LAND ABANDONMENT AND THE DYNAMICS OF AGRICULTURAL LANDSCAPES IN MEDITERRANEAN MOUNTAIN ENVIRONMENTS: THE CASE OF RIBAGORÇA (SPANISH PYRENEES)

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With 5 figures, 1 table and 2 photos
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Summary: This article examines the territorial changes that have occurred in the Pyrenean region of Ribagorça (Spain) over the last 150 years by analysing the evolution in its land cover and land uses. The study focuses on one specific area of this region that is highly illustrative of Mediterranean mountain environments. To do so, it adopts a qualitative approach and takes as its starting point the concept of the agricultural landscape. The results indicate a gradual decline of the region in terms of its ecological, human and cultural elements. Beginning in the second half of the nineteenth century, the decline accelerated through the 1960s, and continues virtually unabated to the present day. The outcome is interpreted here as an "abandoned agricultural landscape". The article concludes by reflecting critically on the fact that the current model of land colonisation in the region is leading to the simplification, if not the complete disappearance, of the landscape as a complex reality; that is, the arena in which the multiple relations between man and the environment manifest themselves.

Zusammenfassung: In dem Beitrag wird der Landschaftswandel der Region Ribagorça in den spanischen Pyrenäen im Rahmen einer Bodenbedeckungs- und Landnutzungsanalyse untersucht. Die Studie konzentriert sich auf die letzten 150 Jahre und auf ein ausgewähltes Gebiet innerhalb dieser Region, welches von mediterranen Landschaftselementen geprägt ist. Epistemologisch ausgehend von dem Begriff „Agrarlandschaft", verfolgt die Studie einen qualitativen Ansatz der Landschaftsbeschreibung und Analyse der Veränderung. Anhand der Ergebnisse wird der allmähliche Verlust regionaler Identität hinsichtlich ökologischer, sozialer und kultureller Zusammenhänge aufgezeigt. Während dieser Prozess sich bereits in der zweiten Hälfte des 19. Jahrhunderts abzuzeichnen beginnt, unterliegt er, einhergehend mit einer Industriealisierung der Agrarwirtschaft, ab den 1960er Jahren einer deutlichen Beschleunigung. Exemplarisch belegt die Studie den Wandel einer vielgestaltigen, räumlich und funktional hochgradig differenzierten traditionellen Kulturlandschaft hin zu einer modernen und vereinheitlichten „aufgegebenen Agrarlandschaft". Die Studie belegt exemplarisch wie die technischen und gesellschaftlichen Veränderungen der zurückliegenden Dekaden das spezifische Erscheinungsbild einer ganzen Region bis zur Unkenntlichkeit überprägt haben und steht stellvertretend für eine Vielzahl anderer Regionen, namentlich periphere Gebirgsregionen, in Europa.

Keywords: Rural exodus, abandoned agricultural landscapes, land use, Mediterranean mountain environments, Pre-Pyrenees, Ribagorça, Spain, landscape history

1 Introduction

1.1 Background, aims and epistemological framework

The abandonment of rural and mountain areas is one of the most far-reaching phenomena to have affected Western Europe in the post-war era (MacDonald et al. 2000). This is particularly true of Mediterranean mountain environments, such as the southern slopes of the Pyrenees, where the processes of capitalist economic development have accentuated the social and economic differences between these environments and high mountain areas, the former being unable to adapt to the modern processes of capital accumulation (Arqué et al. 1982).[1] Building on the magnificent legacy of geographical

[1] Geographically speaking, the Mediterranean mountain environments correspond to regions whose features – including their relief, vegetation, climate and human activities – enable them to be clearly distinguished from high mountain areas. In the central Pyrenees, most of these environments are located in the Pre-Pyrenees – lying within the Mediterranean biogeographical region. They are drier and warmer than the sectors of the High Pyrenees, which lie in the Euro-Siberian biogeographical region and, at their highest altitudes, in the Boreo-Alpine region (Solé i Sabarís 1951; Gil Olcina and Gómez Mendoza 2001).

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studies examining the Spanish sector of this mountain range,[2] the latest studies have focused on a number of fundamental aspects in their attempt to understand its recent evolution. One of these issues, namely, agricultural abandonment and its repercussions for the environment and landscape, has been tackled by studies based on the interpretation of aerial photography and satellite images and the analysis of the evolution in land uses, almost always from the perspective afforded by Landscape Ecology. From this perspective, certain areas in the High Pyrenees have been systematically studied, while a number of recent studies have tackled the same problem in the Eastern Pyrenees.[3]

These precedents provide the foundations for this article, which interprets agricultural abandonment as a major element in our understanding of the changes experienced by Mediterranean mountain environments. Along with this abandonment, this study integrates both socio-economic and political elements as it seeks to measure their visible impact on the territory throughout modern history. The aim of the article, as such, is to identify, describe and interpret the changes in the land cover and land uses of a peripheral mountain region, by adopting a series of methods that include mapping and various qualitative research techniques applied in the field. The overall goal is to provide an integrated explanation of what can be identified as "abandoned agricultural landscapes", defined here as those places – with strong traditions of agroforestry – in which man's impact in the region has gone from being the driving force of change to being a secondary or merely testimonial component. The hypothesis defended here is very similar to that forwarded by several authors from a historical (Tello and Garrabou 2007) and ecological (Chauchard et al. 2007) perspective, i.e., despite the fact that the most aggressive changes to the region and the landscape took place in the second half of the twentieth century – characterized by a "rural exodus", the causes of the peripheral, marginalized, nature of the Mediterranean mountain environments should be sought further back in time. To do so, the study focuses on the situation in the middle of the nineteenth century, when the modern state of Spain was in the full throes of its legal, political and economic formation. And it does so by adopting a markedly regional focus: in other words, by seeking to explain the results – obtained for a given case study (described in the following chapter) – in the regional context in which the area lies.

This article is divided into five chapters (numbered 1 to 5). The first places the research in its broader context, highlights the theoretical foundations on which it is based and describes the techniques used. The second provides a summary of the characteristics of the territory in which the case study is located, essential in order to understand the significance of the research conducted in this local environment. The third chapter presents the results of the research, which are divided into two sections. The first of these (3.1) describes the processes of change in the land cover and land uses by presenting a global analysis based on cartographic techniques. The analysis compares the situation in the mid-twentieth century with that found today, and offers some initial findings. This is a quantitative exercise, clearly delimited in time, which provides a vision of the whole area via four detailed case studies conducted within the zone, selected according to a number of criteria that are detailed below. The analysis of these four cases allows the results to be extrapolated to the whole area, thus constituting an important step in the overall understanding of the process of change.

The second of these two sections (3.2) takes the analysis back to the second half of the nineteenth century to seek out the more distant causes of the changes in the region's land uses. These causes require a more detailed study and one that pays attention to the socio-economic processes, as the factors underpinning them are highly complex. As described below, cartographic analysis remains important, but the interpretation depends on a broader set of qualitative data. The fourth chapter is devoted to a series of reflections made on the consequences of the processes described in the territory under study. Likewise, it provides a series of elements for discussion relevant to other areas that have similar dynamics to those of our case study. Finally, the fifth chapter provides a brief summary of the paper's conclusions.

The theoretical perspective adopted by this article draws on the concept of the *landscape* as an object of study in its own right and, in turn, as a multidisciplinary analytical tool (Farina 2000; Tello and

[2] Particular mention should be made of Pau Vila, Salvador Llobet and Lluís Solé, geographers that ensured Catalonia was a pioneer in this field, following on in the tradition of studies undertaken in France.

[3] For the High Pyrenees see Garcia-Ruiz and Lasanta-Martinez (1990) and, more recently, Vicente-Serrano and Lasanta-Martinez (2007). For the Eastern Pyrenees see, for example, Roura-Pascual et al. (2005).

Garrabou 2007). The focus taken here is based on the way in which various currents of geographical thought have tackled the idea of the landscape. The concept of the cultural landscape (*Kulturlandschaft*), a term coined by the German scholars N. Krebs (1923) and O. Schlüter (1928), defines the region as shaped by man and, as such, alludes to the relationship between its biophysical and anthropic components. This idea underpins the discussion of themes dealt with in the French regional geography of Vidal de la Blache and was subsequently extensively used in Carl Sauer's cultural geography and in both rural (George 1963) and agricultural geography (Meynier 1958). While not all these approaches explicitly use the term "landscape", a common vision is shared, which is the one used here: that is, the will to make compatible the singular with the general in the study of the spatial dimension of phenomena. And, consequently, an attitude that helps overcome longstanding debates in geography between the idiographic and the nomothetic (Sauer and Leighly 1967).

The objective of this article and the chosen case study, both designed to further our understanding of abandonment in rural mountain areas, lead specifically to a focus on the notion of the *agricultural landscape* – an expression that alludes directly to the processes of human colonisation of the territory. Both in the Romance languages (Coromines 1979) and in the Germanic (Olwig 1996), the etymology of the term "landscape" is associated with the idea of "farmland" or, ultimately, with the "land" itself in its tangible sense. The concept is rooted therefore in the historical attachment different societies have with the "land" (Daveau 1998), to the extent that some authors have not hesitated to stress the significance of peasant societies in the configuration of the landscape: both in shaping its "material" reality – the landscape "in situ", in the words of Roger (1997) and everything related to the historical construction of its meaning (Tort i Donada 2006; Luginbühl and Terrasson 2013).

Beyond geography itself, the idea that inspires this conception of landscape – that is, the interrelations between society and nature – has troubled many other disciplines, including Anthropology, sociology, history and ecology (Tress et al. 2003). In order to address these relations in the context of globalisation and increasing complexity, genuinely interdisciplinary approaches have been developed in recent decades, such as the aforementioned landscape ecology (Forman 1995), environmental or ecological history (Winiwarter and Knoll 2007) and social ecology (Fischer-Kowalski 1997). In this line, a number of recent contributions have been made in territories located close to the case study presented here (Tello et al. 2006), which explicitly link certain methods deployed within these approaches with agrarian history, emphasizing the importance of incorporating the geographical legacy so as to deal much more comprehensively with the study of the landscape as a "socio-ecological algorithm" (Folch 1999), capable of accounting for the "social metabolism" of a territory (Fischer-Kowalski and Haberl 1997).

The other concept at the heart of this article is that of "land use", but any examination of a region's land use map has to be conducted in close consideration with its "land cover". As various authors and international projects – such as "Land Use and Land Cover Change" (LUCC) – have shown, there are major differences between the two concepts. From a theoretical point of view, land cover includes all the physical elements that cover the Earth's surface, that is, the layer of soil and biomass, including the natural vegetation, crops and manmade structures. By contrast, land use refers to the explicitly anthropic dimension – it being man who uses the Earth's land surface for a whole series of activities. Consequently, the analysis distinguishes between what exists and can be measured and quantified from an objective point of view (the land cover) – that is, independent of the anthropic use criterion; and the catalogue of anthropogenic activities that are conducted on a portion of that land at any given time – the land uses (Turner et al. 1995). From this we derive an essential point: namely, that the land uses should, in principle, be included within a given distribution of land cover.

1.2 Methods and data sources

The methods used in this paper can be divided in two main groups: on the one hand, the mapping of land cover and land uses based on photo interpretation; and, on the other, a highly diverse set of qualitative research techniques. The mapping has been completed by monitoring the changes in land occupation that have occurred over the last few decades. This occupation involves analysing both the land cover as well as the land uses, as outlined above.

The primary sources drawn upon for completing the cartographic analysis are, principally, aerial photographs, specifically, the film taken during

the "General (or the American) Flight of Spain of 1956/57" (the first systematic survey of the whole Spanish territory) and present-day orthoimages. This material was examined with geographic information systems (GIS)[4], which meant having access to digital photos. In the case of the modern orthophotographs – taken in panchromatic colour at a scale of 1:25,000 and 1:5,000, this caused no difficulty, as they are available online and in digital format.[5] However, in the case of the older, aerial photographs – taken in black and white at a scale of ca. 1:30,000, this meant their first having to be digitalized and then geometrically corrected – by applying a given map projection, according to the corresponding UTM zone. The results obtained from the digitalization were not submitted to any further process (as has been the case in other studies)[6], which would have provided more precise outcomes, leading to the identification of specific land use categories (including, for example, woodland).

Having obtained and digitalized the photographic material, two prior steps had to be completed before creating the vector maps, formed from the polygons that correspond to given categories of land cover and land use. The first step, that of data collection, involved exhaustive fieldwork, which meant a visual inspection of the whole of the study area followed by a comparison to available maps. In the field, our basic tool were the sheets of the *Mapa Topográfico Nacional* (MTN) drawn to a scale of 1:25,000 and published by Spain's *Instituto Geográfico Nacional*. These maps employ a very basic legend describing land cover, which served as a point of reference in the field, but not when compiling our own maps. Note that cartographic data bases of land use – such as those derived from the *CORINE Land Cover* project – were not used for our maps, as the scale of reference used was considered insufficient to provide the necessary detail about the exact contents of each category in the legend.

Together with this field work, the devising of a legend that could respond to the diversity of land covers and uses in the study area – both today and six decades ago – was fundamental. The method chosen to do this involved grouping the set of land cover categories obtained in the field – 11 in the case of the 1956 map; 15 in that of the 2007 map – in seven classes (Fig. 3 and 4): cropland, riparian communities, conifer plantations, woodland, scrubland, grassland and barren and less vegetated. Having devised the legend, a category was then assigned to each of the map polygons. The subsequent comparison involved overlaying the two maps and calculating the variation in the surface area assigned to each category from the legend.[7] It should be borne in mind that the polygons making up the maps in figure 3 have a minimum area of one hectare.

The map in figure 5, depicting the situation at the end of the nineteenth century, was constructed by taking the map of land covers and uses in 1956/57 (Fig. 3) as the base and then introducing any modifications according to information derived from our qualitative data set. This information, which we detail below, is historical in nature. Some of these data are of a fairly systematic character, such as the historical population counts (the censuses). However, the historical cartography – eighteenth and nineteenth centuries – undertaken in the case study area is quite scarce. In fact, there is no single map covering the whole of the territory that predates the first series of the MTN – published between the end of the 1920s and the beginning of the 1930s. The only existing maps are a set of geometric plans made by a State corps of forest engineers at the end of the nineteenth century.[8] These documents provide valuable information about land uses – and, particularly, about the forest stands – at that time. Yet, we have only had access to three of these geometric plans referring to three small sectors within our study area.[9]

[4] The georeferencing of digital photographs and the map-making were completed using ArcMap (ArcGIS), although other tools (Envi, TNT, Erdas) have been shown to perform well when undertaking this process.

[5] Virtually all the orthoimages used were obtained, free of charge, from the webpage of the Institut Cartogràfic de Catalunya (www.icc.cat) and from the Sistema de Información Territorial de Aragón (http://sitar.aragon.es).

[6] In this respect, see Vila Subirós et al. (2006).

[7] The tables are available in Sancho Reinoso (2011).

[8] Details of the historical context in which these plans, today held in the History Archives of Lleida, were drawn are given in section 3.2. Apart from these plans, there exists a set of geometric projections, completed by surveyors with the sole purpose of measuring the land parcels for the first modern cadastral survey, undertaken in eastern Spain in the middle of the eighteenth century (Camarero 2007). However, in the area of study, these sketches no longer appear in the surveys conducted at later dates (19th century). This led us to eventually discard the use of these documents.

[9] They are not included here for reasons of space.

Therefore, other non-cartographic sources of information enabled us to further our analysis of the nineteenth century land use. Here, particular mention should be made first to the "*Catálogo de Montes Públicos*", published first in 1859 (Casals et al. 2005). It provides an inventory of public forest areas undertaken by the State corps of forest engineers (see section 3.2). This helped us identify a number of zones within the study area for which we have been able to determine their exact size and to obtain a brief description of their dominant vegetation type. Second, a series of documents containing historical narratives have been equally important, particularly certain descriptions provided by a number of figures holding government or political posts. This is the case of Francisco de Zamora – civil servant and enlightened traveller who journeyed throughout the study area in the eighteenth century (Boixareu 1973, 1989) – and the jurist Pascual Madoz – Finance Minister and author of a compilation of geographical and historical studies of nineteenth century Spain (Madoz 1845). These tools have been drawn upon time and again in many of the studies of the history of Spain's forests; and, as such, are tried and tested sources for researching this area (Balboa López 1999).

In addition to the aforementioned sources and methods, other elements of a different methodological nature have been crucial for the undertaking of this study. First-hand knowledge of the area's geography, local society and its problems has been acquired through numerous visits to the study area. The ability to observe and to establish relationships between what is observed and knowledge itself – defined by C. Sauer as using the "morphological eye" (Sauer and Leighly 1967) – have played a crucial role, since the method has allowed us to take a critical, qualitative and integrated approach to the problem under investigation. On the other hand, 13 informal conversations with local actors have been conducted. The subjects were selected according to their involvement in key activities of interest in this study – namely agriculture and forestry. To do so, the so-called "snowball technique" (Ruiz Olabuénaga 2012) – a means for sampling opinions in which the researcher builds the sample from the results obtained from previously interviewed subjects (above all, following their advice and recommendations) was used. Since this kind of informal conversation has not been based upon a systematic sampling, they have been used only in very specific cases (which will be mentioned during the paper).

2 Ribagorça: a border territory. Brief geo-historical description of the research's spatial context

Ribagorça[10] occupies the central section of the southern slopes of the Pyrenees, a section that extends from the highest peaks of the range (Aneto, 3,404 m) to the last foothills of the Pre-Pyrenean sierra as they merge with the Ebro Depression (Fig. 1). The river Noguera Ribagorçana acts as the main river axis in a territory that does not, however, constitute a single unit geographically (Solé i Sabarís 1964); nor, as the map in figure 1 shows, administratively. This is because the position occupied by the Pyrenees favours a clear differentiation between the higher altitudes to the north and the mid-mountain areas to the south (see section 1.1). This division allows us, in turn, to differentiate between "upper" and "lower" Ribagorça.

To understand the uniqueness of the case of Ribagorça we need to emphasise its considerable orographic complexity, resulting from the high degree of partitioning of the relief throughout the region. In this regard, it is no coincidence that the place name (Ribagorça) alludes to the "reduced length and marked narrowness of the riverbanks that comprise it" (Coromines 1979 (VI), 385–386). Indeed, from the standpoint of its structural relief, the region consists of several sectors, each with a high degree of internal homogeneity. Communication between these sectors has never been easy as the river courses have been unable to act as the principal axes of articulation. The best example of this is provided by the valley of the Noguera Ribagorçana, which is divided into two large sections by mountain ranges that run perpendicular to the river, forming narrow gorges. This pattern presented by the relief has tended to hamper the internal cohesion of the region. In this sense, some authors emphasise this idea when seeking to explain why Ribagorça does not have a hierarchical network of settlements (Solé i Sabarís 1964), or why the whole region has played the role of borderland between Aragon and Catalonia throughout modern history (Vilar 1962).

Indeed, this absence of physical unity is also reflected in its political-administrative organisation. As a whole, the region covers an area of approximately 3,000 km^2, and has a population of around 18,000 in-

[10] Or Ribagorza in Castilian and Aragonese, the other local languages spoken here alongside Catalan, the language of the majority.

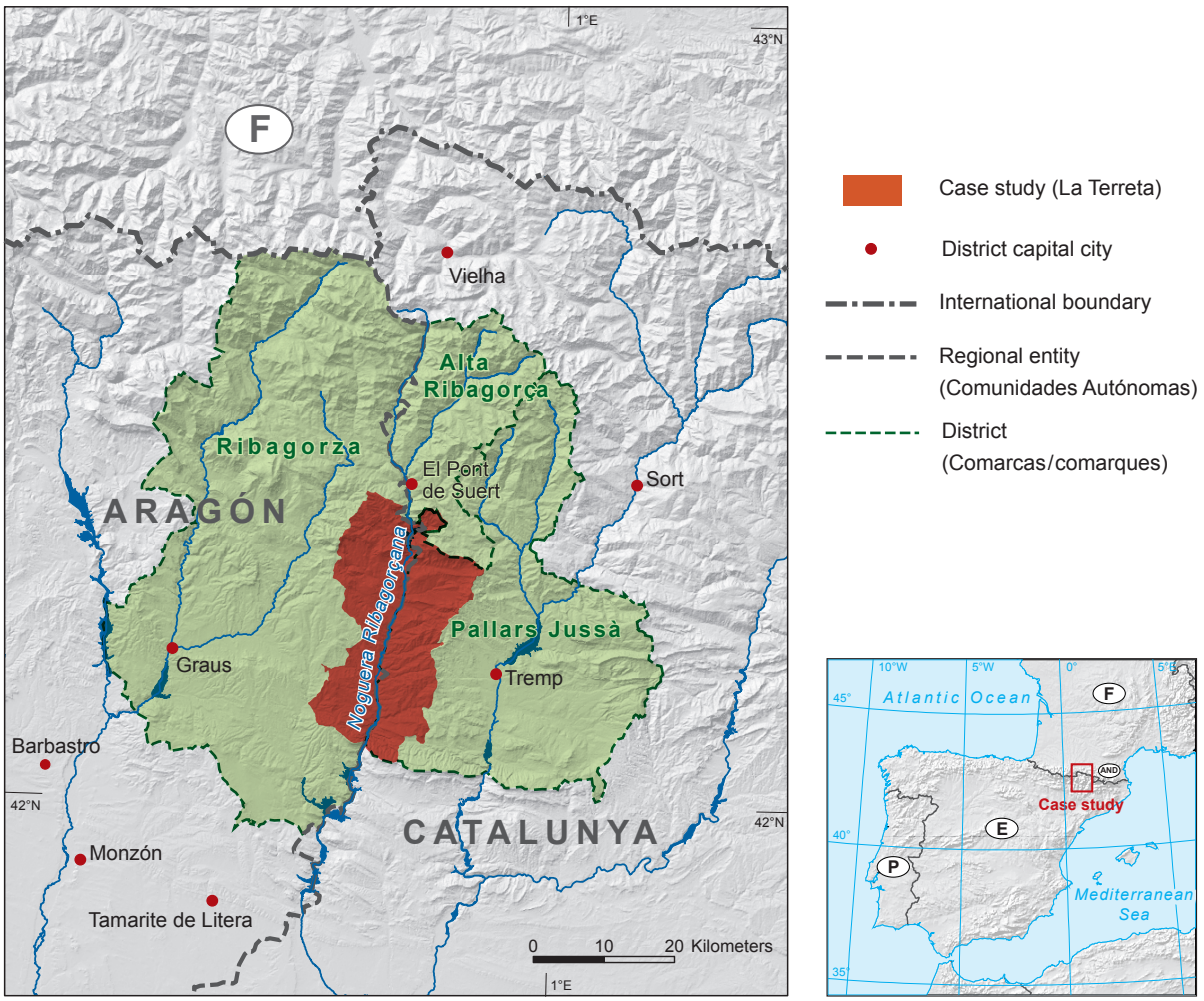

Fig. 1: Map showing the location of Ribagorça

habitants.[11] Its main feature is its internal administrative division – the Aragonese (west) and Catalan (east) sectors – following the course of the river Noguera Ribagorçana. The current border between the present-day autonomous regions of Catalonia and Aragon – in existence since 1979 and 1982, respectively – dates back to the division between the counties in the early fourteenth century. At the same time, the internal political-administrative division of these two regions into their so-called *comarcas* or districts has resulted in greater internal complexity: since 2002 "Ribagorza" (in Aragon) has existed alongside "Alta Ribagorça" (in Catalonia) – created in 1987 following its split from another *comarca*, that of Pallars Jussà, which includes other sectors with much in common with this historic region (see Fig. 1). Neither one nor the other corresponds, however, to the aforementioned duality between "upper" and "lower" Ribagorça. In short, the region has been and is a land of frontiers of differing values: biophysical and economic borders divide north and south, while boundaries of a political-administrative nature and of identity separate east and west.

The great distance separating the area from the main cities – that is, Lleida, Zaragoza and, above all, Barcelona – meant that Ribagorça – and the whole of the central Pyrenees – was marginalized from the impact of the modernization of agriculture and trade as early as the eighteenth century (Vilar 1962). Likewise, nineteenth century industrialization was barely felt in the area (Ayuda Bosque and Pinilla Navarro 2002; Molina Gallart 2002). However, the institutional changes – political and legal – that occurred during

[11] According to the 2011 revision of the population counts made by the Spanish Instituto Nacional de Estadística (http://www.ine.es/jaxi/menu.do?type=pcaxis&path=%2Ft20%2Fe260%2Fa2011%2F&file=pcaxis&N=&L=0; check 22 July 2013).

that period did affect these territories. The best example of this is the application of measures aimed at abolishing the historical privileges of certain social agents, including those of the local authorities (for instance, the confiscation of monastic properties and administrative reforms – see section 3.2).

Thus, the modernization of the Pyrenean valleys has been a very slow and uneven process, and has been focused on very specific activities: essentially, tourism and the exploitation of water resources for the production of electricity. In Ribagorça, the process was characterized by delays – especially compared to the eastern valleys lying in Catalonia (Urteaga 2003) – and by the dominance of an integrated project to exploit the Noguera Ribagorçana river for hydroelectric production. The project was undertaken primarily during the fascist dictatorship (1939–1975) and marked the opening up of Ribagorça to the outside world – and, as a result, its radical transformation. The region, however, was to suffer the reinforcement of the duality between upper and lower Ribagorça: on the one hand, the high valley of the Noguera Ribagorçana benefited from this process – with the emergence of high mountain tourism and the consolidation of the town of Pont de Suert (see map in Fig. 1) as the capital of much of the valley; on the other hand, lower Ribagorça saw its rate of outward migration accelerate and the irreversible abandonment of the land (see next section).

3 The shaping of an "abandoned agricultural landscape" in *la Terreta* (lower Ribagorça)

One of the geo-historical units of Ribagorça occupies the middle sector of the Noguera Ribagorçana river basin in lower Ribagorça (Fig. 1). This sector, divided by the regional border, is known as "*la Terreta*" (Solé i Sabarís 1964; Tremosa i Palau 1991), and is the specific case study presented in this article. The area is clearly delimited, both to the north and south, by commanding limestone mountain chains; although the rest of the area is dominated by sedimentary materials – conglomerates, marls and clays – dating from the end of the Mesozoic and lower Cretaceous. In terms of its bioclimate, its Mediterranean environment is affected by its proximity to the Euro-Siberian zone. This means the predominance of vegetation that has adapted to a relatively dry climate, albeit with marked contrasts between the south – 567 mm mean annual precipitation – and the north – 648 mm, and with a marked continentality – annual Δt of almost 17 °C. The natural vegetation is dominated by woods of *Quercus ilex spp. rotundifolia* in the sectors exposed to the south, and by *Quercus faginea* in those exposed to the north (Bolòs i Capdevila 2001). The Mediterranean shrubland communities – comprising most notably species of *Buxus sempervirens*, *Thymus vulgaris*, *Lavandula angustifolia* and *Rosmarinus officinalis* – play a key role, either as part of the understorey of the native forest, or as the main elements in the existing shrublands – where other species, such as *Genista scorpius* and *Rosa canina*, are also important.

La Terreta is a perfect illustration of the extent of depopulation in the Pre-Pyrenean region of Ribagorça: from a population of almost 7,000 inhabitants on the 1857 census, this has fallen to just 875 in 2009, suffering a period of considerable slump between 1950 (4,325 inhabs.) and 1981 (884 inhabs.), and recording an all time low in 2001 of 790 inhabitants. All this has occurred in an area of slightly more than 500 km^2, which gives it an extremely low population density (less than 2 inhabs./km^2), lower than the densities in upper Ribagorça – where the heads of the valleys are depopulated for purely bioclimatic reasons.

3.1 The abandonment process from a short-term perspective. Rural exodus and the shaping of a modern periphery (1957–2007)

The second half of the twentieth and the first decade of the twenty-first century have been the setting for the contemporary decline of many Mediterranean mountain areas in Spain. In this respect *la Terreta* has been no exception, as illustrated by the changes in its land cover and land uses during this period, highlighting the repercussions of the so-called "rural exodus" in this area. Figure 2 summarizes the changes in its land cover categories during this period of time and reveals a number of trends that are discussed below.

First, the land cover change that attracts most attention is the contrasting behaviour of cropland and woodland areas: while the former has been reduced by half, the latter has multiplied its area three times (six times if we include the conifer plantations). The disappearance of the croplands is hardly surprising given that the possibility of working with modern farm machinery is the factor that determines whether land has continued to be worked or not. As a reflection of this, the maps (Fig. 3) show (precise calculations not reported) that the loss of agricultural land has been most marked in the areas furthest from the main valley.[12)]

[12)] Note the marked reduction in cropland in the former municipalities of Betesa and Santorens (NW) as well as Montanyana (W) (Fig. 3).

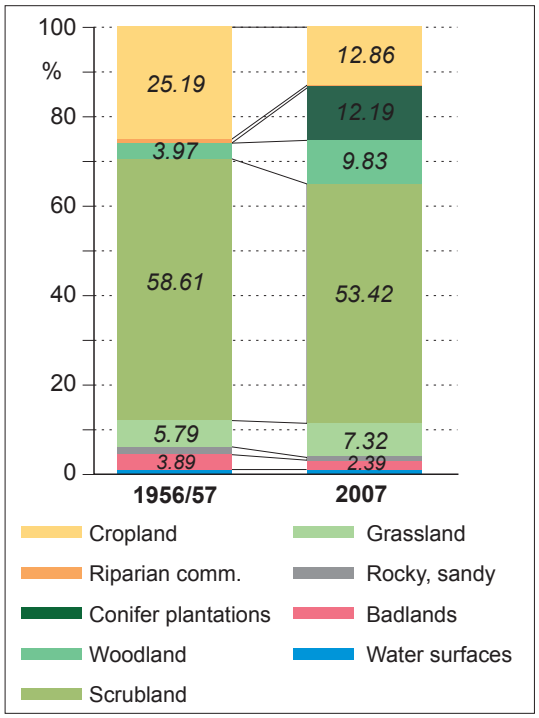

Fig. 2: Land cover change in *la Terreta* (1956/57–2007)

The latter are less suitable in terms of their relief – and, often, in terms of their soils; yet we should not overlook internal differences derived from the lithological diversity of this area.

As for the dramatic increase in the area occupied by forest stands, an inspection of the tree typology highlights the importance of the many sectors dominated by coniferous woodland – basically, *Pinus sylvestris*, *Pinus nigra*, *Pinus pinaster* and *Pinus laricius*. This represents a radical shift in relation to the 1956–1957 map, in which, despite the difficulties encountered in distinguishing between different forest types,[13] in no case were coniferous stands such as these detected – rather we only have evidence of native forest. This would seem to be the usual situation in the Pyrenees: despite the fact that the 1951 Act permitted plantation in the catchment areas of the large reservoirs,[14] most of the large coniferous plantations were executed after the 1957 Forestry Act,[15] as Groome (1988) reports. Oral witnesses consulted in the field, including former managers of the afforestation programmes conducted in this area and present-day forestry officials, confirm this. In any case, the survey highlights a reduction in the area of badlands between 1956/57 and 2007 of about 1.5% (Fig. 2).

Despite the apparent association between agricultural abandonment and programmes of afforestation, the maps in figure 3 explicitly show that, in general, the conifers planted were not a "substitute" for farmland; or at least not directly so: since when the maps are overlaid we see that 62% of the cultivated area in 1956 has become scrubland (*matorral*) in 2007, while only 11% has ended up under pine trees. This serves to emphasize the importance of the dynamism presented by the shrubs and grasslands, because they hold the key to explaining what has happened in recent decades, which is nothing other than the spontaneous development of vegetation following the abandonment of regular farming practices.

As Vicente-Serrano and Lasanta-Martinez (2007) have shown, the most common processes of plant succession in the High Pyrenees have comprised the relatively rapid re-colonisation led by shrub species such as *Genista scorpius* or the various genus of wild rose (*Rosa canina*). Other studies report the occurrence of similar processes elsewhere in the Mediterranean Basin (Mouillot et al. 2005). In *la Terreta*, the abundance of plant cover in the shrubland suggests a general increase in plant mass. In this sense, the surface identified as "scrubland with scattered trees" expanded from occupying 60 km^2 (1956) to 75 km^2 (2007), while the "scrubland without trees" was reduced by half in the same period – from 84 to 41 km^2. However, more detailed evidence is needed to further our understanding of the land use changes over a wider historical period: What changes in land use lie hidden behind the transformations in land cover? How do the differences within *la Terreta* impact on these changes? What have been the consequences of the afforestation programmes?

In the conviction that, in the cartographic study of landscape, the scale not only serves as a measure of affairs, but also of the character of the phenomena (Folch 2003), the first step in the process of furthering our understanding involves selecting four sites within the study area (Fig. 4), the locations of which are indicated on the map in figure 3 (red outlines). The aim of this selection is therefore to be able to observe the changes in land occupation at a more detailed scale – the maps being drawn at a scale of 1:5,000[16] – but for

[13] For technical reasons (see section 1.2), the internal differentiation within the native forest (specifically between deciduous and evergreen forest) was only possible on the 2007 map.

[14] Ley de 19 de diciembre de 1951, sobre repoblación forestal en terrenos de las cuencas de los embalses nacionales.

[15] Ley de 8 de junio de 1957, de Montes.

[16] The maps, not included in this paper, are available in

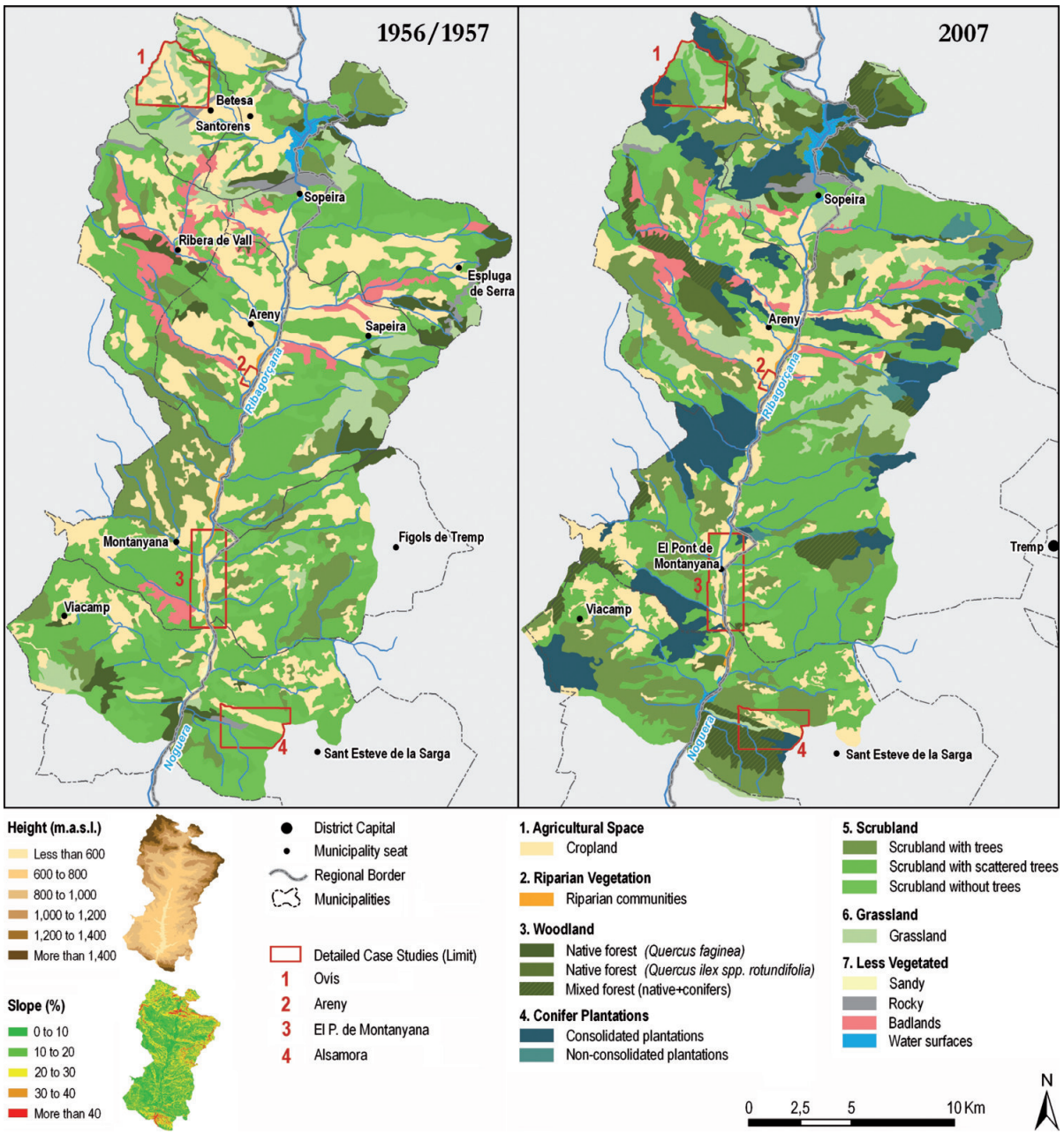

Fig. 3: Changes in the land cover in *la Terreta* (1956–2007). Note that in the 1956/57 map the land use class "woodland" does not differentiate between the three categories and therefore has been represented with the same colour as the category "Native Forest *(Quercus faginea)*"

(almost) the same time period as those in figure 3.[17] The results from this cartographic analysis are fundamental for linking this section with the next one (3.2).

To understand the aim of this exercise more fully, we must first justify the selection of the four case studies. It has been based on the division of the valleys of the Pre-Pyrenees between the *finages* of the riverbanks and those of the interfluves, as devised by the geographer M. Daumas (1976). In his doctoral thesis on the eastern Aragonese Pyrenees, he argues that, while the areas along the main rivers – in our

Sancho-Reinoso (2011).

[17] The survey was undertaken between 2009 and 2010, as shown in figure 4.

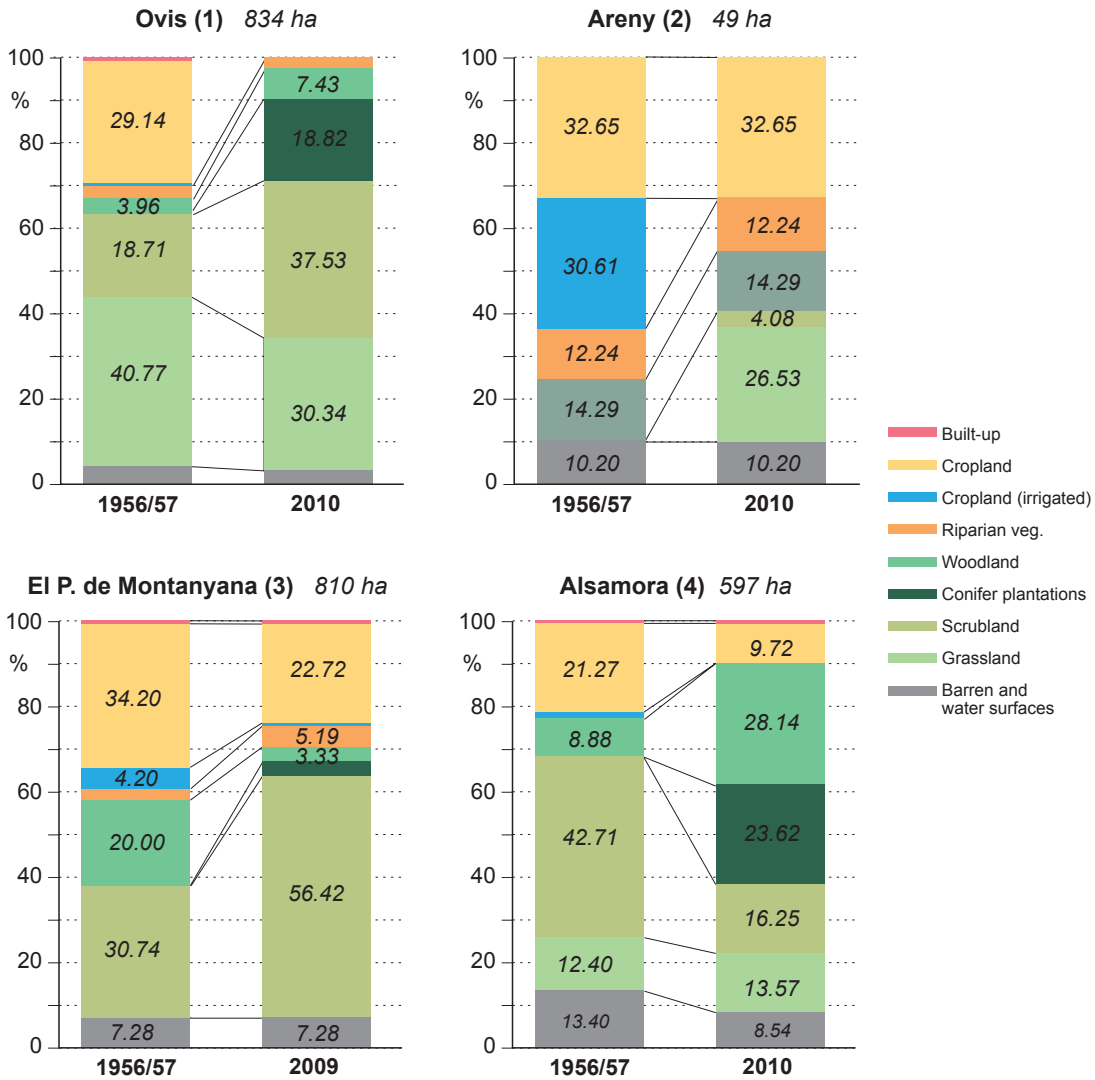

Fig. 4: Land use change in the four selected sites in La Terreta. Their exact location is shown in figure 3

case the Noguera Ribagorçana – have given rise to the "riverbank *finages*", the raised sectors characterised by their highly diverse nature can be grouped under the heading of the "interfluve *finages*". *Finage* is a French expression, with no obvious equivalent in English, or for that matter in the other Romance languages, which refers to the territorial jurisdiction of a settlement, and is typically applied in rural environments. Although this concept is not interchangeable with that of the agricultural landscape, we believe that the association between the two is appropriate for the discussion here, since they both allude to the mosaic of land uses but with a particular emphasis on the area's agroforestry.

The results obtained from the analysis of the four sites enable us to strengthen the lines of interpretation noted above. As expected, the differences between the mapped environmental typologies – the riverbank *finages* and those of the interfluves – are quite marked. The two case studies located in the main valley – Areny (no. 2) and El P. de Montanyana (no. 3) – present major morphological changes in the area under cultivation, which have seen the homogenisation of fodder crops and the total disappearance – in the case of Areny – or partial – in that of El P. de Montanyana – of irrigated cropland area, which used to host gardens for family consumption. In addition, what we note is the abandonment and resulting collapse of the irrigation network – a system of channels and ditches built at the start of the twentieth century, the simplification of the road network and the transformation

of the river environment as a consequence of the intervention during the 1950s of ENHER, a former national hydroelectric company.[18] The key factor accounting for the decline recorded in the agricultural landscapes along the riverbanks is the management of water as the element responsible for the *creation* of these landscapes. In this sense, the area has witnessed a shift from a local water management model – that is, one that was organised at the level of the local population and managed by the users themselves organised into communities of irrigators – to a privately managed model – that is, one controlled by the energy company (privatised in 1998), which enjoys what is virtually a monopoly concession. This change is something that all the valleys in the central Pyrenees have in common, and where for years campaigns have been waged to establish a new management framework more in keeping with local needs (Bergua 2006).

In the case of the study areas in the interfluvial agricultural landscapes – Ovís (no. 1) and Alsamora (no. 4), our results point to the great diversity that is to be found, given that both areas highlight key differences in the land occupation, reflecting the specific characteristics of the local society and the territory in question.[19] Despite these differences, they both suffer the same processes of land abandonment, albeit that the extent of this process is very uneven. Both cases have undergone a dismantling of what was a fairly complex model of land use organisation, but we should stress that it has been in the areas dedicated above all to forestry that this abandonment has been most severe, at least qualitatively, as discussed below. In both areas, the forests played a fundamental role, but their presence was, in terms of the land area occupied, quite minor (less than 4% in Ovís, and less than 9% in Alsamora), coinciding in this respect with the information obtained in the maps in figure 3. But, contrary to what these maps appear to indicate, the presence of agricultural activity – in addition to livestock farming – in the forest areas was very much in evidence as the detailed analysis shows. The cartographic study reflects, in one area as in the other, the complete disappearance (in the case of Ovís) or a reduction by a half (in the case of Alsamora) of agricultural land, accompanied by the irruption of the conifer stands following programmes of afforestation. Yet, as the following section confirms, much of the areas planted with pine trees had prior to the 1950s been under cultivation.

3.2 The abandonment process from a long-term perspective. Institutional changes and increasing pressure on resources (end of the 19th century–early 20th century)

A number of questions arise in relation to the previous discussion, the answers to which are essential for understanding the overall nature of the process by which the abandoned agricultural landscapes of Ribagorça have been shaped: Why was there such a small area of woodland in *la Terreta* compared to that dedicated to farming? What role did factors such as land ownership play in this explanation? Seeking a response to these questions requires our going much further back in time to understand the causes of the shape taken by the landscape, and why it has evolved the way it has over the last six decades.

To undertake this analysis, we draw on data illustrating the demographic evolution of *la Terreta* since the middle of the nineteenth century – from 1857–1860 onwards population censuses began to be conducted with certain regularity in Spain. Combining these data with information taken from the land cover and land use maps of 1956/57, we obtain the results presented in table 1. This shows various ratios between land availability/types of land occupation and the number of inhabitants for four points in time selected according to specific census surveys. These figures suggest a certain land use pattern; however, its validity and credibility are dependent on just how the map in figure 5 is interpreted. This document provides an approximate distribution of land uses in the final decades of the nineteenth century. It can only be an approximation as the cartographic sources for this time period are insufficient and because, as a result, the map is based on non-cartographic sources (see section 1.2). Below the map is explained in terms of the most significant land use categories in its legend.

Category 1 identifies all those areas that present an unmistakeable use as cropland and which maintained this use until the middle of the twentieth century, according to the evidence presented in the map in figure 3. These areas are located along the main valley, but also in the flat interstices that

[18] In addition to two large reservoirs, an underground diversion canal, measuring 23.5 km in length and with a capacity equivalent to the river's mean discharge (30 m^3/s), was built in *la Terreta*.

[19] Reference here is to the internal differences within the Pre-Pyrenees. For more precise details see sections 1 and 2.

Tab. 1: Indicators of historical land use

	(1) Mid 19th century	(2) End 19th century	(3) Mid 20th century	(4) Present day
Population (no. of inhabitants)	**6,981**	**5,410**	**3,708**	**840**
Population density (inhabs./sq km)	13.7	10.6	7.3	1.7
Cropland (ha)		20,997 (8,195+12,802)*	12,802	6,537
Cropland (%)		41.3 (16.1+25.2)	25.2	12.9
Woodland (ha)		ca. 4,270	2,016	12,076
Woodland (%)		8.4	4.0	23,8
Available land per capita (ha/inhab.)	**7.28**	**9.39**	**13.7**	**60.76**
Available cropland per capita (ha/inhab.)	3.01	3.88	3.45	7.78
Available forest per capita (ha/inhab.)	(min. 0.61)	0.79	0.54	14.38

Source: Author's own calculations based on data from the censuses of 1857 (1), 1888 (2), 1960 (3), and the 2007 register (4) and the maps in figure 2.

* Total cropland at the end of the 19th century is calculated by adding the total cropland in the mid-20th century and the areas that were under cultivation before this date (see the detailed explanation in the text).

occur in association with the riverbank *finages*. In terms of their agronomy, these areas lie on the best soils – that is, on the river terraces formed during the Pliocene and the Pleistocene. It is here that we find much of the arable land worked by the wealthy families of *la Terreta* and, consequently, it is where private land ownership was, and still is, dominant. These wealthy farmers were the leading practitioners of a form of specialist agriculture, based on what was known as the "Mediterranean trilogy" – wheat (or, winter cereals in general), olive groves and grapevines – and introduced in the fifteen and sixteenth centuries (Bonales 2005). Indeed, the importance of villages such as Areny (see Fig. 4) as suppliers of wine in upper Ribagorça is well known (Daumas 1976; Tremosa i Palau 1991).

The rest of the territory is characterised by its uneven relief, as illustrated by the map in the top left corner of figure 5, showing the slope gradient. These are the interfluve *finages*, where the diversity of the land use patterns is greater and more difficult to decipher. On the one hand, there are a number of areas, corresponding to category 2 in the legend, which were cultivated in what must have been a systematic manner. The fieldwork conducted for this study revealed evidence of the agricultural use of these areas: namely, the presence of numerous stone walls and terraces – in short: a land that was colonised and almost invariably divided into working plots. However, the aerial photographs of the 1950s indicate that farming was no longer systematically practised on this land by the middle of the twentieth century. Yet, its area – just over 8,000 ha (Tab. 1) – when added to that assigned to category 1, is indicative of the extent of the land under permanent cultivation at the end of the nineteenth century: accounting for 41% of *la Terreta*. Today, these areas are covered, if not by replanted forests, then by a layer of herbaceous or shrublike vegetation, with just a few highly scattered trees (Photo 1).

The historical records consulted speak of a large area of cultivated land which was, originally, under collective ownership, but which during the nineteenth century came under private ownership via a process of registration in the land registry (Bonales 2005). From this, we deduce that the category 2 areas on the map might be largely of this type. In all probability this land belonged to the more modest households of *la Terreta*. Because of its relief, its soil quality was greatly inferior to the land in the valley floors; as such the predominance of dry farming is hardly surprising, with the exception of small enclaves near the courses of the streams, where each family would have farmed an area to produce vegetables and fruit for family consumption (see section 3.1).

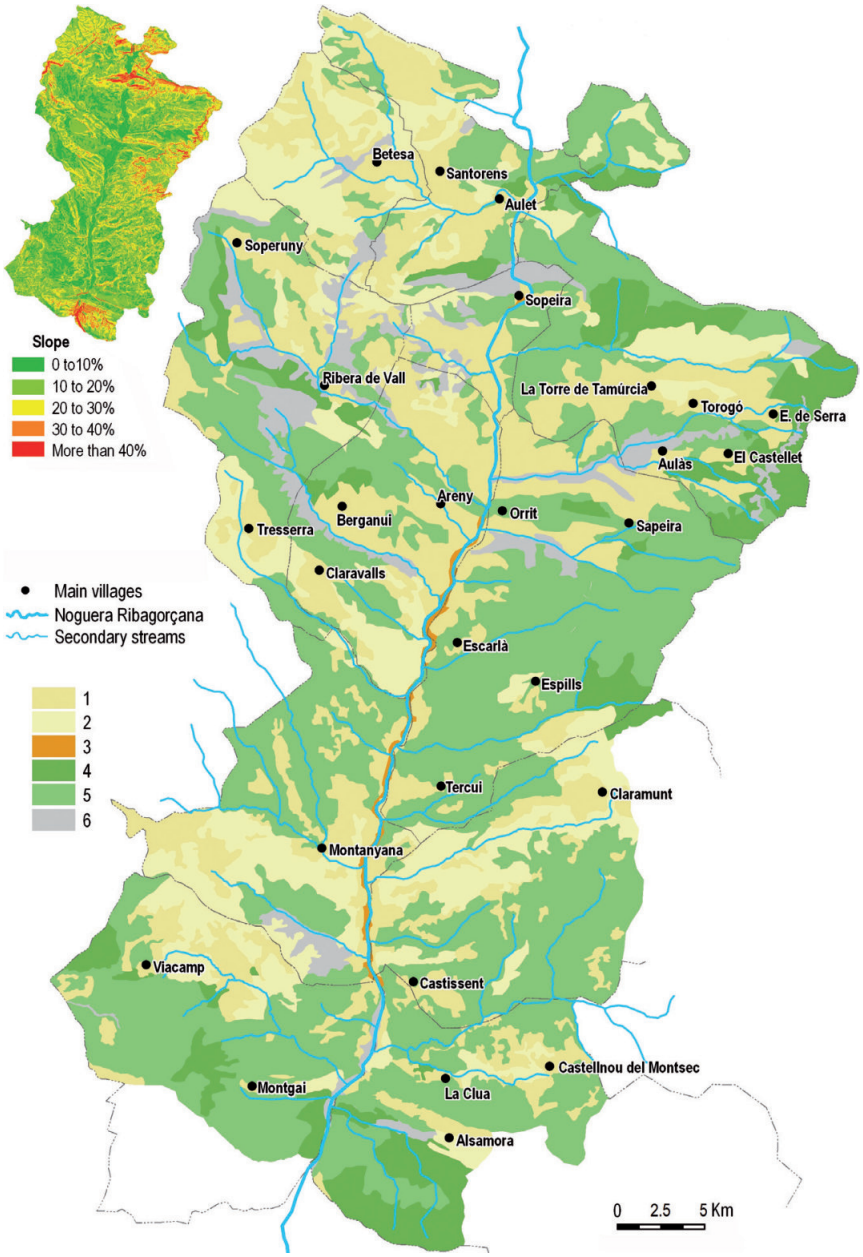

Fig. 5: Reconstitution of the land use in *la Terreta* towards the end of the 19th century. Legend: 1: Cropland, mainly privately owned. 2: Originally collectively owned land, exploited privately as cropland. 3: Main riparian communities. 4: Mostly collectively owned forest land. 5: Mostly collectively owned scrubland exploited via a mixed use pattern (forestry & shifting cultivation). 6: Barren & Unproductive. The map in the top left corner indicates the slope gradient. Based on the aerial photographs from the 1950s, the first series of the 'MTN' Spanish map, the own field survey and also BONALES (1999), MARSAL & PORTA, S.C.P. (2006), MINISTERIO DE AGRICULTURA Y ALIMENTACIÓN (1990), MUGA ESTUDIS FORESTALS, S.L. (2006).

The duality existing between the privately owned lands of the riverbank finages and the "appropriated" lands of the interfluve finages allows us to establish an initial estimation of the amount of land available per capita (Tab. 1). Despite the stability presented by this ratio between the late nineteenth century and the mid-twentieth century – between 3 and 4 hectares per capita – it is quite evident that the soil characteristics of the areas represent a distorting factor that cannot be ignored or underestimated. This fact should help us understand why the 1950's map (Fig. 3) shows that the category 2 land (Fig. 5) had been abandoned before

Photo 1: Area around the village of Alsamora, to the south of the study area (see Fig. 3 and 4), corresponding to a category 2 land use. The photograph shows the terraces built from dry-stone walls. In the background, a conifer plantation. (Photo: A. Sancho-Reinoso, June 2010)

the onset of the most intense phase of depopulation – from the 1960s onwards, according to the censuses.

On the other hand, the areas identified by two shades of green (categories 4 and 5 in the legend) may be associated, in the main, with the collectively owned lands dedicated to silviculture. However, this statement needs to be qualified – first, in line with the information noted in the previous section and, second, on the basis of other research carried out in the area (Sabio Alcutén 1997; Bonales 1999; Bonales 2004; Bonales 2005) – as there has been a gradual convergence of different agricultural and forestry land uses. Specifically, we refer a) to certain practices of shifting cultivation (described in greater detail below); b) to the so-called "*vedats*" or private preserves on which local livestock were not allowed to graze; c) to the pasture – where the transhumant herds usually grazed in winter; and d) to the woodland. In the case of the latter land use, the information in table 1 records a forest area (of approximately 4,270 ha) which more than doubled that found in the 1950s (about 2,000 ha). However, such woodland represents only a minor fraction of the whole of the territory – just over 8% (Tab. 1) of the total surface area. In fact, the available forest per capita at the end of the nineteenth century was, according to our estimates, well below one hectare (Tab. 1). Although it is impossible to determine accurately the extent of the forests at that time, there are several factors, outlined below, that suggest it was not very pervasive.

First, it is generally recognized that in the nineteenth century, tree stands were scarce in numerous Spanish territories (Grupo de Estudios de Historia Rural 1994). In Catalonia, this situation was related to the fact that its forest had, in general, been overexploited since at least the eighteenth century (Casals et al. 2005). Various descriptions provided by the travellers of the age – including the enlightened scholar F. de Zamora (Boixareu 1973) – as well as those published by the authorities of the day – in response to de Zamora's questionnaires (Boixareu 1989) – confirm this tendency in the study area. These written records show a clear continuity in this trend throughout the nineteenth century, as evidenced by the descriptions of the situation of the villages of *la Terreta* in Pascual Madoz's (Madoz 1845) well-known dictionary. These explicitly explain that the forestry resources in most of these villages were supplied largely by the abundant shrubland areas, which ensured that the shortage of trees for wood was not an insurmountable problem (Sancho Reinoso 2011).

The disappearance of the forests in *la Terreta* probably occurred gradually, given that the main cause was "domestic" uses – i.e., those that satisfied the needs of the local population. The progressive increase in population during the eighteenth and nineteenth centuries, which occurred throughout the Pyrenees (Vilar 1962) – meant that, for decades, the children from the more modest houses who were not set to inherit the family's property[20] had to dedicate themselves to shifting cultivation, based on the bush fallow farming of communal shrubland and woodland areas. In the western Catalan Pre-Pyrenees, these methods were known as *boïcs*, and had been practiced since ancient times. The universidades – the forerunners of today's town halls – were the institutions responsible for overseeing these practices, the aim being to ensure equilibrium was maintained with the other land uses of the local community (Bonales 2005). However, the population pressure of those years resulted in an increase in such practices, with the consequent negative repercussions for these areas (most of them, remember, may have enjoyed a legal status of collective owned land), on which other uses related to forestry and hunting would also have been practiced. The areas designated as category 5 on the map would probably have been characterised by the presence of very few scattered trees in the late nineteenth century (Photo 2), while our interpretation is that shifting cultivation would have been widely practiced in many places within these areas.

[20] Note that in Ribagorça, as throughout all of "Old Catalonia" (the area in which Christian culture and Roman law has prevailed along History), property was left in inheritance to the primogeniture (the so-called hereu), which ensured the indivisibility of the family estate.

At this juncture, the aforementioned administrative and legal changes (i.e., the institutional changes) associated with the establishment of the liberal state in Spain should be introduced. Ultimately these were to have a markedly negative impact throughout the Pyrenees (Sabio Alcutén 1997). First, a new modern territorial organisation was drawn up, following the French model. The provinces (1833) and the judicial districts (1834) were created, and the legal foundations for the modern municipalities were established in 1845 (Burgueño and Lasso 2002). As we have seen above (see Chapt. 2), the provincial boundary was drawn along the course of the river Noguera Ribagorçana, thus dividing a homogeneous territory from a territorial perspective – as was the case of *la Terreta* –into two halves along its main axis.

Moreover, the new models associated with economic liberalism, along with the State's dire financial situation, led to a process of land expropriation (*desamortizaciones*), widespread at that time in Spain, but which had markedly uneven results (Grupo de Estudios de Historia Rural 1994). The aim of this process was the privatisation of the public scrub and woodlands; a highly complex category, since it housed such diversity (Balboa López 1999). In *la Terreta*, the vast majority of these public areas were declared "alienable" – that is, subject to eventual public auction. Only a small part were eventually exempted for reasons of public interest and included in the first *Catálogo de Montes de Utilidad Pública* – an inventory completed by the recently created corps of forest engineers (Casals et al. 2005) and published in 1859.[21] In this way, the areas classified in the catalogue came to fall under the control of the public body known as the *Patrimonio Forestal del Estado* (State Forest Heritage). This inventory was completed with a series of geometric plans (drawn by the forest engineers) that sought to provide a better description of the existing vegetation in the exempted areas. As mentioned in section 1.2, in conducting this research three geometric plans corresponding to sectors of *la Terreta* have been examined. According to our calculations based on this set of documents only about 6% of the total area of *la Terreta* was exempted from public auction. In figure 5, these sectors should not always be associated with land use number 4: indeed, most of the land incorporated into the catalogue comprised extensions of matorral scrubland.

[21] Note that it was at this juncture that voices first began to be raised in favour of protecting nature, in Europe as well as in the United States (Cronon 1996). In this respect, the corps of engineers were typified by their environmentalism, at least at the outset (Balboa López 1999).

Photo 2: View typifying category 5 of the land use map in figure 4, situated to the north of the village of Castissent. (Photo: A. Sancho-Reinoso, October 2009)

Thus, the vast majority of public forests in *la Terreta* were subject to auction; however, only a small part of this woodland was to end up in private hands, at least in its Catalan sector (Bonales 1999). By far the most were awarded to the *sociedades de propietarios*, associations founded on an ad hoc basis among the residents of the affected villages. The ensuing collective transactions ensured that many formerly public forests were not in fact privatised. It is important to stress the difference, in terms of the legal nature, of this transfer from "public" to "collective" ownership. The new *sociedades de propietarios* were not created on the basis of the universal census of a given population – as they had been in the past – but rather were made up of the men from the most important families, as well as from the *cabalers* – a Catalan term referring to the younger sons, the non-heirs, who had opted not to migrate (Bonales 1999). Indeed, some authors question whether the result of this collective appropriation would even have allowed these sectors to be classified as public property (Balboa 1999). In any case, this is an illustrative example of what Bonales (2005) calls "strategies of «cointegration»" between the liberal regime and the institutions inherited from the ancien régime, i.e., the earlier (local) regulations governing land use seemed to prevail, even though they no longer corresponded to the new legal status of these lands.

The role played by the *sociedades de propietarios* in relation to the forests from the time they were established has been by no means negligible. During the episodes of afforestation of the mid-twentieth century, these associations retained ownership of the land, while the rights to exploit the forestry resources were reserved for the State (Groome 1988). The experts consulted in the field report that the terms of these agreements were virtually identical in all the munici-

palities of *la Terreta*: of the potential profits, 70% were destined to the State, while the land owners received the remaining 30%. Today, many of these associations of forest owners remain key players in the management of the actual uses of these lands – above all as regards their hunting rights. However, in many other cases they have ceded the rights over their patrimony to the local municipalities.

Therefore, we need to look beyond the demographic pressure and its possible consequences for the appropriation of communal land, and consider various other factors – largely unrelated to the local society – that might also have played a role in the gradual disappearance of forestry resources. Rather than the impact that the demand for wood for shipbuilding might historically have had – an argument widely cited in eighteenth century documents (Boixareu 1973), we should consider the application of capitalist ideals to forestry practices during the nineteenth century, following the period of land expropriations (Balboa López 1999). This new factor led to the establishment of new social hierarchies and generated inequalities in land ownership rights in the Aragonese Pyrenees, as Sabio Alcutén (1997) has argued. During the first half of the twentieth century, when the phase of outward migration had been initiated, we need also to take into consideration the production of charcoal – obtained from the controlled burning of firewood – that was of great importance across southern Ribagorça thanks to the abundance of its oak forests (Solé i Sabarís 1964). Charcoal production mobilized a significant number of families from as far afield as Extremadura and Galicia who came to work in this activity. The impact of this activity represents the last phase of the process that helped shape the territory, as revealed by the aerial photographs of 1956/57, that is, an agricultural landscape marked by the virtual absence of mature forests.

4 Discussion

Having presented both the short- and long-term perspectives, the socio-territorial indicators of historical land use displayed in table 1 can now be interpreted in the light of these new arguments, allowing us to address a number of issues that remain unclear and to draw some final conclusions (see Chapt. 5). In this sense, it is interesting to note that during the period of pre-industrial agriculture, at the time of maximum pressure on the area's resources – a pressure which, as we have seen, responded to a wide range of causes and which was to have considerable continuity – each inhabitant in *la Terreta* had at their disposal over seven hectares of land, or just over three if we consider only land under permanent cultivation (Tab. 1). Thus, the availability of land (regardless of the legal changes introduced by the *desamortizaciones*) was well above the limit that Esther Boserup has fixed for such modes of subsistence – that is, 64 inhabs./ha or 1.5 ha/person (Tello and Garrabou 2007).

However, as stressed, these figures are something of a generalization and need to be clarified. The unstable equilibrium eventually collapsed because the society of these mountain lands was forced to adapt to the impact of a series of demographic, institutional, economic and financial transformations that occurred in the second half of the nineteenth century, and which undermined the foundations of the prevailing model – in other words, most of the households had very limited resources and the 3.26 ha of cropland indicated in table 1 were insufficient for their needs, because of factors closely tied to the nature of the territory. These were the "households" which were to stage a massive movement of appropriation of the collectively owned lands using shifting cultivation practices. Yet, this panorama was to prove transient, and the decline set in with the opening up of Ribagorça – and the whole of the western Catalan Pyrenees for that matter (Arqué et al. 1982) – to the outside world and to the possibility of outward migration during the first three decades of the twentieth century. As a result, the 1956/57 map shows only the vestiges of this historical phase that was to prove so critical for the Pyrenees.

Thus, from the perspective afforded by an integrated analysis of this landscape, it can be argued that the last hundred and fifty years have been witness to the disintegration of its land management model. Underlying this, two complementary landscapes have gradually been shaped since at least the consolidation of the so-called "model of low-density settlement" in the Late Middle Ages (Bonales 2004). This "integrated system", which brought (albeit of course in a context of marked inequality) the wealthiest and the most modest households together in the exploitation of the riverbank and interfluve landscapes – or *finages*, suffered an initial episode of change with the introduction of liberal measures in the second half of the nineteenth century. The precarious balance based on polyculture and the active use of the forest resources survived until the early twentieth century, and it was completely disrupted by the middle of that century, as the 1956/57 map (Fig. 3) makes clear. Around that date, *la Terreta*, in common with many other parts of the Pyrenees (Sabio Alcutén 1997) and the other mountain regions of Spain (GRUPO DE ESTUDIOS

DE HISTORIA RURAL 1994), was heavily struck by a centralistic (and anti-democratic) policy (Groome 1988), which took the form of the construction of large reservoirs and the setting in motion of large afforestation programmes.

Despite the lack of available data for our case study, which prevents us from obtaining a detailed picture of the processes of change in the area's so-called "social metabolism" (see section 1.1), the results of this article do allow us to link the transformation that occurred in *la Terreta* with the processes affecting those areas undergoing urbanisation. It is our contention that the more than 60 ha of land per capita available in the current study area (Tab. 1) can be seen as the flip side of the densely populated urban conurbations, characterised as they are by their severe "territorial inefficiency" or "territorial dysfunction" (Tello and Garrabou 2007; Marull et al. 2010). Indeed, the typical inefficiency of a society dependent on fossil fuels. The numerous, large conifer plantations demonstrate the level of inefficiency of the policies followed in the Spanish mountain areas during the twentieth century. From the perspective of land use dynamics, they can even be considered as a kind of long-term extensive crop rather than as woodland, since the surfaces were prepared ad hoc to host pine trees. However, irrespective of this debate, time has demonstrated how unfeasible this was in the absence of a strong forestry policy capable of involving the local population, i.e., de-centralised and democratic.

At this juncture it is convenient to examine once more the manner in which the long-term perspective has been considered in this study and the consequences of this approach. As argued in chapter 1, this paper strives to present a coherent picture of the whole region. This explains why the very local scale has only been assumed through the analysis of certain case studies (i.e., Fig. 4). Indeed, we need to stress the paucity of available cartographic data as the justification for the approach adopted in this article – namely, the quantitative analysis of the period 1956/57 to 2007, followed by a qualitative study of the second half of the nineteenth century and the first half of the twentieth (see section 1.2). Including all available information (such as the data from the cadastres during the nineteenth and twentieth centuries) would undoubtedly have provided more accurate findings in relation to certain questions, e.g., land ownership (i.e., the proportion of publicly owned land to private land) and the changes to this following the *desamortizaciones*. This could even have allowed us to explore possible internal differences derived from the modern political-administrative division. However, had this approach been adopted, the objectives of this study would have had to be completely redefined. Moreover, a number of studies – cited in this article – have already examined this issue from a historical perspective. Indeed, the geographical (i.e., regional, integrated), agricultural landscape-based approach taken by this paper is, we believe, its main contribution to landscape studies.

A last issue remains pending, namely the need to consider just how representative the results obtained from our case study are for the whole of Ribagorça. Examining our findings (and despite the data deficit discussed above), we conclude that it is not possible to extrapolate directly the dynamics of change in land use in *la Terreta* to the whole of the region, mainly because of the previously outlined internal differences in the geography, history and, economics of Ribagorça (see chapter 2). However, it is well known that other studies conducted in high mountain areas speak openly of processes of abandonment (Vicente Serrano and Lasanta 2007; Barrachina 2008) throughout the central High Pyrenees, where the processes described in *la Terreta* – such as agricultural abandonment – are also present, yet of another nature. For this reason, we believe that the duality between upper and lower Ribagorça (that is, between the sectors lying in the High Pyrenees and the Pre-Pyrenees) may have had an impact, even though the dynamics of land cover and land uses seem relatively similar.

In line with the arguments developed in this article, we believe that the analysis reported in these pages is highly illustrative of the problems that other Mediterranean mountain regions in Europe have to face (O'Rourke 2006). Indeed, many of these areas present very similar features: a mid-mountain environment location, an inability to offer tourist attractions of any real weight and insufficient agricultural or forestry potential that might serve as an economic engine in a globalized and liberalized economy. For this reason it is our belief that from these largely forgotten places, where nothing seems to change, highly informative insights can be obtained into just how the territory is being managed, which is – lest we forget – a finite resource, although one that is not normally included on the lists of non-renewable natural resources.

5 Conclusion

This article has sought to explain the dynamics of land abandonment and the processes by which today's agricultural landscapes in the Pyrenean region of Ribagorça have been shaped. This explanation has involved an analysis of the historical evolution taken

by the land cover and land uses in *la Terreta*, an area lying within the Pre-Pyrenean sector of this region. In seeking to understand the formation of what we refer to here as "abandoned agricultural landscapes", the study has adopted a broad theoretical approach (founded mainly on geographical traditions), as well as a methodology that combines the cartographic analysis of land cover and land uses with a qualitative interpretation of the factors that have had an impact on the study area during the selected period of time. This interpretation has drawn on a considerable variety of sources, integrating physical and biogeographical components with those of a historical and socio-economic nature – with a particular concern for the area's agroforestry as one of the key elements of the agricultural landscape, as argued in the introduction (see Chapt. 1) .

A comparison of the land cover and land use maps of 1956/57 with those of 2007 (Figs. 2, 3 and 4) highlights the social and environmental consequences of the so-called "rural exodus" and its irreversible nature. In *la Terreta*, these processes have seen the land area dedicated to crops cut by half and a dramatic increase (of around 600%) in the area under forest (Tab. 1). This last figure is accounted for primarily by the numerous coniferous tree plantations. As we have discussed in this article, the regeneration of spontaneous vegetation in the abandoned cropland areas has tended to result in the widespread emergence of degraded shrubland, there being few examples in *la Terreta* of the restoration of the natural native forest (*Quercus ilex spp. rotundifolia*, *Quercus faginea*).

Yet, the situation in the 1950s cannot be considered illustrative of a "traditional" system of socio-territorial relations, as has been argued for other areas in the Mediterranean Basin (see section 1.1). The literature consulted and cited throughout the paper as well as the land use maps of selected sites within the study area (Fig. 4) suggest that such a process of transformation has a much longer history, and that this cannot simply be reduced to the events of the second half of the twentieth century. The map created for the second half of the nineteenth century (Fig. 5) constitutes a retrospective exercise offering an approximate interpretation of the landscape of *la Terreta* during a period of great social, political, economic and legal upheavals for Spain. The numerous historical studies undertaken throughout the country – which have been cited throughout this paper – lead us to conclude that the events that unfolded in the case study area were no exception, at least in the Pre-Pyrenean environments.

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