and plants; it may also offer information about wood technology, seasons of gathering or feeding, geographic origin of materials. It includes many different fields of research for analyses of macro or micro-remains. Crossing different data furnishes not merely a sum of information but it multiplies the meaning of single information, allowing detailed and unambiguous interpretation of the results. Case studies are reported.

Introduction

Archaeobotany is the study of the plant remains recovered during archaeological excavations in order to gain information on the ancient floras and vegetation around the sites, and for investigating the interaction between human populations and plants. According to such definition, archaeobotany demands a direct involvement of botanists during excavation, but this has been happening only lately. In the past, archaeobotanical investigations merely consisted of the identification of the plant remains recovered at the sites by archaeologists; archaeobotanists were considered "external consultants" who studied the botanical remains outside their original context.

In the last decades, this kind of relationship is undergoing considerable changes, reflecting the evolution of both archaeology and palaeobotany, which can be considered the "mother" of archaeobotany. A great contribution comes from the new theoretical basis of cultural archaeology and the birth of "environmental archaeology" which occurred about 30 years ago. In fact, "environmental archaeology" is the study of people and their relationship with the environment through time (Branch & al., 2005). In this modern perspective, the study of plant remains is essential, since it provides direct evidence in studying the basis of the subsistence economy. Consequently, the cooperation among archaeologists and other researchers becomes necessary for studying the past of a population in its territory and the history of a landscape.

According to Grove & Rackham (2001), most landscapes are the result of the interaction between the human cultures and the natural environment, with its plants and animals.

In this context, humans must be considered part of the ecosystem where they live. They differ from other species in their ability to settle successfully in a great variety of habitats and are capable of finding solutions for food supply in different environments, using an extraordinary number of different strategies (see Schutkowski 2006). Developing knowledge, tools and behaviors, human populations acquired specific techniques to obtain resources from the territories they inhabited. The result is that different societies evolved subsistence strategies affecting the ecosystems in different manners. When the local conditions became insufficient, trades and exchanges often resulted in the introduction of new elements in the territory. As a consequence, the study of the natural history of a territory cannot ignore the human civilizations which represented, and still represent, an extremely important agent in shaping landscapes. These topics represent a specific field of research in archaeobotany.

Archaeobotany includes palynological analyses, seeds/fruits analysis, wood analysis, phytolith analysis, diatom analysis, etc. The various archaeobotanical investigations use different tools, sampling strategies, laboratory techniques and procedures, and data processing.

All of the types of archaeobotanical investigations provide a list of plants and quantitative information. The plants are identified at different taxonomic levels, depending on the kind of the finding, the state of preservation, the possible accuracy of the analysis. The list of plants is traditionally named “list of *taxa*” because of the different taxonomic ranks achieved during identification. The lists are always partial, because not all of the plants leave traces. However, archaeobotanical analyses may provide many kinds of information. Case studies from archaeological sites are here presented, chosen among the investigations of the author.

Archaeobotanical investigations are commonly used for reconstructing the environmental context surrounding a site. Pollen analysis is mostly used for this purpose, but the seed/fruits contained in soils or the wood/charcoal fragments also furnish useful insights. Wood/charcoal analysis furnish a large variety of information. In fact, wood has been extensively exploited for several purposes: as fuel, as material for constructing buildings, ships, tools or other artifacts which also allow investigating the level of wood technology reached by populations. Moreover, the exploitation of the forests changed their composition in time, underlining the human action in shaping landscape.

"Natural vegetation” is generally studied outside of the archaeological context, because human settlements are strongly affected by human activity. However, in some peculiar cases, archaeological sites can amplify the record of past natural events: in fact, the presence of artifacts, such as buildings, ships, or familiar objects, make “natural events” clearer and more impressive. In these cases, the resolution of the sampling is higher and the reconstruction of the ancient environment is more accurate in the archaeological context.

Natural events: the case of the ship site of Pisa (Italy)

Traces of catastrophic floods were found in Pisa (Italy), where an ancient shipping wharf was excavated (Benvenuti & al. 2006). The archaeological material consisted of several ships, their freight, and also abundant plant remains. This material was radiocarbon-dated from the Etruscan to the late Roman Empire periods. The occurrence of catastrophic floods caused the shifting of the wharf structures from south to north, in different re-constructive phases (Fig.1). Pollen analyses (Mariotti Lippi & al. 2007) identified two different vegetation phases. During the first phase, the Pisa plain was covered with woods dominated by plants which today belong to the mountain vegetational belt, particularly *Fagus*. Leaves, perules and fruits of *Fagus* are the most common macroremains in these levels (Bertacchi & al. 2008). Unfortunately, the chronology of these samples is not unequivocal. The diffusion of *Fagus* at low altitude is related to a wetter and cooler climatic phase, probably at the beginning of the "Sub-Atlantic cold phase" indicated by Lamb (1995) from about 900 to 400 BC. In almost the same period, peaks or increasing values of *Fagus* pollen were recorded in central Italy, for example at Lago di Vico (2650 uncal BP; Magri & Sadori 1999), southern France (Delhon & Thiébault 2005) and in central and northern Europe at about 1000 BC, (Pott 1996).

The second phase mainly refers to the Roman period. The analysis shows a decline of the forest cover and increasing values of pollen of wetland plants, which suggest that the area was a poorly drained alluvial plain. Cultivated plants were only occasionally recorded, probably due to the muddy soils which were unsuitable for farming. The main catastrophic floods occurred during this period, when an increase of the flood frequency of the river Tiber and a slight increase in the rate of sea-level rise are also attested (Camuffo & Enzi 1996). Studies on the Mediterranean climate during the Roman time indicate a climate change occurring between the 5th century BC and the Late Roman Period, in the 5th century AD, in terms of a gradual warming (Lamb 1977; 1982 in: Reale & Dirmeyer 2000). In Pisa, reforestation and spreading of well drained meadows appear to follow the decrease of flood frequency. Accordingly, the mixed oak woodland is well represented and the diffusion of well drained meadows is recorded. The floristic list is very rich and includes many cultivated plants.

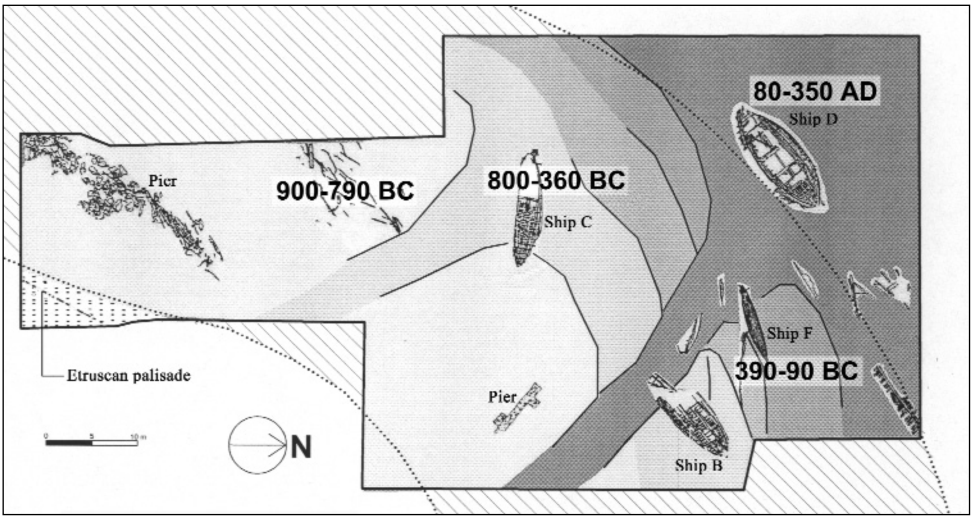

Fig.1. The ship site of Pisa San Rossore (Italy). Dates from Belluomini & al. (2004).

On the whole, the pollen data show a change in the vegetation which may be attributed to different climatic conditions, from cooler to warmer.

Human activity, mainly intended as deforestation, is often considered the cause of degradation or even desertification (Grove & Rackham 2001). In the case of the ship site of Pisa, the hypothesis that the reduction in woodland and the change in its composition were caused by human activity cannot be excluded. Indeed, Strabone (Geographia V,2) wrote that large amount of timber for constructing buildings and ships came from Pisa. On the other hand, pollen data indicate that the woodland decline does not coincide with an increase of spores or microcharcoals, as usually happens when tree-cutting and/or fire are practiced. In addition, a study of the river Arno delta showed a huge sediment supply, related to human impact on the landscape, only after the Roman period (Pranzini 2001). However, despite the possible causes of the floods, it is a fact that repeated catastrophic destruction of the Pisa ship site indicates flooding hazards in a period characterized by a climatic trend similar to the present. Thus, archaeobotanical studies, together with the geo-sedimentological investigations, may offer interesting scenarios suitable for studying the present.

Diffusion of cultivated plants: *Citrus* in Pompeii

Anthropic deposits of seeds/fruits are commonly studied to obtain information on the subsistence economy (the rise of agriculture, the introduction of exotic plants, fodder/food procurement etc.) and to gain palaeo-ethnobotanical insights. However, other kind of analyses (pollen, phytoliths, starch) may also furnish indications about plant cultivation, processing or storage.

The diffusion of plants out of their geographical areas is an interesting topic, particularly when it is related to the diffusion of the most important crops, such as cereals or legumes, the ‘‘founding crops’’ of Neolithic agriculture, or olive and grapevine, which are emblematic plants of the Mediterranean Basin. The diffusion of crops has been investigated for quite some time, but information is still lacking, because of the low number of studies and their fragmentary state. Moreover, as maintained by Coward (2008), the diffusion of crop agriculture assumed the pattern of a network which connect one region to another even when it started from a single centre of origin. The diffusion of plants did not exclude breeding with the native plants and the consequent origin of hybrids: they may result occasional and sterile or may give rise to introgressive hybridization or, even, hybrid swarms.

Together with the plants which were voluntarily introduced by humans in a territory, many weeds and other alien plants were involuntarily or accidentally introduced. As for the first ones, the study of their history must take into consideration ancient documents, texts, inscriptions, but the history of the second ones usually relies solely on data retrieved in the soil, and may be “read” only throughout the study of the fossil or sub-fossil remains.

In Pompeii, an interesting finding was made in the “Casa delle Nozze di Ercole e Ebe”. Among a great amount of pollen grains, pollen grains of *Citrus* were found (Mariotti Lippi 2000), although their number was not high, as it is to be expected for insect-pollinated plants. These grains were strongly similar to those of the present *Citrus limon* (Fig. 2). Plants of the genus *Citrus* had a large diffusion in the Mediterranean Basin, as medicinal,

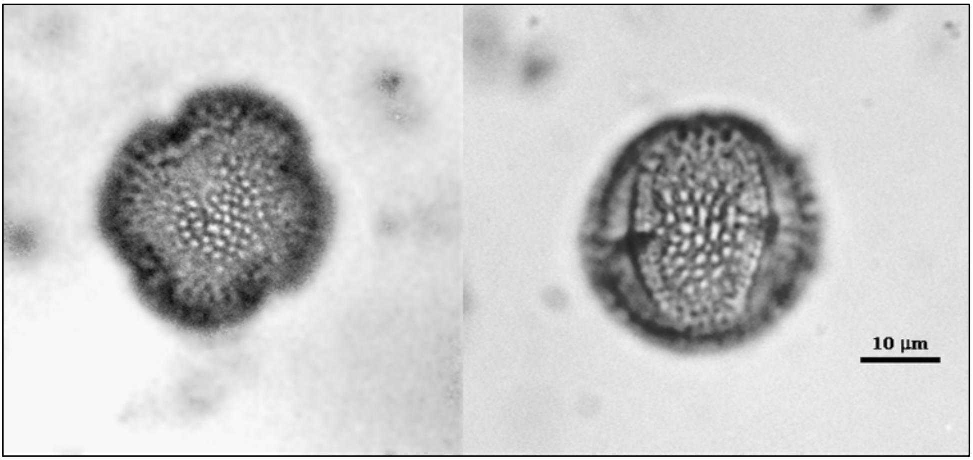

Fig. 2. *Citrus limon* pollen from the Casa delle Nozze di Ercole e Ebe in Pompeii (Italy).

ornamental, and food plant. It is widely accepted that the ancient Romans only knew *Citrus medica* and that it was the only citrus crop grown in the Mediterranean Basin by the end of the 4th century BC. It was introduced from India probably via Persia (*Media*), and for this reason it was named "*medica*" (Mabberley 1997; Zohary & Hopf 2004). In Italy, pollen analyses attested that *Citrus* plants were cultivated at Lago d'Averno (Neaples) during Roman times (Grüger & Thulin 1998).

Pliny and other Latin writers used the name *Citrus* or *Citrea* for all the plants similar to the first "citrus" fruit known to the classical world, which probably was *C. medica*. The use of one name for all the groups makes it difficult to identify more precisely the plants known to the Romans. Apart from *C. medica*, Asian citrus fruits, including lemon, are believed to have been introduced by the Arabs in the Early Islamic Period (Ramon-Laca 2003; Zohary & Hopf 2004).

Even if the attribution of the *Citrus* pollen grains of Pompeii to *C. limon* is uncertain, this is not the first trace of the presence of lemon in the Vesuvian area. Previously, charcoals identified as lemon were found in an amphora in the Villa of Poppea at Oplontis (Jashemski & al. 2002). Moreover, wall paintings attest that several citrus fruits were known in Pompeii (Borgongino 2006): some of them closely resemble lemon. Lemon and citron were also portrayed with their distinctive features in a I-II century mosaic now in the Museo delle Terme di Diocleziano in Rome (Jashemski & al. 2002).

The geographical origin of materials: the resin of the Saqqara coffin.

Plant remains may be contained in honey, resin, dung, and many other materials. As a consequence, archaeobotanical investigations may furnish indication about the season of gathering or feeding, or the geographic origin.

The pollen analysis of an ancient resin found in anthropoid stone coffin from Saqqara (Egypt; II century BC) furnished information about its provenance area. The preliminary analysis demonstrated that the resin was collected from a pine, somewhere in the Mediterranean Basin (Mercuri & Mariotti Lippi 1989). Further testing provided more specific information regarding its area of origin (Mariotti Lippi & Mercuri 1992). More than seventy taxa were identified in less than 1 gram of material. Even if it is not absolutely certain that the resin was used in its pure state and the original pollen content was not altered, it is interesting to note that all of the identified grains belonged to plants which currently grow in the Mediterranean Basin. Even if the Holocene geographical distribution of the plants was not exactly the same as today, the current distribution areas may furnish indications (Fig. 3). Some of the identified taxa include members growing around the entire Basin; others are found in Europe and Asia; others shift the attention out of Europe. The presence of *Cedrus libani* pollen suggests more precisely that the geographical origin of the resin is to be found in the hills or mountain slopes in the hinterland of the Gulf of Iskenderun, from south Turkey to Syria and Lebanon.

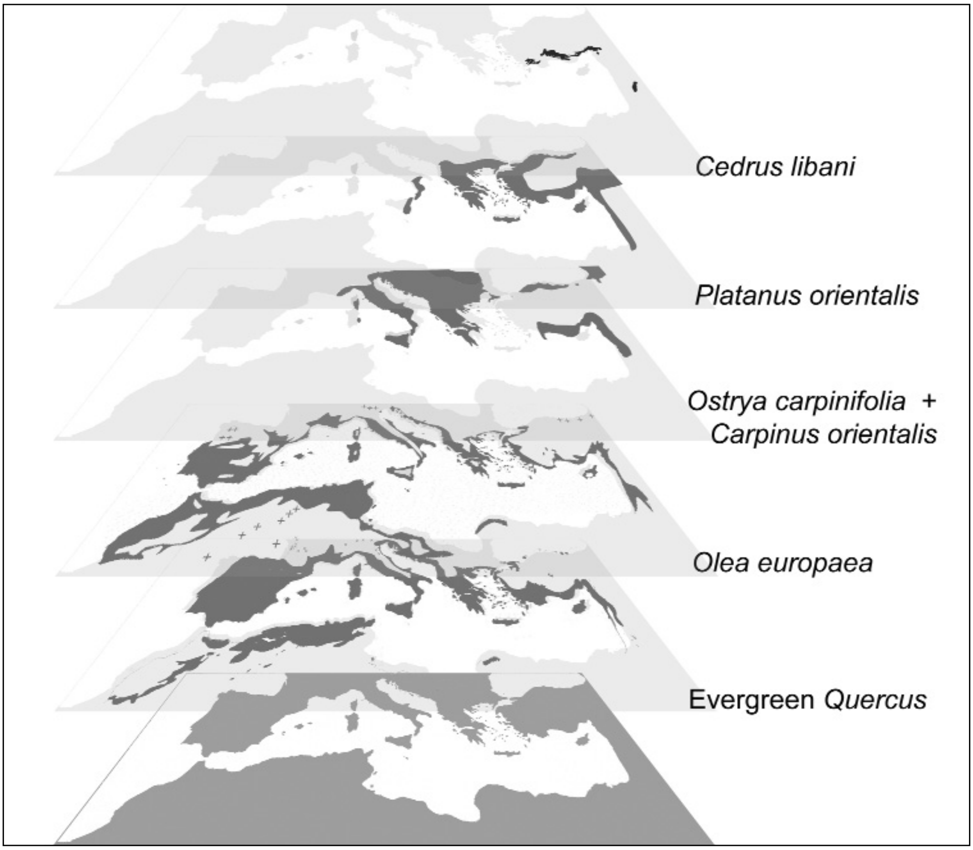

Fig. 3. Distribution area (according to Quezel & Medail 2003) of some of the plants listed in the pollen spectrum of the resin from Saqqara (Egypt).

Crossing the data: the reconstruction of a garden in ancient Pompeii

Each field of research provides useful information, but crossing different data provides more results than by simply summing them up. An example is furnished by the investigations in the garden of the "Casa dei Casti Amanti" (Pompeii, Italy), now "Casa dei Pittori al lavoro", where the careful excavation saved the ancient soil surface and enabled scholars to draw a detailed map of the garden complete with the indication of the root cavities of the herbs (Fig. 4). The palynological analysis supplied a rich list of plants and the recovery of wood fragments in the cavities even allowed for a reconstruction of the ancient appearance of the flowerbeds in 79 AD (Ciarallo & Mariotti Lippi 1993). A row of small plants left root cavities along the perimeters of the flowerbeds. Pollen analysis suggested they could be Caryophyllaceae, perhaps *Lychnis* or *Cerastium*. Larger perforations indicate that the geometry of the beds was emphasized by growing plants, particularly roses and junipers; indeed, their presence is attested both by wood remains in the holes and pollen in the soil. Hundreds of holes, each 3-4 cm in diameter, were distributed for the main part among the peripheral beds. They most likely contained *Artemisia*, whose pollen was abundant in the samples from that location. *Polypodium australe* possibly grew along the small perimeter drains, where many of its spores were found. Moreover, regularly spaced groups of holes were aligned along the perimeter of the geometrically shaped beds. Their morphology suggested that they belonged to reeds of different sizes: the smaller holes were grouped and bent at an angle; the larger ones were isolated, vertically arranged and positioned one meter from one another. The analyses of the wood remains revealed that the smaller holes contained *Phragmites australis*; the larger holes - canes of *Arundo*

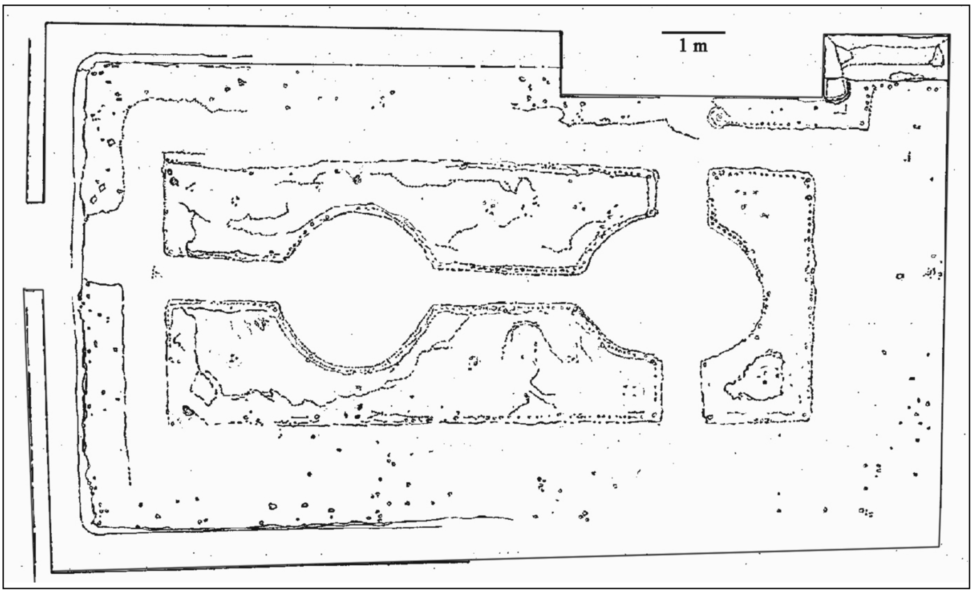

Fig. 4. Map of the garden of the Casa dei Casti Amanti in Pompeii (Italy).

donax. Reeds of appropriate sizes were placed in the cavities to reconstruct the appearance of the trellis framing the beds. It seemed to be similar to the cane trellises painted in several frescos in Pompeii. The complete reconstruction of the garden was possible thanks to the integration of data from different analyses.

Conclusions

Examples like those described above, can be found all over the world, concerning different ages and continents. They show that, when plant micro- and macro- remains are preserved, they can allow quite precise reconstruction of past environments, even at a meter-scale. Nevertheless, in order to achieve comprehensive results as those mentioned above, also information from written and iconographic sources is needed. The utility of archaeobotany is not limited for studying rather ancient times (e.g. prehistoric or classical ages, as quoted), but often even for the last centuries, whenever and wherever plant remains are the principal sources for studying past environments. Thus, archaeobotanical investigations are proved to be a useful tool for the reconstruction of ancient landscapes and for interpreting the current situation.

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