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PALAEOECOLOGY AND LONG-TERM HUMAN IMPACT IN PLANT BIOLOGY

Palaeoenvironment and land use of Roman peasant farmhouses in southern Tuscany

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Abstract
Archaeo-environmental data were obtained from five small rural sites excavated as part of the Roman Peasant Project in southern Tuscany. Archaeo-botanical and archaeological data point to a moment of intensive land use in the late Republican/Early Imperial date and to possible use of convertible agriculture strategies. The diversity of pasture-grazing plant species, the presence of coprophilous fungi, parasite eggs and the high values of pasture indicator pollen suggest that lands devoted to browsing animals covered an important part of the territory all around and in the vicinity of sites. The significant presence of cereals, with occasional presence of vines and olives, attests to the importance of grain agriculture in the same spaces. These data may be read as residues of convertible agricultural strategies in which pasture, including cultivated fodder, alternated with legumes and cereals. Read together, the data thus point to a major moment of intensified use and management of the land.

Keywords: Archaeology, archaeo-botany, pasture, agrarian landscape, Roman

Introduction
An indissoluble link exists between archaeology and ecology, echoed in statement that ecology is a historical science (Boero 2010; Birks 2012; Mercuri et al. 2013). A multi-disciplinary archaeological project – the Roman Peasant Project – has focused on lower-class rural dwellers of southern Tuscany between the 2nd century B.C. and the 6th century A. D. (Ghisleni et al. 2011; Vaccaro et al. 2013). Palaeoenvironment and land use have been a focus of the project, relating as they do to life conditions and subsistence. Plant remains – pollen, non-pollen palynomorphs, charcoal particles, and seeds and fruits – reveal site function and environmental conditions of rural dwellers (Rattighieri et al. 2013; Vaccaro et al. 2013). In a previous paper, Bowes et al. (in press) stressed that a convertible agriculture including crop cultivation and pasture was important in Roman times in this region. The data point to a deliberate strategy of intensive pasture maintenance, breaking down the presumed relationship between pasture and “extensive” agriculture and offering alternative explanations for small-site scatters found in field survey.

This paper presents the comparative bio-archaeological data obtained from five archaeological sites studied from this region. The discussion is based on two sets of evidence: the first comes from the morphology and function of the excavated structures; the second comes from pollen data, together with other biological – plant and animal – remains. The structures provide secondary indicators – evidence for land use and management which could be in turn related to agricultural systems, whereas the environmental data provide something close to primary indicators for agricultural systems – evidence for nearby crops and landscapes (Bowes et al. in press).
The Roman Peasant Project was started in 2009 in the commune of Cinigiano (324 m a.s.l.; Grosseto) in southern Tuscany (Figure 1). The aims of the project were to illuminate the lived experience of lower-class rural dwellers by excavating a range of sites identified in field survey, focusing on the “smaller”/”poorer” end of the surface material spectrum. Cinigiano is located astride the Orcia and Ombrone rivers, some 40 km inland from the coast, and a long day’s walk from the nearest Roman city at Roselle and the Via Aurelia. Although thus geostrategically somewhat marginal, it was hardly isolated from the political and economic impact of either Roman urban development or coastal trade.

The project used a “total” survey carried out by one of the directors: Ghisleni (2010) sampled three major surface transects, along with aerial photography and selective magnetometry, to map 467 topographic units. About 55% were late Republican/Early Imperial Roman sites, and the vast majority of these were small sites of under 500 m² scatter or were off-sites. There was only one villa in the area (Santa Marta), while six others >15,000 m² sites were identified as “villages”. This pattern began in the later 2nd century B.C.: after the later 1st century A.D., all of the smallest sites and the majority of the others seem to vanish (Ghisleni 2010), a similar phenomenon to that known from regional surveys, e.g. Oro, Ombrone (Carandini et al. 2002; Vaccaro 2008).

The Roman Peasant Project has thus far excavated eight sites and off-site scatters. Five of these excavations, subjected to multi-disciplinary analyses, will be discussed here. They focused on scatters of 2500 m² or less, and in one case, on a scatter classified as an off-site, located in a relatively small area and dated to the late 2nd century B.C. to early 1st century A.D. (Table I; Figure 1). Although initially interpreted as “small houses” on the basis of the surface material, these sites have little in common. Accordingly, the narrow functional categories often applied to Italian field survey data conceal a huge range of functional diversity (Witcher 2006, 2012; Ghisleni et al. 2011). Below, a brief description of each site is reported while their structure and archaeological/archaeobotanical contexts are reported in Supplemental files (SF-text, and site plans in SF-Figure 1).

A – Case Nuove (CN; late 1st century B.C./late Republican – 1st century A.D./Early Imperial period; then 5th century A.D./late antique) was a hill-top, small, open-air agro-processing point, with a surface for foot-treading, a tank with a press, a deep well, and a dump with dolia. Residue analyses indicated plant processing (tartaric and other acids in the dolia; possibly oil in the tank). The environmental data obtainable from late Republican phase were challenged by the fact that no pollen could be collected from the use-phase layers due to strata disturbance. Thus, the pollen information comes from the late antique phases, whereas the macro-

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Figure 1. Location map showing: (left) Tuscany region in Italy, the province of Grosseto and the location of the commune of Cinigiano (black spot); (right) the five excavated sites of the 1st century B.C.–1st century A.D., discussed in the text. A, Case Nuove; B, Colle Massari; C, San Martino; D, Poggio dell’Amore; E, Podere Terrato.
Table I. List of five sites discussed in the text, including a summary of sampling data.

<table>
<thead>
<tr>
<th>Label – Name</th>
<th>Coordinates</th>
<th>Location</th>
<th>Excavation year</th>
<th>Archaeological general data</th>
<th>Ceramics&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Fauna&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Archaeobotanical samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A – CN</td>
<td>42°54'06.00&quot;N</td>
<td>Hill-top site, some 500 m from the villa of Santa Marta</td>
<td>2010</td>
<td>[Late Republican/early Imperial + late Roman]/late 1st c. B.C./early 5th c. A.D.</td>
<td>432</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>(Case Nuove)</td>
<td>11°19'42.00&quot;E</td>
<td></td>
<td></td>
<td>[Small house]/agro-processing point</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B – CM</td>
<td>42°53'57.00&quot;N</td>
<td>Highly fragmentary off-site, between the villa of Santa Marta and Case Nuove</td>
<td>2011</td>
<td>[Roman]/late Republican/early Imperial?</td>
<td>146</td>
<td>1 sheep/goat molar</td>
<td>7</td>
</tr>
<tr>
<td>(Colle Massari)</td>
<td>11°19'41.00&quot;E</td>
<td></td>
<td></td>
<td>[?]/field drain</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C – SM</td>
<td>42°56'42.89&quot;N</td>
<td>In the northern edge of the survey area</td>
<td>2010</td>
<td>[Late Republican]/late 1st c. B.C.</td>
<td>326</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>(San Martino)</td>
<td>11°23'04.97&quot;E</td>
<td></td>
<td></td>
<td>[Small house]/temporary work hut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D – PA</td>
<td>42°56'37.21&quot;N</td>
<td>Just across a low valley from San Martino</td>
<td>2011</td>
<td>[Early Imperial]/early 1st c. A.D.</td>
<td>133</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>(Podio dell’Amore)</td>
<td>11°23'34.08&quot;E</td>
<td></td>
<td></td>
<td>[Small house]/temporary work hut</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E – PT</td>
<td>42°55'39.00&quot;N</td>
<td>Some 2 km from San Martino and Poggio dell’Amore</td>
<td>2011</td>
<td>[Roman]/early Imperial</td>
<td>466</td>
<td>3 equid teeth</td>
<td>11</td>
</tr>
<tr>
<td>(Podere Terrato)</td>
<td>11°22'32.00&quot;E</td>
<td></td>
<td></td>
<td>[House]/house/temporary work hut and drain</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The archaeo-botanical samples refer to samples where pollen or macro-remains were found, and data are reported in this paper. ?, uncertain information. <sup>a</sup>From stratified contexts of late Republican/early Imperial dates only. Ceramics include ALL sherds, diagnostic and non-diagnostic. <sup>b</sup>NISP, number of identified specimens.
remains and faunal data come from both phases (Vaccaro et al. 2013).

**B – Colle Massari** (CM; late 1st century B.C./early 1st century A.D.) was an off-site, 13-m-long field drain (some 0.6 m wide × 0.3 m deep). The drain was seemingly constructed to remove the stagnant water from a groundwater seepage point where water had accumulated.

**C – San Martino** (SM) was a small, single-phase, temporary or seasonal-use site. A fragmentary gravel gutter on one side suggested a single pitch roof, possibly in straw. The house seems to have had no hearth, no water storage, and ceramics and fauna were extremely poor.

**D – Poggio dell’Amore** (PA; late 1st century B.C. until c. A.D. 70) only 1 km east of SM, was another small, single-phase, temporary site, albeit with someone richer material culture. The structure was originally c. 3 m × 5 m, a tiny quantity of glass was found on the site, although its ceramic and faunal collections were as lacunose as SM.

**E – Podere Terrato** (PT; late 1st century B.C. – first half of the 1st century A.D.) was a larger more stable habitation site, located some 2 km from SM and PA. The excavation shows a two-roomed structure, with a kind of porch and possibly garden beds.

The function of these five small sites varies enormously. All, however, suggest a late Republican/Early Imperial moment of increasing investment in and intensive use of agricultural land. The small structures at PA and SM do not represent permanent habitations traditionally defined. Their tiny collections of material culture, lack of clear cooking and storage installations, and near total absence of faunal material point to spaces used on a less permanent basis. Their most likely function was as general work huts and temporary animal shelters. A site like PA, with more complex architecture and material culture yet still very thin, reveals the spectrum of “permanence” of such points, from overnight stopping point to a larger structure, adjacent to the fields, complete with herb garden. The field drains at both CM and PT point to the careful drainage of even minor groundwater seepage points and a concern to prevent field flooding and stagnant groundwater accumulation. CN points to yet another type of specialized site – the stand-alone pressing point. The absence of any roofed structures and the distance from habitations, plus the small scale of the apparatus, lead us to interpret this site as a collective endeavour, used by a variety of nearby farmers during the fall harvest months (Vaccaro et al. 2013).

**The land units and suitability**

The whole of the survey area was subject to a Land Units analysis producing a map of soil suitability (Figure 2). The map offers a way to read, communicate and interpret the physical landscape and helps in evaluation hypotheses about agricultural production potential. Land Units are defined as portions of the territory with homogeneous characteristics of soil, substrate, geomorphology and hydrology (Sombroek & Sims 1995). The map was created by combining data from stereoscopic aerial photographs with the available geological maps, thus representing presumable zones of soil qualities, underlying geologies and hydrological resources. The contents and outlines of the map units were then field checked and tested (Arnoldus-Huyzendveld & Pozzuto 2009). The Land Suitability for crops and tree crops were then established for each Land Unit: for each Land Unit, the suitability to defined land uses was then assessed through Land Evaluation (FAO 1976; Van Joolen 2003). For low-technology agriculture, clayey soils were considered more suitable than fine sandy soils, because they have a higher natural fertility and water availability, although they are harder to plough.

**Materials and methods**

Botanical analyses included pollen, non-pollen palynomorphs – fungi and algae – and seeds/fruits as palaeoethnological and palaeoecological indicators for environmental reconstructions (López-Sáez et al. 2000; van Geel et al. 2003; Buonincontri et al. 2013). Samples were taken from undisturbed sections or structures.

**Macro-remains**

All stratigraphically significant contexts were wet-sieved for plant macro-remains with sieves of 10, 0.5 and 0.2 mm. Seeds and fruits from each fraction were sorted under a Wild M10 stereomicroscope. The identification was made at 80 × magnifications with the reference collection, atlases and keys. The number of seeds/fruits found in the examined litres of initial volume are reported in the SF-Table I.

**Palynology**

Pollen was collected through syringe extraction from newly cleaned sections, as well from non-archaeological contexts to obtain near-site background levels. The treatment of 5–10 g of dry sediment per sample included the sieving through a 7-μm nylon-handheld sieve and heavy liquid separation with sodium metatungstate hydrate (Florenzano et al. 2012). Lycopodium tablets were added to calculate concentrations (p or npp/g = pollen or non-pollen palynomorphs, per gram). A mean of c. 500 pollen per sample was counted. Counts on pollen and NPPs were carried out on the same samples and on permanent slides. Identifications were made at 1000
magnification with the help of keys, atlases and the reference pollen collection of Modena University. Percentage pollen spectra are calculated on the total pollen counted. Crushed or damaged pollen grains that could be identified were summed in the relevant taxa. Only pollen that could not be identified was included in the deteriorated sum.

Local Pastoral Pollen Indicators (LPPIs), a group of taxa strictly correlated to local pastoral activities (Mazier et al. 2006), includes some Asteraceae (Aster type, Centaurea nigra type, Carduus, Cirsium type, Matricaria type and Cichorieae), Galium type, Heracleum cf., Potentilla type, Ranunculus type and Ranunculaceae indiff. Cluster analysis of mean data per site was performed with Tilia program (CONISS – Constrained Incremental Sum of Squares; Grimm 2004).

As in other fields of palynology, there is not a linear correspondence between the amount of one type of pollen in a spectrum and its significance. Moreover, pollen arrives in layers mainly by human transport i.e. after a selection. Therefore, the interpretation of palynological analyses must be based on the assumptions that are at the base of site formation and palynology of archaeological sites (Dimbleby 1985; Mercuri et al. 2014). Similar percentage values of pollen of different taxa may mean different things, because some species may be high or low pollen producer, thus, respectively, over- or under-represented in the spectra. Selection and distance of the plant source are further important variables in pollen spectra composition. Low amount of cereal pollen may be an indicator of crop fields near the site, where high amounts are more easily
indicators of some type of plant accumulation as in
warehouses or rubbish pits (e.g. Mercuri et al. 2006;
Bosi et al. 2011; Mariotti Lippi et al. 2014). The
interpretation is so tightly linked to the archae-
ological context that similar values may be differently
interpreted (Mercuri 2008).

Furthermore, even excavated pollen is the result
of the many years of accumulated pollen: the pollen
spectrum for a particular archaeological context
thus may represent phenomena that had occurred in
different years (such as the accumulated residues of
different crops grown). As we shall see below,
teasing rotation and other forms of convertible
systems from pollen data is challenging. Thus,
rather than a definitive map, the pollen data provide
a set of hypotheses that can be laid against other
data – structures, faunal data and Land Units
analysis.

**Results**

Pollen was found with variable concentrations
depending on the richness of organic matter and
the preservation conditions: min 900 p/g in one
sample from CM (2200 p/g on average) up to
127,700 p/g in one sample from SM (37,200 p/g on
average).

The diversity of identified pollen taxa varies from
23 to 59 taxa per sample (CN = 34–46; CM = 23–
59; SM = 37–51; PA = 37–45; PT = 38–51).

Pollen spectra describe open areas, with grass-
lands, scanty woodlands and presence of wet
environments (SF-Table I; Figure 3). In fact, herb
taxa prevail (Asteraceae, Poaceae-wild group and
Fabaceae), whereas forest cover is always low (10%–
20%) with dominance of deciduous Quercus, Pinus
and Alnus. Significant at every site are pollen evidence
of cereal/legume cultivation and breeding/pastures.
Below, data are reported as average value of each site.

**A – Case Nuove** (pollen 5th century A.D.; seeds/
fruits and fauna 1st century B.C., 5th century A.D.).
The Arboreal/Non-Arboreal pollen ratio (AP/
NAP = 13/87) suggests that trees and shrubs were
sparse. In the late Republican period, a small
quantity of olive stones (Olea endocarps), some
grape pips and a few pedicels (Vitis), found in the
tank (Figure 4), indicate that these crops were
carried to the site. However, their pollen, taken from
later contexts, is so low (Olea 0.1% and Vitis 0.03%,
on average) that there is no evidence that olive trees
and vineyards were grown near the site.

Castanea pollen is found in traces (0.01%), and other fruit
trees possibly collected in the wild are
Corylus and some woody Rosaceae.

Cereals are 4.5% on average, a value significant of
the presence of cereal fields around the site. The cereals
distinguished in pollen and macro-remains include a
mixture of wheats and other cereals: *Avena/Triticum*
group, and *Triticum aestivum/turgidum, T. dicoccum,
Hordeum group, and T. monococcum*, cultivated barley,
besides some wild species; and *Secale*.

LPPI were abundant (41%) but at the lower level
of these pollen spectra (SF-Table I). Fabaceae
(4.5%) are important evidence of legume fields,
probably cultivated for fodder and useful to
regenerate cereal fields. Further, secondary evidence
for pasture, fodder or grassland comes from
ascospores of coprophilous fungi, mainly *Sordaria*
type and traces of *Sporormiella* type, and parasite eggs
(*Dicrocoelium, Trichuris*).

**B – Colle Massari** (pollen 1st century B.C.; seeds/
fruits not found). Moving over the hill to this field
drain, a similar picture of that microenvironment emerges from pollen that may be contemporary with the late Republican/Early Imperial phase of Case Nuove. A somewhat similar environment is suggested with AP/NAP at 19/81 with a heavier dominance of oaks. Among fruit trees, pollen of Castanea is again in traces (0.09%), Olea (0.1%) has the same value while Vitis is absent. The only evidence of Juglans pollen is found here.

Cereals are likewise significant in this site (3.8%) again indicating proximate cereal crops. Again, pasture dominates with an LPPI of 47.8% but not associated with parasite eggs. Coprophilous fungi have insignificant concentrations.

**C – San Martino** (late 1st century B.C.). The AP/NAP ratio (15/85) was almost identical to Case Nuove, again pointing to few woods and a predominance of herb plants. Olea, the only tree with crop value, is <0.1%. Cereals, again of several taxa, are the lowest of these spectra (1.4%).

Here, it is overwhelmingly pasture species that dominate the pollen spectrum. LPPi pollens are 43%, and include Ranunculaceae, Galium type and Cichorieae, which are most abundant (35%). Other herbs (Brassicaceae, Caryophyllaceae, Lamiaceae) may represent grazing lands. Legumes and part of the Poaceae-wild group pollen include species that may be cultivated for fodder. The combined high values of seeds – Hedysarum, Medicago, Medilotus and Trifolium – and pollen from Fabaceae (Dorycnium, Lotus, Trifolium and Fabaceae indiff.) indicate fodder. Coprophilous fungi (Sordaria type and Sporormiella type) and parasite eggs (Dicrocoelium, Trichuris) suggest presence of excrements. Finally, a high concentration of algae, three or higher than in the other sites, was found (SF-Table I).

**D – Poggio dell’Amore** (1st century A.D.). The AP/NAP ratio was approximately the same, 13/87, and Pinus and deciduous Quercus (4.4%) predominate among trees while Olea is low. Unlike San Martino, however, there is somewhat more evidence for cereals: Hordeum group, and less amounts of Avena/Triticum group with total some 3%, twice the percentages as at San Martino, and this, along with the presence of Tilletia, which is a pathogen fungus of cereals (including T. tritici and T. secalis). Pasture predominates (LPPI = 47%, with Cichorieae 34%). The possible evidence for animal stabling in the form of coprophilous fungi and parasite eggs was present, but in lower concentrations than at San Martino. Like San Martino, the pollen and seeds of herbaceous plants, again pointing to occasional presence of fodder, characterized the archaeo-botanical record.
E – Podere Terrato. The AP/NAP was approximately the same as the aforementioned sites at 16/84, with Pinus and Quercus again predominating. Unlike the other sites, however, the area around Podere Terrato had a more significant presence of woody crops, particularly Corylus (0.2%), Vitis (0.1%) and Rosaceae fruit trees. Moreover, fragments of pips were found in the building. Cereal fields (3%, again Hordeum group, Avena-Triticum group and here Secale) were probably found nearby.

Pasture predominates with LPPI of 44.6% (Cichorieae 32%). This site, while largely dominated by pasture, had grain, vineyards and possibly hazelnut trees nearby, while adjacent vegetables may have been grown. Interestingly, the pollen and macro-remains evidence included a series of species, that, if cultivated and not wild, could indicate a garden (Rosaceae cf., Syringa, Campanula cf. lusitanica, Cistus and Geranium also found as seeds). Also, there were herbs such as Peucedanum palustre type, Apiaceae indiff., Echium, Sedum, Malva, Mentha type, Salvia, Ruta cf. and Valerianella. Together these comprise 3% of the pollen spectrum. Among the macro-remains, the aromatic Apium graveolens and Atriplex hortensis were found: they could be cultivated as both vegetables and herbs.

Discussion

The palaeoenvironment of the area of Cinigiano as suggested by the pollen spectra was characterized by open areas, grasslands without densely forested areas near the sites. The high diversity in pollen spectra points to an articulated mosaic of habitats. Broad-leaved oak woods, and woods with draft shrubs and conifers, were probably distributed far on the hills. Hygrophilous woods surrounded the rivers and water bodies that were available in the area.

Interestingly, Rattighieri et al. (2013) calculated that, in San Martino, the off-site samples showed much the same AP/NAP ratio (20/80) to the on-site samples indicating that the advent of the site had only a minor practical impact on the forestation of the immediate area. If a moment of deforestation did occur in this micro-region, it is thus probably located before the Roman period. Although no local evidence of pre-Roman settlement near these sites was studied, there is general evidence in the broader region for significant Iron Age alteration – as biomass and composition – to the natural state of the pre-existing woodlands. This was found from off-site pollen analyses (Biserni & van Geel 2005; Drescher-Schneider et al. 2007; Sadori et al. 2010). In the Tusco-Appennines, a significant decline of Quercus and Abies pollen associated with an increase in Corylus were considered signals indicating either the influence of Mesolithic people or varying competition between these plants during the early Holocene (Lowe et al. 1994). On the other side, early decrease of woodlands was evident in many mid-Holocene spectra from north-central Italy (Mercuri et al. 2012).

Roman agricultural practices: Pollen and functional indicators

Rather than deforestation, the Roman-period occupation was probably most marked by a well-developed and complex agrarian landscape.

While the expansion of small sites, the micro-management of the land and the significant investment in structures bespeaks intensive agricultural systems. Indeed, the pollen evidence points overwhelmingly towards a major part of land being allocated to a grazed pasture.

The significant presence of pasture indicator pollen, such as Cichorieae, indicates specifically pastures whose plant composition has been impacted by animal browsing (Bottema 1975; Hjelle 1999; Mercuri et al. 2010; Farris et al. 2013). Cichorieae tend to be over-represented and may be better preserved than other pollen grains in poor sediments because they have a very resistant exine (Kouli & Dermitakis 2008). However, the spectra from these sites are so coherent that it seems an environmental, rather than a taphonomical significance must be attributed to Cichorieae (Florenzano et al. 2014).

In SM, several data suggest that the structure was occasionally used for animals: (i) the combined high values of seeds and pollen from Hedysarum, Medicago, Melilotus and Trifolium point to the occasional presence of fodder; (ii) ascospores of Sordaria type and Sporormiella type, coupled with the relatively high presence of certain parasite eggs (Dicrocoelium) is likewise strongly indicative of the presence of ruminant excrement, whereas other such eggs (Trichuris) may derive from domesticates or humans (Florenzano et al. 2012, and references therein); (iii) finally, the relatively high concentration of algae inside the structure points to water transported to the site – this may be for drinking purposes or a result of transfer via urine.

The significant quantities of fodder plants at SM and to a lesser extent at PA and PT suggest both deliberate cultivation of fodder plants, and the collection of fodder in these structures, presumably, judging from the NPP data, for the likewise occasional stabling/shelter of animals. The structures in question are too small to have acted as shelter for large herds; rather, we should imagine them as serving as multipurpose shelters/work huts in a pastoral landscape.

The faunal assemblages of these sites are small and shed little light on diet and economy. However, significant faunal remains come from another site
excavated by the project – Pievina that during the late Republican phase probably was a farm. The faunal species assemblage was similar to elite sites in the region with a preponderance of pig (61% number of identified specimens) followed by sheep/goat (26%) and cattle (13%). Unlike elite sites, cattle and sheep were old at age of slaughter, suggesting that they were used principally for traction/wool/milk. This as yet limited data set suggests that the major pastoral animals – sheep/goat and cattle – were principally kept for non-dietary reasons, and that when consumed at the end of their lives, they and especially pigs provided a significant meat addition to even smallholders’ diets (Ghisleni et al. 2011).

Roman agricultural practices: Pastures and fields rotation

Pollen suggests that pasture, or cereal/legume fields alternating with pasture, were grown proximate to the drains at both CM and PT. The practice of convertible agriculture, also called ley farming, was practised by these small-scale Roman farmers (Bowes et al. in press). In convertible agriculture, arable land is alternated not only between nitrogen-weak crops (cereals) and nitrogen-fixing plants (legumes), but even more importantly, cultivation alternates with extended periods of ley or pasture. During these periods, pasture is actively, even intensively managed, fodder plants are encouraged and the land used for grazing. Ley farming could leave land under pasture for several years. The alternating use of arable and pasture land in multiple year alternations challenges the intensive/extensive binary, which tends to read a widespread allocation of land to pasture as “extensive”, presuming less investment and less return per unit area. Geoffrey Kron has argued for the widespread use of ley farming in the Roman period based on an exhaustive examination of the Roman agronomists (Kron 2000, 2012: 159–160).

Near PT, PA, CM and possibly near CN in its Republican phase, we find significant areas of pasture alternating – either spatially or in temporal rotation – with cereal fields and legumes. The cereals found were always a mix of wheats and barley, and less evident rye. The pollen data may be describing yearly alternation of species, or cereal varieties being cultivated together in a single year. Near PT, small vineyards were also added to the mix, whereas olive groves seem to have been of low importance and few throughout the landscape.

The high quantities of pasture pollen from our sites, balanced with significant percentage of cereals, suggest either the spatial proximity of pasture and cereals or the rotation of cereal and pasture. There is no way at the moment to distinguish between these two possibilities, as the data cannot be so finely chronologically parsed. On the balance, however, particularly when combined with the presence of field drains, fodder crops and other evidence for intensive pasture maintenance, the data point towards convertible agriculture. Furthermore, a spectrum of convertible farming rotations may be envisaged: (i) in sites like SM and PA, pasture may have been more extensive and quasi-permanent; the short occupation of these sites likewise introduces the possibility that they were constructed only for the period in which these lands were under pasture; (ii) around PT somewhat less land was given over to ley and more frequent rotation towards cereals was made; (iii) at CM and the 5th century A.D. CN pasture presents

Figure 5. Cluster analysis (constrained total sum of squares made with TGView; Grimm 2004) of the mean pollen spectra of the five archaeological sites and Land Unit Suitability Class of the relevant areas. On the right, data elaboration includes all data (TPC, total pollen concentration). The other two clusters are calculated by basically excluding TPC, and then each of the other selected pollen taxa or sums reported below the relevant cluster tree.
the opposite end of the spectrum, where the least
land was given over to pasture and/or the land was
more frequently rotated with cereals.

Land use and suitability
An examination of the surrounding geological and
hydrological conditions further suggests that this
mixed regime with important presence of pasture was
not only dictated by environmental conditions, but
by choice (Bowes et al. in press). Cluster analysis of
mean pollen spectra of these sites, in fact, follows
Land Suitability class identification but the sites
grouped according to their use/land use when
selected taxa or sums are excluded (e.g. SM and
PA are more similar if Asteraceae, Fabaceae or
aquatics are excluded by the elaboration; Figure 5).
The land around SM, PT and PA, although the
adjacent land was highly suitable for cereal and other
kinds of agriculture (Class S1), was instead devel-
oped as pasture with interspersed fields of cereals and
occasional vineyards near PT. Conversely, the Land
Units around CN and CM were far less adapted to
widespread cerealiculture, with S1 land units
interspersed with land less adapted (S2 and S3) for
such cultivation. Nonetheless, during late antiquity
at least and possibly earlier, the area immediately
around the CN and perhaps CM was probably
surrounded by cereal fields and some vineyards.

The comparison of Land Units and pollen data
thus suggests that choice, rather than solely land
suitability, played a major role in the articulation of
agricultural land. Even confronted with very similar
environmental conditions – as existed between SM
and PT, for instance – landowners/workers might
make very different choices as to how to cultivate and
manage a particular piece of land: in the case of SM,
the land was heavily invested in pasture while at
Podere Terrato, a more mixed regime, including a
possible herb garden, was elected.

Conclusions
The five sites here studied represented a whole range
of functions – temporary work or stabling point,
drain, agro-processing point, permanent habitation –
that can be interpreted as signals of greater human
control over productive landscapes. The construction
of field drains and temporary use structures point to
an investment of labour and materials, particularly if
these structures are used only sporadically and last
only a generation or two. This investment appears to
be a concentrated, short-lived moment, lasting
from the end of the 1st century B.C. and ending by
the mid-first century A.D.

At the same time, the diversity of pasture-grazing
plants and other species, the presence of coprophi-

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References
del paesaggio attuale: il territorio di Castel di Pietra tra
antichità e medioevo. In: Citter CS, editor. Dieci anni di
ricerc a a Castel di Pietra. Firenze: All’Insegna del Giglio.
pp. 15–39.

Birks HJB. 2012. Ecological palaeobiology and conservation
biology: Controversies, challenges, and compromises. Int J
Biodivers Sci Ecosyst Serv Manage 8: 292–304.

palaeoenvironment and sedimentation history of the Ombrone
alluvial plain (South Tuscany, Italy). Rev Palaeobot Palyno

Boero F. 2010. Ecology is an historical discipline. In: Gertwagen
R, et al., editors. When humanities meet ecology: Historic
changes in Mediterranean and Black sea marine biodiversity
and ecosystems since the Roman period until nowadays.
Proceedings HMAP International Summer School, 2009,

Bosi G, Bandini Mazzanti M, Florenzano A, Massamba N’siala I,
parasite remains as evidence of site function: Piazza Garibaldi –
Parma (N Italy) in Roman and Mediaeval times. J Archaeol Sci
38: 1621–1633.


