

A classification of pastoralism in Spain: understanding the past to address present challenges. Supplementary Material 2.

Detailed description of Spanish pastoral systems

I.	LARGE MIGRATORY SYSTEMS	2
I.1.	Transhumance	2
I.1.A.	South of Iberian range and Levantine plains	2
I.1.B.	<i>Dehesas</i> -Central System	3
I.1.C.	Merina	4
I.1.D.	Pyrenees-Ebro.....	5
I.2.	Medium mountain-valley transterminance.....	6
I.2.A.	Betic	7
I.2.B.	Castilian-Leonese	7
I.2.C.	Pre-Pyrenees.....	8
I.3.	Medium mountain-coast transterminance.....	9
I.3.A.	Canary Islands.....	9
I.3.B.	Cantabrian fringe	10
I.3.C.	Levantine	12
I.3.D.	Penibetic	12
II.	SHORT DISTANCE TRANSTERMINANCE	13
II.1.	Agricultural transterminance.....	13
II.2.	Forage transterminance	14
III.	DAILY MOBILITY	15
III.1.	Agro-silvo-pastoralism on <i>Pinus</i> woodlands.....	15
III.2.	Agro-silvo-pastoralism on <i>Quercus dehesa</i>	16
III.3.	Cereal grazing	17
III.4.	Polyculture.....	18
III.5.	Browsing	20
IV.	SEMI-WILDERNESS.....	21
	REFERENCES	21

I. LARGE MIGRATORY SYSTEMS

I.1. Transhumance

Livestock migrations are based on seasonal complementarity of food availability, and are considered a managed version of the migrations of wild herbivores (Garzón 1992; Manzano Baena & Casas 2010; Manzano et al. 2023). The main bioclimatic constraints on plant growth are winter cold in central-northern Spain (especially in mountainous areas) and summer drought and high temperatures in most of the Mediterranean bioclimate. As a result, there is mobility between these two complementary conditions, making it possible to support large herds of animals throughout the year. There are three main wintering areas: the south-western lowlands, the Ebro valley, and the Mediterranean coast. The wintering areas are mountainous systems (Manzano & Casas 2010). Within the transhumance system, three pastoral communities can be distinguished on the basis of these wintering areas, each with its own mountain system for the summer season.

I.1.A. South of Iberian range and Levantine plains

Geography

In the eastern part of the peninsula, the gradient of pasture productivity is more longitudinal than latitudinal. The wintering areas extend along the central third of the Mediterranean coast, from the Ebro delta to the fertile plain of Segura river, with mild temperatures that do not excessively limit plant growth. These coastal areas tend to be used for crops (especially horticultural and fruit crops), whose residues contribute to animal nutrition. The summer areas, traditionally used for livestock rather than agriculture (Royo Pérez 2020), are more concentrated in the northern Iberian system, with the Sierra de Albarracín and the Serranía de Cuenca standing out. These areas have the capacity to support large livestock populations due to their large surface area. This transhumance model is similar to that observed in most Mediterranean countries (Farnós et al. 1993). There is a great diversity in the distances covered, which makes it difficult to clarify the boundaries between long and medium-distance movements. Because of their tradition and common evolution, no distinction is made in this classification.

Tradition

The narrative of transhumance is monopolised by Castile and the *Mesta*, and this has eclipsed other transhumance of great historical and ecological importance, such as that of the Crown of Aragon (Fernández Otal 2003). In this area, examples of regulations for the movement of animals between Christian and Muslim regions predate the 12th century, when real borders still existed (Fernández Temprano et al. 1996). Subsequently, livestock organisations of great importance developed, such as the Mesta de Albarracín, together with other smaller organisations such as *ligallos*, *juntas* or *cofradías* (Fernández Otal 2005 & 2003). Although there was not a centralist institution as the Castilian Mesta, transhumance developed important economic and cultural relations throughout the region. For example, the wool and cotton textile centres of Terrassa and Sabadell attracted an important flow of migrants from Aragon, with consequent exchanges between the two regions. The old Mesta de Albarracín was destined for the areas of Valencia, Murcia and Alcudia (Fernández Otal 2003). But there is an important difference: transhumance to Alcudia was and is dominated by merino, while the other transhumances to the coast included *rasa aragonesa* (mostly), *guirra* or *cartera* (Rivera i Merino 2003), which is a differentiating element between the two transhumance communities. Importantly, this transhumance to the coast was not exclusive to the Crown of Aragon, as the Castilians also migrated to Murcia during winter (Fernández Temprano et al. 1996). Coastal pastures are not as productive as the *dehesas* or other areas under the influence of the Atlantic Ocean, so winter supplementation was

common, favoured by the availability of crop residues (Bacaicoa Salaverri et al. 1993). Another constraint is the predominance of small farms in the wintering areas, which limits the size of the pastures. Despite all this, the transhumant herds of the Crown of Aragon were smaller than the Merino herds and followed more flexible and adaptive schemes.

Development

The progressive human transformation of the coastal area complicated the transhumant activity, in contrast to inner areas, which have not suffered competition for land use. During the 20th century, the transhumant shepherds had a process of sedentarisation in the coastal areas, favouring the depopulation that nowadays characterises inner areas. Meanwhile, the Mediterranean strip, from Catalonia to Murcia, has developed a large industrial livestock production of poultry and pigs since the 1970s. Changes in land use on the coast, along with the absence of railway infrastructure that did articulate the merino transhumance, have weakened the maintenance of this activity. At the end of the 20th century, the ratio was ten Merino transhumant animals for one of other types in the Crown of Aragon. Currently, the breeds (mainly sheep) that move under this regime are the *rasa aragonesa* (from Teruel) and *Alcarreña* (from Cuenca). The *segureña*, *cartera* and *guirra* breeds are also used (Fernández Temprano et al. 1996). Bovine transhumance has also appeared, such as the *bruna de los Pirineos* breed in the high Iberian massif (Elías Pastor et al. 2005). Currently, almost the entire area covered by this transhumant community is covered by two new Aragonese associations that facilitate the management of transhumance herds: the *Asociación Ligallo General de Pastores* and the *Asociación Nueva Mesta de la Sierra de Albarracín* (Argudo Pérez 2006). Rural abandonment is very relevant in this transhumance, especially in Teruel and also in Tarragona (Fernández Otal 2003), associated with the *cartera* breed (Rivera i Merino 2003).

I.1.B. *Dehesas*-Central System

Geography

With a partial spatial overlap with merino transhumance, transhumant management of cattle became more and more relevant in the second half of the 20th century. The wintering areas are located around *dehesas*, in Extremadura and Sierra Morena. There are large movements from the Central System range, Sierra de Gredos standing out. Other relevant mountain range for cattle are Sierra de Albarracín (south of the Iberian System) (Bacaicoa Salaverri et al. 1993; Gómez Sal & Lorente 2004), in this case included within the large area of traditional merino transhumance.

Tradition

Despite their relevance in Antiquity (Manzano & Casas 2010), in our study framework, cattle *dehesa* transhumance has not been traditionally too relevant. Despite not having the same cultural identity or a comparable recent historical evolution, its importance relies on its current size, developing in circumstances similar to those of other transhumances. In cattle *dehesas*, agricultural supplementation is necessary in times of scarcity. Meat breeds stand out, such as *avileña-negra ibérica* in the Central System (Pérez Figueras et al. 1992; San Miguel et al. 2009); and the *Pajuna* breed in the Sierras Penibéticas (Sierra de Cazorla, Sierra del Segura and Sierra Nevada). Also, the *lidia* bull (mix of different breeds for bullfighting) is relevant in this transhumance.

Development

Cattle *dehesas* have become more relevant with the progressive substitution of the merino transhumance throughout the 20th century. Being such a recent movement, its development has been very significant. Great economic profitability, and a reduced need for labour in the

context of recruiting difficulties, were incentives for driving such transition. For example, the prestige of transhumant cattle puts them in a better position to compete than sheep. Much of the cattle transhumance is carried out by truck, but important sections of these drover roads are still done by walk. This is probably the transhumant community in the best conservation status. The Conquense drover road with cattle is the most important drover road currently used in all the sections. The growth of the bovine herd has been such that it is common to hear of problems due to overgrazing.

I.1.C. Merina

Geography

The pastoral complementarity in merino transhumance is based on the latitudinal gradient, with migrations from the north (summer) to the south (winter). The northern areas are scattered in the mountainous regions of the northern part of Spain's two great plateaus: the southern slopes of the Cantabrian Mountains (particularly the provinces of León and Zamora) and the entire Iberian System, from the Sierra de la Demanda to the Montes Universales. The wintering areas are associated with the *dehesas* and, to a lesser extent, with the more sheltered plateau meadows. These are the lowlands of the southwest: Extremadura, western and southern Castile-La Mancha and Sierra Morena (Gómez Sal 2001, 2005, Manzano Baena & Casas 2010).

Tradition

Merino sheep transhumance was strongly linked to the Kingdom of Castile, as wool was its main export and economic activity. Therefore, Merina management and privileges were protected by the Concejo de la Mesta from the 13th century until its disappearance in 1836, with numerous documentary sources showing the priority of transhumance over other livestock systems. The traditional Merino herd is therefore made up of merino sheep, with a variable proportion of goats, less than 10 per cent. Other breeds, such as the churra, are also associated with this type of transhumance (Elías Pastor et al. 2005). Traditionally, the shepherds come from mountainous areas, although there are reverse cases, such as the Extremaduran shepherds who graze in the mountains of León or Zamora.

Development

Merino transhumance has been in continuous decline for centuries after a peak of 3,750,000 transhumant sheep in 1765. Starting with a socio-economic crisis, followed by the loss of the Spanish monopoly on merino wool after the Napoleonic invasion, and enhanced by the liberalisation processes of the eighteenth and nineteenth centuries, there were serious consequences for a giant organisation as the Mesta was. Competition for agricultural production, in a context of collapsing wool prices, led to the prioritisation of new land uses (especially agricultural and later industrial). This situation continued with the rise of liberalism in the 19th century and was accentuated by several land confiscation and privatisations (especially that of Madoz). The privatisation of land made access to pasture more difficult for shepherds. However, reforms were not homogeneous in all regions. For example, a more conservative legal framework in Extremadura allowed transhumance to continue in a better state than in other areas until recent times. However, the general trend was the same in all regions (García Sanz 1994). Progressively, merino transhumance shifted from a wool specialisation to a more meat-based specialisation (Elías Pastor et al. 2005). The arrival of the train supposed a major change in this transhumance. Merina is the breed that migrates the greatest distances, and the one that has had the greatest importance in terms of total herd size. This predominance is reflected in the design of the train, which came to articulate the entire Merino transhumance area, while no lines were designed for other drover roads. Throughout

the 20th century, this development led to a reduction in the number of journeys on foot. Subsequently, with the expansion of the truck as the preferred means of transport and the decline of the transhumance herd, the suppression of rail services became more and more common until today it is a means of transport of limited use. During this century, the agronomic industrialisation and the influence of cheap fodder available directly impacted merino transhumance. There is a broad consensus that the ageing of the transhumant pastoralists population and the lack of generational replacement are major problems for the subsistence of this practice (Gómez Sal & Rodríguez Pascual 1992; Rubio de Lucas & Martínez López 1992; Terés Landeta et al. 1995).

I.1.D. Pyrenees-Ebro

Geography

There is a strong complementarity of forage between the Pyrenees and the depressions of the Ebro. In the Pyrenees, at an altitude of between 1,500 and 2,500 metres, there are nutritious pastures during the hottest periods of the year, with little water limitation due to orographic rainfall. However, cold and snow make grazing impossible for most of the year. The wintering areas are steppe valleys with high salinity and therefore nutritionally rich pastures, such as the Bardenas (in the current Navarre region), Cinco Villas (Aragon) or Monegros (Aragon and Catalonia). They have a very continental climate and are strongly influenced by the cool, dry winds (Cierzo), which hinders the growth of pasture when water is scarce. Although the distances between the two areas are often more than 100 km, the migration gradient is more altitudinal than latitudinal. The territorial extension is very wide along the longitudinal axis, although there are differences in this gradient that characterise pastoralism in this direction (Pallaruelo 1993; Pallaruelo Campo 2003, Montserrat & Fillat 1990).

Tradition

There is a cultural homogeneity throughout the Pyrenees, largely derived from this transhumant activity (Leonardo Plato 2003) and facilitated by a common political-economic-social organisation. The traditional territorial unit in the Pyrenees is traditionally the valley, the main place of origin of the transhumant shepherds. The valleys are located below the supra-forest heights, but they have historically managed the alpine pastures. A self-government has given the Pyrenean transhumants the greatest political independence (Pallaruelo Campo 2003). Even after the development of more feudal governance structures, local historical rights have maintained within a proto-parliamentary structure. The *facerías* manage border crossings with France and the common use of pastures since many centuries (García Martín 1996). There was also a great deal of organisation at a social level, with three main types of farm: large herd owners and hired shepherds, associations of shepherds and family transhumance (Pallaruelo Campo 2003). Despite many convergences, it is complex and controversial to speak of a uniformity in this transhumance, to the point of two main groups being clearly identified. Differences arise in the west-east Pyrenean gradient, with a limit in Ribagorza. The distance between the mountains and the plains is less in the east, where the pre-Pyrenean mountains are interspersed with large valleys that allow agricultural production. This, together with a more north-south orientation, means that in the east movements have traditionally been direct between areas of origin and destination. In the west, with less agricultural potential, there has been greater specialisation in livestock farming. Here there was often a short stop at the shepherd's house (in the valley), grazing 'at three grasses'. In Navarre and Aragón, these intermediate grazing areas are called *aborrales* (Pallaruelo Campo 2003; Rivera i Merino 2003). The *pardinas*, agricultural areas of low productivity, are an example of *aborrales* rented by shepherds during the winter grazing period (Ubieto Arteta 1987). The unit of *aborrales* is located

between Sangüesa and Guara. Consequently, renting is the typical form of land use on the western side, while on the eastern side, higher stocking rates and agricultural specialisation have led to greater land ownership. Most relevant sheep breeds are *rasa aragonesa* in the west, with a great degree of specialisation. In the east, *tensina*, *xisqueta* and *ripollesa* breeds stand out. Transhumance with *ripollesa*, from the pre-Pyrenean areas of eastern Catalonia, is almost extinct, while the *xisqueta* (western area) remains in better condition, although no breed is currently in a state comparable to what it once was.

Development

The decline of transhumance in the Pyrenees was later than in other areas, since the lack of centralising institutions such as the *Mesta* did not lead to a sudden loss of privileges with the onset of liberalism. The decline is more linked to the changes induced by technology and the green revolution (Pallaruelo Campo 2003). Nevertheless, the decline since the 1960s has been abysmal (Pallaruelo 1993), due to the abandonment of less productive, non-mechanised areas and the rise of tourism, especially remarkable in the Catalan Pyrenees (Gómez Sal 1994). Whereas at the end of the 19th century there may have been between 1,000 and 1,500 transhumant shepherds, in the early 2000s there were little more than 100 (Fernández Otal 2005). In the wintering areas, agriculture was traditional from Navarre (Pallaruelo 1993) to Catalonia (Rivera i Merino 2003), but the expansion of irrigation has completely changed the management of transhumance, causing competition for land use, particularly in Catalonia (Rivera i Merino 2003). This abandonment phenomenon is identified as the cause of a major ecological imbalance (Gómez Sal 2005; Montserrat & Fillat 1990). Following the common trends, there was replacement of sheep by cattle in the second half of the 20th century. Cattle transhumances do not reach the Ebro, being more transterminant (short-distanced) than transhumant. Transhumance is also being replaced by wintering in the valleys, which in many cases takes place in confinement (Pallaruelo Campo 2003). In the Catalan region, livestock industrialisation is very remarkable (Rivera i Merino 2003).

1.2. Medium mountain-valley transterminance

In Spain, the Atlantic and Mediterranean bioclimates are separated by the Cantabrian Mountains, which block the passage of rainfall and make most of the country very continental. However, several mountain ranges in the Mediterranean bioclimate have sub-Mediterranean characteristics: moderate temperatures and slighter summer droughts than in the surrounding plains. Harsh winter conditions in these highlands prevent grazing for much of the year, in periods when a more temperate climate in the lowlands allows sufficient food to be produced. This altitudinal complementarity allows for similar animal feeding in many regions, with considerable migration distances (generally <100 km). The availability of winter fodder is usually complicated by the lack of resources such as winter fruits in the plains (such as acorns or chestnuts) or large areas of available pasture. Therefore, competition for land with agriculture and the legacy of deforestation for this purpose had notorious consequences for winter food shortages. Some degree of supplementation is often necessary, and the use of stubble or supplementation with fodder and cereals is common. These versions of upland migrations do not require very long distances, but they are long enough to require the shepherd to migrate with the livestock, at least at the times before the transport revolution. In short, they are altitudinal migrations to large mountain ranges, but close to areas with sufficient forage resources to feed large numbers of animals – even in winter (Gómez Sal 2001).

I.2.A. Betic

Geography

The Betic transterminant herders are linked to the migrations between the Sierra Morena (in winter) and the Sierras Béticas (in summer), in the south and south-east of the Iberian Peninsula. The particularity of Sierra Morena for wintering is that, despite its altitudinal gradient on the southern slope, the northern facet is the limit of the Central Castilian Plateau, i.e., the northern slope is not perceived as a geographical feature. Thus, characterised by a *dehesa* configuration, Sierra Morena is traditionally a fodder resource for many shepherds. Meanwhile, the Betic mountain ranges (especially Cazorla and Segura, and Sierra Nevada, but also other smaller ones such as Arana, or Sierra Lucena) are poor for agriculture, but produce limited yet nutritious pastures – very useful for pastoralists. Due to their more humid climate, these mountain ranges are productive in the months of vegetative standstill. Migration distances are very variable, with lengths of up to 250 km for the case of Sierra Nevada (Rubio de Lucas et al. 1995), which can be considered an authentic long-distance transhumance.

Tradition

These seasonal migrations are so logical that they could date at least from the Roman period (Aranda García 2016). The main associated breeds are the Segureña and Montesina sheep, the blanca andaluza and negra serrana goat, or the pajuna cow (Rodero Franganillo & Rodero Serrano 2007). Due to the low plant productivity in these areas – for bioclimatic and edaphic reasons –, herds have traditionally been small compared to other comparable mobile systems.

Development

Betic transterminance shows an increasing proportion of cattle in the last century, replacing sheep and goats. Even so, the most important recent changes are related to the strong trend toward sedentarisation. The pressure for economic solvency has fully impacted this low-productive region, so pastoralism in all its versions is in great regression. In addition, south-eastern Spain is particularly vulnerable to drought – exacerbated by climate change (Marchi et al. 2020) that adds to the traditionally difficult animal feeding during dry spells (Rubio de Lucas et al. 1993).

I.2.B. Castilian-Leonese

Geography

The pastures on the southern slopes of the Cantabrian Mountains, Central System and Septentrional Iberian Systems provide abundant and quality grazing resources that have made available important amounts of animal feed, due to high rainfall along with significant sunshine (Gómez Sal & Rodríguez Pascual 1992; Gómez Sal et al. 1995; Montserrat & Fillat 1990). In autumn, animals move to the grain-producing plains, where they spend most of the year in a daily mobility regime. In this system, the movements from the mountains of León (currently highlighting the region of Luna) and Zamora (Sanabria and Aliste standing out) are particularly relevant. But transterminances have been widespread in Palencia, Burgos, Caceres, Avila, Salamanca, Soria, Navarre and La Rioja spending the summer in the Cantabrian Mountains, Central and Iberian systems. Distances range from 10 to 100 km, which is considered true transhumance, but such distances are not very common (Terés Landeta et al. 1995).

Tradition

The importance of the transterminant tradition becomes blurred due to the spatial overlap with transhumance in these areas. Its importance begins with the great agricultural expansion and later with irrigated crops that provide feed during winter. In fact, due to the lack of grazing land,

it is usually necessary to supplement with straw or hay in winter, and to graze on waste and fallow land in spring. The breeds currently associated with this transterminance (mainly sheep) are a mixture of merina and an extinct breed of the 'churra' supergroup in the case of León (Gómez Sal & Rodríguez Pascual 1992) and castellana in the case of Zamora (Terés Landeta et al. 1995). Even if there is little documentary evidence, traditional transhumance movements have existed for at least centuries. The Churreros de Aliste pastoralists are a good example where, although there have been changes in management, such as the incorporation of new breeds (for example, manchega), the basis of transterminance has remained traditional in this region.

Development

The development of irrigation systems really influenced transhumance (Gómez Sal 1994) and the increase of Castilian-Leonese transterminance during this transformation is an example. In the fertile plains of Duero river, irrigated crops have made it possible to maintain large herds of livestock even during periods of winter scarcity. Despite its development, the territorial extent of this transhumance has been reduced to the west of the Cantabrian Mountains. Until recently, for example, shepherds from La Rioja migrated to the Navarrese or Aragonese Ribera del Ebro, a transterminance associated with the chamarita breed, which is currently in danger of extinction (BOE 2018; Elías Pastor et al. 2005). In addition, as was the case throughout the 20th century, there has been a significant increase in the number of cattle in relation to sheep, with breeds such as alistana-sanabresa in Zamora and parda de montaña in León. Although they are native breeds with strong territorial links, problems have been reported due to higher impact of cattle on land (Rodríguez Pascual 2003). In addition, the development of transterminance has been identified as problematic because it competes with, and replaces, transhumance (Gómez Sal 1994). There is no consensus on whether this is really a substitution of transhumance or it is just a logical adaptation to a new agricultural context. For example, in areas such as Riaño (León), the absence of this transition to the transhumance model has led to a sharp decline in grazing, which is not the case in other nearby regions, such as Luna, which have developed a transterminant system (Rodríguez Pascual 2003). The decline is very worrying in the context of a lack of generational replacement: Zamora and León are the first and fourth most aged provinces in Spain (INEbase 2022).

I.2.C. Pre-Pyrenees

Geography

The Pre-Pyrenean valleys and the summits have complementary productivity due to the altitude gradient that separates them. The valleys of the intra-Pyrenean depression (such as Jaca, Aínsa or Tremp) have a sub-Mediterranean climate, allowing agriculture for both human and animal consumption (Pallaruelo 1993). Unlike the Pyrenean-Ebro transhumance, most shepherds stop in the Pre-Pyrenean valleys during the winter, instead of continuing down to the Ebro valleys. The distance covered is therefore relatively short, but with a strong gradient in altitude.

Tradition

In the second half of the 18th century, half of the livestock in the Pyrenees was not transhumant (Fernández Otal 2003), which highlights the existence of other, historically invisible systems, such as transterminance. Pre-Pyrenean valleys were economically linked to the diversification of resource uses, with agricultural, livestock and forestry production. The complexity of land use has therefore required organisation and coordination among neighbours. Pasture and forest management have been linked to communal management, while agriculture was rather private. Livestock breeds in this transterminance are diverse, with different ecotypes adapted to the

different regions of the Pyrenees. For sheep breeding, *rasa aragonesa*, *aranesa*, *ansotana*, *churra tensina* or *xisqueta* have been common. Cattle have been reared mainly for meat, with breeds such as *parda de montaña*, *roya pirenaica*, *pirenaica* or more recently, *bruna pirenaica*. The presence of goats in these migrations, with the *pirenaica* breed, is very significant, with pure flocks of this species. Horse pastoralism (traditionally mostly mules) also plays an important role, with highly specialised areas such as the Camprodon valley or Pallars.

Development

Pastures with greater water availability developed a specialisation in horses (as in Cerdanya, from 18th century) and dairy cattle for cheese (as in Alt Urgell and Cerdanya). In the 20th century, however, there was a typical general decline, although less than in transhumant livestock. Complemented by agriculture, transterminance has better resisted the pressures of modernisation. The abandonment of *panares* (high-altitude cereal crops related to polyculture) at the beginning of the 20th century increased the possibility of spring and autumn grazing, thus increasing the possibilities for transterminance. In addition, the agricultural system shifted from cereals or potatoes to fodder (*alfalfa*, *sainfoin*) since the 1950s and then to pastures from the 1970s on (Pallaruelo 1993). There have also been changes in the species used. Up until the 1950s, cattle – partly dairy – were the main species used, but then they became more meat-oriented, with a radical increase (400 per cent between 1959 and 1993 in the Aragonese Pyrenees alone) (Pallaruelo 1993). This has led to the decline of almost all other species. Goats, horses and pigs are now scarce. There has also been a strong tendency towards stabling and intensification. Particularly in the southern valleys of the Catalan Pyrenees, there has been a huge intensification of livestock production for dairy cattle and fattening pigs, to make cereal production more profitable. In the Alta Garrotxa, for example, the landscape has changed in 50 years from a predominantly agro-pastoral one (almost 50 per cent) to a predominantly forestry one (over 90 per cent) (Vila et al. 2003). The expansion of tourism has also had a significant impact on the abandonment of livestock farming (Ventura et al. 1995).

1.3. Medium mountain-coast transterminance

It is common all along the Iberian coastal regions to be surrounded by the sea on one side and mountain ranges on the other. This situation simultaneously limits and allows migrations, which follow the altitudinal gradient. There are many regional differences, but proximity to the sea, with high humidity and mild temperatures, allows more plant productivity in winter than in the interior. In addition, the saline pastures associated with marshes and wetlands play (or played) an important role in animal nutrition. Summer drought in these areas is mitigated by the shift in the altitude gradient towards the mountain ranges of each region. Here, the dependence on agronomic supplementation is less than in the mountain-valley transitions, but there is often a co-dependence between pastoralism and horticultural agriculture of the coastal plains, favoured by these mild temperatures.

1.3.A. Canary Islands

Geography

The volcanic origin of the Canary Islands has configured an orography of strong altitudinal contrast in several islands: Tenerife, Gran Canaria, Gomera and El Hierro. This generates strong ecological differences that condition the availability of pasture throughout the year. Thus, oscillating migrations are logical in the short, but abrupt, distance that separates the coast from the high volcanoes. In the archipelago, rainfall is progressively reduced from west to east. In turn, in each volcanic island there are differences in productivity due to the Foehn effect of the orographic barriers. As a result, different ecoregions are found in a reduced geographical scale.

Tradition

Transterminance occurs on the islands of El Hierro, La Palma, Tenerife and Gran Canaria, the latter being the island where pastoralism is most deeply rooted. Sheep and goats have traditionally been the main grazing species, but cows are also widely used and appreciated on the more productive islands, such as Tenerife and Gran Canaria (canaria breed) or La Palma (palmera breed). A symbol of the mobility of livestock at high altitudes is the shepherd's leap, made with a kind of pole used to advance in areas with complex orography. A particular example of this transterminance is the *mudada* of El Hierro. It consists of seasonal migrations between the coastal areas, such as El Golfo in winter, where agriculture predominates, and the highlands, such as Nisdafe in summer, where pastoralism predominates. This movement had a family character and involved the migration of all the members. The peculiarity of this transterminance lies in the fact that the migrations in both directions are not annual, but bi-annual, descending to the coastal areas in December and early summer, and ascending to the plateau in March and September (Sánchez Perera 2011).

Development

The Canarian maritime isolation has not prevented them from the influence of the farming systems of their continental neighbours (Velasco Vázquez et al. 2001). The origin of local breeds is blurred between the arrival of the peninsular settlers and the previous movements of aborigines of North African origin. There is evidence of the evolution of agricultural production models in the centuries prior to colonisation (Moreno Benítez & González Quintero 2013). Later changes include the arrival of cattle, with the Canarian breed as a legacy of this introduction (Castellano-Alonso et al. 2018). Thus, continental livestock was adapted to the specific characteristics of the islands, leading to numerous ecotypes: goats (majorera, palmera or tinerfeña), sheep (canaria or canaria de pelo), cattle (canaria or palmera), pig (cerdo negro canario) or donkey (majorero donkey) (MAPA 2019). It must be said that not all Canarian breeds are linked to transterminance.

The isolation of the islands maintained certain stability in livestock farming until the 20th century. Agricultural ploughing accentuated then the need for mobility in the context of scarce grazable land (Sánchez Perera 2011). However, throughout the 20th century, the abandonment of grazing and livestock farming was very important. With four national parks, the Canary Islands are the Spanish Autonomous Community with the highest number of protected areas. The limitations of grazing in these protected areas has had a significant impact on the decline of pastoralism. For example, the transterminance of Tenerife to the Teide disappeared with the declaration of the National Park in 1954, with similar situations in the rest of the islands. On El Hierro, transterminance persisted until the 1960s (Sánchez Perera 2011) and on La Palma it is still present today (Cáceres 2021). In Gran Canaria, the decline has been and continues to be constant, although it is the island with the best survival of this management.

I.3.B. Cantabrian fringe

Geography

Transterminance of the Cantabrian pastoralists covers the distances between coastal areas (Asturias, Cantabria and Basque Country) and the Cantabrian Mountains, between the Montes de León and the Atlantic Navarrese mountain ranges (Urbasa and Andia). These large mountain pastures are available in summer when pasture is scarcer in valleys and coastal areas. The gradient of complementarity is therefore altitudinal, even if in the coast, the Atlantic influence allows vegetative growth almost during the whole year. Overall, three types of pastures can be distinguished in the area used by these transterminating systems: coastal, lowland or highland

rangelands. The backbone of transterminance is highland rangelands, migrating to both lowlands and coastal areas. On the coast, marshes with salty nutritious grass have historically played an important role in transterminance, although it has dwindled now.

Tradition

Transterminance was logical in the north of Spain, with an orography that allowed a low dependence on agriculture. In the Cantabrian pastoral community, there are included communities with great cultural and even ethnic traditions that have been relatively well preserved, such as the shepherds of Vaqueiros de Alzada or the Pasiegos. The transterminance in Asturias and Cantabria is carried out with the bovine species, highlighting the tudanca, asturiana de los valles and asturiana de la montaña. In the Basque Country and Navarre, although extinct at the beginning of the 20th century, there was an important transterminance of Latxas sheep for several centuries. These migrated from inland mountain ranges, such as Aralar or Urbasa, to the coast of Guipúzcoa and Vizcaya (Aragón Ruano 2002). Equine transterminance was also widespread in this area. With such pastoralist tradition, there is a particular diversity of species and breeds related to these ecoregions (Velado-Alonso et al. 2022).

Development

Cantabrian transterminance is influenced by different strong social and identitarian groups that have led to different developments. In Asturias, for example, transterminance was traditionally managed by the Church. When the Church turned to a more sedentary pastoralism, transterminant management was relegated to groups which over time became almost an ethnic group: the Vaqueiros de Alzada. After liberalist land confiscations and privatisations, the pastures available for transterminance became increasingly marginal, especially on the coast, to the point that, currently, only remain in poor soils and sloping terrain (García Martínez 2003). Similarly, the Cantabrian Pasiegos have a semi-nomadic way of life with several dwellings along their management area. The Pasiegos move between the inland valleys of the Pas and the port areas of Cantabria and Burgos. In the Pas valley, largely due to its orography, traditional management has been well preserved (Rubio de Lucas 2003). The private nature of the Pasiego transterminants contrasts with the usual communal management of land in mountain areas. The movement of Tudanca cattle takes place between intermediate areas near the coast of the Nansa, Saja and Besaya valleys and the mountain pastures in Alto Campoo (both areas in Cantabria), regulated by the 'Comunidad de Campoo-Cabuérniga' which administers one of the most extensive common lands in Spain, with regulations establishing different categories of grazing rights for the villages in the area. The reference locality for Tudanca breed is Cabezón de la Sal, where an important fair is held every year. The breed is also widespread in some mountain areas of Palencia (Gómez Sal et al. 1995).

Finally, in the Basque Country, transterminance is extinct since the beginning of the 20th century. In the whole transterminant area, there has been a loss of the pastoralist activity from the coast to the mountains – related to the widespread industrial activity and the competition for land, e.g., for forestry uses. In this gradient, Friesian dairy farming replaced traditional farming systems by the beginning of the 20th century (Rubio de Lucas 2003). Similarly, the rate of abandonment is higher in the valleys than in the mountains. Today, intensive dairy farms have largely replaced long-established farming systems such as the tudanca cow transterminance in the valleys of the Pas. Generational replacement, although worrying, is in a better state than in other transterminances (Mayor López 2002). The Asturian scenario, for example, seems to be

relatively favourable in terms of conservation measures and economic viability (Rubio de Lucas 2003).

I.3.C. Levantine

Geography

From Catalonia to Murcia, there is a similar orographic structure along a coast-interior axis. The coastal areas are valleys, with increasingly irregular mountainous areas when moving inland. With such a configuration, and because of abundance of limestone aquifers providing stable irrigation resources, the coastal areas have traditionally been used more for horticultural activities and trade, pastoralism being less relevant here (Fernández Temprano et al. 1996). However, this has not prevented a complementary link between mountain productivity in summer and coastal productivity in winter. This allows the stocking rate in these areas to be much higher than in sheep-cereal systems (Correal & Sotomayor 1998).

Tradition

Livestock farming in the Spanish Levant has been mainly transhumant. Pastoralists usually lived in the pre-coastal and mountain ranges, and here agriculture was scarce due to the difficulties of farming. Even the inland valleys of Alicante and Murcia (Elche, Murcia or Bajo Segura), nowadays eminently agricultural, were more pastoral-oriented when population density was low. Since at least the fourteenth–fifteenth centuries, these areas have been receiving livestock farmers from further west, even transhumant ones (Madrid, Guadalajara, Cuenca, Albacete and Valencia). Conversely, livestock had a rather domestic function on the coast, and it was common to exchange crop residue or stubble pasture for manure (Fernández Temprano et al. 1996).

Development

The large-scale ploughing of the Mediterranean valleys affected all these areas from the 18th century onwards. The profitability of agriculture increasingly reduced pastoralism, which was seen as antagonistic to agriculture, and it became an increasingly marginal activity. Throughout the 20th century, there was a process of migration and settlement of mountain pastoralists to the coast, which led to the sedentarisation of livestock farming (Fernández Temprano et al. 1996). Often, landowners have increased the concentration of animals and/or intensified livestock, linked to the importation of feed by sea. As a result, grazing in general, and in particular transhumance, are now very minor activities in the Spanish Levant.

I.3.D. Penibetic

Geography

Eastern Andalusia has a semi-arid climate with low crop productivity, severely limiting forage availability, especially during summer. However, the presence of numerous mountain ranges allows summer grazing over relatively short distances when plant growth is otherwise at a standstill. Pastures in these areas are generally limited, although highly nutritious. The logical wintering areas extend from the coastal pastures of Almería to Málaga. Sierra Nevada Range is the largest summer area, although it is not the only one (Rubio de Lucas et al. 1995). There are also logical movements between smaller mountain ranges and the coast, such as those from Alhama de Granada or Loja to La Axarquía, or from Ronda to Estepona (Rubio et al. 1998).

Tradition

Livestock has not had a very relevant tradition in these areas in absolute terms. Goats have been especially relevant, with highly productive breeds such as the Malagueña and the Murciano-

Granadina, the latter especially associated with more arid areas (Granada, Murcia, Almería). In wintering areas, constant movements in crops such as almond and olive trees are very common.

Development

Throughout the 20th century, there was a specialisation of goat farming to the detriment of sheep farming. Meanwhile, the expansion of irrigated horticultural crops has been enormous in semi-arid coastal areas, especially thanks to the expansion of irrigation. With a spectacular increase in greenhouse crops, problems for livestock farming arise, due to non-organic agricultural waste and the lack of available pasture. Therefore, the number of animals migrating to the coast has been dramatically reduced and largely replaced by truck transport (Rubio de Lucas et al. 1995).

II. SHORT-DISTANCE TRANSTERMINANCE

In mountainous regions, the functioning of the ecological dynamics of pastoralism is often linked to short altitudinal movements. Local movements are less intense than other types of movement capable of supporting large livestock herds, but they may be enough to maintain a sparse pastoralism throughout the year. Historically, it may have been one of the most important pastoral systems in Spain, as the changing management of the territory by different societies and political systems may have hindered more complex forms of organisation (Fernández Otal 2005). In the case of short transterminance, valley areas frequently need supplementation in times of scarcity, especially when there is competition for land use with agriculture. This agricultural use is determined by bioclimatic factors – a clear distinction arising between the Atlantic and Mediterranean bioclimates. In the former, supplementation is based on fodder harvested during the year, while in the latter it is complemented with agricultural inputs, such as stubbles.

II.1. Agricultural transterminance

Geography

Along the Mediterranean bioclimate, agriculture has been a major component of land use. Most of it is cereal cultivation, especially in the plains and sedimentary basins. The most remarkable are the broad plateaus of Castile and León, Castile-La Mancha, the Ebro basin and the lower Guadalquivir basin. But the Mediterranean coast also stands out for its horticultural farming. In many of these areas, the nearby non-arable mountains facilitate small-scale complementarity of animal feed, with support from crops. In the mountainous areas, the silvopastoral use of deciduous *Quercus* in the north, *Pinus* and evergreen *Quercus* in the east, and evergreen *Quercus* in the southwest, is very important. Agricultural transterminant areas include nearly all the Mediterranean mountain ranges in Spain: Montes de León, Sistema Central, Sierra de la Demanda, Cameros, Sierra Ministra, Sierra del Moncayo, Montes Universales, Sierra de Gúdar, Cordilleras Costero Catalanas, Sierra Norte de Sevilla, Sierra de Córdoba, Sierras Béticas and the mountains of Málaga and Cádiz, among others. At the country level, there is a west-east productivity gradient, although the differences in livestock production have not been significant until recently when in arid eastern areas, such as the Montes Universales, the use of the land for forestry has dominated over grazing. Given the vast geographical extent of transterminance, the diversity of management, breeds and cultures is evident.

Tradition

The use of cereal crop residues, mainly by sheep, has been interpreted as essential for the compatibility of activities, although the use of goats is also important in more arid areas. A relevant example of this relationship is the 'derrota de mieses', which turned private agricultural

land into public ownership for livestock grazing. The law was in force by law until the liberal era of the early 19th century, when private land rights prevailed. There are many breeds associated with transterminance, especially sheep, with other species also frequent: cattle in the more humid areas (e.g. León) or goats in drier areas (e.g. Penibetic mountain ranges). Some of the most important breeds are the castellana, churra, ojalada soriana, alcarreña, guirra or segureña sheep, or the pajuna cow.

Development

With the productive needs of a growing population after the 17th century, two main reasons encouraged the adoption transterminant pastoralism of reduced distances in agricultural areas: low availability of grazing land in the lowlands due to competition with agriculture, and the availability of agricultural residues as food source. The most relevant crop residues are stubble and fallow lands in the autumn and winter months, with horticultural residues also been used in hotspots such as Valencia or Cádiz. In the horticultural hotspots, however, transterminance only became relevant more recently, encouraged by high feed availability from the expansion of irrigation or mechanisation. This may have led to reduced distances travelled by transhumant or transterminant pastoralists. The Green Revolution implied the final decoupling between livestock and agriculture, driving all kinds of grazing systems to collapse. At the same time, other problems, such as the rising price of arable land, and agricultural waste such as greenhouse plastic or pesticides, also caused farmers to lose interest in these resources. In parallel, industrial livestock farming with weak territorial links developed throughout the 20th century. In some regions, industrialisation was encouraged by the need to satisfy the needs from a high human population density: the Mediterranean strip, the Pre-Pyrenees, and the Central System around Madrid. These difficulties, exacerbated by urban-oriented regulations, led to a dramatic abandonment of mobile pastoralism from the second half of the 20th century onwards.

II.2. Forage transterminance

Geography

This short transterminance extends widely along the Cantabrian coast, including the upper valleys of the Pyrenees, in areas ecoregionally uniform for livestock (Velado-Alonso et al. 2022). Here we find a climate very suitable for pasture productivity with irregular orography. This makes it possible to keep livestock herds close to settlements while enabling short seasonal migrations. Forage production is very high in the spring and even in the autumn, with an overproduction difficult to consume, so haying allows the maintenance of livestock during winter (Montserrat & Fillat 1990). Agricultural supplementation has traditionally been low compared to the proportion of spontaneous or harvested natural fodder sources.

Tradition

While private land ownership generally encourages more sedentary management, public ownership encourages mobility to common or shared lands (Aragón Ruano 2006). Public ownership added to a strong organisation with key rights at the local level (Barandiarán et al. 2000) resulted in a prevalence of transterminance until the present day. Transterminating herds are smaller in size than those with longer mobility, but also more numerous (Pallaruelo 1993). Equine transterminance has been particularly symbolic, in addition to the more common bovine and ovine transterminance. In addition, pig transterminance was common in silvopastoral regimes in the past, although this system is now extinct (Barandiarán et al. 2000; García Martínez 2003; Montserrat & Fillat 1990).

Development

Despite its traditionality, changes in mobility in the second half of the 20th century helped to encourage forage transterminance, allowing the farmer to stay at home for the whole year. Transterminance persisted better with moderate population density, while the decadence is evident in areas such as the Pyrenees, with a sharp population decline and a shift to other economic activities such as tourism. In the Cantabrian strip, the abandonment of cereal crops seems to have contributed to the maintenance of transterminance through the expansion of rangelands (Mayor López 2002), which has not occurred in the plateau areas. Today, the transterminant species show a gradient from the predominance of cattle in Galicia to sheep in the Basque Country and Navarre (latxa breed), although, prior to the extensive land clearing from the 16th century on, cattle and pigs were also the main species here (Aragón Ruano 2006). In Asturias, sheep and goats used to be more common, but were gradually replaced by cattle. In Navarre and the Pyrenees there is a better balance between sheep and cattle and also goats. Short transterminance with horses is also still very important, with several breeds of related phylogenies, such as the galaica, asturcón, monchina, losina, pottoka, jaca navarra and pirenaico catalán (Cañon et al. 2000).

III. DAILY MOBILITY

In the absence of seasonal migration, livestock in Spain probably need to keep some kind of short-distance mobility (Gómez Sal 2001), leading to daily mobile grazing. Typically, stocking rates are small (compared to migrating systems) due to reduced forage availability, which may be limited at certain times of the year. In addition, it is common for these farms to be located close to population centres where there is competition for land use (especially in earlier times when the population was sparser). This constraint means that in times of scarcity, animals are largely dependent on inputs derived from agriculture.

III.1. Agro-silvo-pastoralism on *Pinus* woodlands

Geography

Limited by a long dry season, small farms in private land have developed a common grazing system in most of Mediterranean Catalonia. Although potentially dominated by *Quercus*, the historical vegetation is dominated by *Pinus* (*halepensis*, but also *nigra* and *sylvestris*) on rosemary, garrigue, and vineyard terraces abandoned after the phylloxera 19th century epidemic. Medium-size farms in low mountainous areas have adequate area and slope for cereals, vines and olive trees. This situation enables a combination of *Pinus* silvopastoralism with crop-derived resources such as cereal stubbles, or vine and olive chaff. The protein obtained from the forest undergrowth and the humidity conserved by shade allowed for subsistence, avoiding the need for transhumance and fertilising poor soils in organic matter. The provinces of Barcelona and Tarragona stand out in this system, although it is also widespread in parts of the Mediterranean Girona.

Tradition

These are family-run, medium-sized holdings (150 to 250 ha), centred on the farmhouse as the management unit. Traditionally, interior crops have been cereals (pre-coastal and inland depressions) and vineyards (coastal and pre-coastal mountain ranges). Forest management (wood and charcoal) was an important source of income until the second third of the 20th century. Sheep and goats were used for this purpose, the most important being the Ripollesa sheep.

Development

The general trend towards intensification, labour shortage and profitability decline of forestry led to the abandonment of activities that were difficult to mechanise. Since the 1970s, farmers have focused on cereal production and on industrial pig farming. In the border areas between the Mediterranean and Eurosiberian biomes, pastoralism was better preserved, with a shift to cattle (bruna pirenaica and other breeds imported from Occitania such as salers). More recently (1990s and 2000s), *Pinus* silvopastoralism recovered to reduce wildfire risk. Recent investments by institutions in private land have made it possible to open up forests that had been abandoned and were structurally dense and closed. This, together with fire prevention programmes, is leading to a large increase in the cattle population.

III.2. Agro-silvo-pastoralism on *Quercus dehesa*.

Geography

Quercus is the potential tree genus in most of the Peninsula and the Balearic Islands (IGN 2019). Its compatibility with herbivory has made it an essential resource for most pastoral systems. The *dehesa* is a specific case of this traditional use, which is of great socio-economic and environmental importance. The physical structure of the *dehesa* is, by definition, a semi-natural savannah with a constant effort to keep it open, without an excess of shrubs, and with a controlled balance in the tree layer. This responds to the Mediterranean area of the Hercynian Massif not being suitable for crops, due to a combination of a long summer drought and a thin soil layer. For this reason, pastoralism has been the predominant use in this area (Costa Pérez et al. 2006). The *dehesa* configuration is popular in the temperate Mediterranean climate, with strong seasonal variations in rainfall that limit the growth of herbaceous grasses – but where the tree shadow extends the growing period (Joffre et al. 1999). With different degrees of tree cover, the *dehesa* landscape (mainly *Q. ilex*) expands from the southwest of Salamanca to Sierra Morena in a north-south direction, and from the Portuguese Alentejo to Ciudad Real in a west-east direction. In addition to *Quercus*, there are also *dehesas* of species such as ash (Ruiz & Beaufoy 2015) or wild olive (Costa Pérez et al. 2006). In more humid areas of the peninsular north, other *Quercus* agro-silvo-pastoral configurations such as *Q. robur* or *Q. faginea* also abound, without being associated with the *dehesa*. This is the case of the *boalares* in the Aragonese Pyrenees (Pallaruelo 1993).

Tradition

Quercus agro-silvo-pastoralism is one of the oldest documented pastoral systems in Spain. The word '*dehesa*' is documented around the year 924 and its archaism *defesa* seems to appear much earlier (Olea Márquez de Prado 2011). In its evolution, the dominance of *Q. ilex* over other tree species and *Quercus* is a deliberate selection for food production (Ezquerria Boticario 2011), since its acorn has been highly valued for its nutritional importance in autumn and, more recently, as a quality indicator (Díaz-Caro et al. 2019). In a delicate ecological balance, the *dehesa* has been appreciated for its self-sufficiency. Typically, 10–30 per cent of the land is cultivated, while the rest is variably managed (Montserrat & Fillat 1990; Olea Márquez de Prado 2011). Browsing also plays an important role in the diet of ruminants in the *dehesa* (Costa Pérez et al. 2006). Classifying the *dehesa* is difficult because it is frequently integrated with other pastoral systems. This is the case of transterminance between mountain areas and *dehesa* areas, such as that between Sayago and Guareña-Tierra del Vino in Zamora (Prada Llorente 2016). Land tenure of the *dehesa* is often linked to latifundia. The tree cover increases in a north-south gradient, similar to the density of pigs (of the ibérico breed), due to the importance of acorns in their diet. The ibérico pig is associated with *montanera*, the acorn-based grazing and fattening phase between November and February (Olea Márquez de Prado 2011). Apart from the ibérico pig,

many ruminant breeds are associated to *dehesa*, e.g., cattle (morucha and negra avileña ibérica) and sheep (entrefina) in Salamanca. Also in Salamanca, the sayaguesa cow combines grazing in *dehesas* with transterminance. In Extremadura, most relevant breeds are cacereña cow and merino sheep. Throughout Sierra Morena, there is high cattle diversity (retinta, berrenda en negro y berrenda en colorado, lidia, cardena andaluza), with an important sheep presence (merino negra) and also goat in the rougher pastures of the eastern area (blanca serrana andaluza). It is common for one single farm to host several livestock species, such as the Morucha cow keeping the ground clear of brush for the sheep to graze on (Montserrat & Fillat 1990).

Development

In the past, when the extension of *dehesas* was bigger (Fernández Temprano et al. 1996; Royo Pérez 2020), they were very associated with the rearing of draught cattle (*dehesas boyales*) – the word derives from ‘defence’, rangeland areas defended/protected from ploughing. Sedentary farming was therefore very common in the *dehesa* even before the availability of stubble as a result of agricultural expansion. After the mechanisation phase, cattle *dehesas* have specialised in meat and bullfighting cattle. Nowadays, the *dehesas* are preserved relatively well in central-western Spain, while being replaced further east by agriculture and silviculture, with the disappearance of *Quercus*. With the demographic pressure of the 20th century and after a series of confiscations and land privatisations, the communal organisation was lost. In the second half of the 20th century, pigs stopped using stubble and were mostly supplemented with feed. At the same time, the African swine fever also reduced the number of *dehesas* due to the difficulties of sanitary control in grazing systems (Costa Pérez et al. 2006). More recently, with the revaluation of the ibérico pig, the *dehesa* value also increased. Its socio-economic recognition makes it one of the most important extensive farming systems in Spain today. Among ruminants, a shift from sheep to cattle is also taking place in the *dehesa* (Olea Márquez de Prado 2011), to the point that almost all the grazing cattle of the Mediterranean biome are found in the *dehesas*.

Among the current problems of the *dehesa*, there is a consensus that the lack of tree renewal, abandonment and climate change are the main threats to its sustainability – trashumance playing a positive role in tree regeneration (Carmona et al. 2013). The Spanish *dehesa* and the Portuguese *montado* deserve an evolutionary comparison. The *montado* partially collapsed to the point of extinction after Portugal's independence in 1640. At that time, as a result of the mistrust caused by the war, borders were established that hindered and restricted the movement of people and goods (Rodríguez Tejo 2015), a situation that was aggravated by the crisis in Extremadura and ended up being permanent (García Barriga 2008). The closure of the borders put an end to transhumance, but also to the importation of cereal from Castile (White 1987). Accompanied by greater pressure to feed a growing population, the *montado* was increasingly disrupted and experienced a major setback in favour of a much more agricultural orientation (Pinto-Correia & Margarida Fonseca 2009). At present, the dimensions of the *montado* are in no way comparable to the Spanish *dehesa*, which is likely to have been protected from ploughing by transhumant production.

III.3. Cereal grazing

Geography

Cereal is the main land use in the Spanish vast plateaus and in the sedimentary basins of great rivers such as Ebro and Guadalquivir. Sheep is the species best adapted to this bioclimate, so due to the need for the decomposition of agricultural residues and its value as feed source,

cereal grazing is logical in all these areas. The interdependence between livestock and agriculture is particularly relevant here. The need to remove stubble and fertilise fallow land is ideal for feeding livestock during periods with no vegetation growth.

Tradition

The main winter crops were, and are, wheat, barley, oats and rye. After the harvest, the use of stubble and fallow land by sheep has been essential in Spain, and this was considered the necessary link between agricultural and livestock practices (Correal & Sotomayor 1998; Pérez Badia et al. 2011). It was also essential for livestock subsistence during the vegetative fallow period. During the rest of the year, grazing was carried out according to the spontaneous resources available, such as in silvopastoralism. Livestock then usually graze on low-productivity wasteland, natural pastures, forests or fodder (Pérez Badia et al. 2011). Other agricultural by-products related to livestock feed, such as sugar beet, vines, or olives, are also traditional. The main breeds are churra, castellana, rasa aragonesa and manchega. The florida goat also has a similar productive base.

Development

The importance of stubble fields was such that, until the end of the Old Regime in 1812, the 'derrota de mieses' transformed private agricultural land into public access land for livestock use. This law was considered a political solution to the expansion of arable land, allowing the coexistence of agriculture and livestock (Bacaicoa Salaverri et al. 1993). However, the progressive specialisation of agriculture in the last century had a sudden impact on this system, which was deeply rooted in tradition and interdependence. The availability and cheap price of fertilisers, and the mechanisation of agriculture, have made animal digestion of stubble unnecessary. In addition, the consequent possibility of farming every year the same land has reduced the amount of fallow land. Moreover, the surplus of cereals for human consumption and their redirection to animal feed has ended with the need for animals to access stubble fields. Grazing problems have also increased with the progressive reduction in stubble production, due to the genetic and productive improvement of cultivated cereals, the scarcity of pastures in cereal areas, or problems with agrochemicals.

III.4. Polyculture

Geography

When the farming model is oriented to self-sufficiency and the population is sparse, it is possible to satisfy animal feeding demands near to the homestead. Therefore, it is probable that polyculture has been one of the major forms of supply since ancient times (Fernández Otal 2005). In the last centuries, polyculture stands out in the Atlantic regions, in the Mediterranean coast (especially in Valencia and the Balearic Islands) and also in areas with difficult agricultural specialisation, i.e. the high-altitude villages of the Pyrenees (Amorena Udabe et al. 1996; Pallaruelo 1993; Ventura et al. 1995), Montes de León (Terés Landeta et al. 1995), Sierra Nevada (Rubio de Lucas et al. 1995) and a large part of the Canary Islands, including the arid easternmost islands (Fuerteventura and Lanzarote) and the mountainous areas of the rest of the islands with little sedimentary material (Burriel de Orueta 1980). Polycultures can sustain low-productive agricultural diversity to feed small livestock. The feeding of polycultures is therefore based on the combination of grazing with the addition of fodder from mowing and agricultural residues, usually supplemented by stands of *Fagaceae* woods such as *Quercus* spp. and *Castanea sativa* (Gómez Sal 1994). Diversity becomes evident in the different reasons for conservation of polyculture: in the Atlantic regions, the complex orography, the communal organisation or the

high pastoral productivity; in the Mediterranean, the mild climate and the consequent diversity of food sources.

Tradition

The polyculture has lost much of its importance during the profound economic and social changes of recent centuries. Due to its diversity, it provided more stability than the specialised orientation and allowed for using smaller fields (Enriquez Fernández & Gogeochea Arrien 1995). However, under high pressure for productivity, it is now threatened with extinction. In areas of high natural productivity, it has better survived until the second half of the 20th century, with the Galician polyculture as symbol (Montserrat & Fillat 1990). On the Atlantic regions, polyculture is characterised by crop rotation, with the forest products as a fertility source (i.e., residues from shrub clearing in rangelands or oak leaves) and the intervention of animals in the agricultural metabolism (especially cows and pigs). Animals are also supplemented with crops and forest resources: rye, turnips, linseed, acorns and chestnuts, and, since the beginning of the 17th century, potatoes and maize (Montserrat & Fillat 1990; Pérez García 2007). Extant breeds associated to polyculture are cattle (rubia gallega) or pork from the Celtic branch (celta gallego, gochu astur-celta, or euskal txerri). In the Mediterranean, livestock had more of a domestic function to digest agricultural by-products of small horticulture plots, and provide meat for the family. Diverse breeds are legacy of this system, Balearic Islands standing out, with sheep (mallorquina, roja mallorquina, eivissenca), pork (porc negre mallorquí) horse (mallorquí y menorquí), goat (mallorquina and eivissenca) and cattle (menorquina). Other examples of polyculture are the Pyrenean *pardinas* and *masadas*, i.e. areas for agriculture, forestry and pasture around a farmhouse (Pallaruelo 1993). In the Canary Islands, agricultural systems such as the *enarenados* in Lanzarote, *nateros* in Tenerife and *gavias* in Fuerteventura were parts of the polyculture, with few animals complementing the agricultural subsistence (Burriel de Orueta 1980).

Development

The pressure to increase production, both in terms of quantity and efficiency, had particular impacts on diversified and unspecialised livestock systems. Because of its manpower and forest input requirements, polyculture suffered many limitations due to demographic growth, which required insufficient renewal of forest resources (Enriquez Fernández & Gogeochea Arrien 1995). The decline of polyculture thus began with the farm specialisation in agriculture, livestock and forestry. Today, polyculture is a residual system. By the end of the 20th century, its extension was limited to mountain areas of Galicia, Asturias and León (Caro Baroja 1977; Gómez Sal 1994; Montserrat & Fillat 1990). In the Atlantic regions, changes arrived along a coast-interior gradient due to geographical factors, such as proximity to the sea, population density, or orography. For example, the arrival of maize translated into crop specialisation in the coast, although the polyculture vocation was not lost until the specialisation in high-productivity dairy happened, also on the same gradient (Pérez García 2007). Another key factor in the loss of Atlantic polyculture is the industrialisation at the end of the 20th century, which attracted labour from the first sector, affecting small and subsistence farms (Etxezarreta 1977), and which triggered *Pinus* and *Eucalyptus* silviculture with no foraging value. Pigs were particularly affected in these transformations, as traditional silvopastoralism in oak and chestnut groves has almost disappeared. In the Mediterranean region, pig was also an optimal animal because of its ability to use agricultural residues without large land use. This family-based pastoralism survived in good conditions until the first half of the 20th century, supported by the wide availability of agricultural by-products such as almond trees, vines, prickly pears and carob trees. With the green revolution, abandonment of pastoralism, and shifts towards more lucrative economic

activities such as tourism, drove the specialisation of livestock farming. However, the importance of polyculture is still evident in the Balearic Islands, where porc negro is considered a hallmark of traditional farming. Finally, the abandonment of polyculture goes hand in hand with the abandonment of cultivation in areas where mechanisation is difficult. Throughout the 20th century, farm abandonment happened in many mountainous areas of Spain, related to accessibility and difficulty of cultivation (Lasanta et al. 2017). Interestingly, abandonment has caused erosion problems in places where natural plant regeneration is difficult, as in the case of the Canary Islands (Burriel de Orueta 1980).

III.5. Browsing

Geography

Shrubs often dominate natural landscape in Mediterranean areas, in the mountainous areas of the south-eastern third and parts of the Balearic Islands, and in areas of the Canary Islands (IGN 2019). Moreover, it is usual browsing of trees regrowth kept rear to ground level, especially *Q. pyrenaica* (bardales, barderas) in the Central System and *Q. ilex* in the Mediterranean. Genetic adaptation of livestock here allows for a diet highly based on browsing. Browsing can also be relevant in other pastoral systems, such as *dehesas* or Mediterranean transterminances. But more sedentary grazing systems of the Spanish southeast fundamentally rely on browsing to feed livestock during long periods of the year. This includes daily mobility in the provinces of Almería, Murcia and Granada, and in mountainous areas in Andalusia (from the Sierra de Grazalema to the border with Murcia), Castilla la Mancha (Sierra de Alcaraz), Valencia (inland mountain ranges) and southern Catalonia (Ebro and Tarragona mountain ranges). Browsing is also widespread in the Balearic and the Canary Islands (in the latter, increasingly important towards the west).

Tradition

The low nutritional quality of wood pastures requires a diversified diet, which explains a widespread agro-silvopastoralism among browsing pastoralism. This is also due to the scarcity of grazing land, which forces the use of all available sources, including agricultural residues from olive trees, almond trees, vineyards or palm trees (Gómez Sal 2001). For example, all almond by-products were used for animal feed, although they could also be used as fuel or as a hygiene product (soaps) (Morey & Fornés 2021). In Valencia, tree stands are also used, varying from halophytes on the coast to garrigue inland, including date orchards. Browsing is closely linked to smallholdings and family farms, as well as to certain species, with high diversity of goat (murciano-granadina, malagueña, florida, blanca celtibérica, blanca de rasquera, payoya, majonera y tinerfeña) or, to a lesser extent, sheep (segureña or guirra).

Development

Since the Green Revolution, the need for profitability has led to the intensification and confinement of this system, especially for dairy goats. A highlighted breed is the murciano-granadina breed in the provinces of Granada, Jaen and Murcia, and the malagueña breed in Málaga (Castel et al. 2003). The expansion of industrial livestock farming has also been typical of these areas in recent decades, especially in Murcia and Valencia. These changes are mainly due to lower demand for meat goats, difficulties in adapting to health regulations, and the increase in milk prices in the 1990s, which led many farmers to switch to this orientation (Castel et al. 2010). Pastoral activity is now marginalised to mountainous and lowest-productive areas (Junta de Andalucía 2016). Persistently low prices of meat and the low recognition of pastoralism are severely threatening the continuity of the system (Morales-Jerrett et al. 2020). In Valencia, the difficulty of access large crop areas leads most of them to use ravines and other rough

terrains. The guirra is in sharp regression, with small herds of a maximum of 200 head, having been replaced by Manchega, Segureña and their crosses. In Catalonia, the abandonment of vast extensions of vineyards, replaced by scrubland, has allowed the subsistence of meat-oriented farming in mountainous Tarragona, with the rasquera goat as the best-preserved breed. In the most productive browsing areas with particularly high rainfall (e.g. in the Sierra de Grazalema), preservation has been better, as it enables the use of grazing animals for milking purposes. For example, the browsing with Payoya goat is in a relatively good state of rusticity and conservation. In the Canary Islands, there has been a sharp decline for decades, driven by conservation plans in the Spanish region with the largest number of national parks.

IV. SEMI-WILDERNESS

Due to a lack of planning, semi-wild systems are poorly documented but are present in different parts of the country. With many possible reasons leading to semi-wilderness, it is difficult to distinguish between tradition and development in such a heterogeneous system. It is generally associated with areas of low population density where there is little competition for land use. The species most associated with semi-wilderness is clearly the horse, with examples all over the peninsula. In Galicia, the pura raza galega horse is widespread in the low mountains and forest undergrowth (MAPA 2019). In the Basque Country, its equivalent is the caballo de monte del País Vasco (pottoka), which grazes on the higher hills due to the high degree of human transformation of the lowlands. The pottoka is also bred here in a semi-wild state, but it is common to find confined in winter (MAP 2019). For Southern Spain, in the Guadalquivir marshes and Doñana, caballo de las retuertas and marismeño horses are maroon or wild breeds of great cultural importance (MAPA 2019; Murphy & González Faraco 2002). A further species is the goat, especially in islands, such as the mallorquina breed in Tramontana and Artà. A particular case are semi-wild mallorquina goats, kept in the past on steep, rocky and unproductive mountains and islets, under hunting regime rather than husbandry. A similar situation existed in the Ibizan islet Es Vedra, where crossbreed goats were kept on islets only accessible by boat. Semi-wild sheep can be found with the sasi ardi breed from Navarre and the Basque Country, whose name literally means 'false sheep'. They graze in the mountains almost all year round, although they are usually brought down to the valleys during the cold season (MAPA 2019). In the Canary Islands, the 'apañada' is a cultural element that brings together the shepherds to distribute, mark and appropriate semi-wild goats and sheep. Canarian cattle is also bred in semi-wilderness (especially in Fuerteventura), where they are known as guanil cattle. But in general, cattle are more difficult to find in this regime. Another case is the albera cow in the Catalan Pyrenean forests (Sierra de la Albera). However, the semi-wild status is probably a recent change due to the abandonment of a former short transhumance, rather than a deliberative semi-wild strategy. Sierra de la Albera is much more Mediterranean (and less productive) than the rest of the Pyrenees, so perhaps this is why it was abandoned in the middle of the 19th century.

REFERENCES

Amorena Udabe, A., Fernández de Pinedo Sáez, C., González Pérez, E., & Orcoyen Abaurre, C. (1996). Pirineo Navarro. In Cuadernos de la trashumancia 20. ICONA.

Aragón Ruano, Á. (2002). Trashumancia 'media', entre las sierras interiores y la costa guipuzcoanas, ¿desde tiempo inmemorial? Boletín de La Real Sociedad Bascongada de Amigos Del Pais, 2, 255–283. Boletín de la Real Sociedad Bascongada de Amigos del Pais 58

- Aragón Ruano, Á. (2006). Ganadería, trasterminancia y trashumancia en los territorios vascos en el tránsito del medievo a la modernidad (siglos XV y XVI). *Cuadernos de Historia Moderna*, 31, 39–61.
- Aranda García, J. A. (2016). De pastores y caminos: trashumancia en el Alto Guadalquivir en época romana. *Antiquitas*, 28(16), 39–64.
- Argudo Pérez, J. L. (2006). Vías pecuarias y asociaciones de ganaderos en Aragón. In Ministerio de Medio Ambiente (Ed.), *I Congreso Nacional de Vías Pecuarias* (pp. 407–418).
- Bacaicoa Salaverri, I., Elías Pastor, J. M., & Grande Ibarra, J. (1993). Albarracín-Cuenca-Molina. In *Cuadernos de la trashumancia* 8. ICONA.
- Barandiarán, J. M. de, Manterola, A., & Arregi Azpeitia, G. (2000). Ganadería y pastoreo en Vasconia. In *Atlas Etnográfico de Vasconia* (1st ed.). Etniker Euskalerrria.
- Orden APM/26/2018, de 11 de enero, por la que se modifica el anexo I del Real Decreto 2129/2008, de 26 de diciembre, por el que se establece el Programa nacional de conservación, mejora y fomento de las razas ganaderas., Pub. L. No. BOE-A-2018-749 (2018).
- Burriel de Orueta, E. (1980). La dualidad agrícola canaria: el policultivo tradicional de secano . In *Asociación de Geógrafos Españoles* (Ed.), *Los paisajes rurales de España* (pp. 351–356). Asociación de Geógrafos Españoles.
- Cáceres, R. (2020). Morando entre las nubes (El Pastoreo en Tijarafe). Ayuntamiento de Tijarafe. <https://www.youtube.com/watch?v=DilUO-INEOo>
- Cañon, J., Checa, M. L., Carleos, C., Vega-Pla, J. L., Vallejo, M., & Dunner, S. (2000). The genetic structure of Spanish Celtic horse breeds inferred from microsatellite data. *Animal Genetics*, 31(1), 39–48. <https://doi.org/10.1046/j.1365-2052.2000.00591.x>
- Carmona, C. P., Azcárate, F. M., Oteros-Rozas, E., González, J. A., & Peco, B. (2013). Assessing the effects of seasonal grazing on holm oak regeneration: Implications for the conservation of Mediterranean *dehesas*. *Biological Conservation*, 159, 240–247. <https://doi.org/10.1016/j.biocon.2012.11.015>
- Caro Baroja, J. (1977). *Los pueblos del norte* (E. Txertoa, Ed.; 2nd ed.).
- Castel, J. M., Mena, Y., Delgado-Pertíñez, M., Camúñez, J., Basulto, J., Caravaca, F., Guzmán-Guerrero, J. L., & Alcalde, M. J. (2003). Characterization of semi-extensive goat production systems in southern Spain. *Small Ruminant Research*, 47(2), 133–143. [https://doi.org/10.1016/S0921-4488\(02\)00250-X](https://doi.org/10.1016/S0921-4488(02)00250-X)
- Castel, J. M., Ruiz, F. A., Mena, Y., & Sánchez-Rodríguez, M. (2010). Present situation and future perspectives for goat production systems in Spain. *Small Ruminant Research*, 89(2–3), 207–210. <https://doi.org/10.1016/J.SMALLRUMRES.2009.12.045>
- Castellano-Alonso, P., Moreno-García, M., Rodríguez Rodríguez, A., Sáenz Sagasti, J. I., & Onrubia Pintado, J. (2018). Gestión de la ganadería y patrones de consumo de una comunidad indígena expuesta al fenómeno colonial: el caso de la Estructura 12 de la Cueva Pintada (Gran Canaria, España). *Archaeofauna*, 27, 37–56. <https://doi.org/10.15366/archaeofauna2018.27.003>

- Correal, E., & Sotomayor, J. A. (1998). Sistemas ovino-cereal y su repercusión sobre el medio natural. *Pastos*, 28(2), 137–180.
- Costa Pérez, J. C., Martín Vicente, Á., Fernández Alés, R., & Estirado Oliet, M. (2006). *Dehesas de Andalucía. Caracterización Ambiental* (Consejería de Medio Ambiente. Junta de Andalucía, Ed.). Tecnographic S.L.
- Díaz-Caro, C., García-Torres, S., Elghannam, A., Tejerina, D., Mesias, F. J., & Ortiz, A. (2019). Is production system a relevant attribute in consumers' food preferences? The case of Iberian dry-cured ham in Spain. *Meat Science*, 158, 107908.
<https://doi.org/10.1016/j.meatsci.2019.107908>
- Elías Pastor, J. M., Elías Pastor, L. V., & Grande Ibarra, J. (2005). Alto Macizo Ibérico. In *Cuadernos de la trashumancia 4* (Vol. 1990). ICONA.
- Enriquez Fernández, J. C., & Gogeoascoechea Arrien, A. (1995). Agricultura tradicional en la vertiente norte del País Vasco: Prácticas productivas y organización ecológica familiar. *Lurralde*, 18, 245–256.
- Etxezarreta, M. (1977). *El caserío vasco*. IKER.
- Ezquerria boticario, F. J. (2011). De cómo las *dehesas* se confundieron con su nombre. Reflexiones sobre la génesis histórica de los sistemas adehesados. In C. López Carrasco, M. P. Rodríguez Rojo, A. San Miguel Ayanz, F. Fernández González, & S. Roig Gómez (Eds.), *Pastos, paisajes culturales entre tradición y nuevos paradigmas del siglo XXI* (1st ed.).
- Farnós, A., Arasa, J., Argudo, J. L., Gargallo, E., Porres, A., & Virgili, J. (1993). Gúdar-Maestrazgo. In *Cuadernos de la trashumancia 14*. ICONA.
- Fernández Otal, J. A. (2003). La trashumancia en la antigua Corona de Aragón. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 63–93).
- Fernández Otal, J. A. (2005). Las vías pecuarias en Aragón. Una retrospectiva histórica. In Ministerio de Medio Ambiente (Ed.), *I Congreso Nacional de Vías Pecuarias* (pp. 103–142).
- Fernández Temprano, C., Farnós i Berl, A., Obiol Menero, E., Rodríguez García, M., Virgili Guardia, J., & Arasa Centelles, J. (1996). Mediterráneo. In *Cuadernos de la trashumancia 19*. ICONA.
- García Barriga, F. (2008). Sociedad y conflicto bélico en la edad moderna: Extremadura ante la guerra con Portugal (1640–1668). *Norba. Revista de Historia*, 21, 29–47.
- García Martínez, A. (2003). La trashumancia en Asturias. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (Barcelona, pp. 95–107).
- García Martín, P., & Sánchez Benito, J. M. (1996). Contribución a la historia de la trashumancia en España (P. García Martín & J. M. Sánchez Benito, Eds.; 2nd ed.). Ministerio de Agricultura, Pesca y Alimentación.
- García Sanz, Á. (1994). La ganadería española entre 1750-1865. Los efectos de la reforma agraria liberal. *Agricultura y Sociedad*, 72, 81–120.
- Garzón, J. (1992). La trashumancia como reliquia del paleolítico. In A. de Extremadura (Ed.), *Trashumancia y Cultura Pastoril en Extremadura* (pp. 27–36). Asamblea de Extremadura.

- Gómez Sal, A. (1994). The rural landscapes of northern Spain. *Landscape Issues*, 11(1), 5–12.
- Gómez Sal, A. (2001). The ecological rationale and nature conservation value of extensive livestock systems in the Iberian Peninsula. In ALTERRA (Ed.), *Examples of European agri-environment schemes and livestock systems and their influence on Spanish cultural landscapes* (pp. 103–123). <https://edepot.wur.nl/81891#page=104>
- Gómez Sal, A. (2005). Vías pecuarias y pastoreo extensivo. Valores de conservación y servicios ambientales. In Ministerio de Medio Ambiente (Ed.), *I Congreso Nacional de Vías Pecuarias* (pp. 175–188).
- Gómez Sal, A., & Rodríguez Pascual, M. (1992). Montaña de León. In *Cuadernos de la trashumancia* 3. ICONA.
- Gómez Sal, A., Rodríguez Merino, E., Busqué, J. y Rodríguez Pascual, M. 1995. Pernía-Páramos-Alto Campoo. *Cuadernos de la Trashumancia*, nº 17. Icona. 88 pp.
- IGN. (2019). España en mapas. Una síntesis geográfica. Compendios del Atlas Nacional de España. (2nd ed.). <https://doi.org/10.7419/162.06.2018>
- INEbase. (2022). Índice de Envejecimiento por provincia. Indicadores de Estructura de La Población. <https://www.ine.es/jaxiT3/Tabla.htm?t=1489&L=0>
- Joffre, R., Rambal, S., & Ratte, J.P. (1999). The *dehesa* system of southern Spain and Portugal as a natural ecosystem mimic. *Agroforestry Systems*, 45, 57–79. <https://doi.org/10.1023/A:1006259402496>
- Junta de Andalucía. (2016). Análisis de la ganadería extensiva de Andalucía.
- Lasanta, T., Arnáez, J., Pascual, N., Ruiz-Flaño, P., Errea, M. P., & Lana-Renault, N. (2017). Space–time process and drivers of land abandonment in Europe. *Catena*, 149, 810–823. <https://doi.org/10.1016/j.catena.2016.02.024>
- Leonardo Platón, A. (2003). Cultura material de los pastores. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 157–172).
- Manzano-Baena, P., & Casas, R. (2010). Past, present and future of Trashumancia in Spain: nomadism in a developed country. *Pastoralism: Research, Policy and Practice (Practical Action)*, 1(1), 72–90. <https://doi.org/10.3362/2041-7136.2010.005>
- Manzano, P, Azcarate, F.M., Bencherif, S., Burgas, D., Byambaa, B., Cabeza, M., Cadahía, L., Chatty, D., Eronen, J.T., Galvin, K.A., Herrera, P.M., Holand, Ø., Itani, M., Niamir-Fuller, M., Pauné, F., Perrier, G., Scoones, I., Seitsonen, O., Stenseth, N.C., Varela, E. & Waters-Bayer, A., 2023a, 'eLetter: Grazing research should consider mobility and governance', *Science*, 378(6622).
- MAPA. (2019). Razas de ganado del catálogo oficial de España (Ministerio de Agricultura Pesca y Alimentación, Ed.).
- Marchi, M., Castellanos-Acuña, D., Hamann, A., Wang, T., Ray, D., & Menzel, A. (2020). ClimateEU, scale-free climate normals, historical time series, and future projections for Europe. *Scientific Data* 2020 7:1, 7(1), 1–9. <https://doi.org/10.1038/s41597-020-00763-0>
- Mayor López, M. (2002). Landscapes of northern Spain and pastoral systems. In *Pasture Landscapes and Nature Conservation* (pp. 67–86). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-55953-2_5

Montserrat, P., & Fillat, F. (1990). The systems of grassland management in Spain. In A. Brey Meyer (Ed.), *Managed grasslands* (Vol. 3).
https://www.researchgate.net/publication/274715800_The_systems_of_grassland_management_in_Spain

Morales-Jerrett, E., Mancilla-Leytón, J. M., Delgado-Pertíñez, M., & Mena, Y. (2020). The Contribution of Traditional Meat Goat Farming Systems to Human Wellbeing and Its Importance for the Sustainability of This Livestock Subsector. *Sustainability*, 12(3), 1181.
<https://doi.org/10.3390/su12031181>

Moreno Benítez, M. A., & González Quintero, P. (2013). Una perspectiva territorial al uso del suelo en la Gran Canaria prehistórica (siglos XI-XV). *Tabona*, 20, 9–32.

Morey, A., & Fornés, J. (2021). El cultivo tradicional del almendro en el Mediterráneo: Baleares en el contexto Español (ca. 1770–2017). In *Historia Agraria* (Issue 84, pp. 107–140).
<https://doi.org/10.26882/HISTAGRAR.084E01M>

Murphy, M. D., & González Faraco, J. C. (2002). Las yeguas marismeñas de Doñana: naturaleza, tradición e identidades sociales en un espacio protegido. *Revista de Dialectología y Tradiciones Populares*, 57(2), 5–40. <https://doi.org/10.3989/rdtp.2002.v57.i2.172>

Olea Márquez de Prado, L. (2011). La *dehesa*: reflexiones de un ganadero. In C. López Carrasco, M. P. Rodríguez Rojo, A. San Miguel Ayanz, F. Fernández González, & S. Roig Gómez (Eds.), *Pastos, paisajes culturales entre tradición y nuevos paradigmas del siglo XXI* (1st ed.).

Pallaruelo Campo, S. (2003). La trashumancia en el Pirineo aragonés. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 108–119).

Pallaruelo, S. (1993). Pirineo Aragonés. In *Cuadernos de la trashumancia* 6. ICONA.

Pérez Badia, R., Caballero, R., & Fernández-González, F. (2011). Pastoreo y diversidad florística en el sistema cereal-ovino manchego: entre la tradición y el abandono. In C. López Carrasco, M. P. Rodríguez Rojo, A. San Miguel Ayanz, F. Fernández González, & S. Roig Gómez (Eds.), *Pastos, paisajes culturales entre tradición y nuevos paradigmas del siglo XXI*.

Pérez Figueras, C., Terés Landeta, F. J., Valero Sáez, A., & Barrios Montenegro, J. C. (1992). Sierra de Gredos. In *Cuadernos de la Trashumancia* 1. ICONA.

Pérez García, J. M. (2007). La España agraria septentrional durante el Antiguo Régimen (1500–1850). *Studia Historica: Historia Moderna*, 29, 83–129.
https://revistas.usal.es/uno/index.php/Studia_Historica/article/view/1515

Pinto-Correia, T., & Margarida Fonseca, A. (2009). Historical Perspective of Montados: The Example of Évora. In J. Aronson, J. S. Pereira, & J. G. Pausas (Eds.), *Cork Oak Woodlands on the Edge. Ecology, adaptive management, and restoration* (pp. 49–56). Island Press.

Prada Llorente, E. I. (2016). Paisajes de enlace para el clima: la costumbre trasterminante y el aprovechamiento de rastrojeras en la provincia de Zamora. In P. Riesco Chueca, E. I. Prada Llorente, J. Garzón Heydt, V. Casas del Corral, & P. J. Cruz Sánchez (Eds.), *Pastores: Trashumancia y Ganadería Extensiva* (pp. 43–69).
<https://dialnet.unirioja.es/servlet/articulo?codigo=5691137>

Rivera i Merino, J. (2003). Cataluña, un país trashumante. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 173–201).

- Rodero Franganillo, A., & Rodero Serrano, E. (2007). Las razas ganaderas de Andalucía. Patrimonio ganadero andaluz. Volumen II (Junta de Andalucía. Consejería de Agricultura y Pesca, Ed.; Vol. 2). Viceconsejería .Servicio de Publicaciones y Divulgación.
- Rodríguez Pascual, M. (2003). Evolución de la trashumancia leonesa durante el siglo XX y su adaptación al siglo XXI. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 215–225).
- Rodríguez Tejo, M. J. (2015). Acerca de los passos por donde pasan de Portugal a Castilla: La lucha frente al contrabando a mediados del siglo XVII. In J. J. Iglesias Rodríguez, R. M. Pérez García, & M. F. Fernández Chaves (Eds.), *Comercio y cultura en la edad moderna. Comunicaciones de la XIII reunión científica de la fundación española de historia moderna* (pp. 787–800). Editorial Universidad de Sevilla.
- Royo Pérez, V. (2020). Espacios comunales en las montañas septentrionales del reino de Valencia (s. XIII-XVI). *Aragón En La Edad Media*, 31, 255–294.
https://doi.org/10.26754/ojs_aem/aem.2020314535
- Rubio de Lucas, J. L. (2003). Desplazamientos de ganado y caminos pecuarios en la cornisa cantábrica. In F. Novoa Portela & L. V. Elías Pastor (Eds.), *Un camino de ida y vuelta. La trashumancia en España* (pp. 133–144).
- Rubio de Lucas, J. L., Albert Gamboa, M. J., Muñoz Municio, M. del C., & San José Gómez, S. (1995). Sierra Nevada. In *Cuadernos de la trashumancia* 12. ICONA.
- Rubio de Lucas, J. L., & Martínez López, C. (1992). Valle de Alcodia. In *Cuadernos de la trashumancia* 2. ICONA.
- Rubio de Lucas, J. L., Muñoz Municio, M. C., San José Gómez, S., & Albert Gamboa, M. J. (1993). Alcaraz, Cazorla y Segura. In *Cuadernos de la trashumancia* 10. ICONA.
- Rubio, J. L., Pastor, P., & Castaño, J. P. (1998). Sierras Penibéticas. In *Cuadernos de la trashumancia* 23. ICONA.
- Ruiz, J., & Beaufoy, G. (2015). Informe sobre la elegibilidad para pagos directos de la PAC de los pastos leñosos españoles. Justificación y conclusiones.
- Sánchez Perera, S. (2011). Caminos de ‘Mudada’ al Valle del Golfo. El Pajar: Cuaderno de Etnografía Canaria, 29(29), 143–153.
<https://dialnet.unirioja.es/servlet/extart?codigo=3727028>
- San Miguel, A., Roig, S., Alzuetta, C., Cañeque, V., & Ortuño, S. (2009). Los pastos de la Comunidad de Madrid. Tipología, Cartografía y Evaluación. In Dirección General de Medio Ambiente (Ed.), *Serie Técnica del Medio Natural* (Vol. 4).
- San Miguel, A., Roig, S., Alzuetta, C., Cañeque, V., Ortuño, S., Cañellas, I., Malo, J., Martínez, T., Rodríguez, M. P., Monleón, J. L., Sánchez, D., Barbeito, I., Gea, G., Álvarez, I., Martínez, M., & Muñoz, J. (2009). Los pastos de la Comunidad de Madrid Tipología, Cartografía y Evaluación. <http://www.madrid.org/bvirtual/BVCM003367.pdf>
- Terés Landeta, J., Pérez Figueras, C., & Valero Sáez, A. (1995). Sanabria. In *Cuadernos de la trashumancia* 11. ICONA.
- Ubieto Arteta, A. (1987). Las pardinias. *Aragón En La Edad Media*, 7, 27–38.

Velado-Alonso, E., Morales-Castilla, I., & Gómez-Sal, A. (2020). Recent land use and management changes decouple the adaptation of livestock diversity to the environment. *Scientific Reports*, 10(1). <https://doi.org/10.1038/s41598-020-77878-2>

Velado-Alonso, E., Morales-Castilla, I., & Gómez-Sal, A. (2022). The landscapes of livestock diversity: grazing local breeds as a proxy for domesticated species adaptation to the environment. *Landscape Ecology*. <https://doi.org/10.1007/s10980-022-01429-5>

Velasco Vázquez, J., Morales Mateos, J., & Alberto Barroso, V. (2001). Evidencias carpológicas de la actividad agrícola en la prehistoria de Gran Canaria. Cebada, trigo, lentejas. Excavaciones en la antigua ermita de San Antón. *Tabona*, 10, 195–212.

Ventura, X., Contreras, J., Cots, P., Font, J., Pau Gómez, M., Miquel Parès, P., Peret, M., Ros, I., & Such, X. (1995). Pirineo Catalán. In *Cuadernos de la trashumancia* 13. ICONA.

White, L. (1987). Las actitudes civiles hacia la guerra en Extremadura (1640–68). *Revista de Estudios Extremeños*, 43(2), 487–502.

