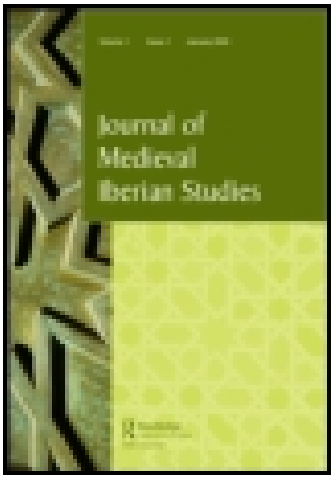

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Medieval landscapes in the Spanish Central System (450-1350): a palaeoenvironmental and historical perspective

Antonio Blanco-González[a], José Antonio López-Sáez[b], Francisca Alba[c], Daniel Abel[b] & Sebastián Pérez[d]

[a] Department of Archaeology, University of Durham, South Road, Durham DH1 3LE, UK

[b] Archaeobiology Group, Institute of History, CCHS, CSIC, Albasanz 26-28, 28037 Madrid, Spain

[c] Department of Botany, University of Granada, 18071 Granada, Spain

[d] GEODE, UMR 5602 CNRS, Université Toulouse-Le Mirail, 31058 Toulouse, France

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Medieval landscapes in the Spanish Central System (450–1350): a palaeoenvironmental and historical perspective

Antonio Blanco-González[a*], José Antonio López-Sáez[b], Francisca Alba[c], Daniel Abel[b] and Sebastián Pérez[d]

[a]*Department of Archaeology, University of Durham, South Road, Durham DH1 3LE, UK;* [b]*Archaeobiology Group, Institute of History, CCHS, CSIC, Albasanz 26–28, 28037 Madrid, Spain;* [c]*Department of Botany, University of Granada, 18071 Granada, Spain;* [d]*GEODE, UMR 5602 CNRS, Université Toulouse-Le Mirail, 31058 Toulouse, France*

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This paper presents a long-term synthetic overview of the socio-ecological dynamics responsible for the shaping of present-day rural landscapes in the Spanish Central System. Available historical and palaeoenvironmental records have been compiled and cross-referenced to characterise key transformations unfolding in this mountainous macro-region during the medieval time span. A sharp deforestation of upland pines and midland oaks was due to extensive Late Antique strategies. Pre-tenth-century trajectories are diverse and exhibit the recovery of high-mountain pine forests and highly localised agro-pastoral impact on selective mid-altitude niches. The eleventh-century early repopulation policy implied migrations, increased momentum of rural village foundation and extension of colonised agrarian landscapes in the tablelands of the Extremadurii. The pace and intensity of these phenomena depended on ecological and historical circumstances, leading to subsequently different realities. By the mid-thirteenth century the definitive pacification and the rising demographic trend facilitated the later permanent occupation and the ensuing integral and sustainable exploitation of the highlands – and especially the Transierra – within the feudal system. High-altitude landscapes exhibit intensive forest clearances due to transterminant livestock movements and the benefit of seasonal resources, whereas low-altitude settings specialised in arboriculture and diversified crops to supply urban markets.

Keywords: palaeoenvironment; palynology; colonisation; agro-pastoral footprint; Spanish Central System; high-mountainous rural settings

The question of the interaction of humans with the environment in the past may be adequately approached by combining the methods of natural and historical sciences. Through time people have lived in and with their surroundings and for several thousand years, they have transformed them into landscapes[1] crucial for their economy and survival. Information on the history of vegetation and the development of economic activities – agriculture, animal husbandry or mining – is mainly gained through palaeoecology and environmental archaeology, where pollen analysis is

*Corresponding author. Email: ablancoglez@gmail.com

[1]For the purposes of this paper, a systemic approach has been adopted to past landscapes akin to the one posited by Quirós Castillo, "Early Medieval Landscapes," 286–87.

especially important to obtain information on the dynamics of vegetation development through a diachronic approach.[2]

Palynology can be defined as the study of the distribution of small biological elements by wind and animals. Originally, only pollen and spores were studied, but later, also other microorganisms were taken into account: fungi, algae, cyanobacteria, zoological remains, etc. The total palette of a palynologist's research material is comprised of what are nowadays called palynomorphs.[3] Palynology can be applied to a great variety of research topics. In this paper, the focus will be on vegetation history and the impact of medieval peasant communities on the forest cover. The best sources for this kind of research are: (1) "natural archives" – lakes or organic soils such as peatlands,[4] because in these sedimentary contexts pollen is deposited stratigraphically (in layers) and is normally well preserved; but also (2) anthropogenic records such as archaeological sites. By combining pollen diagrams from several spots within a region, it is possible to identify vegetation developments and human impact on several spatial scales: from local differences within a valley or small region to differences between neighbouring but distinctive ecological environments.[5] The latter constitute the sort of comparative perspective adopted here.[6]

Pollen analyses in the Spanish Central System have enabled the reconstruction of broad patterns of environmental change during the last 9000 years. Such contributions vary considerably with respect to their location, temporal and taxonomic resolution and the number and quality of radiocarbon dates, but these datasets have supported, for the first time, overall diachronic accounts at a macro-regional scale.[7] However, the current panorama is very unbalanced due to natural and research factors. Hence, peat bogs occur more frequently in the western and central ranges, where archaeological research is also more developed. Several issues remain unsolved. On the one hand, there have been few attempts to integrate the palaeoecological data, the archaeological records and written sources in order to evaluate the relationship between human activities and environmental change.[8] There is also a marked temporal bias among available pollen sequences for Iberia, which heretofore tend to cluster in the later prehistory – i.e. from the Neolithic to the Iron Age. The knowledge on vegetation patterns during more recent periods is often patchy, and for the uplands relies upon extrapolation and interpolation from a small dataset of predominantly lowland pollen sequences. Nevertheless, there remains a paucity of high-resolution palaeoecological records which afford the opportunity to reconstruct

[2]See, e.g., Behre, "Rôle of Man," especially 647–51; Dincauze, *Environmental Archaeology*; López-Sáez, López-García, and Burjachs, "Arqueopalinología," 7–8. The key role of palynology or pollen analysis, in the current research agenda of medieval scholarship has recently been highlighted by Escalona, "Early Castilian Peasantry," 133.

[3]López-Sáez, van Geel, and Martín-Sánchez, "Microfósiles no polínicos," 18.

[4]Peatlands are natural archives for past climatic changes due to their sensitivity to changes in the water balance and the dating possibilities of peat sediments. See, e.g. de Jong et al., "Climate and Peatlands," for peat stratigraphy and chronology, and especially the interpolation methods to provide age models for each level of a pollen record from peat sediments.

[5]See, e.g., Berglund, *Cultural Landscape*; Berglund, "Ystad Project"; Carrión et al., "Paleoclimas," 131–32; Carrión et al., "Expected Trends," 466, 469–70.

[6]For several diachronic approaches to mountainous medieval landscapes in Iberia see Riera, Wansard, and Julià, "2000-Year Environmental History"; Riera et al., "Variabilité climatique"; Pèlachs et al., "Changes in Pyrenean Woodlands."

[7]López-Sáez et al., "Vegetation History"; López-Sáez, López-García, and Burjachs, "Arqueopalinología." These papers present a thorough description of the material (the palaeoecological records) and methods used to analyse them (treatment of samples, radiocarbon datings, scientific criteria used for obtaining the pollen diagrams and how they have been interpreted).

[8]Blanco-González, López-Sáez, and López-Merino, "Ocupación y uso"; López-Merino et al., "2000 Years of Pastoralism"; López-Sáez et al., "Contribución paleoambiental," 12, 22–30, 37.

environmental changes. Owing to the lack of written sources before the mid-tenth century – or later to the south of the river Duero – there is a temporal bias within medieval scholarship, which has tended to minimise pre-tenth century developments and has over-stressed "the period round about the year 1000 as crucial in the creation of rural space."[9]

Taking into account the above-mentioned weaknesses and potential, this paper aims to undertake a synthetic overview of the heterogeneous and unevenly distributed palaeoecological and historical – documentary, place name and archaeological – datasets spanning nearly a millennium (450–1350)[10] from the upland zone (~1000–2000 m asl) of the Spanish Central System. This time span ranges from the intense human impact on high-altitude forest cover in post-Roman times to the climax of the agro-forestry exploitation of these settings in the late medieval period. In fact, the traditional rural ways of life in this mountainous area date back to the High Middle Ages (twelfth–thirteenth centuries), when key socio-economic and ecological transformations occurred.[11] These trajectories of change have been so far independently tracked by different disciplines. In the last decade, the numbers of historiographical studies using documentary archives and botanical records with a micro-regional approach have multiplied. This produces a fragmentary perspective. By contrast, this paper aims to highlight the need to analyse the mountains of the Central System of Iberia in a comprehensive way, as a homogeneous and coherent geographical unit, subject to similar ecological phenomena and coherent socio-economic trajectories. The Central System represents a large mountainous macro-region, whose human occupation, management and conservation present common particularities typical of the highland domains[12] so far misunderstood and only preliminarily recognised. A diachronic integral analysis based on the foregoing variate but complementary information sources has been able to shed new light upon the intertwined dynamics of change brought about by successive peasant communities, shaping these vulnerable highland environments. As a result we can offer a series of working hypotheses to paint the wider pictures within which it is possible to understand the local historical and ecological records.

The study area

The Spanish Central System (Figure 1) is a mountain range approximately 400 km long which divides the Duero and Tagus basins, with a WSW–ENE general layout. It consists of a series of mountain ranges or *sierras* separated by depressions or troughs which represent natural corridors between the two sub-plateaus. It is a chain of sunken and elevated blocks which, according to its granitic or metamorphic materials, is sorted in different tectonic styles. Related to this orogeny is the asymmetry between the northern and southern slopes of the mountain range, particularly in the western sector, because of the altitude of the Northern Meseta with respect to the deeply set valleys in the Tagus basin. Glacial morphologies are also present at the highest elevation areas of the range. Along with these processes, modelling by fluvial erosion has essentially determined the current relief.

The climate is of a Mediterranean type, with a summer drought period lasting three to five months and more intense rainfall in autumn and winter. As for temperatures, there are warmer conditions on the southern slopes, thanks to their lower elevation and greater sun exposure. Furthermore, there is a continentality gradient which tends to increase from more western areas, near the Atlantic coast, to the inland sectors. Dominant southwest humid winds cause, similarly, a

[9]Escalona, "Early Castilian Peasantry," 130.
[10]All radiocarbon dates referred to palaeoecological records in the text are expressed in calibrated years AD.
[11]Barrios García, *Estructuras agrarias*; Barrios García, "Tierra de nadie"; Monsalvo, "Frontera pionera"; Clément, *De la marche-frontière au pays-des-bois*, 60–65.
[12]Lasanta, "Diversidad de usos"; Llorente, "Identidad serrana"; Galop et al., "Grazing Activities," 54.

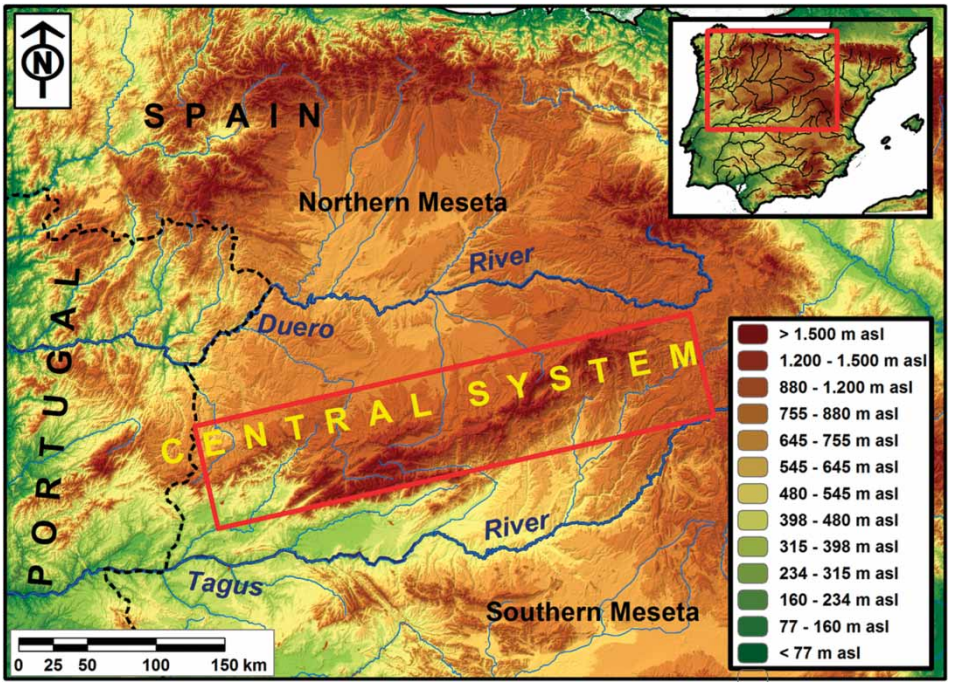

Figure 1. The Central System in inner Iberia. Drawing by A. Blanco-González, using the SRTM (Shuttle Radar Topography Mission) Digital Elevation Model (NASA).

greater abundance of precipitation on the southern slopes. Differences in altitude offset in many cases the influence of these gradients. Vegetation is dominated by deciduous oak forests of *Quercus pyrenaica*, especially in the western sector at mid-altitudes. In the lowlands, these forests contact with holm oak (*Quercus ilex*) and cork oak (*Q. suber*) woodlands. Above them, different oak forests communities develop according to rainfall ranges. To the east, pine forests acquire greater prominence, especially in the mountains of Gredos and Guadarrama, where *Pinus sylvestris* and *Pinus nigra* stands represent the timberline. Altitudes over 1600 m asl are widely occupied by shrublands, where brooms like *Cytisus oromediterraneus*, *Echinospartum ibericum*, *E. barnadesii* or, in more humid areas, heathlands mostly composed of *Erica* species, constitute the main features of the landscape. Grasslands are the dominant vegetation in the highest areas.[13]

The Central System constituted a physical and also a cultural frontier in medieval times, somehow reflecting the mentioned natural contrasts. In the early medieval period the consecutive Islamic states in al-Andalus did not succeed in gaining effective and permanent control to the north of this mountainous range. The progressive political possession and colonisation of the region by the northern Christian kingdoms from 930 onwards – the so-called reconquest – was a long-term process, with particular tempos and resulting in quite different historic realities. Regarding these differences, when studying the medieval Central System from a palaeoenvironmental and historical approach, two chief domains should be distinguished: (1) the sedimentary tablelands in the Northern Meseta extending from the Duero river to the northern hillslopes of the

[13]Rivas-Martínez et al., "Piornales, enebrales y pinares oromediterráneos."

Central Range, also known as the *Extremadura* or *Extremadurii* – "the confines of the Duero's territory"; and (2) the *Transierra* – "the lands beyond the range" – or the southern slopes of the central highlands and the plain of the Tagus basin (Figure 2).

The formation of medieval landscapes in this region passed through two recognisable phases: (1) a prelude of uneven and localised anthropisation (conversion of natural environments by human action) trajectories during the early medieval times (late fifth to early twelfth centuries) mainly in those early colonised lands by the Christian settlers to the north of the Central System; and (2) the colonisation of the highlands and the full extension of the interspersed settlement during the High Medieval and early Late Middle Ages (mid-twelfth to fourteenth centuries). The following sections tackle both stages in more detail, collating historical and palaeoecological data to get a holistic interpretive account.

The early medieval period and first populations in the *Extremadurii* (450–1120)

It is important to refer to the centuries before the earliest historic colonisations in the upland areas, the setting of the permanent network of medieval villages and the definitive agro-forestry outline

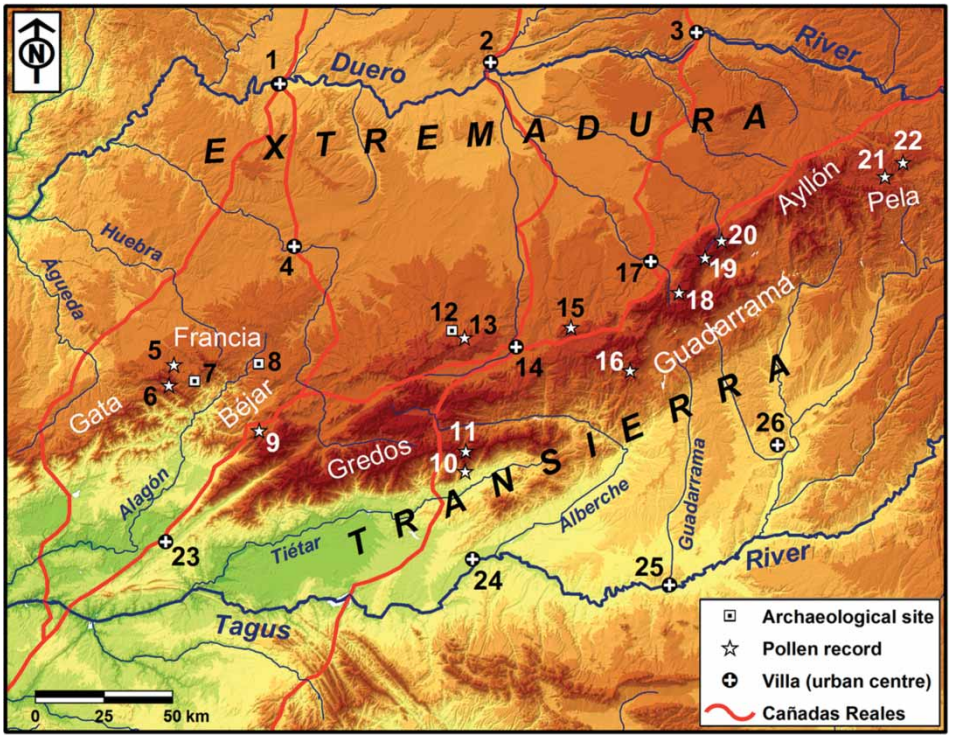

Figure 2. Study area and sites mentioned in the text: 1. Zamora; 2. Simancas (Valladolid); 3. Roa (Burgos); 4. Salamanca; 5. El Maíllo (Salamanca); 6. La Meseguera (Salamanca); 7. La Legoriza (San Martín del Castañar, Salamanca); 8. Monte Alcaide (Monleón, Salamanca); 9. Peña Negra (Salamanca); 10. Lanzahíta (Ávila); 11. Serranillos (Ávila); 12. Las Henrenes (Cillán, Ávila); 13. Narrillos del Rebollar (Ávila); 14. Ávila; 15. Ojos Albos (Ávila); 16. Arroyo de la Hoz (Madrid); 17. Segovia; 18. Peñalara (Segovia): 19. Rascafría (Madrid); 20. Lozoya-Paular (Segovia); 21. Pelagallinas (Guadalajara); 22. Somolinos (Guadalajara); 23. Plasencia (Cáceres); 24. Talavera (Toledo); 25. Toledo; 26. Madrid. Drawing by A. Blanco-González, using the SRTM (Shuttle Radar Topography Mission) Digital Elevation Model (NASA).

in the study area. Post-Roman times may be regarded as the background for the complex long-term processes leading to the formation of the current rural landscapes. The starting point of such transformation processes can be set during the Visigothic period (450–711). The settlement during this phase can be portrayed through several archaeological studies both in lowland regions bordering the range – such as the sedimentary tablelands in the Duero basin or in the countryside near the capital Toledo in the Tagus basin – as well as in mid-altitude environments within the heart of the Central System, such as La Legoriza (San Martín del Castañar, Salamanca) or Monte Alcaide (Monleón, Salamanca).[14]

From a palaeoclimatic viewpoint (the study of climate change employing several methodologies), the onset of the Early Medieval Cold Episode (450–950) was characterised by lower temperatures and greater aridity,[15] factors which contributed to difficult cultivation with the techniques available during this period. The evidence of large deforestation strategies in montane areas – mainly driven by means of fire (which produces high macrocharcoal, burnt wood, concentrations in pollen records) – within the Central System is remarkable during the Visigothic *regnum*. It points to a considerable zooanthropogenic impact of human beings and animals. We know that from the abundant remains of anthropozoogenous taxa and coprophilous fungi, fungi which live on manure. Probably this is the result of livestock-oriented activities and the breaking up of new fields for cereal farming. These facts are documented (Figure 3) in mid-altitude pollen records (∼900–1100 m asl) such as Lanzahíta (Gredos range), El Maíllo (Peña de Francia range) or Peña Negra (Béjar range) by decreasing percentages of deciduous oaks, and by much more intense records from upland sites – e.g., Somolinos (Pela range), Pelagallinas (Ayllón range), Narrillos del Rebollar and Serranillos (Gredos range)[16] – where high-mountain pine forests suffered a significant reduction. The introduction of rye (*Secale cereale*) – a non-exigent cereal well adapted to low temperatures and poor soils – has been detected in the Ojos Albos (Gredos Range) and Peña Negra (Béjar range) pollen records during this period.

To sum up, these observations seem to match the implementation of expansive agro-forestry strategies based on the diversification of resources, including further alternative crops such as the cultivated variety of olive (*Olea europaea* var. *europaea*)[17] or sweet chestnut (*Castanea sativa*).

After the collapse of the Visigothic *regnum* in 711 and the arrival of the Muslims to the Iberian Peninsula, an elusive reality pervades the last centuries of the first millennium in northern Iberia. The archaeological invisibility of the post-Visigothic settlement and material culture constitutes a real challenge, and written sources disappear till 930 in the Duero river line and up to *c*. 1150 further south of the Duero. However, several lines of evidence support the persistence of remnant peoples in central Iberia throughout this period and make it possible to seriously discredit the *depopulation thesis* posited by juridical-institutionalist medieval

[14]Blanco-González, López-Sáez, and López-Merino, "Ocupación y uso"; Quirós Castillo and Vigil-Escalera, "Networks of Peasant Villages"; Gómez-Gandullo, "La Legoriza"; Patricio and Vinuesa, "Monte el Alcaide"; Quirós Castillo, "Early Medieval Landscapes."

[15]Desprat, Sánchez-Goñi, and Loutre, "Revealing Climatic Variability," 68, 72; Currás et al., "Climate Change."

[16]López-Sáez et al., "Late Holocene Ecological History," 204; Morales-Molino et al., "Holocene Vegetation, Fire and Climate"; Abel-Schaad and López-Sáez, "Vegetation Changes"; Franco-Múgica et al., "Evolución de la vegetación"; Currás et al., "Climate Change"; López-Merino et al., "2000 Years of Pastoralism," 48; López-Sáez et al., "Contribución paleoambiental," 22–24; Blanco-González, López-Sáez, and López-Merino, "Ocupación y uso."

[17]*Olea europaea* var. *sylvestris* (commonly called in Castilian, *acebuche*) is an introduced thermophilous subspecies in the warmer Mesomediterranean zone of the middle Tagus basin, which cannot grow on those cold and humid high-mountainous settings naturally (i.e. cannot be a spontaneous occurrence since it needs human intervention to survive in such conditions). See Terral et al., "Historical Biogeography."

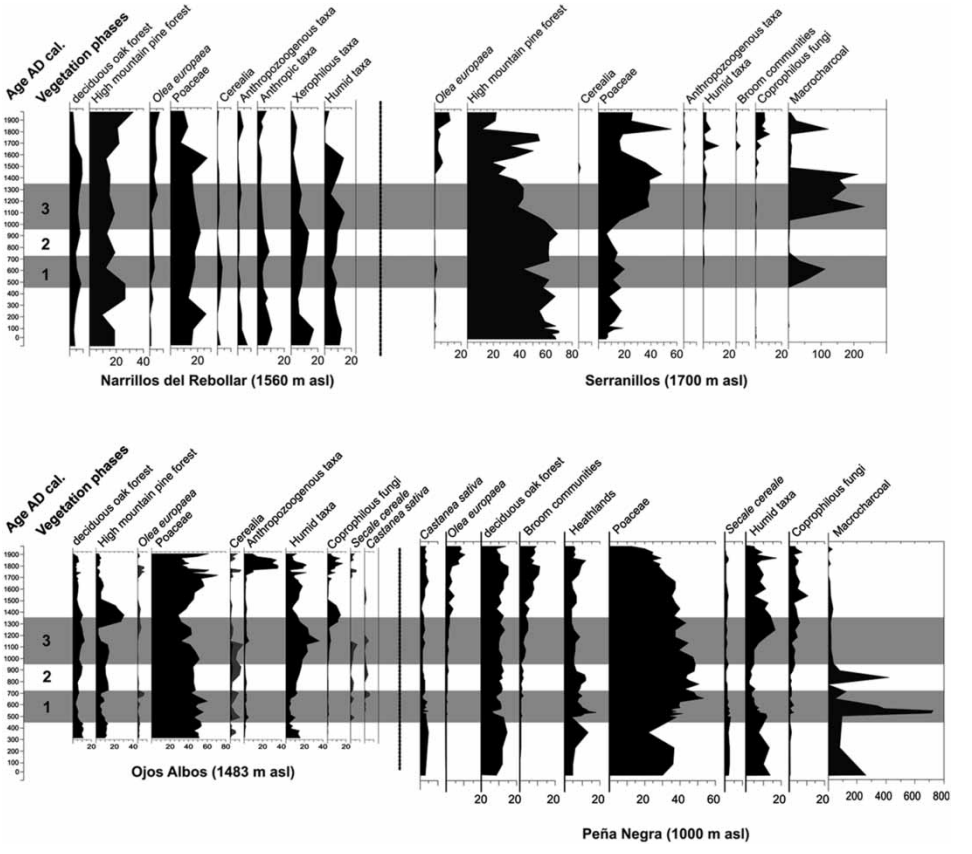

Figure 3. Synthetic pollen diagrams of four peat bogs records from the Gredos and Béjar ranges and mean features of vegetation evolution. Phase 1: Visigothic period (450–711); Phase 2: Post-Visigothic or early medieval period (711–950). Phases 1 and 2 correspond to the Early Medieval Cold Episode (450–950); Phase 3: High Medieval period and later colonisations (950–1350) corresponding to the Late Medieval Warm Episode (950–1350).

historiography.[18] One example is the frequent pre-Roman, Latin, Berber and Mozarab micro-place names in the area, regarded as proof for the curation and transmission of such immaterial heritage by local settlers.[19] Moreover, several pollen records across the Spanish Central System show a moderate but uninterrupted trend of human impact on certain ecotones (ecological border areas between two homogeneous regions). No doubt, the nature and scale of the practices responsible for it are different from the aggressive strategies implemented during Late Antiquity. In the western sector, the subsistence of the remaining relatively self-sufficient and dispersed household groups was based on livestock grazing, forestry and small crops, restricted to specific

[18]See, e.g., Sánchez-Albornoz, *Despoblación*, 349–60; Sierra Vigil, "Bases de partida," 251. For an updated critical assessment of the depopulation scenario and the role of peasantry, see Escalona, "Early Castilian Peasantry."

[19]Barrios García, "Tierra de nadie"; Villar García, *Extremadura castellano-leonesa*; Mínguez Fernández, "Repoblación de los territorios salmantinos"; Peterson, "Men of Wavering Faith."

mid-altitude niches (~900–1110 m asl).[20] This is the case of the farm of Las Henrenes (Cillán, Ávila) in the Sierra de Ávila, dated to the ninth–tenth centuries.[21]

Among the more conspicuous traces of these elusive peoples are the isolated rock-carved tombs. Their scattered spatial pattern and dislocation from any contemporary churches suggest their interpretation as landmarks for individual memories linked to relatively autonomous kinship groups.[22] Beyond these settings the agro-pastoral footprint is weaker, both in the valleys and in the highlands. In fact several high-altitude (>1400 m asl) pollen records in these western areas (Béjar, Gata and Gredos ranges) point to a phase of forest recovery before 950 related to the decline in heathlands, grasslands and anthropozoogenous taxa, whereas olive or sweet chestnut cultivation disappeared (Figure 3). By contrast, in the eastern sector of the Central massif this panorama should be nuanced: human activity can be mostly traced in the river valleys, while in the upland settings a certain number of watchtowers were built or rebuilt over previous *husûn* (the plural of *ḥiṣn*, a military fortress in al-Andalus) erected by the Muslims to guarantee the surveillance of some strategic passes.[23] Some high-altitude pollen records from the Guadarrama range (e.g. Peñalara) exhibit a noticeable human impact – the increase of anthropozoogenous taxa and decreasing forest cover – which may be linked to sporadic pressure and itinerant frequentation by small pastoral groups. For instance, in the Lozoya-Paular valley (Guadarrama range), the Rascafría record shows a remarkable increase in anthropozoogenous taxa and a decline of tree cover *c*. 800–1170.[24]

The political control of the region by the emergent Astur-Leonese and Castilian monarchies was carried out in different phases. This section addresses the earliest one. In the mid-tenth century the strategic Duero river line was militarily secured and the main frontier cities were fortified by Christian powers. By means of the official repopulation initiatives – *repopulare* meaning a political[25] as well as an ensuing demographic process – every town or *villa* became the capital of a large ascribed territory, known as *alfoz* or *tierra*. By 1035 the subsequent occupation of the fertile plains in the *Extremadurii* to the south of the River Duero was achieved (Figure 2). This widespread model, the so-called *comunidades de villa y tierra* revolved around the urban centre and a network of aggregated and dependent rural "village communities" (*aldeas*). This process led to the shaping of agrarian rural landscapes, exploited and maintained by peasant communities, especially via the expansion of cereal crop fields – the *tierras de pan* or *ager* – around the small *aldeas* gained by breaking up the forest formations or *saltus*. In contrast, the highlands of the Central System remained for several decades scarcely and patchily populated as an insecure territory.[26] The main source of insecurity in these uplands was the sporadic and recurrent military expeditions or *razzias* launched by both opponents – the Muslim and Christian states – lasting up to the late twelfth century. Thus, until the definitive conquest of Toledo in 1085 by the emperor Alfonso VI, the Central System acted as a physical and also a cultural, if permeable, borderline

[20]García-Oliva, "Espacio sin poder"; Blanco-González, "Tendencias del uso del suelo," 170; Blanco-González, López-Sáez, and López-Merino, "Ocupación y uso"; López-Merino et al., "2000 Years of Pastoralism"; López-Sáez et al., "Contribución paleoambiental," 23–25; Martín Viso, "Espacios sin Estado."
[21]Díaz de la Torre et al., "Despoblado de San Cristóbal."
[22]Martín Viso, "Paisajes sagrados, paisajes eclesiásticos"; Martín Viso and Blanco-González, "Ancestral Memories."
[23]Martín Viso, "Castillos, poder feudal"; López Estébanez et al., "Evolution of Forest Landscapes," 163–64.
[24]Franco-Múgica, García-Antón, and Sainz-Ollero, "Vegetation Dynamics."
[25]There is a wide current consensus on interpreting the term *repopulare* in textual sources as the negotiation of central power with local aristocracies, e.g. Quirós Castillo, "Early Medieval Landscapes," 303.
[26]Barrios García, *Estructuras agrarias*; Barrios García, "Tierra de nadie"; Monsalvo, "Frontera pionera"; Mínguez Fernández, "Repoblación de los territorios salmantinos"; Martín Viso, "Espacios sin Estado"; Escalona, "Early Castilian Peasantry," 102–21; López Estébanez et al., "Evolution of Forest Landscapes," 164.

between the successive powers in hostility, beyond their effective political control. Once Toledo was captured, northern colonisers arrived for several generations (1087–1120) mainly settling in urban areas.[27]

Pollen diagrams from the Spanish Central System show the onset of long-term environmental impact. Regarding the climate situation, the Late Medieval Warm Period (950–1350) is characterised by temperatures similar to present-day ones and moderate rainfall, with a distinct dry period between the ninth and eleventh centuries.[28] In fact, harsh drought episodes have been factually documented throughout the period on the southern slopes of the Central System.[29] The occurrence of episodes of famine, some of them mentioned in contemporary textual sources, added further uncertainty to the agrarian ways of life. After the initial phase of forest recovery during the early eighth to the early tenth centuries, woodland clearance was continuous, by 950, in the high-altitude deposits of the Gata, Béjar, Gredos and Guadarrama ranges, probably related to the seasonal exploitation of these areas. This is indicated by the high values of coprophilous fungi in both Ojos Albos and Peña Negra pollen records (Figure 3).

Deposits located at lower altitudes show a different pattern. The cultivation of cereals was widespread during this phase, helped by the milder climatic conditions of the Late Medieval Warm Period. Olive and sweet chestnut groves grew everywhere in the highland Mediterranean ecotones, and so did cereal crops, especially from 1000 onwards, as shown in Ojos Albos, peat bog where both *Cerealia*-type and rye (*Secale cereal*) increase their representation (Figure 3). Pastoral activities involved neither broad clearances of forest formations, nor the extensive use of fire, rather a recovery of pinewoods and oak forests. This was achieved by means of pasture management, probably using irrigation in previously deforested areas, such as in Peña Negra (Béjar range),[30] Rascafría and Arroyo de la Hoz (Guadarrama range), or Pelagallinas (Ayllón range). However, in the time span 1000–1100, fire and grazing indicators are more visible in La Meseguera pollen record (Peña de Francia range), probably pointing to slightly more intense circumstantial and intermittent human pressure, rather than an actual multiannual permanence of settlers in these mid-altitude settings.

The later *Transierra* colonisation and the feudal system (1120–1350)

The highland landscapes of the region were shaped in the High Middle Ages (twelfth–thirteenth centuries). This is a period of generalised growth, both in economic and also in demographic terms, involving some crucial technological improvements – such as the hydraulic mills and the textile manufactures, the heyday of the rural settlement foundation and the consolidation of the feudal socio-political order. This trend lasted until the beginning of the Modern period, in the early sixteenth century and its ecological footprint is evident in the palaeoenvironmental records obtained in the Spanish Central System. Climate in this time span is still characterised by the mild Late Medieval Warm Period, which ends with the onset of the Little Ice Age *c.* 1350. Similarly to the previous centuries, during the twelfth–fourteenth centuries there are numerous documentary references to natural catastrophic episodes related to droughts, rainfalls and the

[27]Barrios García, *Estructuras agrarias*, 129; Villar García, *Extremadura castellano-leonesa*, 92–116; García-Oliva, "Espacio sin poder"; Martín Viso, "Castillos, poder feudal"; Escalona, "Early Castilian Peasantry."
[28]Desprat, Sánchez-Goñi, and Loutre, "Revealing Climatic Variability," 68, 72; Currás et al., "Climate Change."
[29]García-Oliva, "Espacio sin poder."
[30]Abel-Schaad and López-Sáez, "Vegetation Changes."

flooding of rivers in the study area.[31] Despite the overall demographic increase and the economic prosperity, these adverse climatic events led to "bad years" and had direct repercussions for the agrarian life cycles.

This phase is characterised by the irreversible configuration of the mountainous landscapes in central Iberia via their full occupation and integral exploitation. As a result of the rising demographic trend, the availability of vacant agrarian lands and the definitive pacification of those territories between the Duero and Tagus rivers, some later colonisation enterprises occurred in the study area between 1250 and 1350. On the one hand, in the northern *Extremadurii*, these expansive dynamics were mainly carried out through the internal fission and duplication of the successful nuclei founded some decades before. The outcome was a dense network of *aldeas* forming an interspersed rural settlement pattern which filled in the empty spaces left by the earlier generations of settlers. On the other hand, in the highlands of the Central Range and southwards, in the *Transierra*, dispersed vernacular pastoralists had followed wandering and semi-itinerant ways of life theretofore, living in *majadas* (summer highland pastures with huts and pens) and *tinaos* (pastoral seasonal shelters).[32]

Two chief factors had impeded their long-term permanence in these environments: (1) the risk of exposure to violent episodes by armed hordes; and (2) the structural difficulties in tackling the exigent management of any mountainous milieu successfully. Indeed, the sustainable and integral exploitation of the unevenly located and vulnerable highland resources is a tough task, only affordable with a minimum workforce and resorting to peasant solidarity to face the agropecuarian uncertainty.[33] These conditions had been previously met in this region only during the Iron Age (800–50 cal BC).[34] In historical times they were only fulfilled in the mid-thirteenth century, resulting in the definitive sedentarisation of those peoples both by an internal aggregation process in more stable nuclei and by the arrival of northern and southern settlers – initiatives promoted or facilitated by the feudal powers. These vectors of change led to the foundation of the bulk of present-day villages in intra-mountainous valleys such as the Águeda, Huebra, Alagón, Tiétar, High Alberche and Guadarrama[35] (Figure 2).

The most conspicuous feature gained from the documentary corpus and the archaeological record[36] is a general process of settlement intensification during the twelfth and thirteenth centuries, with a relative loss of momentum in the mid-fourteenth century. During the High Middle Ages the consolidated urban councils (*concejos*) succeeded as secular seigniorial agents in frontier *villas* such as Zamora, Salamanca, Ávila and Segovia, triggering radical transformations in so far as they promoted the intensification of the rural economies within their territories (*tierras*) in order to supply the urban markets.[37] This led to the formation of more integrated and interdependent agrarian landscapes, with the imposition of formalised schemes of production towards the

[31]Barrios García, "Repoblación y colonización," 317–19; Mínguez Fernández, "Repoblación de los territorios salmantinos."
[32]Barrios García, "Repoblación y colonización," 328; González Calle, *Despoblados*, 418; García Garcimartín, *Valle del Alberche*, 69.
[33]Lasanta, "Diversidad de usos"; Llorente, "Identidad serrana"; Wolf, *Campesinos*.
[34]Blanco-González and López Sáez, "Dynamics of Pioneer Colonisation."
[35]Barrios García, "Tierra de nadie"; López Estébanez et al., "Evolution of Forest Landscapes"; Mínguez Fernández, "Repoblación de los territorios salmantinos"; Martín Viso, "Castillos, poder feudal"; Clément, *De la marche-frontière au pays-des-bois*.
[36]Barrios García, "Repoblación y colonización"; Mínguez Fernández, "Repoblación de los territorios salmantinos"; Blanco-González, "Tendencias del uso del suelo."
[37]Monsalvo, "Frontera pionera"; Monsalvo, *Comunalismo*; Mínguez Fernández, "Repoblación de los territorios salmantinos"; Clément, *De la marche-frontière au pays-des-bois.*

extraction of a staple surplus taken as rent.[38] The Church benefited from these socio-economic strategies and contributed to their legitimisation by means of a network of parish churches and communal cemeteries that attached peasants to their feudal demesnes (*parroquias*).[39] In this regard, the list of parishes in the bishopric of Avila ordered by Cardinal Gil Torres is an extraordinary document which confirms the full running of the system by 1250 in a large territory crossing the study area north to south and comprising landscapes on both hillslopes of the Central System.[40]

The palaeoecological records in the highlands within the study area are highly explicit on the major phenomena defining the different high medieval landscapes in central Iberia. The percentage of cereal in pollen records, after an initial rise, suffers a continuous decrease (Figure 3), perhaps because of the small scale of the subsistence crops in these highland areas and the increasing dependence on the grain supply from the fertile northern and southern lowlands. Despite this dataset, the high-mountain palynological records are scarcely informative about the role of agriculture because the cereal pollen is *authogamous* (that is, the pollen production is low and its dispersal rather limited) and thus it is often infra-represented in this kind of natural deposit. However, the importance of the cereal crops for those communities is assured, and numerous historical data back this assertion.[41] In the lowlands of the *Extremaduras*, the fields were designed with a radial plan, and most of them were devoted to dry cereal-growing – barley and wheat – under a short fallow regime, two-field system. In the *Transierra* the newly founded villages were surrounded by an irregular and discontinuous plot of elongated fields adapted to the topography (called in common Castilian, *longueras*). Some terms used in the textual documentation dated to the thirteenth century – e.g. *quinchones*, *quiñones*, *roturas* (assartings) – testify to the advancement of the crops over those vacant lots.[42]

In this southern domain it is possible to find certain specialised spots devoted to livestock husbandry, forestry and production of highly demanded staples such as olives and wine. The consolidation of highland villages brought a process of arboriculture intensification – especially the so-called Mediterranean polycultive – in certain ecological niches with mild, protected microclimates such as in the Alberche and Tiétar valleys.[43] Throughout the Central System both a moderate increase in chestnut pollen (*Castanea*) percentages and a more evident rise of olive (*Olea*) are documented (Figure 3). Wine was a key agrarian product, with abundant written evidence about its production, even in those intra-montane valleys such as the Amblés (Gredos range) where vineyards only thrived in sheltered places (Figure 2). Unfortunately it has not been possible to detect grape pollen (*Vitis*) in the studied peat bogs because of its zoophilous nature (plants that secure their pollination through the action of animals), which severely limits its pollen dispersion, even in the case of local cultivation close to the studied peat record.

A more visible ecological footprint can be traced in high-altitude pollen diagrams regarding the intensification of pastoral activities. The importance of livestock raising in landscapes such as the high Tormes, Alberche, Tiétar or Guadarrama rivers – with poor and thin soils and lacking permanent settlements before 1250 – seems indisputable. On the one hand, fire became a key

[38]Barrios García, *Estructuras agrarias*, 155; Villar García, *Extremadura castellano-leonesa*, 135–53; Franco-Moreno, "Territorio y poblamiento."
[39]Martín Viso and Blanco-González, "Ancestral Memories."
[40]Barrios García, *Documentos de la Catedral de Ávila*, 146–57, doc. 83; Barrios García, "Repoblación y colonización."
[41]Barrios García, *Estructuras agrarias*; Villar García, *Extremadura castellano-leonesa*; Mínguez Fernández, "Repoblación de los territorios salmantinos."
[42]Barrios García, "Repoblación y colonización," 277, 322.
[43]García Garcimartín, *Valle del Alberche*; Troitiño, *Evolución histórica*.

driver of landscape formation to transform forest into pastureland, as shown, for example, in the highest macrocharcoal values recorded in the Serranillos peat bog (Figure 3). It has been highlighted how very ubiquitous minor place names in the study area, such as *ahumada* (= smoky), *carbonera* (= charcoal yard), *quemada* (= burnt), *ceniceros* (= ashy spot) or *rozas* (= slash and burn) may refer to these medieval practices, and sometimes they even appear in texts dated to this period.[44] The extensive landscape clearance can be deduced from the maximum extent of the heathlands and meadows (*Poaceae*) and the spread of broom communities with *Cytisus oro-mediterraneus* and other shrub legumes throughout the mountain range (Figure 3).

This period represents the "golden age" of La Mesta, the organisation officially established by King Alfonso X in 1273 to favour owners of large transhumant flocks moving from northern summer pasturelands to southern wintering areas through the Spanish Central System.[45] A series of sheep paths (*cañadas* and *cordeles*) pertaining to two major routes crossed the study area: the *Cañada Real Leonesa Occidental* through the western passes (Gredos and Francia ranges) and the *Cañada Real Segoviana* through the central and eastern sectors (Guadarrama range) (Figure 2). The key inner passes in the study area such as Menga, Peñanegra and Chía in the northern slope and El Pico, Serranillos and Mijares to the south were not integrated in such long-distance transhumance routes. The main passes were the Puerto de Béjar to the west or bordering the River Alberche to the east (Figure 2).[46] These gateways were also used for the crossing of itinerant muleteers (*arrieros*) carrying wine, oil, chestnuts, honey and beeswax from the *Transierra* to the northern markets.

From 1200 almost all high-altitude pollen diagrams of the whole Spanish Central System show the maximum extent of grasslands (*Poaceae*) and a clear rise in the levels of livestock indicators (anthropozoogenous taxa and coprophilous fungi).[47] This evidence suggests the use of such critical high-altitude resources within a pattern of short-distance transterminant movements (around 50 kilometres) during the hot season. This so-called livestock *de travesío* (itinerant flocks) was a widespread strategy used from the thirteenth century, based upon agreements between neighbourhood councils linking the *Extremadurii* and the *Transierra*, and constituted a frequent source of dispute.[48] Finally, other places testify to the conservation of large forest formations lacking intense pastoral impacts, such as Lanzahíta (Gredos range) or the pinewoods in Arroyo de la Hoz (Guadarrama range) and Pelagallinas (Ayllón Range), whereas birch forests reach their maximum extent in El Maíllo (Francia range).[49] Even though the present large *Pinus* forests of the eastern *Tierra de Pinares* are due to massive afforestation in the 1850s, there are plenty of place names of vegetation and documentary evidence dating them back at least to the eleventh century.[50]

Concluding remarks

This paper has addressed the socio-ecological trajectories of environmental change and human impact and the socio-political circumstances framing these interactions as a whole set of

[44]Barrios García, "Repoblación y colonización," 274–87; Clément, *De la marche-frontière au pays-des-bois*, 123–41.
[45]Klein, *Mesta*; Anes and García Sanz, *Mesta, trashumancia*; Asenjo González, "Espacios ganaderos."
[46]Barrios García, "Repoblación y colonización," 293–94.
[47]López-Sáez et al., "Contribución paleoambiental."
[48]García Garcimartín, *Valle del Alberche*, 259–61; Troitiño, *Evolución histórica*; Monsalvo, *Comunalismo*; Asenjo González, "Espacios ganaderos."
[49]López-Sáez et al., "Contribución paleoambiental"; López-Sáez et al., "Vegetation History."
[50]Barrios García, "Repoblación y colonización," 273–74; Clément, *De la marche-frontière au pays-des-bois*, 68–76.

interdependent factors shaping the rural landscapes of a highland macro-region in inner Iberia. Because of its strategic location and morphology, the Central System has played a major role in the dynamics of warfare, colonisation, definitive settlement and exploitation of these varied landscapes. Despite the heterogeneous current status of the factual evidence – with its spatio-temporal uneven distribution and suffering from important lacunae – the paper has underlined the overall coherence of such diverse historical and ecological processes. Their integral reading from an interdisciplinary approach has succeeded in tracing the major phenomena occurring during the analysed time span in a coherent study area. These generalised pictures constitute comprehensive working hypotheses that would be subsequently nuanced by more in-depth local studies.

Strong human pressure on high-mountain resources has been recognised in Late Antiquity, involving an aggressive farming expansion under cold and arid climatic conditions – increase of xerophilous taxa and decrease of humid ones – related to the initial Early Medieval Cold Episode (450–950). These expansive strategies were based on agro-forestry diversification, involving deforestation processes mediated by fire – high values of macrocharcoal (Figure 3), and the decline of upland pinewoods and midland oak forests, cereal-growing and arboriculture and pastoral exploitation of the high-mountain pasturelands, shown by the rise of *Poaceae* values (Figure 3). This footprint was not irreversible and during the early medieval phase (eighth–tenth centuries) different highly localised micro-regional dynamics arose, with an uneven ecological impact which, nonetheless, is able to track the persistence of small dispersed communities in specific privileged mid-altitude ecotones in the *Extremadurii*. The early repopulation initiatives throughout the lowlands of the Duero basin created the conditions for subsequent colonisation and permanent residence in the Central System uplands. However, these early processes of repopulation were quite unequal. The decline in livestock and farming activities – decrease of cereals and grass (Figure 3) – implied forest recovery in high-mountain environments, such as the increase of pinewoods – favoured by the cooler and drier climate. However, agro-pastoral pressure increased in low altitudes – with an increase in macrocharcoal and heathlands in Peña Negra (Figure 3).

The High Middle Ages (twelfth–thirteenth centuries) represent the momentum in the long-term processes modelling these highland landscapes, void of permanent settlers up to the mid-thirteenth century. From 1250 onwards the foundation of small rural nucleated settlements or villages (*aldeas*) in the main intra-mountainous valleys within the *Transierra* in the southern slope of the Central System represents the definitive sedentarisation of previous dispersed and itinerant pastoralists in these hostile environments. These phenomena led to a new phase of forest clearance related to transterminant movements of flocks *de travesío* and the seasonal exploitation of high-altitude areas – increase of taxa derived from the action of human beings and animals and fungi associated with manure, high concentration of macrocharcoal (Figure 3), related to the milder weather conditions of the Late Medieval Warm Period (950–1350). The full integration of high-mountain landscapes in the feudal system represents the maximum extent of grasslands (*Poaceae*) in the highlands and a marked specialisation in certain crops – rye, olive, sweet chestnut – in low-altitude spots.

This case study confirms the potential of high-altitude mountain areas to assess the resilience and vulnerability of these settings and trace their context-specific trajectories of occupation and use. From the previous observations, the Central System emerges as a sensitive laboratory for studying medieval social practices and their imprint on vegetal formations. Mountains constituted a privileged scenario due to the balanced availability of resources for agriculture, forestry and pastoralism[51] and medieval people developed successive strategies to remain in these environments.

[51]Gutiérrez González, *Poblamiento antiguo y medieval*, 256–58; Gil-Romera et al., "Interpreting Resilience."

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Notes on contributors

Antonio Blanco-González (ablancoglez@gmail.com) was awarded a doctoral degree in History from the University of Salamanca in 2009, receiving a Premio Extraordinario. His thesis examines later prehistoric settlement in central Iberia using geographic information systems. His research interests include landscape archaeology, prehistoric ceramics and human–environment interactions in a long-term perspective (from the Neolithic to the Middle Ages), topics on which he has published over thirty papers in peer-reviewed journals. He currently holds a Marie Curie post-doctoral fellowship at Durham University (UK).

José Antonio López-Sáez (joseantonio.lopez@cchs.csic.es) is a Tenured Researcher at the Instituto de Historia (Consejo Superior de Investigaciones Científicas, CSIC) in Madrid. His research areas of expertise include palaeopalynology and archaeobotany (pollen, spores, non-pollen palynomorphs) from periods ranging from the Palaeolithic period to the Middle Ages, and in different sedimentary contexts (lakes, peat bogs, archaeological sites, etc.). He has been involved in many research projects across Europe (France, Spain, Portugal, Italy, Russia, Gibraltar, Greece) and Central America (Guatemala, Mexico, Nicaragua, Brazil, Antilles) working on aspects related to prehistoric plant use, anthropisation dynamics and the origin of agriculture. He has also carried out various palaeoecological projects focusing on climatic change and its cultural responses.

Francisca Alba (falba@ugr.es) is a Lecturer in the Department of Botany (University of Granada). Her research is focused on the field of palaeopalynology. She has worked in Quaternary geography of Mediterranean species, participating in over fifteen projects. In addition, her expertise in palynology has allowed her to collaborate with international research groups dealing with archaeology, phylogeography, flora conservation, ecoinformatics and global change biology. In the context of these interdisciplinary collaborations, she has set the foundations for the coordinated operation of complementary methodological approaches, leading to the publication of several scientific papers in JCR-indexed journals.

Daniel Abel (dabel222@hotmail.com) received his doctoral degree in Biology and Vegetal Production from the University of Extremadura in 2012. He is interested in Quaternary palaeophytogeography of Atlantic-Mediterranean species, especially from high-mountain environments, participating in a number of projects related to this subject.

Sebastián Pérez (sebas.perezdiaz@gmail.com) received his doctoral degree in History from the University of the Basque Country in 2012, with a thesis entitled "The Vegetal Landscape during the Late Prehistory in the Mediterranean Area of Euskal Herria." He currently holds a three-year post-doctoral fellowship on Quaternary evolution of vegetation in the northern Iberian Peninsula. His publications include papers in journals such as *Quaternary International*, *Phytocoenologia*, and *Grana*.

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