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Palaeovegetational Reconstruction of the Krios Valley, Northern Achaia (Greece): Archaeobotanical Analysis Conducted as Part of the Aegialia Survey Project

La reconstruction de la paléovégétation de la vallée du Krios, nord Achaïe (Grèce) : les analyses archéobotaniques réalisées dans le cadre de l'Aegialia Survey Project

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Abstract: Since 2001 the Aegialia Survey Project (A.S.P.) has sought to reconstruct the dynamics of human occupation in Aegialia, northern Achaia (Greece). In doing so it has followed a multidisciplinary approach, with the involvement of various skills and institutions. The surveys in the Krios Valley also entailed the recognition and recording of the current flora in the area.

The survey made it possible to identify the site of Kassaneva, characterised by a high concentration of ceramic artefacts near the surface, which were subsequently subjected to chrono-typological analysis and attributed to the Early Helladic II phase (3rd millennium B.C.). The archaeological excavation yielded palaeoenvironmental data directly from the ancient context. Specifically, systematic sampling strategies were adopted in order to recover burnt plant remains belonging to arboreal, shrub and herbaceous species.

Together with data from the regional-scale palaeoenvironmental survey, the archaeobotanical analyses enabled us to reconstruct the palaeovegetation in the Bronze Age and the ways in which ancient communities supplied themselves with fuel in numerous ecological areas.

In addition, the recovery of seed and fruit remains provided a rare opportunity to highlight agricultural practices in these marginal and inland areas, raising questions about olive cultivation in Achaia from the Early Helladic period onwards.

Résumé : Depuis 2001, l'Aegialia Survey Project (ASP) a cherché à reconstruire la dynamique de l'occupation humaine dans la région de Aegialia, dans le nord Achaïe (Grèce). Ce faisant, on a suivi une approche multidisciplinaire, avec la participation de diverses compétences et institutions. La recherche dans la vallée de Krios impliquait aussi la reconnaissance et l'enregistrement de la flore actuelle dans la région.

La recherche a permis d'identifier le site de Kassaneva, caractérisée par une forte concentration d'artefacts en céramique sur la surface, qui ont ensuite été attribuée à la phase de l'Helladique Ancien II (3^e millénaire avant J.-C.). Les fouilles archéologiques ont fourni des données paléoenvironnementales directement sur ce contexte ancien. Plus précisément, des stratégies d'échantillonnage systématique ont été utilisés afin de récupérer les restes des plantes brûlées appartenant à espèces des arborées, arbustives et herbacées.

Avec les données de la recherche à l'échelle régionale paléoenvironnementale, les analyses archéobotaniques nous ont permis de reconstruire la paléovégétation dans l'Age du Bronze et les façons dont les communautés anciennes se sont approvisionnés en bois dans les différentes zones écologiques.

En outre, la récupération des restes des graines et des fruits offert une rare occasion de mettre en évidence les pratiques agricoles dans ces zones marginales et intérieures de la Grèce, ce qui soulève des questions aussi sur la culture des oliviers en Achaïe à partir de la période Helladique Ancien.

Keywords: Northern Achaia region (Greece), Aegialia Survey Project, Early Helladic II, plant remains, ancient landscape, olive cultivation.

Mots clé : Nord Achaïe (Grèce), Aegialia Survey Project, Helladique Ancien II, macrorestes végétaux, Ancien paysage, oléiculture.

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1. INTRODUCTION

The Landscape Archaeology research conducted by the *Aegialia Survey Project* (A.S.P.) in the last five years in the Krios valley and the stratigraphic investigations carried out at the Early-Helladic II site of Kassaneva (3000-2500 B.C.) (fig. 1) are the result of cooperation coordinated by the University of Salerno (Italy) with the Laboratory of Archaeobotany and Palaeoecology (University of the Salento, Italy), the Italian Archaeological School in Athens (Italy), the University of Paris Ouest-Nanterre (Paris 10) (France), the 6th Ephorate of Prehistoric and Classical Antiquities in Patras and KERA.

Figure 1: Kassaneva site in the northern Achaia region (Greece).
Figure 1 : Site de Kassaneva dans le nord de la région Achaïe (Grèce).

The new research builds on a tradition of archaeological studies that have focused on the various phases of human occupation of Greece, from prehistoric to ancient times (Cavanagh *et al.*, 2005; Cherry *et al.*, 1991; Davis & Sutton,

1995; Lee, 2001; Lloyd *et al.*, 1985; Simpson, 2007; Sutton, 2000; Wells & Runnels, 1996).

As part of a long-term project, the specific skills of each research unit were aimed at the reconstruction of the region's ancient landscape and its relationship with the dynamics of human occupation (Bintliff, 2008; Butzer, 1996; Findlow & Ericson, 1980; Higgs & Vita Finzi, 1972; Le Roy Ladurie & Barry, 1962), by means of integrated archaeological and environmental survey methods and a dedicated GIS platform (Santoriello *et al.*, in press).

2. THE GEOGRAPHICAL SETTING AND HISTORICAL CONTEXT

The area is characterised by the presence of mountain chains running parallel to the coast, with short, deep valleys such as that of the river Krios below mount Evrostina (about 2000 m above sea level). The broad river basin, which has an area of about 100 km², is crossed by tributaries and lesser watercourses that have carved deep valleys of their own, such as the Tholopotamos flowing from the left and the Vathy Lakoma from the right, immediately to the east of the ancient city of Aegira. A ridge joins the area of the city to the mountainous hinterland, which on the right bank of the river Krios is characterised by steep slopes that give way in places to small terraces. On the left bank the landscape is more varied. North of the Goulas and Chalandra, tributaries of the Krios, there are high and broad plateaux that host modern villages. To the south of the Goulas the territory is more mountainous.

The substrate is made up of Plio-Quaternary geological formations. Due to the continuous isostatic lifting of the southern edge of the Gulf of Corinth, these are now found at altitude and are subject to intense erosion. The constant lifting and the distinctive lithology which lends itself to various forms of erosion have generated the steep valleys and the linear regressive erosion of the tributaries of the Krios.

At the foot of the plateau, formed by Plio-calabrian conglomerates, a large fault has been a major factor in the creation of the valley of the Goulas. The fault has also caused the destabilisation of the valley slopes (Fig. 2).

On these slopes are large badlands that formed as a result of both streamcutting erosion and landslides. The underlying marls also favour the creation of badlands and landslides due to their clayey matrix. All the steep valley walls along the river Krios and its tributaries are receding rapidly due to landslides, particularly on the left bank (Petropoulos *et al.*, 2003).

Figure 2: Geomorphological map (Petropoulos *et al.*, 2003, modified).

Figure 2 : Carte géomorphologique (Petropoulos *et al.*, 2003, modifiée).

The main archaeological site in the area is that of ancient Aegira. The city was identified on the right bank of the river on a series of terraces rising to a height of 416m on the northern side of Mount Evrostina.

On the left bank of the Krios the archaeological literature describes other discoveries of interest, especially in the area lying between the Krios and the Krathis (Petropoulos *et al.*, 2002).

3. THE AEGIALIA SURVEY PROJECT AND THE EXCAVATION OF THE SITE OF KASSANEVA

The high concentration of ceramic fragments attributed to the Early Helladic II has made it possible to delimit the area of a settlement on the northern side of the plateau, 250 m a.s.l., that descends by means of a series of artificial terraces of various dimensions and orientations (Fig. 3). Immediately to the north-east of the upper flat area, two narrow terraces descend in a northerly direction, separating the main plateau from a smaller, lower plateau which, in turn, is part of a system of terraces that descend from east to west.

At the point in which the two different systems of terraces meet, a stretch of wall running along an east-west axis was identified (Fig. 4). Composed of large irregular blocks of

conglomerate, it is roughly 25m long and 4m high. Slightly higher up the slope, another more recent wall was recognised. Built of small stones, the wall marks the limit of the upper terrace. Linked to it is another stretch of wall running along a north-south axis; now obscured by dense vegetation, it acts as a retaining wall for another, larger terrace.

The various systems of terraces are clearly part of a single site, probably a fully fledged settlement from which numerous fragments of protohistoric ceramics have been recovered (Petropoulos *et al.*, 2005).

The archaeological excavation of a roughly 100 m² portion of the plateau has brought to light numerous remains of walls. These are mainly limestone blocks and stones, bound with clay and containing a central filling of clay and small stones, of which only the bottom row is conserved. These stretches of walls, discovered in association with fragments of pots used for the preparation and storage of food, are believed to have belonged to structures for human habitation (Petropoulos *et al.*, 2006). It is not clear however whether the remains discovered here correspond to continuous or merely seasonal forms of occupation of the plateau.

Figure 3: Altimetric map (Petropoulos *et al.*, 2004, modified).
Figure 3: Carte altimétrique (Petropoulos *et al.*, 2004, modifiée).

4. RECONSTRUCTION OF THE PALAEOVEGETATION: INTEGRATED ANALYSES OF MODERN PLANT COVER AND ANCIENT MACROREMAINS

The modern landscape represents the starting point for the reconstruction – by means of a reverse process – of the variations in regional plant coverage over time.

The analysis began with a survey of the current vegetation, focusing on a 1.7 km² transect stretching from the plateau to the hilly country further inland, which recorded the geomorphological and ecological characteristics of the individual stations considered (Fig. 2).

The second approach focused on the archaeological deposit and the archaeobotanical analysis at the site of Kassaneva. Standard samples of sediment were taken from the various archaeological contexts being excavated, from hearths and floors in household structures, and were subsequently subjected to flotation in order to recover plant macroremains

(Fig. 5). The selected material was analysed at the Laboratory of Archaeobotany and Palaeoecology of the University of the Salento by stereomicroscope (Nikon SMZ 645) and metallographic microscope (Nikon Eclipse ME600), comparing the recorded characteristics with reference collections of seeds/fruits and charcoals of Mediterranean plants as well as traditional atlases of reference (Abbate Edlmann *et al.*, 1994; Andergerg, 1994; Cambini, 1967; Greguss, 1955; Jacomet, 2006; Jacquot, 1955; J.M. Renfrew, 1973; Schweingruber, 1990).

5. RESULTS

Modern vegetation

The survey of the vegetation around the site has allowed us to recognize the syntaxonomic order of *Quercetalia ilicis*, common to the whole of northern Achaia. This is a floristic association found in the thermo-Mediterranean belt and particularly in coastal, hilly and sub-mountainous areas (Verroios & Georgiadis, 2011). The altitude of the plateau, 250m above sea level, in the transitional climate zone between the coast and the inland hills, favours the presence within this order of two vegetational alliances, *Olea-Ceratonion* and *Quercion ilicis*. The first characterizes highly xerophilous environments, populated by sclerophyllous Mediterranean maquis (olive, mastic, ceratonia, Aleppo pine etc.), whereas the second characterizes is usually found in thermo-mesophilous environments, with oaks, terebinth, European black pine, etc. (Dafis, 1976; Tan *et al.*, 2001) (Fig. 6).

Another aspect of the plateau is the deep impact of the agricultural practices on the natural environment. The presence of human beings is clear from the intensive agriculture, based on olive and citrus groves. Completing the picture of the rural landscape are the numerous retaining walls of the terraces typical in much of the Peloponnese (Price & Nixon, 2005), built in our area during the Early Helladic Period, as well as Kassaneva excavation testifies (Petropoulos *et al.*, 2004).

Traces of natural vegetation are present in those parts of the plateau that are not suitable for agriculture due to outcrops of bedrock or the steepness of the land at its edges. These areas are host to Kermes oak, isolated remnants of the original maquis (Malanson & Trabaud, 1988; Trabaud, 1991; Tsiouvaras, 1987). The latter is associated with shrubs, such as mastic and tree heath, typical of the secondary maquis, probably of anthropic origin (Gavrielides, 1976; Riba, 1997; Tomaselli, 1977).

Figure 4: Excavation area and two ancient systems of terraces (Petropoulos *et al.*, 2004, modified).

Figure 4: La zone de fouille archéologique et les deux anciens systèmes de terrasses (Petropoulos *et al.*, 2004, modifié)

Along the western edge of the plateau, characterised by the presence of rocky slopes, the sclerophyllous Mediterranean maquis species gradually give way to species typical of thermo-mesophilous woods (Bussotti *et al.*, 2005).

Here one finds the Aleppo pine associated with the European black pine; the terebinth replaces the mastic and deciduous oaks, such as the Downy oak, begin to appear.

In the deep natural channels that surround the rest of the plateau, in which flow the Krios, Chalandra and Goulas, the vegetation becomes more clearly riparian, composed mainly of plane trees and oleanders.

Archaeobotanical analysis

The archaeobotanical analyses of the material gathered at the site, from hearths and floors in household structures

and under the walls of the terraces archaeologically dated to Early Helladic Period, yielded a number of plant macroremains that were used to reconstruct the characteristics of the past vegetation. The recovered remains were charred fragments of secondary woody tissue, seeds and/or fruits.

In total 487 charcoals were identified, corresponding to 14 *taxa* (Fig. 7) and 16 macroremains of seeds and/or fruits, corresponding to 5 *taxa*.

An important feature was the considerable concentration of remains of *Olea*, although it was not possible to establish whether these belong to the wild and/or cultivated variety. Other Mediterranean maquis plants that were identified include mastic (*Pistacia lentiscus*), evergreen oaks (*Quercus* sp. evergreen type), tree heath (*Erica* cf. *arborea*) and pines (*Pinus* type *brutia-halepensis*) (Fenaroli, 1998; Gaudenzio *et al.*, 2002).

Figure 5: Grid of archaeobotanical sampling.

Figure 5 : Grille des prélèvements archéobotaniques.

There was also a conspicuous number of charcoals of terebinth (*Pistacia terebinthus*) and deciduous oak (*Quercus* sp. deciduous type), generally associated with thermo-mesophilous environments.

The remaining fragments were poplar (*Populus* sp.) and plane tree (*Platanus orientalis*) probably from woods growing near watercourses (Sfikas, 1983).

As well as remains of charred woody tissue, a small quantity (16 items) of seed and fruit remains of trees and herbaceous plants were also recovered (Fig. 7). Of these, carbonised remains of fig syconia (*Ficus carica*) accounted for most of the finds. There was also an emmer wheat caryopsis (*Triticum dicoccum*), a goosegrass achene (*Galium aparine*) and a grape seed (*Vitis vinifera*). The rounded shape of the latter, according the archaeobotanical literature (Stummer, 1911; J.M. Renfrew 1973; Mangafa & Kotsakis, 1996), requires further analyses in order to establish whether it is a cultivated variety (*Vitis vinifera* subsp. *vinifera*) or a wild type (*Vitis vinifera* subsp. *sylvestris*).

6. DISCUSSION AND CONCLUDING REMARKS

The archaeobotanical analyses of material from the site of Kassaneva and the reading of the current vegetation allow us to advance a series of hypotheses about the characteristics of the palaeoenvironment in the course of the 3rd millennium

BC in the region of Aegialia. The remains of woody tissue from various trees used as fuel in household and craft activities illustrate the composition of the vegetation surrounding the settlement and at the same time allow us to describe its catchment area and the way it was exploited.

Though limited, the taxonomic range (14 tree *taxa*) highlights the presence of ecologically distinct environments, as well as modern vegetation survey suggests (Fig. 6). Specifically, adjacent to the sclerophyllous evergreen species that are typical of the xerophilous environment of the lowland areas (*Olea europaea*, *Quercus* sp. evergreen type, *Ficus carica*, *Prunus* sp. and *Pistacia lentiscus*), there are trees typical of riparian environments (*Populus* sp. and *Platanus orientalis*) found in river valleys that were more accessible in ancient times than they are now (Petropoulos *et al.* 2004). In contrast, the remains attributed to thermo-mesophilous species (cf. *Cupressus*, *Quercus* sp. deciduous type, *Erica* cf. *arborea* and *Pinus* type *brutia-halepensis*) identify a third environment corresponding to the hillsides. These are heights near the settlement that stretch inland, where the increasing altitude is associated with moderately cooler temperatures and increased precipitation (Dufaure, 1975).

The varying degree of exploitation of the different types of environment is shown in the pie chart, which excludes data concerning olive trees due to their evident over-representation (Fig. 8). It emerges that the vegetation most affected by human pressure by fuel gathering is that of the xero-

Figure 6: Modern vegetation pattern in the Krios valley.
 Figure 6 : Modèle de la végétation moderne dans la vallée de Krios.

philous maquis, presumably situated in the lowland areas (accounting for 39% of the finds). The surface area covered by this type of vegetation is governed, as in the past, by natural boundaries, such as the deep channels of the rivers Chalandra, Krios and Goulas, situated to the north, east and south of the plateau respectively.

The thermo-mesophilous vegetation (24%) highlights the exploitation of the hilly areas to the west of the settlement. It is probable that the deciduous oaks, found on the hills, were used for carpentry.

The riparian trees (18%) constitute something of a novelty. The current topography of the terrain near the watercourses is probably the result of a process of gradual erosion that has made these areas more inaccessible than in the past.

In this regard, the terracing that is still visible in the area is evidence of the careful management of space in terms of both slowing down the process of erosion and exploiting the land for agriculture.

The carpological data recovered at the site are still too limited to allow reconstruction of the characteristics of the crops. However, the presence of an emmer wheat caryopsis is evidence of the use of cereals that are particularly hardy and suitable even for cultivation in hilly environments. The presence of the grape seed and the uncertainty as to the subspecies (i.e. whether it was a cultivated or a wild variety) means that there may have been vines among the natural vegetation, particularly as a climber near the rivers. The presence of the two olive endocarps and the over-representation of fragments of charred woody tissue from olive trees require a fuller account.

The use of olives as a plant to be eaten directly as food or pressed to obtain oil is at the centre of a lively debate on the origin of olive cultivation in the Aegean region in the course of the 3rd millennium BC. Renfrew's hypothesis concerning the birth of olive cultivation in accordance with a model of endogenous development dating back to the

Figure 7: Anthracological diagram with transversal section of olive-wood charcoal (*Olea europaea*) (100x) and carpological diagram with olive stone (*Olea europaea*) (10x).

Figure 7 : Diagramme anthracologique avec section transversale de charbon de bois d'olivier (*Olea europaea*) (100x) et diagramme carpologique avec endocarpe d'olivier (*Olea europaea*) (10x).

pre-palatial period (3650-1900 BC) (A.C. Renfrew, 1972), with specific reference to remains of endocarps discovered in Myrtos (Crete) together with remains of branches believed to have been pruned (Rachkam, 1972; J.M. Renfrew, 1973), has been contested (Hamilakis, 1986; Runnels & Hansen, 1996). The quantities involved are not considered sufficient proof of cultivation. Recently the hypothesis of olive cultivation in the course of the Ancient Bronze Age was proposed

on the basis of remains recovered from the site of Akrotiri on Santorini (Asouti, 2003). The problem remains unsolved due to the complex biometric distinctions between the seeds of the different varieties (Buschan, 1895). However, recent approaches based on geometric morphometry seem to provide new tools for distinguishing wild from cultivated subspecies, working with either seeds (Terral *et al.*, 2004) or wood charcoal (Terral & Arnold-Simard, 1996; Terral,

Figure 8: Exploitation of the different types of environment.

Figure 8 : Exploitation des différents types d'environnement.

2000). The high heterozygosity of the olive tree and the use of asexual reproduction for cultivation purposes make the distinction between wild and cultivated plants even more complex (Zohary & Hopf, 2000).

The abundant discoveries of olive remains in Aegean region, both endocarps and woody tissue, and the presence of equipment for the production of oil, seem to indicate that cultivation began during the post-palatial period (1400-1100 BC) (Hamilakis, 1986; Runnels & Hansen, 1996).

In this framework the archaeobotanical data of the Kassaneva site highlight the special role of olives among the local Early-Helladic communities. The species was certainly present in the natural vegetation of the xerophilous environment of the Mediterranean maquis and in the thermophilous hilly areas, together with oaks and terebinth. It was exploited not only as a fuel but probably also to obtain

materials for carpentry (Fiorentino & Solinas, 2008) and for fruits. In this regard, the archaeobotanical data are still scarce but the analysis of the anthropic components of the landscape highlight terracing, whose purpose was probably olive cultivation. Further archaeobotanical analyses will provide a better understanding of the dynamics of this process in an apparently marginal area of the Peloponnese.

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