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NOTES

ARCHAEOBOTANICAL INVESTIGATIONS AND HUMAN IMPACT AT THE IMPERIAL HARBOUR OF ROME

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Abstract – Remnants of the ancient harbour of Rome are located in the Tiber delta area 3.5 km away from the present coastline. It was the main Rome maritime port from the middle of the first century to Late Antiquity. In 42 AD, emperor Claudius started the excavation of the harbour. Then, the emperor Trajan added to the former construction, which had gradually silted up, a hexagonal basin in an inner position. The objective of this multidisciplinary study was to reconstruct the plant cultural landscape in the harbour applying detailed pollen, microcharcoal, and plant macroremains recovered from two cores (PTS5 and PTS13) drilled in the area of the Claudius harbour. The chronological framing of the records is based on stratigraphical criteria, radiocarbon dates, archaeological and historical data. The two cores record different periods of time. One core shows the first phases of the harbour activities, with a plant landscape typical of a coastal environment. The other one records a stronger human impact related to the presence of *Portus* town and of medieval settlements. Anthropogenic pollen indicators (sensu Behre and Jacomet 1991) as well as strong fire use/occurrence were increasing in the first centuries AD. These results will be completed with new core data from the extant Trajan lake, granting the possibility to study a record spanning the last two millennia.

Keywords: Imperial harbour of Rome, plant landscape, palynology, archaeobotany, microcharcoals, Tiber delta

Introduction

Human impact versus climate forcing

How modern society should mitigate and adapt to the effects of climate change is subject to worldwide scientific discussion (e.g. Rosen, 2007; Wossink, 2009). Archaeological and historical studies, documenting human responses to environmental change, can play a key role in understanding past cultural trends because decisions about the future are made with knowledge about the past (Mercuri & Sadori, 2013). Archaeological and historical records provide unique and effective means of following changes through time in the demography and social organization of human societies. At the same time, the past three decades have seen a continuous refinement of natural archives, the so-called palaeoclimate proxy records, and palaeoclimate models (Berger and Guilaine, 2009; Jalut et al., 2009; Wossink, 2009). The "climatic determinism" theories have in fact been suggesting that climate and environment have been a first-scale factor determining transformations in human societies, and the relationship between humans and environment was eventually transformed under climate changes (Rosen 2007; Mercuri et al., 2011; Roberts et al., 2011; Sadori et al., 2010a).

In order to assess the degree of human-environment interaction there is the urgent need to carry out scientific investigations on natural archives linked to human history. Failure to consider the complex interactions between humans and their environment could lead either to an

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environmentally deterministic view of socio-cultural change or to a complete neglect of possible environmental impact on human action and history. There is a close relationship between humans and their environment, and the way individuals or groups adapt to or impact on their environment, or do both, must be considered on a case-to-case basis (Wossink, 2009).
Joint actions of increasing dryness, climate oscillations and human impact are hard to disentangle. The aim of this study is to investigate climate changes and human activities under the lens of pollen and plant macroremains found in sediment cores from the imperial port of Rome.
Archaeopalynology and archaeobotany more in general could provide insights to understand the human-environment relations. Archaeobotany is the study of both microscopical (pollen, non-pollen palynomorphs- NPP, phytolits, microcharcoals) and macroscopical (seeds/fruits, woods) plant parts recovered from archaeological sites or human- disturbed contexts. Pollen assemblages found in sediments are used to reconstruct past flora and vegetation. Generally they are recognised at the botanical level of family or genus, while species are fairly difficult to identify. Seeds and fruits, woods and charcoals are part of plants, which can be frequently identified as plant genera or species. But, while the pollen rain mirrors the surrounding vegetation, the seed finds are rather fortuitous. We can therefore consider complementary the two analyses.

The imperial harbour of Rome and its town

The ancient port built along the Tyrrhenian coast by Roman Emperor Claudius (1st century AD), and modified by Emperor Trajan (2nd century AD) was Rome's principal maritime port from the middle of the first century onward and an important gateway between Rome and the Mediterranean. Located at present ca. 3.5 km East from the present Tyrrhenian coast, the imperial harbour of Rome (Fig. 1) was formed by two large artificial basins excavated both in *terra firma* and in lagoons (Testaguzza, 1970; Giraudi et al., 2009). The ancient harbour of Rome is the most impressive artificial feature of its kind in the antiquity and its ruins are well represented in a late Renaissance age fresco by Ignazio Danti shown at the *Galleria delle Carte geografiche* of the Vatican museums (www.ostia-antica.org/past/danti1.htm). Some remnants of the monumental imperial port are still visible in the archaeological area directed by *Soprintendenza Archeologica Speciale di Roma* (www.ostia-antica.org/portus/portus.htm) and in the adjacent park of *Oasi di Porto* in which the basin is located today (www.romeguide.it/oasidiporto/oasidiporto.htm).

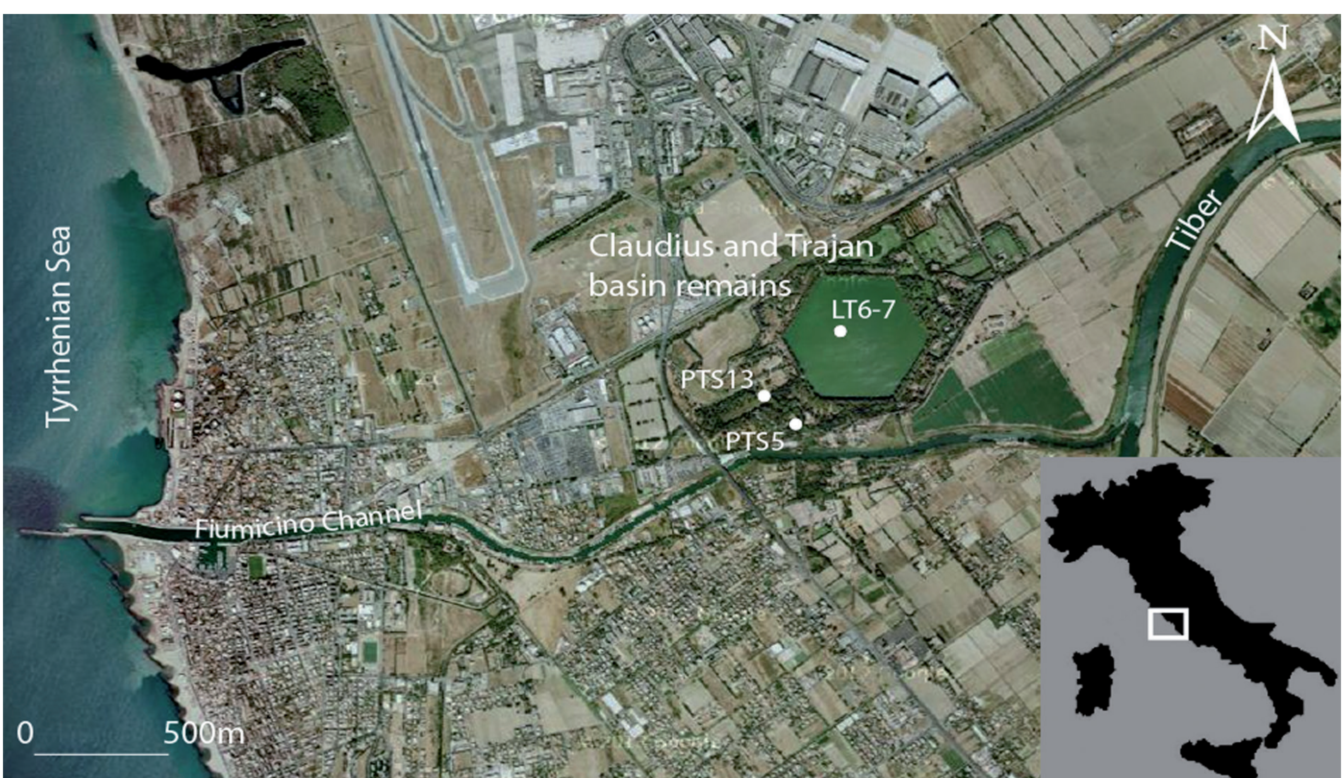

Fig. 1. Location map of the ancient port of Rome and of the cores in study. Copyright TerraMetrics, 2013 Google.

During the Republican age, the closest port to Rome was the river port of Ostia, not efficient enough for managing the goods imported by many Mediterranean countries. In 42 AD, a food shortage induced emperor Claudius to start the building of a new port in the Tiber delta, 3 km north of ancient Ostia. The port was inaugurated in 64 AD under Nero but due to the rapid silting of the Claudius basin (both for storms and Tiber river floods) an innermost hexagonal closed basin was excavated under Trajan, between 100 and 112 AD. The basin, named at present lake of Trajan, has still water and is connected with the Tiber River.

The harbour town, named *Portus*, arose in the area, and developed together with the port itself, expanding in the following centuries and becoming very soon more important than ancient Ostia. The town was sacked and fired in occasion of frequent barbarian invasions between the 4th and the 6th century AD (Testaguzza, 1970) until the conquest of the port and its town by the Goths (Procopius, *De bello Gothico*). The ruins of the imperial harbour were gradually buried and came to the light during the excavations of the 19th century and, especially, of the second half of 20th century, when the *Leonardo da Vinci* international airport (Roma Fiumicino) was built in the area.

Remnants of natural vegetation are rather rare in the intensely urbanized Tiber delta area and found just in some protected areas along the nearby coast (Lucchese and Pignatti, 1990, Bianco et al., 2002; Crescente et al., 2002; Gratani et al., 2010). Most likely, the vegetation of these protected areas is very similar to that present in the delta during Roman times. Proceeding along a transect running from the sea to inland, different aspects of vegetation can be described as: a) psammophilous vegetation, growing on sandy dunes and constituted by pioneer herbaceous species; b) low macchia vegetation, covering the inland, more stabilized dunes; c) high macchia with evergreen arboreal elements mixed with mesophilous trees and shrubs; d) deciduous vegetation, constituted by the plain oak forest growing on old dunes and on the alluvial sediments with high water availability; e) riparian vegetation along the rivers, with freshwater and salt tolerant trees.

Material and methods

Aims of the research and chronology of cores

Besides palynology and archaeobotany, the current multidisciplinary research on the area of the ancient port has involved several disciplines such as archaeology, geomorphology, ostracodology, sedimentology and geochemistry (Goiran et al., 2010; Sadori et al., 2010a, b; Mazzini et al., 2011; Pepe et al., 2012; Salomon et al., 2012). The objective of this study was and still is to reconstruct both the plant cultural landscape and the water environment in the harbour basins. To this purpose four sediment cores have been selected taken in the ancient dock (PTS13) and in the Canale Trasverso (PTS5), today inside the archaeological park, and two (LT6 and LT7) in the lake of Trajan (Fig. 1) private property.

The chronological framing of the records is based on stratigraphical criteria, radiocarbon dates, historical data and pottery fragments. The correlation between cores and their chronological relation is a challenging issue. In PTS13 two radiocarbon dates have been provided by Sadori et al. (2010a): 1805±40 years BP (calibrated age, 2 σ interval: 85-340 AD, corresponding to ca. 212±128 AD; laboratory code: Rome 1914) on the wood remains occurring between 3.23 and 3.17 m and 1780±25 (calibrated age, 2 σ interval: 130-340 AD, corresponding to 235±105 AD; laboratory code: Ua 33764) on pollen extracted from the sediment rich in organic matter at 1.75 m. The core PTS5 could not be dated directly: it represents a time frame bounded between the date of dredging of the Canale Trasverso (4th century AD) (Paroli, 2004) and that of the top sediments (Renaissance). Another element useful to assess the chronology of the core is a pottery shard dated between 2nd and 4th century AD, found at the base of the core. A hypothesis of correlation with the historical documented Tiber floods has been recently advanced by Pepe et al. (2012). Multy-proxy analyses of the lake Trajan sediment cores are still in progress.

Results and discussion

Pollen and plant macroremain assemblages confirm that PTS5 and PTS13 cores record different periods of time. The dock core shows the first phases of the harbour activities, with a rather preserved plant landscape typical of a coastal environment. The other core records a stronger human impact related to the presence of the port town. The environmental changes were linked to natural changes, to the harbour human management and to the development of *Portus*, the harbour town.

Two thick pieces of wood ascribed to deciduous oak and elm, probably timber of boat(s) or used for boat restoration, constitute core PTS13 between 2.90 and 3.60 m.

Pollen, plant macroremain and seed results are summarized in two figures, the first with selected groups curves of terrestrial plants and microcharcoals (Fig. 2), the second with plants linked to water environment (Fig. 3).

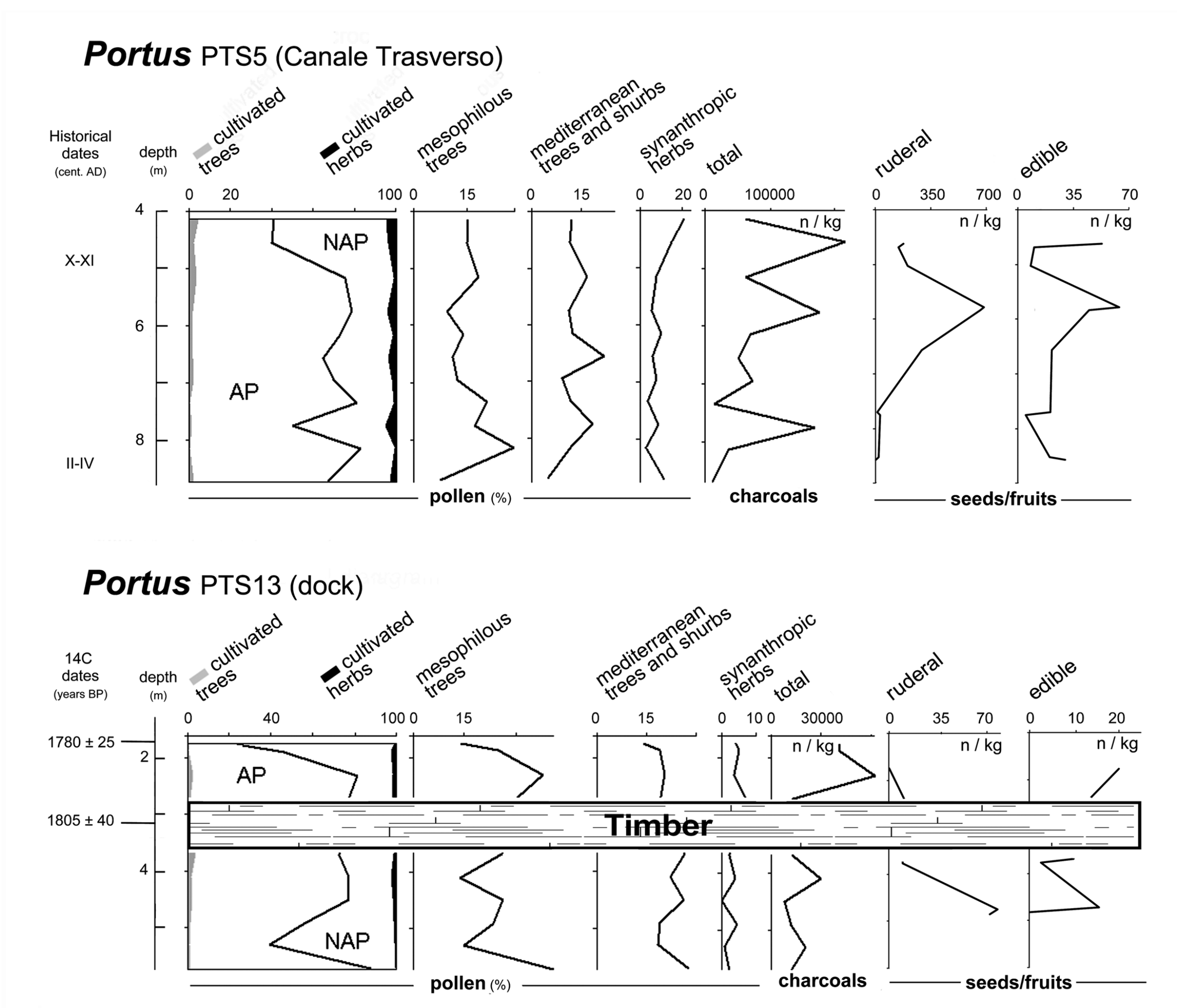

Fig. 2. Pollen and plant macroremain diagram of selected groups. Pollen groups (**PTS5-PTS13**). **Cultivated trees**: *Castanea*, *Juglans*. **Cultivated herbs**: legumes, cereals. **Mesophilous trees**: *Acer*, *Carpinus betulus*, *Ostrya/Carpinus orientalis,* deciduous *Quercus*, *Ulmus*, *Tilia*. **Mediterranean trees and shrubs**: *Cistus*, *Ephedra fragilis*, Ericaceae, *Fraxinus ornus*, *Juniperus*, *Olea*, *Pistacia*, *Phillyrea*, *Quercus ilex* type, *Rhamnus*. **Synanthropic herbs**: Asteroideae, Caryophyllaceae, Cichoriodeae, *Plantago* cf. *lanceolata*, *Rumex*, Urticaceae. Plant macroremain (seeds/fruits) groups. **PTS5- Ruderal**: *Agrimonia* cf. *eupatoria*, *Agrostemma* sp., *Amaranthus graecizans*, Apiaceae undiff., Caryophyllaceae undiff., *Cerastium* sp., *Chenopodium murale*, *Cichorium* sp., *Convolvulus* sp., *Hypericum perforatum*, *Papaver* cf. *rhoeas*, *Rumex crispus/obtusifolius*, *Rumex* sp., *Silene* cf. *gallica*, *Urtica dioica*, *Verbena officinalis*. **Edible**: *Cucumis melo*, *Ficus carica*, *Morus nigra*, *Pinus pinea*, *Rubus* sp., *Vitis vinifera*. **PTS13- Ruderal**: cf. *Apium*, Caryophyllaceae undiff., *Cerastium* sp., *C. murale*, *Clinopodium acinos*, *H. perforatum*, *Minuartia* sp., *P.* cf. *rhoeas*, *Petroselinum* cf. *crispus*, *Picris echioides*, *Portulaca oleracea*, *R. crispus/obtusifolium*, *S.* cf. *gallica*, *V. officinalis*. **Edible**: *Corylus avellana*, *C. melo*, *F. carica*, *Olea europea*, *P. pinea*, *Rubus* sp., *Vaccinium* sp., *Vitis vinifera*.

At the onset of the Claudius port life (1st century AD), PTS13 core (Fig. 2 and 3) shows high values of mesophilous and Mediterranean pollen taxa (e.g. deciduous and evergreen oaks). This suggests that the typical vegetation of a Mediterranean coast, with evergreen elements along the sea and deciduous woods typical of alluvial plains further inside, was widespread. The temporary strong decrease in arboreal plants (AP) pollen percentages is mainly due to a contemporary expansion of chenopods (Fig. 3). Soon after, salt resistant riparian trees such as *Tamarix* show an expansion. *Tamarix* is generally severely under-represented in pollen diagrams (van Zeist et al., 1968/69). The occurrence

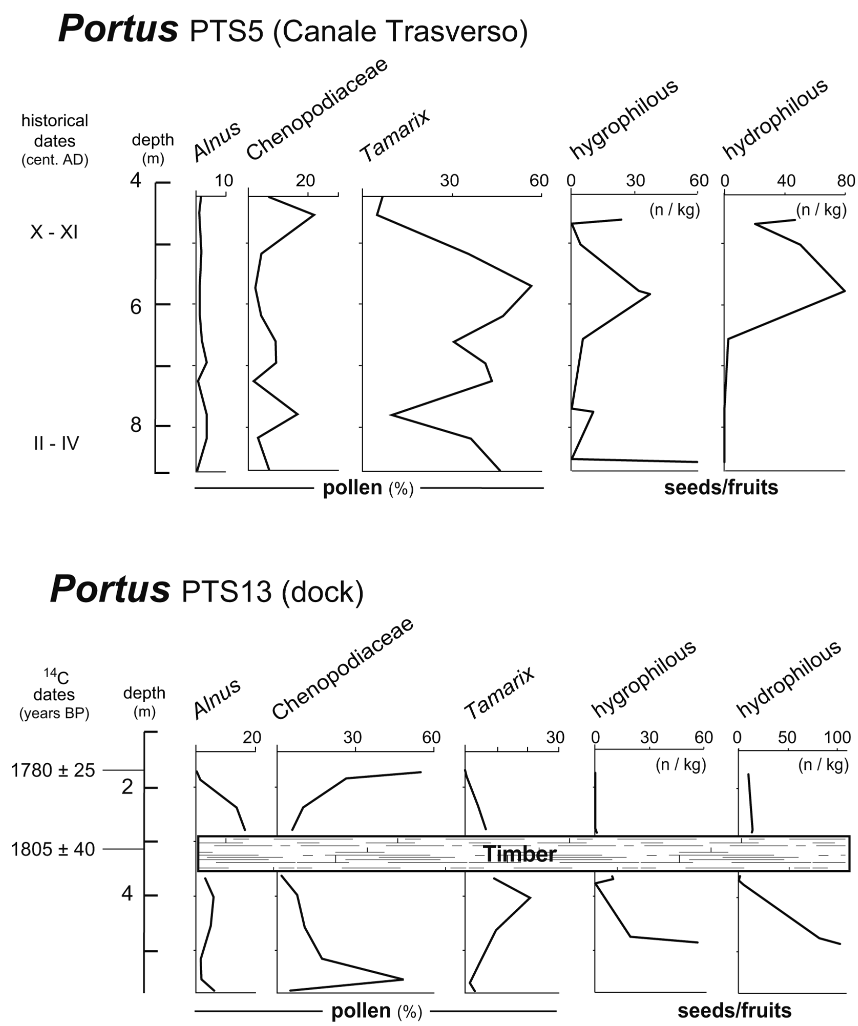

Fig. 3. Pollen and plant macroremain diagram of selected groups. Plant macroremains groups: **PTS5- Hygrophilous**: *Carex* cf. *strigosa*, *Eleocharis palustris/uniglumis*, *Epilobium* sp., *Galium* cf. *palustre*, *Medicago* cf. *marina*, *Mentha pulegium*, *Ranunculus sardous*, *Scirpus* sp., *Solanum* cf. *dulcamara*/*Physalis alkekengi*. **Hydrophilous**: *Baldellia ranunculoides*, *Cyperus* sp, *Juncus* cf. *bulbosus*, *Nuphar lutea*, *Typha latifolia*. **PTS13-Hygrophilous**: *Carex* sp., *C.* cf. *strigosa*, *M. pulegium*, *R. sardous*. **Hydrophilous**: *B. ranunculoides*, Cyperaceae undiff., *Cyperus* sp., *J.* cf. *bulbosus*, *N. lutea*, *Ranunculus* cf. *aquatilis*, *T. latifolia*.

of high amounts of this pollen are typical in anthropic contexts (e.g. Mercuri et al., 2009). Freshwater trees (mainly alder) are abundant just over the timber deposition, decreasing towards the end of the diagram, when a peak of chenopods occurred. Hydrophilous (mainly *Cyperus* sp., *Juncus* cf. *bulbosus*), hygrophilous (mainly *Carex* sp., *Mentha pulegium*, *Ranunculus sardous*) and ruderal (mainly *Caryophyllaceae* undiff., *Cerastium* sp., *Chenopodium murale, Hypericum perforatum, Papaver* cf. *rhoeas, Portulaca oleracea, Rumex crispus/obtusifolium, Silene* cf. *gallica, Verbena officinalis* seeds concentration) is rather high from the bottom sample, while the edible taxa *mainly Cucumis melo*, *Ficus carica*, *Rubus* sp., *Vitis vinifera*) show the highest value in the top sample, when mesophilous and Mediterranean trees decrease and fire use/occurrence is increasing. Pollen of cultivated trees and herbs shows similar values all over the core.

The PTS5 core, taken in the channel excavated by Trajan and connecting the basin to the Tiber, possibly dates back to the 4th century AD. The diagram starts with a peak of *Tamarix*, first followed by an increase of mesophilous trees and then by Mediterranean taxa. A maximum of charcoal is recorded in correspondence with the strong decrease of tamarisk and the increase of evergreen taxa and chenopodiaceae. It could be tentatively correlated with a fire of *Tamarix* trees. Synanthropic pollen taxa show rather constant percentages, slightly higher than in PTS13, for most of the period, peaking at top diagram and following two maxima in seed concentration.

On the basis of the very high pollen percentages found in both cores, Sadori et al. (2010a, b) (Fig. 3) made the hypothesis that Romans could have planted tamarisks. This could be true for the expansions at the bases of core PTS13 and PTS5, but not for the last increase of tamarisks (salt-tolerant plants typical of wetlands in delta areas) probably occurring at the beginning of the High Middle Ages, when the environment turned into a marshland and malaria spread in the area (Nibby, 1837; Sallares, 2006). Following the correlation advanced by Pepe et al. (2012) between core proxies and Tiber floods, the peak in the microcharcoal curves below 7 m (core PTS5, Fig. 2) may correspond to one of the violent Barbarian assaults of the 6th century. In fact, charcoal particles can be taken as an evidence of local fire (Sadori & Giardini, 2007).

CONCLUSIONS

Palynology turned out to be a good tool to shed new light on the complex relationships existing between ancient societies and the land they exploited, but useful and complementary information is also provided by the study of plant macroremains and microcharcoal analyses. In particular, the contribution of archaeobotany would have been unfruitful without using a multidisciplinary approach. In fact, in archaeological settings as complex as harbour basins, multidisciplinary analyses resulted of fundamental importance to comprehend the relations between human impact and natural environmental changes.

The plant landscape of the harbour appears to have been progressively modified by human pressure, with increasing clues in the Late Antiquity sediments. Local settlements of High Middle Ages populations left important traces on the sediments too. Despite these strong plant landscape changes in the area, the macchia belt and the inland deciduous wood near the harbour persisted, probably due to the geomorphological features of the delta environment.

The study in progress of the lake Trajan sediments will mark a step further in the understanding of the environmental history of the area as could be read in the natural and historical archives of harbour basins sediments.

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