pca

european journal of
postclassicalarchaeologies

volume 8/2018

SAP Società Archeologica s.r.l.

Mantova 2018

Post-Classical Archaeologies (PCA) is an independent, international, peer-reviewed journal devoted to the communication of post-classical research. PCA publishes a variety of manuscript types, including original research, discussions and review articles. Topics of interest include all subjects that relate to the science and practice of archaeology, particularly multidisciplinary research which use specialist methodologies, such as zooarchaeology, paleobotany, archaeometallurgy, archaeometry, spatial analysis, as well as other experimental methodologies applied to the archaeology of post-classical Europe.

Submission of a manuscript implies that the work has not been published before, that it is not under consideration for publication elsewhere and that it has been approved by all co-authors. Each author must clear reproduction rights for any photos or illustration, credited to a third party that he wishes to use (including content found on the Internet). For more information about **ethics** (including plagiarism), copyright practices and guidelines please visit the web site www.postclassical.it.

PCA is published once a year in May, starting in 2011. Manuscripts should be submitted to **editor@postclassical.it** in accordance to the guidelines for contributors in the webpage http://www.postclassical.it

Post-Classical Archaeologies's manuscript **review process** is rigorous and is intended to identify the strengths and weaknesses in each submitted manuscript, to determine which manuscripts are suitable for publication, and to work with the authors to improve their manuscript prior to publication.

This journal has the option to publish in **open access**. For information please visit the web site www.postclassical.it

How to **quote**: please use "PCA" as abbreviation and "European Journal of Post-Classical Archaeologies" as full title.

Cover image: vectorialised cadastre of Borgo Rudena, Padova (F. Giacomello).

"Post-Classical Archaeologies" is indexed in Scopus. It was approved on 2015-05-13 according to ERIH PLUS criteria for inclusion. Classified A by ANVUR (Agenzia Nazionale di Valutazione del sistema Universitario e della Ricerca).

DESIGN
Paolo Vedovetto

PUBLISHER
SAP Società Archeologica s.r.l.
Strada Fienili 39/a, 46020 Quingentole, Mantova
www.archeologica.it

PRINTED BY
Tecnografica Rossi, Via I maggio, Sandrigo (VI)

Authorised by Mantua court no. 4/2011 of April 8, 2011

For subscription and all other information visit the web site www.postclassical.it

ISSN 2039-7895

pca
european journal of
postclassicalarchaeologies
volume 8/2017

CONTENTS PAGES

EDITORIAL 5

RESEARCH - NEW APPROACHES IN URBAN ARCHAEOLOGY

G.P. Brogiolo A new urban archaeology for a systemic history of the post-classical cities 7

E. Lorans, X. Rodier, A.-M. Jouquand Tours: origins of urban archaeology, new approaches and new questions 19

M. Fondrillon, A. Laurent-Dehecq, with E. Morin, X. Rolland Methods of assessment and characterization for urban stratification at Tours and Bourges (France) and the question of early medieval dark earth deposits 43

Y. Devos, A. Degraeve Urban environmental archaeology in Brussels (Belgium): perspectives at the onset of the 21st century 73

E. Castiglioni, M. Rottoli Brescian archaeobotanical studies, Romanization to Early Medieval periods 91

A. León El urbanismo de Córdoba andalusí. Reflexiones para una lectura arqueológica de la ciudad islámica medieval 117

F. Giacomello Rudena in Padova: sources and data integration for an analysis of a late medieval district 165

B.J. Groenewoudt, R.J. van Lanen Diverging decline. Reconstructing and validating (post-)Roman population trends (AD 0-1000) in the Rhine-Meuse delta (the Netherlands) 189

BEYOND THE THEME

M.Á. Valero Tévar Anthropic dynamics and vegetation landscape in the inland area of the Iberian peninsula: new perspectives drawn from palynological studies at the *villa* of Noheda (Cuenca, Spain) 219

L. Lamanna Il canino mandibolare con doppia radice come indicatore di parentela nei cimiteri antichi. Il caso studio della necropoli altomedievale di Montichiari, Monte San Zeno (BS) 243

M. Asolati, M. Kenawi, G. Marchiori La moneta nel contesto archeologico, la moneta come contesto archeologico: il caso dell'Unità 4 di Kom al-Ahmer (Delta del Nilo, Egitto) 253

A. Cosseddu Un'eredità da proteggere e comunicare. *Summative evaluation* del *Museo Nacional de Arqueología Subacuática. ARQUA* di Cartagena (Spagna) 271

M. Valenti Aspetti risarcitori e comunitari nell'Archeologia Pubblica nord americana: tra dibattito e approcci di ricerca diversificati 303

PROJECT

F. Niccolucci Integrating the digital dimension into archaeological research: the ARIADNE project 325

REVIEWS

337

F. Pennick Morgan, *Dress and Personal Appearance in Late Antiquity. The Clothing of the Middle and Lower Classes* - by **T. Lewit**

E. Cirelli, *La ceramica di Cencelle nel Medioevo. I materiali rinvenuti negli scavi dell'*École française de Rome *(Settore III, 1994-1999)* - by **S. Mazzocchin**

S. Oosthuizen, *The Anglo-Saxon Fenland* - by **C. Citter**

P. Diarte-Blasco, *Cities, Lands and Ports in Late Antiquity and the Early Middle Ages: Archaeologies of Change* - by **R. Montoya González**

R. Kiddey, *Homeless Heritage. Collaborative Social Archaeology as Therapeutic Practice* - by **F. Benetti**

PCA 8 (2018) ISSN: 2039-7895 (pp. 219-241)
Post - Classical Archaeologies

beyond the theme

Anthropic dynamics and vegetation landscape in the inland area of the Iberian peninsula: new perspectives drawn from palynological studies at the *villa* of Noheda (Cuenca, Spain)

MIGUEL ÁNGEL VALERO TÉVAR Castilla-La Mancha University, Departament of History, Avda. Camilo José Cela s/n, 13071, Ciudad Real. *miguelangel.valero@uclm.es*

This paper presents the initial findings of an archaeopalynological study to reconstruct and trace the evolution of the vegetation landscape at the site of the Roman *villa* of Noheda (Cuenca, Spain). The analysis of the pollen diagram enables the reconstruction of the economic foundations of the rural environment during each phase of the site's occupation. Changes in the crop types, planted area, and forest use were identified, as was an increase in the pressure exerted by animal husbandry.
Keywords: Roman *villa,* palynology, landscape, anthropic dynamics, economy

L'articolo presenta i primi risultati di uno studio archeopalinologico per ricostruire e tracciare l'evoluzione del paesaggio e della vegetazione relativi al sito della villa romana di Noheda (Cuenca, Spagna). L'analisi dei diagrammi pollinici ha permesso di comprendere la base economica dell'ambiente rurale durante ogni fase di occupazione del sito. Sono stati identificati cambiamenti nei tipi di coltura, di aree coltivate e di uso delle foreste, così come un aumento dell'allevamento.
Parole chiave: *villa romana, palinologia, paesaggio, dinamiche antropiche, economia*

1. Introduction

The study of the geographical framework in which a given culture develops is a fundamental prerequisite to understanding it. Thus, knowledge of what a site's surrounding ecosystem was like, particularly through the study of lifeforms, production types and methods, and the overall economic practices of a given society, is a fundamental starting point to explain and understand human behaviour in the past.

Received: 20-01-2018 - Accepted: 25-01-2018 - Revised: 18-02-2018

Traditionally, texts and other written sources have been the main source of archaeobotanical information on the chronological history of archaeological sites. However, in recent decades, the use of innovative methodologies and techniques such as palynology has enabled a new approach based on interdisciplinary methods.

Although initially this interdisciplinary approach was mainly applied to prehistoric archaeology (López Merino *et al.* 2008, p. 26), today it is used for a much broader chronological range of sites and has become a fundamental tool for ensuring the thorough analysis of a site.

The current paper presents the initial findings of a study to reconstruct and trace the evolution of the vegetation landscape of the Noheda site. To this end, it will first identify the plant *taxa* at the site following the abandonment of the first Roman complex in the Early Imperial period. Next, it will address the anthropic dynamics to which the ecosystem was subjected when the site was at its height, coinciding with the emergence and rise of the great *villae* in the western half of the Empire, as has been documented elsewhere (Vera 1992-1993, p. 299; Volpe 1996, p. 210; Sfameni 2006a, pp. 19-21; Chavarría Arnau 2006, p. 19; Chavarría Arnau 2007, p. 53; Pensabene 2010-2011, pp. 171-174; Hidalgo 2014, p. 229). Finally, it will analyse how different vegetation groups varied throughout the subsequent phases of occupation, revealing a dramatic change in the methods used to exploit the environment.

As a fundamental part of the aforementioned territorial research, which aims to afford an exhaustive understanding of the rural complex, it is crucial to reconstruct the landscapes of the bygone eras. This is because humans carry out their activities within given spatial and temporal coordinates and thus are strongly dependent on the physical milieu in which they live.

Therefore, this paper presents a previously unpublished paleoenvironmental reconstruction at the paleopalynological level of Alcarria Conquense, an inland region of the Iberian Peninsula. This reconstruction spans a chronological and cultural period – the Roman, Late Roman, late antique, medieval, and Early Modern periods – that has scarcely been documented to date.

2. Material, methods, and archaelogical context

The Roman *villa* of Noheda has long been known (Santa María 1897, pp. 13-14; Coello 1897, p. 21; Larrañaga 1966, p. 438; Abascal 1982, p. 68; Palomero 1987, p. 169). It is located in the central area of the Iberian Peninsula, 17 kilometres north of the city Cuenca and close to

the towns of *Segobriga*, *Ercavica*, and *Valeria*. It lies a mere 500 metres northeast of the place it is named forand is part of the municipality of Villar de Domingo García (fig. 1).

To date, two areas of the late period *villa* have been excavated. The current study will focus on these areas. The first comprises a set of structures that, judging by the excavated area, seem to have belonged to the *pars rustica*. Hence, the complex had the necessary buildings to indicate that the *villa* had an inherently agricultural purpose (Richmond 1970, p. 51; McKay *et al.* 1975, pp. 100-108; Percival 1976, p. 13; Johnston 1983, pp. 3-8; Balmelle 2001, p. 16; Gros 2001, p. 265; Mulvin 2002, p. 3; Chavarría 2005, pp. 523-526; Chavarría 2007, pp. 32 and 54; Arce 2006, p. 14; Arce 2009, p. 136; Sfameni 2006a, p. 110). The second contains a section of the *pars urbana* consisting of the *balneum* and certain other rooms pertaining to the residential building.

Research undertaken in the last few years has further shown that, following the peak of the complex's use as a Late Roman period *villa*, subsequent inhabitants gradually carried out a structural transformation of the *pars urbana* (encompassing both the residential sector and the *balneum*), refitting old rooms to have a dual function. In some cases, the

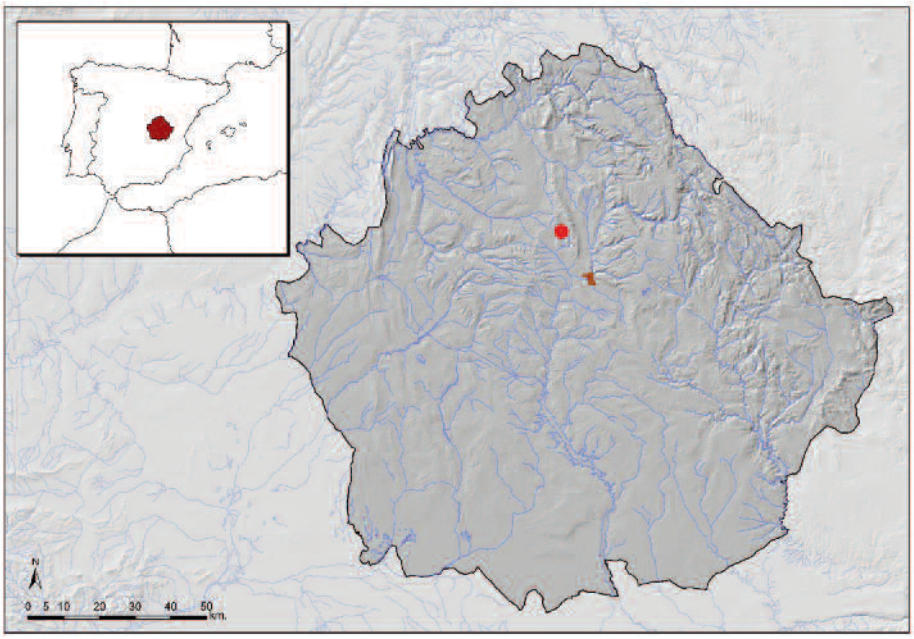

Fig. 1. Location of the site of Noheda within the peninsular context.

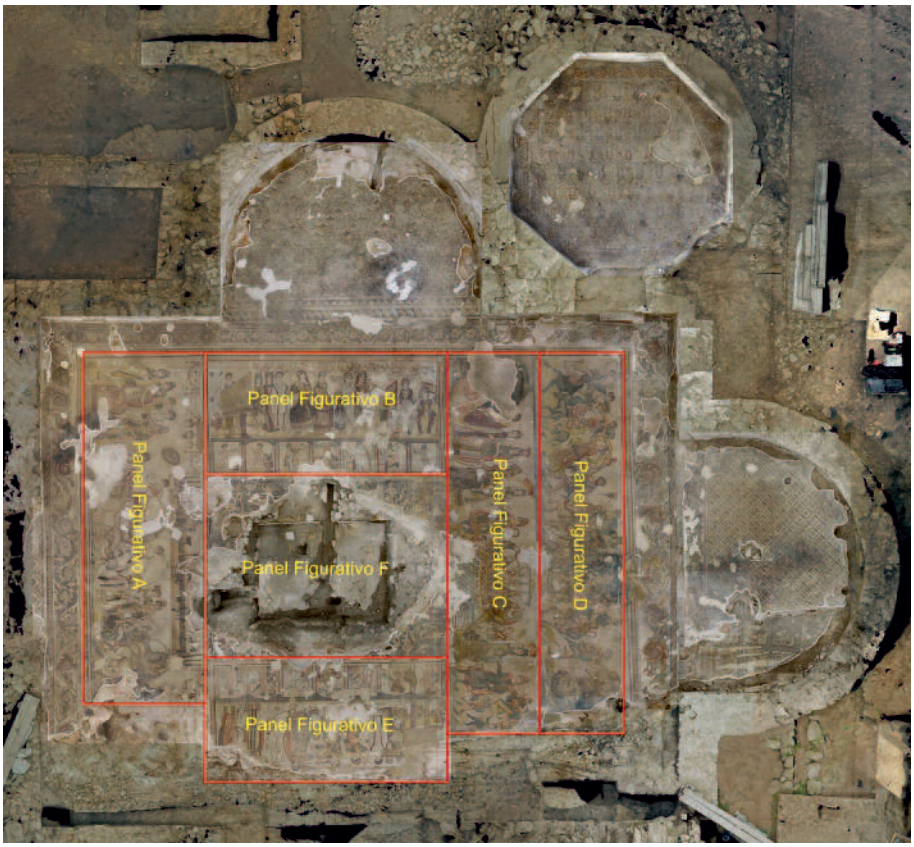

Fig. 2. Subdivision in the mosaic's figurative panels in the *triclinium* in Noheda (image by M.Á. Valero of the photo of the mosaic by J. Latova).

original habitational purpose of the rooms was restored through the construction of walls made of precarious materials. In others, these same spaces were devoted to local production activities or even used for burial purposes.

In addition to the above, Early Imperial archaeological structures have been shown to exist beneath the Late Roman period *villa*, some in a good state of conservation despite having been used as a quarry for the overlaid constructions (Valero 2017b, p. 68). Moreover, some areas bear witness to construction techniques of an outstanding quality involving the use of large ashlar stones.

The current paper grew out of the need to contribute to the comprehensive study of the site. Although to date the figurative mosaic has been the element to draw the most attention (Valero 2010, p. 6; 2011,

pp. 91-105; 2013, pp. 312-327; 2014b, pp. 54-60; 2014c, pp. 81 ss.; 2015a; 2015b, pp. 1347-1350; 2015c, pp. 439-444; 2016a, pp. 131-152; 2016b, pp. 10-12; 2017a, pp. 79-80; Valero, Gómez 2013, pp. 87-95), it is believed that research on the site should be conceived as a whole. In other words, without neglecting the mosaic tapestry, the focus should be expanded to include all the other aspects of the *villa* as well (fig. 2).

To this end, some research has sought to architecturally analyse a number of rooms (Valero 2014a, pp. 522-529; 2017c, pp. 31-36). Likewise, the decorative elements of the complex's *pars urbana* have been analysed (Valero *et al.* 2015, pp. 395-397). Furthermore, an analysis of the territory that may have constituted the *fundus* of the *villa* is also underway, with special emphasis on the changes and transformations it has undergone throughout history (Valero 2017b, p. 74-77).

In 2010, the University of Alcalá de Henares was commissioned to carry out a pollen analysis of four stratigraphic units corresponding to, and encompassing, the time span between the abandonment of the Late Imperial period *villa* and the Early Modern and Late Modern periods. That analysis, performed by specialists (M.B. Ruiz Zapata, M.J. Gil García, T. Martín Arroyo), was the technical basis for the present paper.

The samples were taken from the southern side of Section 18, located in the southwest corner of Sector A, by the outer edge of the *triclinium* on its southern flank. Specifically, they were taken from stratigraphic units UE 23, UE 10, UE 2 and UE 1. From bottom to top, the stratigraphic units were as follows (fig. 3):

- UE 23 and a number of associated stratigraphic units correspond to the time span between the moment of abandonment of the Early Imperial period complex and the construction of the monumental Late Period buildings. It consists mainly of silting strata.
- Following the filling and levelling of the underlying strata in various areas of the complex, a new period of occupation with substantial construction activity has been documented. A new building complex was raised with brand new, astonishingly large edifices that underwent successive enlargements or changes for the purpose of monumentalising the *villa*. Such monumentalisation was a fundamental aspect of power display by the *possessores* of great Late Antique complexes. This latter period corresponds to the apogee of the *villa* (late 3rd to 4th centuries), a phase recorded in the pollen analysis of UE 10.
- UE 2 corresponds to the new use to which the complex was put in the Late Antique period (5th-6th centuries), where the various original rooms of the previous period were kept but transformed for reuse by the new inhabitants. In particular, some of the wall structures of the

Fig. 3. Location and detail of the pollen sequences.

residential sector were reused, the *balneum* was entirely reformed, the mosaics were drilled (Valero 2016c, p. 360), the peristyle was closed and modified, new bays were opened, etc. The various *aedificia* that previously made up the *villa* were profoundly transformed, and the rooms were adapted to a new and austere way of life.

- The top levels (UE 1) correspond to the collapse and reuse of materials linked to the abandonment of this area as a developed habitat, between the Middle Ages and the Early Modern period, and its transformation into an area of agricultural production and animal husbandry associated with the new rural entity: the hamlet of Noheda, which lies 500 metres away.

With regard to methodology, in order to extract pollen grains, the samples were chemically treated with acids and alkali in accordance with currently accepted standard protocols (Girard, Renault-Miskovsky 1969, p. 276; Couteaûx 1977, p. 260). Following this treatment, the resulting residue was subjected to enrichment techniques with Thoulet solution (Goeury, Beaulieu 1979, p. 240). Pollen types were identified according to Moore *et al.* (1991) and Reille (1992, 1995).

The pollen sum (PS) was established based on the total count of pollen grains (trees, shrubs and herbaceous vegetation) (López Sáez *et*

al. 2003, pp. 8-11). The percentages of arboreal and non-arboreal (shrubs and herbaceous vegetation) *taxa* were calculated in relation to the total pollen sum (TPS) from the cited sources. Furthermore, this assumption made it possible to determine the ratio of arboreal pollen (AP) to non-arboreal pollen (NAP), which defines the vegetation structure for each sample.

The following software packages were used for the statistical processing of the data: Tilia, Tilia Graph (Grimm 1992), and TGView 1.6.2 (Grimm 2004). The results were graphically represented in a bar chart or pollen histogram, recording the frequency and relative percentages of arboreal, shrub, and herbaceous vegetation *taxa* with regard to the PS. Aquatic *taxa*, spores, and non-pollen palynomorphs were represented as a percentage of the TPS. The latter proved crucial to interpret environmental conditions in the surroundings due to their distinctly local nature, as has been widely demonstrated (López Sáez e*t al.* 2000, 2005; López Sáez, López Merino 2007; Ruiz Zapata *et al.* 2012, p. 44).

In accordance with the objective of the present paper, the data were represented in a synthetic pollen diagram, grouping all *taxa* (pollen and non-pollen) that showed ecologic analogies (fig. 4).

Furthermore, to provide a detailed analysis of the vegetation and its significance in light of the evolution of the *taxa* percentages by phase, two additional graphic formats were used: a pie chart, which makes it easier to envision structural changes in vegetation over time (fig. 5); and a cumulative frequency curve table of the *taxa* (fig. 6), which more clearly shows the impact of anthropic and/or climatic aspects in each phase.

3. Results

The analysis of the pollen histogram first revealed a certain degree of homogeneity, as evidenced by the notable scarcity in the composition of the species. This is not an isolated occurrence; the literature shows that this is a typical feature of sediments from archaeological sites on the Iberian Peninsula (López Sáez *et al.* 2003, pp. 12-13; Carrión *et al.* 2009, pp. 16-21).

A total of 23 pollen types were identified – 6 arboreal pollens, 3 from shrubs, 14 of herbaceous origin – together with 3 aquatic elements, monolete and trilete spores, and 10 non-pollen palynomorphs of various types.

As can be seen in the graphic representation of the data (fig. 4), the pollen sum of all the samples was rather homogenous, reflecting the predominant presence of herbaceous elements distinctive of open landscapes. The predominance of the following in particular should be noted:

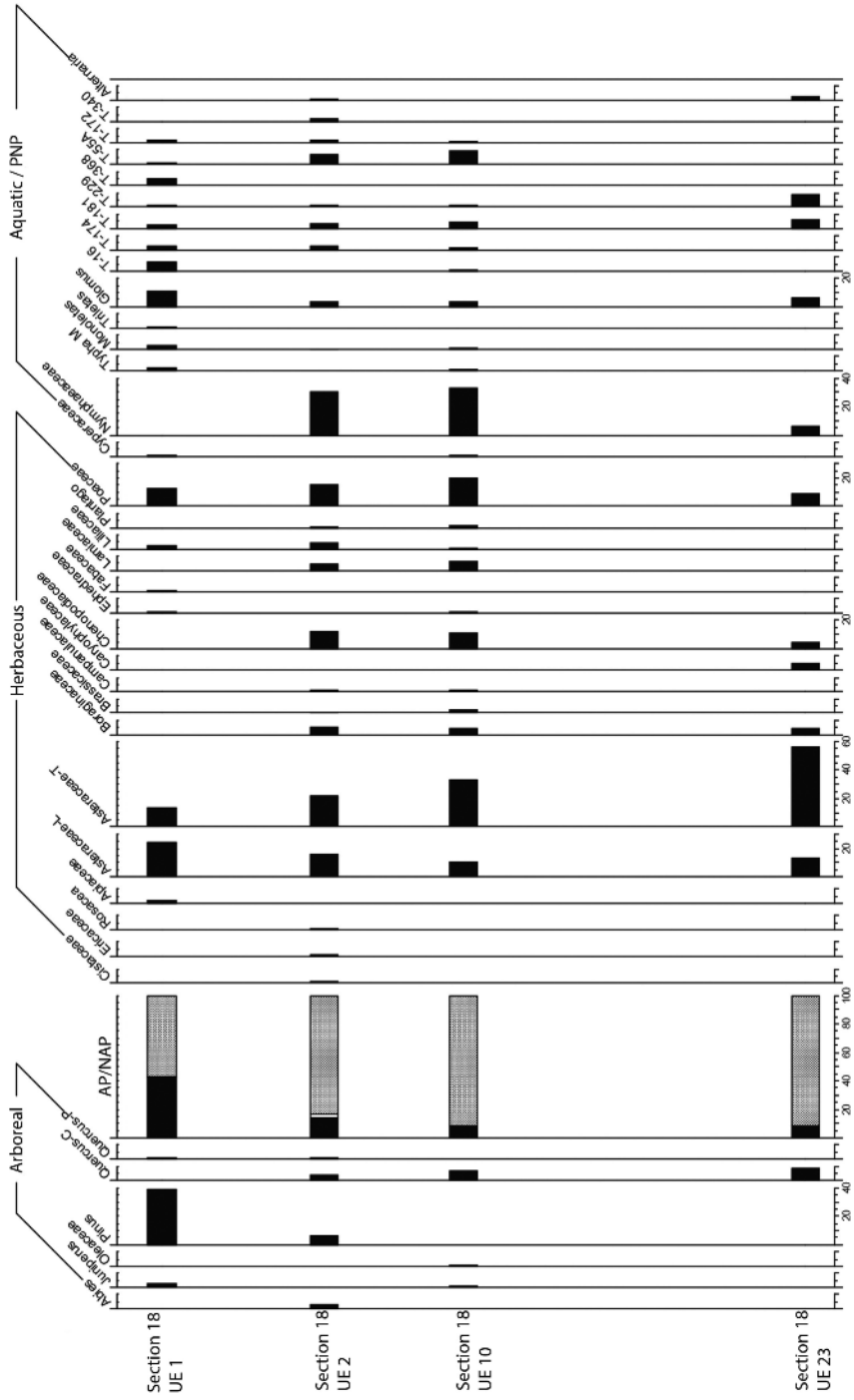

Fig. 4. Pollen histogram of the samples taken from the Roman *villa* of Noheda (Ruiz Zapata *et al.* 2012, 2, fig. 1).

Asteraceae liguliflorae, *Asteraceae tubuliflorae*, *Poaceae*, and, to a lesser extent, *Chenopodiaceae*.

In short, herbaceous elements in Noheda fundamentally comprised three types of communities:

- Nitrophilous and ruderal vegetation of an anthropic nature, the presence of which is related to the existence of assimilable nitrogen in the soil that is not zoogenic in origin (*Asteraceae liguliflorae*, *Asteraceae tubuliflorae*, *Boraginaceae*).
- Anthropozoogenous-nitrophilous communities associated with soils highly nitrified by cattle, subjected to a certain degree of trampling, that proliferate close to urban centres, property lines, irrigation hedges, stabling facilities, troughs, or regular animal paths where the accumulation of excrements fosters the community's development (*Chenopodiaceae*, *Plantago*, etc.).
- Anthropozoogenic perennial plant grasslands or hay meadows, generally coming from annual pasturelands devoted to grazing activities (*Poaceae*, *Brassicaceae*, *Caryophyllaceae*, *Cistaceae*, *Lamiaceae*).

In addition to the herbaceous group, varied amounts of non-pollen palynomorphs have been documented, the development of which is closely related to the nature of the milieu. Coprophilous fungi stand out (*Sordaria*, or Type 55 A, and *Podospora*, or Type 368), as do themeso-eutrophic Type 181 spores (Van Geel *et al.* 2003, pp. 875-877; Van Geel, Aptroot 2006, pp. 321-321; Riera *et al.* 2006, pp. 130-134) and *Glomus* (Type 207), which is related to deforestation processes (Ruiz Zapata *et al.* 2012, p. 2) (fig. 5).

Cerealia pollen was not documented. It is thus impossible to infer the existence of agricultural processes in the site's immediate vicinity (López Sáez, López Merino 2005, p. 57). However, the discovery of carbonised wheat seeds close to the excavation area itself proves that they were widely grown in relatively distant areas.

In contrast to other relatively nearby sites that are partially synchronic with the stages examined here in the case of Noheda (Casas *et al.* 2012, p. 22), wet pastures showed considerable variations. Strikingly, the percentage of *Nymphaeaceae* was greater in the early stages. This is notable because they fall within the so-called Roman Warm period, which overlapped with the Imperial period (López Merino *et al.* 2008, p. 33; Cacho *et al.* 2010, p. 18). Furthermore, these *taxa* rebounded in the second and third stages, both of which coincided with moments of anthropic exploitation of the site.

The above findings indicate an environment heavily influenced by anthropic activities, together with a widespread presence of grazing pastures in the immediate vicinity of the *villa*.

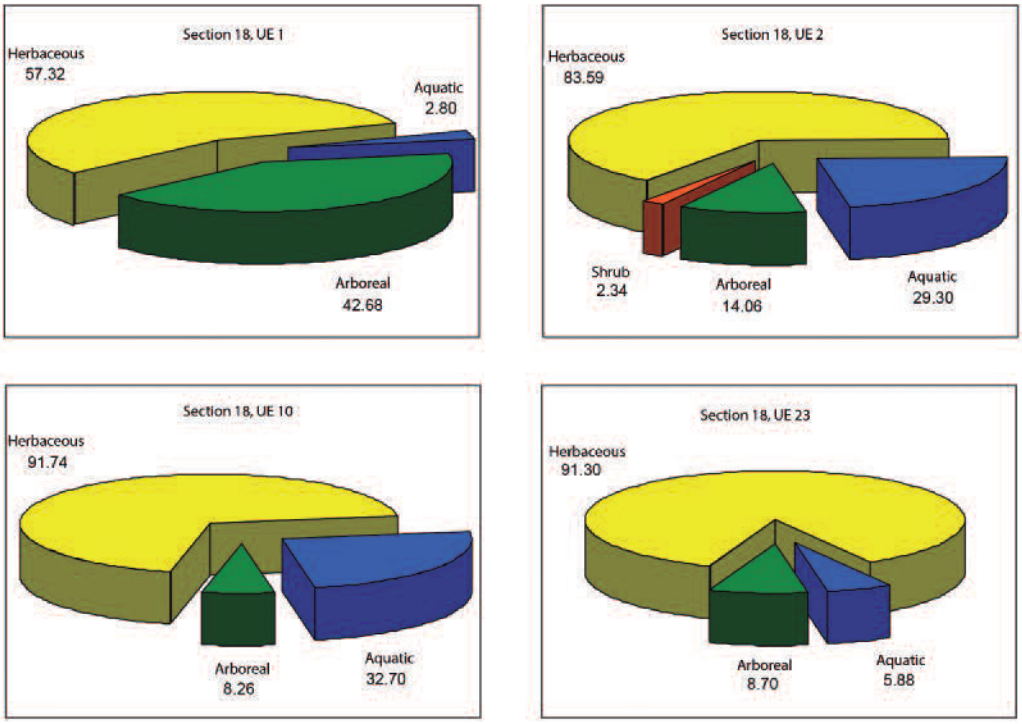

Fig. 5. AP-NAP-aquatic ratio for each sample (Ruiz Zapata *et al.* 2012, 3, fig. 2).

The arboreal strata showed lower values for the palynoflora. These included perennial and deciduous *Quercus*, *Oleaceae*, *Juniperus*, and the presence of *Abies*, as well as *Pinus* in the final phase. The latter confirms the presence of a Mediterranean-type landscape. The absence of riparian *taxa*, such as elm trees, should not be interpreted as a result of a lack of water (the Tejar stream runs parallel to the rural complex, thereby guaranteeing the area's water supply), but rather a consequence of where the samples were taken. Likewise, the presence of aquatic *taxa* should not be interpreted as reflective of an increase in humidity, but rather of the presence of waterlogged areas probably related to human activity. However, the strong presence of deciduous-type *Quercus* in the sequence, in the context of the analysis of the first phases, could be interpreted as reflecting an increase in water availability and a benign climate related to the aforementioned Roman Warm period (fig. 6).

In the pollen diagram, the shrub strata do not play an important role within the vegetation landscape. This does not imply a lack of shrubs in the area, but rather reflects the origin of the samples. In other words, the samples were extracted from the layers of the *villa* itself, a place that

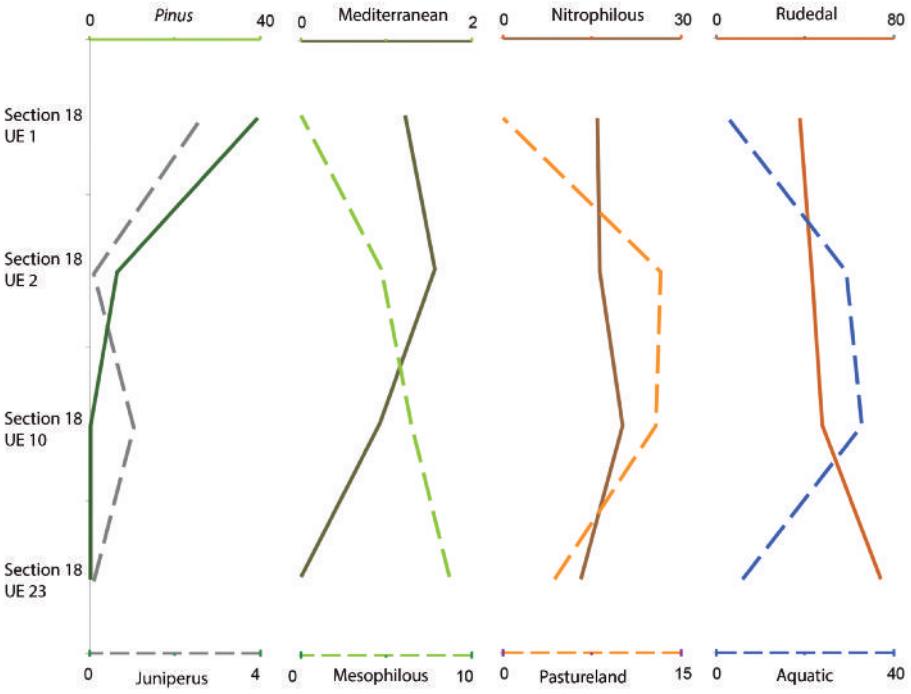

Fig. 6. Development of the most significant arboreal groupings and herbaceous taxa in each sample (Ruiz Zapata *et al.* 2012, 4, fig. 3).

would, presumably, have been heavily urbanised and ornamentally cared for. It is thus unlikely that there existed a large amount of shrubbery amongst the buildings. The rural complex, particularly the *pars urbana*, was clearly subject to frequent refurbishment work, with particular care being taken to remove unwanted shrubs. In fact, a slight increase in the presence of shrubs was found only in the Late Antique phase, coinciding with the property's occupation by near-autarkic communities, and, of course, in the late phases, when the area became depopulated.

4. Diachronic interpretation of the historic flora of Noheda: ecological and anthropic considerations

The pollen diagram for the vegetation for the time period under study-varied considerably from one phase to the next. However, the existence of an open ecosystem subject to strong anthropic pressure was constant throughout all the phases.

Based on the data obtained from the palynological study, coupled with the initial data from the ongoing carpological and anthracological analyses, which have found evidence, primarily, of the presence of pine, holm oak, oak, and juniper wood, as well as wheat, barley, olive, and grape seeds, amongst others, the vegetation dynamics of the past 1,800 years can be reconstructed. The references offer enough information to enable the quantification of vegetation types in each phase, revealing considerable trend fluctuations amongst them. This latter finding, placed within the appropriate chronological context, makes it possible to verify how anthropic dynamics were exerted on the environment in each chronological and cultural phase and the close link between the human actions undertaken in the environment and the behaviour of the vegetation in the face of the most significant events.

4.1. Phase 1

UE 23, corresponding to the time span in which the complex was abandoned between the Early Imperial occupation phase and the Late Imperial period, is characterised by the scarce presence of the deciduous-type *Quercus* forests that historically have had a notable presence in the area (González Echevarría *et al.* 2006, p. 19). This scant presence may have been due to excessive felling of the *silva* in the previous phase. In other words, throughout the existence of the Early Imperial period *villa*, a large area had to be cleared to create agricultural and grazing lands both to endow the rural complex with a *surplus* yield in the spirit of the age and to extract the necessary wood from the forest to construct buildings and manufacture tools for domestic use (Revilla 2007-2008, p. 316).

This era witnessed the gradual implementation of a new agricultural system intended to make the land ever more profitable and an increasingly complex productive cycle, as well as to allow for the inclusion of manufactured materials in the trade circuit for economic gain. This way of working the land entailed the construction of various specialised structures in the *villae* for the processing of raw materials and, in particular, the treatment, conservation and storage of products, a fundamental process to allow for their export (De Neeve 1984, pp. 74-75). The *villa* of Noheda was no exception, and the excavations carried out to date have begun to uncover significant structures used for these purposes.

In contrast to this arboreal scarcity, there was a widespread dominance of mostly nitrophilous herbaceous vegetation (91.30%). Indeed, once the production system ceased to operate, the extensive tracts of agricultural land required to ensure a surplus economy for the primitive *villa* tended to turn into wasteland. Consequently, in the current unit,

there is a significant amount of *Asteraceae*, which occupied previously cultivated but then unused lands.

However, the area's abandonment was by no means absolute, since herbaceous *taxa*, such as *Chenopodiaceae* and *Poaceae*, together with certain non-pollen palynomorphs show that the surroundings of the rural complex — now uninhabited — were used extensively for animal-husbandry-related activities.

Additionally, the proportion of aquatic pollen (5.88%) shows that, during the aforementioned Roman Warm period, the Tejar stream played an important role, generating hydrological vegetation consisting of plants that grew naturally in the environment as opposed to ornamental plants cultivated by man.

In this phase, in addition to the aforementioned medium-to-low-intensity pastoralist use of the land, erosion processes increased, as evidenced by the presence of other non-pollen palynomorphs that such conditions entail, such as *Glomus* (Van Geel *et al.* 1989, pp. 55-58).

4.2. Phase 2

Following this period of abandonment, a new construction effort has been documented at the rural complex, dating to the late 3rd and early 4th centuries. Subsequent construction undertakings, lasting until the late 4th century, sought to monumentalise the *villa* through expensive architectural and decorative plans. In fact, over the 4th century, the *villae* kept and even enlarged the monumental structure begun in the previous century alongside other technical and ornamental features. These features point to continuous residential use by powerful social elites who appeared around that time as the owners of multiple vast estates, the buildings of which were consistent with the *fundus*.

The recreational aspect of these complexes became more pronounced, turning these country estates into sites for both *otium* and *negotium*. In other words, the new owners sought luxury and ostentation without neglecting the economic functions. One example of this multifaceted use can be found in the texts of the writer and aristocrat Symmachus (Matthews 1974), who, at the time, owned a number of *domus* in Rome and another one in Capua, various suburban *villae*, and, at least, five *latifundia* (Sfameni 2006b, pp. 62-63). Many of the letters written by this author describe the various construction activities carried out on the *pars urbana* of his estates (Symm. *Epist.*, IV, 60), as well as the acquisition of a new mosaic (Symm. *Epist.*, VIII, 42), highlighting the existing dynamism at the time of these great rustic complexes (fig. 7).

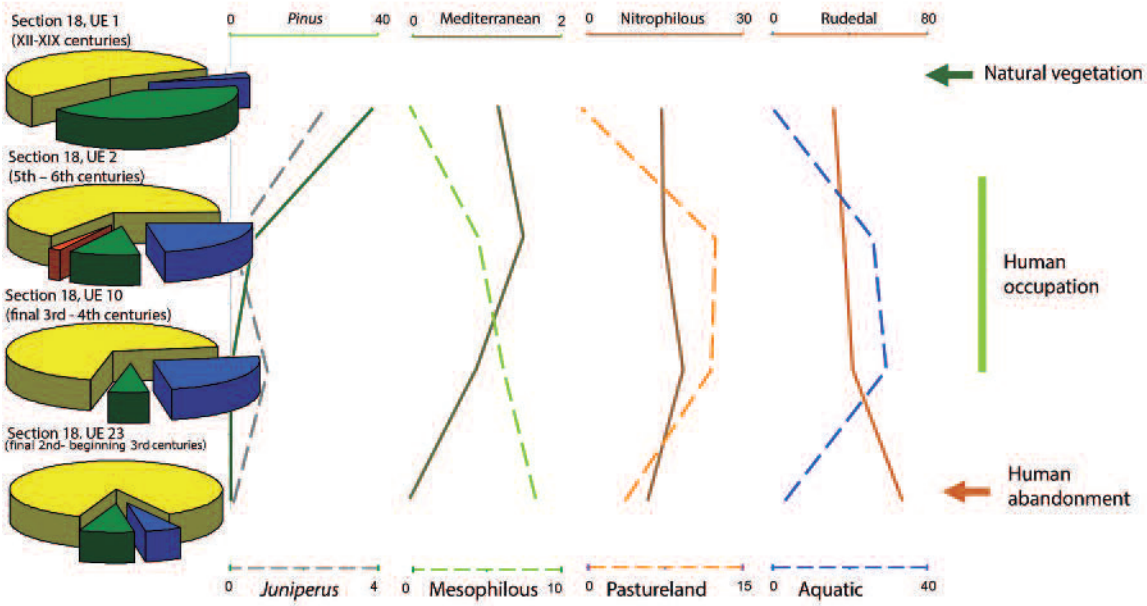

Fig. 7. Evolution and interpretation of the structure and composition of the vegetation (Ruiz Zapata *et al.* 2012, 7, fig. 4).

The *taxa* found in UE 10 for this historical period show a gradual reduction of deciduous *Quercus* forests, clearly signalling a renewed deforestation process – probably carried out by means of fire, as evidenced by the presence of the fungus *Coniochaeta* cf. *ligniaria* (Type 172), (López Sáez *et al.* 2000, p. 13) – under the authority of the *dominus*, or the *villicus*, who controlled and established the activities to be undertaken in the *fundus* of the estate. The aim was surely to maximise the returns on each plot of land: *ager*, *saltus*, and, of course, the wood of the *silva* from which the materials needed to reconstruct the various buildings of the *villa* were extracted.

In particular, for this period, *Oleaceae* and *Juniperus* were found in similar proportions in the forest. *Juniperus* wood was widely used to manufacture different types of tools and wares thanks to its malleability when freshly cut and toughness once dry.

Again, ruderals became dominant, and hay meadows were reclaimed whilst nitrophilous vegetation receded, showing considerably lower values than in the previous phase. Likewise, there was an increase in herbaceous elements related to agricultural activities, which received a strong boost at the time. The emergence of other wild plants that usually grow in agricultural lands during production periods is also telling. To-

gether with the rest of the herbaceous vegetation, it shows that the pressure exerted by the livestock increased in this phase and, along with agriculture, was one of the area's economic engines. This aspect is apparent given the strong irruption of *Sordaria* (HdV-55A), a fungus that uses the excrements of domestic herbivores as substratum, as shown by the presence of *Podospora* and *Plantago*.

Notably, there was an exponential growth of aquatic *taxa*, including, along with the elements naturally linked to water courses, a strong presence of floating ornamental plants that were no doubt used to decorate the various monumental ponds that have recently been discovered in the monumental *villa*.

As in the previous phase, non-pollen palynomorphs such as *Glomus* bear witness to the aforementioned deforestation processes. Hence, as documented in sites of analogous chronology (López Merino *et al.* 2008, p. 33), the pressure exerted by livestock activities would in a certain sense have played a positive role in terms of the nutrient enrichment of humid areas that, by then, would have been meso-eutrophic, as evidenced by the presence of Type 181 (López Sáez *et al.* 1998, p. 449; López Sáez *et al.* 2000, p. 16).

4.3. Phase 3

Over time, Noheda reached a new phase, as illustrated by UE 2, corresponding to an entirely new social and political situation in the Western Mediterranean. This is evidenced by various forms of rural occupation (López Quiroga 2009, pp. 59-115), in which, amongst other things, the *villa* gradually ceased to be used as a residential facility, although it continued to function as part of an economic system.

This phase saw the transformation of the old monumental estates through the partition of the lands amongst the inhabitants. This division of the land into lots meant that each family unit focused primarily on its agricultural possessions, neglecting areas such as pastureland or forests. As a result, the latter became a communal territory, freely used for the supply of wood, wild fruit, and animals.

The aforementioned reality is apparent in the diagram for this phase, in which arboreal *taxa* grew exponentially. For the first time, *Pinus* can be seen to gradually spread over and repopulate the areas of the ancient *silva* that, in the previous phases, had been claimed and transformed into areas for agricultural use.

Furthermore, the gradual decline in deciduous *Quercus* continued, even as the first perennial *Quercus* types appeared. The proliferation of these new arboreal types reveals two realities. The first was the emer-

Fig. 8. Landscape and general view of the vegetation in the site's current surroundings.

gence of a completely natural type of forest, only seldom affected by man through the felling of a small number of trees for construction or heating purposes. The second was a possible change in climate trends, perhaps related to the first signs of the new Early Medieval Cold period already documented at other sites (López Merino *et al.* 2008, p. 33).

Further evidence of the powerful re-emergence of nature due to the lack of anthropic activities is the presence, for the first time, of *Abies*, which seems to have grown freely on formerly productive and now barren lands (fig. 8).

Herbaceous *taxa* also suggest the natural recovery of vegetation. Thus, shrubs (*Rosaceae*) and heather (*Ericaceae*) appear for the first and only time in the diagram, whilst the rest of the groups detected in the preceding phase remain. Furthermore, the presence of *Asteraceae tubuliflorae* and *Poaceae* declined, whilst the proportions of *Asteraceae liguliflorae* and *Chenopodiaceae* slightly increased.

Paleo-economic strategies barely changed in relation to the previous phase, even though the way the land was worked did. Although agricul-

ture remained one of the fundamental pillars of community subsistence, judging from the pollen diagram readings, there was a slight reduction in agricultural fields. This is probably the result of the allotment of lands amongst the new inhabitants, who occupied only that land which was needed for the development of a new and nearly autarkic production system that did not require the holding of large estates. Parallel to this decline in the size of the agricultural lots, the pressure exerted by the livestock population increased. Animal husbandry accelerated and became a high-intensity activity. This is suggested by certain coprophilous non-pollen palynomorphs, such as *Sordaria* and *Podospora*, which also were related to other new erosive processes as evidenced by the presence of *Glomus*.

Such a context is also implicit in the presence, in this phase, of aquatic plants. The proportion of this type of *taxa* increased significantly, although the analysis of their components suggests that irrigated areas were of a different nature from those of the previous phase; they mainly consisted of natural streams and man-made ponds built for livestock purposes, which apparently underwent a progressive process of eutrophication.

As already noted, the settlement became depopulated at some indefinite point in the Late Antique period (6th-7th centuries), ushering in changes in the area's use.

4.4. Phase 4

The vegetation register from UE 1 shows that the later phases saw the emergence of a new social and economic reality inherited from the Middle Ages, which was sustained until relatively recently.

From the end of the 12th century, the area was subject to a widespread process carried out in the inland regions of the peninsula, namely, Christian repopulation through the establishment of a large number of small settlements. Two such settlements were established in the town Villar de Domingo García (located 6.5 km from the site) and the hamlet of Noheda (a mere 500 metres away from the site). Together with other settlements, such as Sacedoncillo (1.8 km away), they would house the area's population (González González 1960, p. 459; Romero 2011, p. 23).

This situation is reflected in the disproportionate growth of arboreal *taxa* at the site, particularly *Pinus*, coupled with the presence of *Juniperus*, offering proof of a vegetation reality in the area that remains largely unchanged to this day. This reality consists of a dense pine forest at high and medium altitudes in the Sierra de Bascuñana, where the resinous

trees share the environment with perennial *Juniperus* and *Quercus*. Indeed, in this phase, trees accounted for nearly half the vegetation spectrum (57.32%), indicating the development of a scarcely anthropised landscape (fig. 9).

In this respect the data offered by the herbaceous elements is clear, showing a slight increase in *Asteraceae liguliflorae*, whilst *Asteraceae tubuliflorae* and *Poaceae* continued to decline. This latter finding, along with the total disappearance of *Chenopodiaceae*, *Boraginaceae*, *Lamiaceae* and *Campanulaceae*, as well as the emergence, for the first time in the pollen histogram, of *Fabaceae*, reveal a fundamentally natural landscape.

The percentage of aquatic *taxa* drastically declined, essentially consisting of *Cyperaceae*, which would have been concentrated around irregular streams and areas of upwelling water.

In short, the findings point to the establishment of a medieval exploitation system that was inherited by subsequent phases. This system was based on extensive cultivation of cereal, along with grapevines and olive trees, and was supported by ample pastureland areas. An extensive forest area, mainly used for wood supplies, completes the picture.

Fig. 9. Vegetation in the immediate environment of the site of the Roman *villa* of Noheda.

This distribution of the land remained constant until recently, given that the historical estate, which was part of the lands owned by the crown in the 13th century, was ceded to the Church in 1215, which retained ownership until the Spanish government seized it as part of the so-called Madoz Disentailment (1854-1856). However, the area was purchased by a landowner who kept the property as a single land unit, without changing the uses made of it, until the end of the 20th century.

5. Conclusions

The data from the archaeopalynological studies conducted to date in Noheda make it possible to analyse the evolution of the site's vegetation, as well as the anthropic influence, over a period stretching back nearly 2,000 years.

The landscape revealed was mostly open, due to either agricultural processes, anthropised pasturelands, or even periods of abandonment. However, the forest had a significant specific weight, showing a certain amount of taxonomical variability, mainly due to the varying degree of pressure exerted by man.

From the point of view of the evolution and transformations undergone by the landscape, the pollen *taxa* clearly show the successive variations in the vegetal context caused by anthropic pressure or its opposite, i.e., the lack of habitation in the area.

Thus, the first documented phase corresponds to a time span between the High Imperial and Late Roman periods in which the *villa* was abandoned. The landscape reflected this reality, showing evidence of large wastelands where there had once been fertile agricultural lands, which, having lost their original purpose, were used as pastureland.

The second phase coincides with the period of the emergence of large rural complexes for which evidence has been found in the Western Empire. In accordance with the monumental buildings constructed in the *villa*, the surrounding environment was deeply transformed in order to maximise the agricultural, livestock, and forestry yield, reflecting the estate's sense of *negotium*. However, the second aspect inherent to such rustic complexes was not neglected. Thus, evidence of *otium*, amongst other facets, can be seen in the construction of large ponds filled with numerous ornamental aquatic plants.

The third phase was contemporaneous with the late stages of the late antique period. In keeping with the austere lifestyle of the complex's new inhabitants, the forest reclaimed terrain, and the agricultural fields decreased, although they clearly continued to exist. In contrast, *taxa* re-

lated to pastureland increased, bearing witness to a change in economic and, perhaps, dietary behaviour.

Finally, the abandonment of the complex entailed a new change in the landscape. The forest naturally spread over most of the available space. The rest of the surface area was divided almost equally between agricultural lands and pastureland.

In light of the above, it can be concluded that the archaeopalynological studies enabled a faithful reconstruction of the historical landscape around the Roman *villa* of Noheda, as well as of the changes in the economic foundations of the communities that inhabited it. Clearly, the environment directly influences human behaviour, but it is a two-way relationship: humans are conditioned by the physical environment, whilst the environment, in turn, is constantly being modified by humans.

Additionally, the technological level of a population at any given point in history has been shown to directly influence its ability to transform the environment. Thus, societies such as Roman society, which had a high degree of specialisation throughout almost all its phases, had a strong influence on the ecosystem. People sought to extract the greatest possible benefit from the physical environment, adapting and/or transforming both the means they used and the landscape itself to the benefit of the community. This was accentuated at settlements such as the *villae*, where economic activity tended to be centred on agriculture and animal husbandry.

References

J.M. Abascal Palazón 1982, *Vías de comunicación romanas de la provincia de Guadalajara*, Guadalajara.

J. Arce 2006, *Villae en el paisaje rural de Hispania romana durante la Antigüedad tardía*, in Chavarría Arnau, Arce, Brogiolo 2006, pp. 9-15.

J. Arce 2009, *El último siglo de la España romana, 284-412*, Madrid.

C. Balmelle 2001, *Les demeures aristocratiques d'Aquitaine: société et culture de l'Antiquité tardive dans le Sud-Ouest de la Gaule*, "Ausonius-Aquitania", Suppl. 10, Bordeaux-Paris.

I. Cacho, B. Valero Garcés, P. González Sampériz 2010, *Revisión de las reconstrucciones paleoclimáticas en la Península Ibérica desde el último glaciar*, in F.F. Pérez, R. Boscolo (eds), *Clima en España: pasado, presente y futuro*, Madrid, pp. 9-24.

J. F. Carrión, S. Fernández, P. González Sampériz, S.A.G. Leroy, G.N. Bailey, J.A. López Sáez, F. Burjachs, G. Gil Romera, M. García Antón, M.J. Gil García, I. Parra, L. Santos, P. López García, E.I. Yll, M. Dupré 2009, *Quaternary pollen analysis in the Iberian Peninsula: the value of negative results*, "Internet Archaeology", 25, pp. 1-53.

M. Casas Gallego, J. Morín De Pablos, D. Urbina Martínez 2012, *Análisis palinológico del yacimiento arqueológico de Las Madrigueras II (Carrascosa del Campo, Cuenca),* "Polen", 22, pp. 15-24.

A. Chavarría Arnau 2005, *Villas in* Hispania *during the fourth and fifth centuries*, in K. Bowes, M. Kulikowski (eds), Hispania *Late Antiquity. Current Perspectives*, Leiden-Boston, pp. 518-555.

A. Chavarría Arnau 2006, *Villas en Hispania durante la Antigüedad tardía*, in Chavarría Arnau, Arce, Brogiolo 2006, pp. 17-35.

A. Chavarría Arnau 2007, *El final de las villae en* Hispania *(siglos IV-VIII)*, Turnhout.

A. Chavarría Arnau, J. Arce, G.P. Brogiolo (eds) 2006, *Villas Tardoantiguas en el Mediterráneo Occidental*, "Anejos de AespA", XXXIX, Madrid.

F. Coello 1897, *Caminos romanos de Cuenca*, "Boletín de la Real Academia de la Historia", XXXI, pp. 19-25.

M. Couteaux 1977, *A propos de l'interprétation des analyses polliniques de sédiments minéraux, principalement archéologiques*, in *Le milieu végétal, les faunes et l'homme*, Suppl. du "Bulletin de l'Association Francaise pour l'Étude du Quaternaire", 47, pp. 259-276.

P. De Neeve 1984, *Colonus. Private farm-tenancy in Roman Italy during the Republic and the early Empire*, Amsterdam.

M. Girard, Y.J. Renault-Miskovsky 1969, *Nouvelles techniques de préparation en palynologie appliquées à trios sédiments du Quaternaire final de l'Abri Cornille (Istres, Bouches du Rhône)*, "Bulletin de l'Association Française pour l'Étude du Quaternaire", 4, pp. 275-284.

C. Goeury, J.L. De Beaulieu 1979, *À propos de la concentration du pollen à l'aide de la liqueur de Thoulet dans les sédiments minéraux*, "Pollen et Spores", XXI (1-2), pp. 239-251.

R. González Echevarría, A. Fernández Santos, S. Sanza Candales 2006, *Ideas para la educación ambiental basada en el territorio*, "Propuestas de Educación Ambiental", 2, pp. 17-23.

J. González González 1960, *El Reino de Castilla en la época de Alfonso VIII*, Madrid.

E.C. Grimm 1992, *Tilia version 2*, Springfield-IL.

E.C. Grimm 2004, *TGView*, Springfield-IL.

P. Gros 2001, *L'architecture romaine, 2. Maisons, palais, villas et tombeaux*, Paris.

R. Hidalgo Prieto 2014, *¿Fue Cercadilla una villa? El problema de la función del complejo de Cercadilla en Corduba*, "Archivo Español de Arqueología", 87, pp. 217-241.

D.E. Johnston 1983, *Roman Villas*, Aylesbury Shire.

J. Larrañaga Mendia 1966, *Guía de Cuenca*, Cuenca.

L. López Merino, J.A. López Sáez, D. Abel Schaad, F.J. Sánchez Palencia, G.S. Reher Díez 2008, *Dinámica antrópica en el Bierzo (León) desde época romana: estudio palinológico de Castro Ventosa*, "Polen", 18, pp. 25-36.

J. Lopez Quiroga 2009, *Arqueología del hábitat rural en la Península Ibérica (siglos V – X)*, Madrid.

J.A. López Sáez, P. López García, F. Burjachs 2003, *Arqueopalinología: Síntesis crítica*, "Polen", 12, pp. 5-35.

J.A. López Sáez, L. López Merino 2005, *Precisiones metodológicas acerca de los indicios paleopalinologicos de agricultura en la Península Ibérica*, "Portugalia", 26, pp. 53-64.

J.A. López Sáez, L. López Merino 2007, *Coprophilous fungi as a source of information of anthropic activities during the prehistory in the Amblés valley (Ávila, Spain): the archaeopalynological record*, "Revista Española de Micropaleontología", 38(1-2), pp. 49-75.

J.A. López Sáez, B. Van Geel, S, Farbos-Texier, M.F. Diot 1998, *Remarques paléoécologiques à propos de quelques palynomorphes non-polliniques provenant de sédiments quaternaires en France*, "Revue de Paléobiologie", 17(2), pp. 445-459.

J.A. López Sáez, B. Van Geel, M. Martín Sánchez 2000, *Aplicación de los microfósiles no polínicos en palinología arqueológica*, in J. Oliveira (ed), *Actas 3 Congresso de Arqueologia Peninsular*, vol. IX, Porto, pp. 11-20.

J.F. Matthews 1974, *Letters of Symmachus*, in J.W Binns (ed), *Latin Literature of the Forth Century*, London, pp. 49-75.

A.G. McKay, M. Grant, R. Kitzinger 1975, *Houses, Villas and Palaces in the Roman World*, London.

P.D. Moore, J.A. Webb, M.E Collison 1991, *Pollen Analysis,* Oxford.

L. Mulvin 2002, *Late Roman Villas in the Danube-Balkan Region*, Oxford.

S. Palomero Plaza 1987, *Las vías romanas de la provincia de Cuenca*, Cuenca.

P. Pensabene 2010-2011, *La villa del Casale tra Tardo Antico e Medioevo alla luce dei nuovi dati archaeologici: funzioni, decorazioni e trasformazioni*, "Rendiconti della Pontificia Accademia Romana di Archeologia", LXXXIII, pp. 141-226.

J. Percival 1976, *The Roman Villa: a Historical Introduction*, London.

M. Reille 1992, *Pollen et Spores d'Europe et d'Afrique du Nord*, Marseille.

M. Reille 1995, *Pollen et Spores d'Europe et d'Afrique du Nord. Suppl. 1*, Marseille.

V. Revilla Calvo 2007-2008, *Producción agrícola, territorio y formas de hábitat en el NE de Hispania*, "Anales de Prehistoria y Arqueología", 23-24, pp. 311-329.

I. Richmond 1970, *The plans of roman villas in Britain*, in A.L.F. Rivet (ed), *The Roman Villas in Britain*, London, pp. 49-70.

S. Riera, J. A. López Sáez, R. Julià 2006, *Lake responses to historical land use changes in northern Spain: the contribution of non-pollen palynomorphs in a multiproxy study*, "Review of Palaeobotany and Palynology", 141, pp. 127-137.

M. Romero Saiz 2011, *Pueblos de Cuenca*, Cuenca.

M.B. Ruiz Zapata, M.J. Gil García, T. Martín Arroyo 2012, *Análisis polínico de la villa romana de Noheda*, unpublished.

J. Santa María 1897, *Itinerarios romanos de la provincia de Cuenca*, "Boletín de la Real Academia de la Historia", XXXI, pp. 5-19.

C. Sfameni 2006a, *Ville residenziali nell'Italia Tardoantica*, Bari.

C. Sfameni 2006b, *Le ville tardo-antiche in Italia*, in Chavarría Arnau, Arce, Brogiolo 2006, pp. 61-73.

M.A. Valero Tévar 2010, *La villa romana de Noheda: Avance de los primeros resultados*, "Informes sobre Patrimonio", 1, pp. 5-19.

M.A. Valero Tévar 2011, *Les images de ludi de la mosaïque romaine de Noheda (Villar de Domingo García, Cuenca)*, "Nikephoros", 24, pp. 91-114.

M.A. Valero Tévar 2013, *The late-antique villa at Noheda (Villar de Domingo García) near Cuenca and its mosaics*, "Journal of Roman Archaeology", 26, pp. 307-330.

M.A. Valero Tévar 2014a, *El* triclinium *de la villa de Noheda (Villar de Domingo García (Cuenca)*, in P. Pensabene, C. Sfameni (eds), *La villa restaurata e i nuovi studi sull'edilizia residenziale tardoantica*, Bari, pp. 521-531.

M.A. Valero Tévar 2014b, *Estudio arqueométrico de las muestras procedentes del mosaico de la villa romana de Noheda (Cuenca): primeros resultados*, in *Actas del X Congreso Ibérico de Arqueometría*, Castellón, pp. 54-68.

M.A. Valero Tévar 2014c, *La representación de instrumentos musicales en el mosaico de la villa romana de Noheda*, Cuenca, pp. 81-104.

M.A. Valero Tévar 2015a, *La villa romana de Noheda: la sala triclinar y sus mosaicos*, PhD thesis, Universidad de Castilla-La Mancha.

M.A. Valero Tévar 2015b, *Los mosaicos del triclinium de la villa romana de Noheda (Villar de Domingo García, Cuenca)*, in *Proceedings 18th International Congress of Classical Archaeology*, Mérida, pp. 1347-1351.

M.A. Valero Tévar 2015c, *Los mosaicos de la villa romana de Noheda (Villar de Domingo García, Cuenca)*, in G. Trovabene (ed), *XII Colloquio AIEMA*, Verona, pp. 439-444.

M.A. Valero Tévar 2016a, *La iconografía del mito de Pélope e Hipodamía en la musivaria romana. Nuevas aportaciones a partir del mosaico de Noheda*, "Anales de Arqueología Cordobesa", 27, pp. 125-160.

M.A. Valero Tévar 2015c, *Primeras aproximaciones a los mosaicos del* balneum *de la villa romana de Noheda (Cuenca)*, in L. Neira (ed), *Estudios sobre mosaicos antiguos y medievales*, Roma, pp. 358-363.

M.A. Valero Tévar 2016b, *Los mosaicos de la villa de Noheda (Cuenca*), "Arqueología Somos Todos", 4, pp. 10-12.

M.A. Valero Tévar 2017a, *La representación del circo en el mosaico de Noheda*, J. Vilar (ed), *Tarraco Biennal. La glòria del circ. Curses de carros i competicions circenses*, Tarragona, pp. 75-82.

M.A. Valero Tévar 2017b, *El proyectos Fundus de la villa romana de Noheda: planteamientos metodológicos y primeros resultados*, in C. Teixeira, A. Carneiro (eds), *Arqueologia da Transiçao: entre o mundo romano e a Idade Média*, Coimbra, pp. 65-94.

M. A. Valero Tévar 2017c, *La escenografía del poder en los grandes complejos de la Antigüedad Tardía: los* triclinia *triabsidados en la* pars occidentalis *del Imperio*, "Scientia Antiquitatis", 1, pp. 27-46.

M.A. Valero Tévar, J. Gómez Pallarès 2013, *El mimo del celoso adinerado: literatura y espectáculo en la villa de Noheda (Cuenca)*, "Quaderni Urbitani di Cultura Classica", 102, pp. 87-106.

M.A. Valero Tévar, A. Gutiérez García, M.-I. Rodà De Lanza 2015, *First preliminary results in the* marmora *of the late roman villa of Noheda (Cuenca, Spain)*, in P. Pensabene, E. Gasparini (eds), *Interdiscipinary Studies on Ancient Stone*, Roma, pp. 393-402.

B. Van Geel, A. Aptroot 2006, *Fossil ascomycetes in Quaternary deposits*, "Nova Hedwigia", 82, pp. 313-329.

B. Van Geel, J. Buurmaman, O. Brinkkemper, J. Schelvis, A. Aptroop, G. Van Reenen, T. Hakbijljl 2003, *Environmental reconstruction of a Roman period settlement site in Uitgeest (The Netherlands), with special reference to coprophilous fungi*, "Journal of Archaeological Science", 30, pp. 873-883.

B. Van Geel, G.R. Coope, T. Van Der Hammen 1989, *Palaeoecology and stratigraphy of the Late glacial type section at Usselo (The Netherlands)*, "Review Palaeobotany & Palynology", 60, pp. 25-129.

D. Vera 1992-1993, *Schiavitù rurale e colonato nell'Italia imperiale*, "Scienze dell'Antichità Storia Archeologia Antropologia", 6-7, pp. 291-339.

G. Volpe 1996, *Contadini, pastori e mercanti nell'*Apulia *tardoantica*, Bari.