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Historical and recent changes in the Spanish forests: A socio-economic process

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ABSTRACT

The evolution of Spanish landscapes through history is mainly a story of deforestation. Through time, exploitation of natural resources increased to cope with the requirements of more and more complex civilizations. In this work, a review of how the Spanish forests were influenced by human activities and their changes is provided. Forests were cleared for mining, charcoal, shipbuilding and caulking. The most fertile lands were converted into cultivation and more productive cultivars were introduced. Mobile livestock, in particular sheep, became widespread, and with it the burning of wooded land to produce pastures. Woods were privatized through a series of disentailments. All these factors have occurred during the history of Spain, linked to profound changes in the landscape and vegetation. Not until the beginning of the 20th century were real efforts devoted to invert the trend to deforestation inherited from the negative woodland management of previous centuries.

1. Introduction

The Spanish word for wood, *madera*, comes from the Latin word *materia*, whose original meaning has been retained in the English term *material*. The history of these words illustrates the fact that, until very recent times, wood has been the main manufacturing material and the only source of energy. From the milking stool to the King's throne, everything was made of wood. Firewood and charcoal were the main domestic fuels for Spanish rural homes up to the 1970s. It is not surprising therefore that forests and their products have represented a crucial role in the history of Mediterranean nations (Thirgood, 1981; Le Houérou, 1981) as in other parts of the world. The political, social and military histories of these countries have all been linked with habitat destruction and wood deforestation (Perlin, 1999; Janssen and Scheffer, 2004); in extreme cases this leads to the collapse of societies within very short periods (for example, Moai culture in Eastern Island (Hunt and Lipo, 2006) or the Norse Vinland in Greenland (Barlow et al., 1997)). Changes in the land area used for cultivation and grazing reflect historical fluctuations of human populations. With each increase, more land has been cleared for agriculture. Grazing pressure intensified as domestic animals became a safe source of milk, proteins and manure, and often essential to preserve soil fertility. As populations have declined, cultivated land was abandoned, grazing pressure was reduced and, to a certain extent, natural vegetation has grown back. However, each cycle frequently resulted in soil loss and progressive retrogression of plant cover (Thirgood, 1981).

Human disturbance has been suggested as the major cause of vegetation change in the Iberian Peninsula at least for the last 4500 years (Barbero et al., 1990; Stevenson and Harrison, 1992). Nevertheless, direct evidence for anthropogenic transformations in prehistorical times, such as cereal pollen, micro- and macro-charcoal and archaeological remains, are not uniform in Spain. Moreover, anthropogenic effects are often confused with those of climate evolution. In some places, the effects of the climate aridification since the Mid-Holocene (*ca.* 5200 cal. yr BP) have been accentuated by increased anthropogenic pressure whereas, in other cases, it is anthropogenic forces alone that are responsible for vegetation changes (Carrión et al., 2001).

Vegetation composition is the result of a combination of the physical environment and stochastic changes in time and space, for instance animal–plant interactions (Bennett and Willis, 1995; Moore et al., 1996). The introduction of domestic animals by man in a territory is therefore another important factor that helps to explain local extinctions and the transformation of woodlands. Learning from nature, humans shifted natural cycles of fire increasing its incidences and prompting changes in vegetation composition. In general, the opening of forested lands favoured the expansion of pioneer species, whereas taxa with stricter ecological requirements or less resilient to perturbations have displaced or disappeared. Moreover, adaptation mechanisms to fire favoured the expansion of resprouting species in grazed territories, and among non-resprouting species, those adapted to crown-fires were able to avoid disappearance. The combined action

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of recurrent fires and grazing caused progressive deforestation in mountains. The natural recruitment of pine forests in particular have been severely affected, triggering the local extinction of numerous populations (Pardo and Gil, 2005) (Fig. 1). Associated to microcharcoal increase, palynological records indicate these extinctions in several Mediterranean mountain ranges (Riera Mora et al., 1994; Franco, 1995; Carrión, 2002; see other references in Riera Mora (2006)). Pine woodlands, which presented a marked resilient character in the eastern mountain ranges during the climatic changes of the Holocene, were only replaced by *Quercus* species and Mediterranean maquis when fire perturbation rates increased (Carrión, 2003; Riera Mora, 2006).

Difficulties in distinguishing natural from anthropogenic effects on landscape transformations in the light of paleorecords could be solved by the use of documentary sources. Thus, further efforts are needed in order to interpret historical causes of vegetation changes to be able to assess appropriate conservation policies. Evidences from palaeoecology, phylogeography, toponymy and historical sources aid in inferring the impact of past changes. The present work attempts to review the evolution of Spanish forests influenced by human activities focussing on several agents of deforestation that explain the present physiognomy of our landscapes: wars and invasions; cultivation; fires followed by grazing; and industry and mines. For each historical period, factors responsible for the changes in the Spanish woods are discussed and their determination by the land ownership highlighted. Within the text, the historical milestones that implied radical changes in the structure and composition of our landscapes are underlined. Altogether, the aforementioned factors were responsible of the progressive deforestation of Iberia, a process only reversed during the 20th century with the development of reforestation programmes.

2. Prehistory and antiquity: towards a productive economy

The evolution of human societies involved crucial changes from a hunter–gathering lifestyle to a productive economy linked to the spread of agriculture. The way in which Neolithic tribes and cultures dispersed from the Near East into Europe is open to different interpretations (Cavalli-Sforza, 1996; Zvelebil, 2000).

2.1. The colonization of the coasts; shipbuilding for maritime trade

The progress of maritime trade in a search of natural resources, especially metal ores previously depleted in the Near East, helped to spread the productive economy into Western Mediterranean. The expansion of civilizations across the Mediterranean basin was based on the control of maritime routes. Access to the sea shore was the key factor in the establishment of new colonies. Keeping commercial routes between cities required a large fleet. As a result, since classical times, shipbuilding and pine-tar to caulk the ships became an additional factor of deforestation which would continue along the subsequent historical periods. Mediterranean trade was carried in wooden-hull ships. Conifer timber was used for planking and masts and oak wood for oars and keels. Beech was used instead of oak when ships were to be hauled along isthmuses and between river systems (Theophrastus, *De Historia Plantarum* III) (Thirgood, 1981).

Phoenicians, Greeks, Carthaginians and Romans built ships in the Iberian coasts. Along the shores of the Mediterranean sea (*Mediterraneum* means *between lands* in Latin), xerophytic pinewoods were the major elements of the littoral landscapes, as described by the poet Mosco in the second century BC (Glacken, 1967). The abundance of pines is also implicit in the name given to Ibiza by the Phoenicians

Fig. 1. Desert landscape in Sierra de Espuña (SE Spain) in the 19th century as an example of devastated scenery after centuries of human wood degradation (Photo: Dirección General de Patrimonio Natural y Biodiversidad de la Región de Murcia).

(*Ebussus*) and Greeks (*Pytiusas*), both meaning "pine island" (Macabich, 1966). The pinewoods along the Mediterranean shores were the most available sources of timber and pitch for shipbuilding and caulking.

Littoral pinewoods suffered the most as a result of the expansion of maritime commercial routes. Their early extinction has been documented in palynological deposits close to ancient economically important enclaves such as the *Sinus Tartessii* (the actual Bay of Cádiz, south-western Spain) (Stevenson, 1985; Stevenson and Moore, 1988). Along the Mediterranean coasts pinewoods were depleted due to the shipbuilding practices described by Plutarch (*Moralia* VIII, V, 3, 676) (Clement and Hoffleit, 1969) and the tar production. The generalized use of pine and fir wood for shipbuilding was shown by Avienus (*Ora Maritima*, vv.103–105) (Villalba i Varneda, 1994). At the beginning of the Christian era, Pliny the Elder (23–79 AD) reviewed the timber resources of the Mediterranean basin. Although the major supply centres in the East were still quite important, attention was moving westward. By that time, exploitation of forests was no longer limited by proximity to the sea shore. Forests were laboured in the hinterland such as in hills and mountains of the Apennines, Alps, Corsica and Pyrenees. Strabo's Geography pointed out that, overall, forests were abundant in the Mediterranean mountain regions. In Iberia, the slopes of the Pyrenees were "covered with forest containing numerous kinds of trees and evergreens" (III, 4, 11) (Blázquez Martínez, 1978). The high density of settlements along the littoral resulted in further deforestation of the hinterlands (Plato, *Critias* III) (Thirgood, 1981). Timber was piled in river beds and floated to the coast with the help of the seasonal peaks of the water level. Only remote mountain forests, from where the transport of timber was difficult, escaped exploitation.

Avienus, in his *Ora Maritima* (vv. 435–436), recounts the loss of stone pinewoods along the coasts of Malaka (now Málaga, southern Spain) (Villalba i Varneda, 1994). Cones and wood charcoal fragments dating from before 18,940 ± 530 not cal. yr BP in the Upper Paleolithic to the Neolithic confirm the past abundance of stone pine (*Pinus pinea*) in the area (Badal, 1998). Stone pine traces were found together with less abundant remains of European black pine (*P. nigra*) and Aleppo pine (*P. halepensis*) (Badal, 2001).

2.2. The expansion of agriculture

The varied physiography of the Iberian Peninsula and its geographical location at the western edge of the Mediterranean basin determined a heterogeneous expansion of the Neolithic cultures that arrived by sea. The colonization started along the East coast, gradually moving inland following the fertile lands of the valleys. Slowly, a hunting–gathering economy changed into a farming one, transforming the forests that once grew in the rich deep soils of the fluvial plains into cultivated and grazing areas, leading to deep changes in the concept of the territory (Tilley, 1994; Ingold, 2000).

The first Neolithic farmers used recurrent fires to clear the original forest vegetation (Fábregas Valcarce et al., 1997; Hernando, 1999). Deciduous and evergreen oaks, which occurred in deep soils close to human settlements in plains and valleys were most affected (Carrión et al., 2003, 2007). The clearings reduced the area of exigent tree species, whereas sprouting gave a selective advantage to those Mediterranean taxa adapted to natural fires when humans artificially increased their frequency. For example, recurrent fires account for the gradual replacement of the local Maritime pine woods (*Pinus pinaster*) by sclerophyllous communities dominated by evergreen *Quercus* species during the Mid Holocene in Eastern Iberia (Carrión et al., 2000). Transformation of the ancient Iberian woodland into farmland seems to have begun in the Levant and coastal Andalusia at about 6850–5700 cal. yr BP, whereas the retreat of the natural forests occurred later in the central areas of the Iberian Peninsula (Carrión et al., 2001). Certainly, during the Bronze Age, regional settlements became more systematic and the importance of livestock increased. During this period agriculture improved; cereals, vineyards, esparto grass, flax and other textiles expanded, and breeding of domestic animal progressed.

Meanwhile, the economy of the inhabitants of the Central and Western Iberia remained mostly based on stock raising, principally goats and sheep (Almagro-Gorbea and Ruiz-Zapatero, 1991). Stock-breeding was important especially in Central Plateau and Northern Iberia, where the rearing of pigs fed on acorns developed, while abundant herds of horses and cattle grazed in Southern and Western valleys (Blázquez Martínez, 1957). The peculiar topography of the Peninsula, with two central sub-plateaus surrounded by high mountain ranges, promoted a mobile pastoralism which exploited pastures available in every season in the proximity of the settlements (see references in Gómez-Pantoja (2004)). During the Iron Age, evidence of expansion of wool industry is documented by an abundance of loom-weights (Vega Toscano et al., 1998). The high quality of Iberian wool was praised many times in classical texts (Strabo III, 2, 6; Pliny, VIII, 191; Marcial, XIV, 133) (Blázquez Martínez, 1971). These shepherd tribes used fire to create new pastures for their animals, a technique which contributed to initiate the extinction of *Carpinus* and *Quercus* species 2000 years ago, in the Island of Tenerife (Canary Archipelago) (de Nascimento et al., 2009). Although traditionally excluded from the native flora of the Archipelago, these species were important constituents of the thermo-xerophilous forest. Their rapid decline – in a period of only 400 years for *Carpinus* – bestows on the Guanches, the first inhabitants of the Tenerife Island, the main role in changing the natural mesic habitats into more xeric forests.

The pressure of agriculture on the natural Iberian ecosystems increased with the waves of colonization of Eastern Mediterranean cultures. First were the Phoenicians in the South of the Peninsula from the ninth century BC. Then the Greeks along the Mediterranean shore in the sixth century BC, and finally the Romans after the second century BC. The new colonizers promoted intensive farming to increase the production of agricultural products (Buxó, 2008). The statement by Theophrastus (*De Historia Plantarum*, 313 BC), "use your rich soil for grains and thin soils for trees", illustrates how forests were only left in those areas where agriculture was less productive or impractical. Afterwards, Varro (116 BC–27 BC) described the typical physiognomy of a cultural landscape: farming in the plains and summer pastures in the mountains (*Rerum rusticarum*). Coppice forests (*silva caedua*) were important for firewood, while forests with acorns (*silva glandaria*) were esteemed for pig feeding (Meiggs, 1982). The clearings of forests in the lowlands and foothills that accompanied this process greatly modified the landscape.

In ancient times, the most important woody crops were the grape vine and the olive tree. Together with cereals, they constitute the classical Mediterranean triad. Archaeological evidence suggests that both grapes and olives were consumed in the Iberian Peninsula since the Epipaleolithic. Their cultivation would later expand during the Roman domination (Buxó, 2008). It is commonly believed that the spread of these two crops also involved the introduction of domesticated varieties from the East Mediterranean to the West. However, genetic studies suggest that local domestication of wild vines and oleasters predominated over the adoption of introduced varieties (Sefc et al., 2003; Breton et al., 2006, 2008).

An exception to the domestication of local varieties is the field elm (*Ulmus minor*). The use of elms and other trees to support and train grapevines probably evolved with the development of viticulture in the Middle East during the Neolithic (Fuentes-Utrilla et al., 2004). Farmers would have noticed the natural growth of wild vines over trees in the riparian forests where they naturally grow (Ocete et al., 1999). As the cultivation of grape vines spread towards the western Mediterranean, farmers would discover which trees were the best to plant to maximize the outputs of this agroforestry system. In this process, field elm became favoured as it can tolerate summer drought

despite being a riparian tree, and because it can be easily propagated vegetatively by root suckers (Richens, 1983). These traits allowed the field elms to be planted far from their natural habitat. In the vineyards, their leaves provided a very valuable source of food for cattle especially under the Mediterranean summer, when grass dries out (Heybroek, 2003). Field elm was already planted with the vines in Ancient Greece, but it was during the Roman period that the domestication of the elm reached its maximum level with the selection of a clonal elm cultivar, the Atinian elm (Gil et al., 2004; Fuentes-Utrilla et al., 2004). Circa AD 50, the Latin agronomist Columella recommended the elm, and in particular the Atinian clone, as the best tree to train the vines (*De Re Rustica* V) (Forster and Heffner, 1954). After the publication of Columella's work, cultivation of vineyards rapidly expanded across the Roman Empire, as farmers sought to obtain better harvests (Martin, 1971). Genetic markers have shown that the Romans, following Columella's recommendation, propagated Italian elms (mostly the Atinian clone) across other provinces like Hispania and Britannia (Gil et al., 2004).

2.3. The mining industry and the exploitation of the Iberian mineral resources

Metals provided power and control to human groups that allowed the expansion of their cultures and influences over others. However, the development of metallurgy increased the pressure over the existing forest resources. The smelting of metals for military purposes, among other uses, resulted in a continuous demand for charcoal as warfare acquired greater importance during the Bronze and Iron Ages, evidenced by the establishment of walled settlements on hill tops, for instance, in Los Millares culture (Whittle, 1996).

Mining activities were mainly located in the South and Northwest areas of the Iberian Peninsula (Orejas and Sánchez-Palencia, 2002). Mining gradually increased as its mineral wealth attracted multiple Eastern Mediterranean cultures (Phoenicians, Greeks and Romans) (Smith, 1998; Aubet, 2001; Orejas and Sánchez-Palencia, 2002). The Romans, the last to arrive, left the only written descriptions of the pre-Roman Iberian inhabitants and landscapes. The geographer Pomponius Mela, in his Description of the World (*ca.* 43 AD) (*De Chorographia* II, 5, 86), enumerated the natural resources of Hispania: "[…] also abundant in men, horses, iron, lead, copper, silver and gold and at such a point fertile that, if in any part it is differently barren from itself, overall, in these places it produces flax and esparto grass" (Bejarano, 1987). Pliny the Elder praised Hispania in his *Naturalis Historia* (XXXVII 77, 203) saying that "even being partially wasteland, certainly, where it produces, it is abundant in oil, wine, horses and every kind of metals […] the esparto grass of its deserts and the selenite, the gentleness of its dyes" (Bejarano, 1987).

The development of mining in the Iberian Peninsula by ancient cultures expanded the depletion of forests caused by agriculture. Strabo (63/64 BC–*ca.* AD 24) pointed out in his Geography that regions containing ores were lacking in vegetation (III 2, 3) due to the continuous tree felling for mining activities (Blázquez Martínez, 1978). Theophrastus in his *Historia Plantarum* (V 9, 3) reflected that blacksmiths preferred pine (*peuke*) rather than oak charcoal as it heats up better into a flame (Hort, 1916). The huge amount of Roman mines recorded by Domergue (1990) in the Peninsula and the resulting forest loss created many bare areas surrounding the mines.

3. The Medieval forest: the pastoral use of the land and the power of the *Mesta*

Extensive woodland still remained at the end of the classical period. The crisis following Emperor Commodus's reign (193 AD) plunged Roma into a general unstable life: violence and pillage hindered the exploitation of land and industry and diminished the international trade.

The Visigothic social structure that evolved in Hispania after the Late Roman Empire was based on subsistence farming. The fall of international trade eased the pressure on forest resources. Population was concentrated in the countryside; the old Roman *villae* were transformed into the medieval *curtis* albeit maintaining the same structure of large scale farm (*latifundium*). Visigothic economy, reported by Isidore of Seville (*ca.* 560–636) in his Etymologies was based on pastoral and agrarian activities: cereals, vineyards, vegetable gardens products, beehives, hunting and fishing (Oroz and Marcos, 1983).

From the early Middle Ages dates the *Liber iudiciorum*, a Latin code that comprises a set of laws promulgated in 654 AD. This important codex was afterwards translated into Romance (*Fuero Juzgo*, 1241), and its clauses were incorporated into the legislation codes of the forthcoming Christian kingdoms which ruled the Iberian Peninsula. Regarded as the first legislation on woods, the *Liber iudiciorum* established severe punishment for illegal logging and forest fires. In the English translation of the Eighth book (Scott, 1910) (*Concerning Acts of Violence and Injuries*), Title II (*Concerning Arson and Incendiaries*), Law II (*Where Forests are set on Fire*) it reads: "Anyone who burns a grove belonging to another or any pine or fig tree, or any other tree […] shall be arrested by order of the judge; shall receive hundred lashes; and shall render pecuniary satisfaction for the injury done; […] If a slave should commit this offence without the knowledge of his master, he shall receive a hundred and fifty lashes. Where the master is unwilling to render satisfaction for the act of his slave, he shall surrender him, in full amends for the same, even if the loss occasioned by said slave should amount to double or triple his value" (Scott, 1910). The magnitude of these punishments, at that time, suggests the need to preserve those forest resources that might be scarce.

During the Visigothic period the absence of wars, the stabilization of the agrarian population and the continuation of Gothic customs did not cost any further damages to the forest. Moreover, the Goths favoured the presence and spread of fruit trees which provided nourishment for economically important livestock (mainly pigs and horses) like oaks and chestnuts (González González de Linares, 1999). The *Liber iudiciorum* contained three laws concerning the herding of hogs at the time acorns were ripened (*tempore glandis*) (VIII, Title V). Different fines were imposed as punishments for tree felling depending on the type of tree, which shows how Medieval people could promote fruit species "Where anyone […], cuts down a tree belonging to another; if it is a fruit tree, he shall pay three *solidi*; if it is an olive, five *solidi*; if it is an oak of large size, two *solidi*" (VIII, Title III, I). The term *forest fruitalization* (González-Bernáldez, 1992) was coined to describe how humans shaped the landscape, focussing on acorn productivity for human and livestock feeding. By selecting trees which produced the best and sweetest acorns, humans facilitated the spread and thrive of holm oak (*Quercus ilex* L.) as a dominant element of Iberian landscapes (Manuel and Gil, 1999).

From 711 to 756 AD, the Arabic culture rapidly spread their domains over the Iberian Peninsula. The presence of Muslims for more than 800 years involved contrasting impacts over the forest across the territory. The advanced irrigation techniques of the Arabs allowed a better use of the land for their agriculture-based economy. El Idrisi (1100–1165 or 1166), an andalusi geographer, describes in his *Spanish Geography* (Blázquez, 1901) a territory where woodlands still supplied important resources and wealth. In his description of the Mosque of Cordoba, El Idrisi registered the provenance of pinewood beams from as far as Tortosa (in present day Catalonia), praising the good quality of that timber and regretting the depletion of forests in the city surroundings.

The Christian Reconquest lasted from 722 till 1492. During this long-lasting campaign, all territories in the Iberian Peninsula were at some point the border between the Moor and Christian Kingdoms. As a result, the land was exposed to tree felling and arson that depleted

the woods that previously covered the landscape (Sánchez Albornoz, 1956). For instance, the Chronic of Albelda (year 883 AD) reports how the troops of Alfonso I left all the area adjacent to the river Duero turned into wasteland after fighting against the Moors in the lands of Toro and Tierra de Campos (Valladolid) (Bauer Manderscheid, 1980).

To reinforce the re-colonization, the Christian Kings had to attract new settlers to the new annexed territories. This process played a major role in the society organization and the landscapes transformation. The land property, established by different kinds of colonization policies described in Corral García (1988), determined the use of the territory and the impact on forests. During the 9th and the 10th centuries, in uninhabited lands, the *presura* system conferred rights of freedom and of land property to the settlers. As properties were divided among the inheritors, fragmentation of woods advanced during these centuries following the demographic increases.

From the 11th century onwards, the Christian Kingdoms consolidated and expanded with the annexation of wide, depopulated territories. The process of establishing settlements changed in order to create large and strong municipalities with enough common and arable lands to attract stable population (*council repopulation*). The Kings provided the municipalities with *Fueros*, city charters documenting the privileges and usages afforded to all people repopulating a town. The common use of woods and pastures brought important rental profits to town councils which alleviated the consequences of the population increase and bad economical periods.

During the 13th century, the Christian Kingdoms had almost completed their expansion to the extreme southern lands of the Peninsula. To guarantee the security of these territories they were given to Christian military orders. These orders were to possess the property and use of most of the land. Livestock herding (mainly sheep) was chosen to exploit these wide, forested and depopulated new territories. This political decision had dramatic consequences since it linked the Spanish economy to the international trade of wool at the expense of a deep transformation of the woodlands.

During the 13th and 14th centuries, and being aware of the importance of woods in rural economy, the Castilian government created strict regulations trying to protect forest resources. King Alfonso XI of Castile ordered to compile a hunting treatise called *El Libro de la Montería* (*ca.* 1340) (Gutiérrez de la Vega, 1877). Its Book III served as a geographic guide or a forest catalogue where the term *monte* is generally used with the sense of vegetation formation. Noteworthy, the Romance term for forest (*silva*) were gradually assimilated to *montes* (meaning mountains in Latin) (Pascual, 1855), *i.e.*, the places where woodlands still remained as they were progressively confined to the roughest areas which were not suitable for agricultural practices. Book III provided a detailed description of tree species and names of the forested lands that were suitable for hunting activities, especially those having wild boars and bears. This Book evidenced the recovery of dense forests all over the Castilian Kingdom's geography, especially in those areas where the *council repopulation* took place: pines were still in the mountains, and large areas covered with holm, cork and other oak woodlands remained in places favoured for pastures. A detailed analysis of the toponymy records contained in the previously mentioned treatise (Ruhstaller, 1995) sheds light on the state of transformation of natural vegetation, the uses of the land, as well as the importance of different tree species in Castilian territories (Table 1).

As mentioned, linked to the settlement policies of the extreme southernmost lands, the livestock industry, which was protected by the Crown of Castile, thrived supported by an increasing powerful institution of stockbreeders: The *Mesta*. Military orders of nobles and clergymen, and the Crown itself, became important owners of sheep herds (Pastor de Togneri, 1973). The Crown took advantage of the new emerging industry conferring it different prerogatives of transit and grazing while, at the same time, collected taxes and tolls originally controlled by local administrations. As *merino* fine wool trade increased the economic profits for Castilian Treasury in the international wool market, the Crown gave more and more power to the members of the shepherds' guild to such an extent that the Mesta took control of the Spanish rural life during more than five centuries (Klein, 1920) (Fig. 2).

Table 1
Relation of toponymy records contained in the hunting treatise *El Libro de la Monteria*, compilation ordered by the King Alfonso XI in *ca.* 1340. Only names related with plant species which appeared more than 5 times have been considered.
Source: Ruhstaller, 1995.

	Number
Broadleaf species[a]	161
Temperate evergreen species [b]	47
Deciduous *Quercus* species[c]	62
Cork oak (*Quercus suber*)	21
Quejigo oak (*Quercus faginea*)	13
Holm oak (*Quercus ilex*)	47
Pinus species	53
Dehesa related toponyms	114
Beehive related toponyms	61
Rubus sp.	40
Cistus sp.	59

[a] Temperate and riparian broadleaf species: *Fagus sylvatica* (35), *Castanea sativa* (30), *Fraxinus* sp. (25), *Salix* sp. (24), *Alnus glutinosa* (16), and others including *Populus* sp., *Ulmus* sp. and *Corylus avellana*.
[b] *Taxus baccata* (27), *Laurus nobilis* (7) and *Ilex aquifolium* (7).
[c] Names related with *roble* (oak) including *Quercus robur*, *Quercus petraea* and *Quercus pyrenaica*.

The *merino* sheep transhumance played a major role in the degradation of the Iberian forests. Gradually, woodlands were transformed to place biomass, previously allocated in the tree canopies, at the level of animal grazing. The way to obtain grazing areas at the expense of the forest is implicit in the origin of the term transhumance, *trashumancia* in Spanish. Etymological interpretations of this word are derived from the Latin *trans* 'across' and *humus* 'ground', referred to seasonal moving livestock in search of pastures. A more modern interpretation of the etymology of *trashumancia* highlights the importance of fire for pasture development, based on the Latin root *fumo* ("smoke"). The smoking forest after being burnt explicitly appears in the *Fuero* of Navarre in the 13th century (Ilarregui and Lapuerta, 1869). In Book VI (Title I: Concerning grazing, Chapter VII) it stated that flocks must pass "trasfumo" (*after-smoke*) and graze the pastures (Gil, 2008a). The Kingdom of Navarre in the Pyrenees had, at relatively short distances, high and low lands to provide pastures for the animals during the whole year.

In the Low Middle Age economy, transhumance over short distances was practised in the northern Iberian Peninsula (Gerbet, 2000). However, as pastures of the southern fertile valleys were annexed during the Reconquest, it was possible to move the flocks over longer distances, up to 1000 km. The opening of numerous cattle tracks (*cañadas*), already well known in the 13th century (Pastor de Togneri, 1973), gave rise to the transhumant herds in Castile. As in other Mediterranean areas, seasonal movements of flocks led to conflicts between breeding and farming for the use of common land (Klein, 1920), which induced the eternal duality between agriculture and stockbreeding. One of these conflicts concerned the rights of easement use and grazing in the open pastures given to livestock (*Fuero Juzgo* VIII, IV, 27; Real Academia Española, 1815), whereas the animals were banned from enclosed pastures (*ibidem*. 9 and 12). This distinction gave rise to a confrontation in relation to the fences used to enclose land (Klein, 1920). Numerous *dehesas* (originally *defended* pastures, currently open wood pastures landscapes) of the communities grew in reaction to the development of transhumant herds (Clément, 2008). (Note that the Spanish term *dehesa* which comes from the Latin *defesa* (defended) and the English term fence, which comes from the shortening of *defens*, have the same origin).

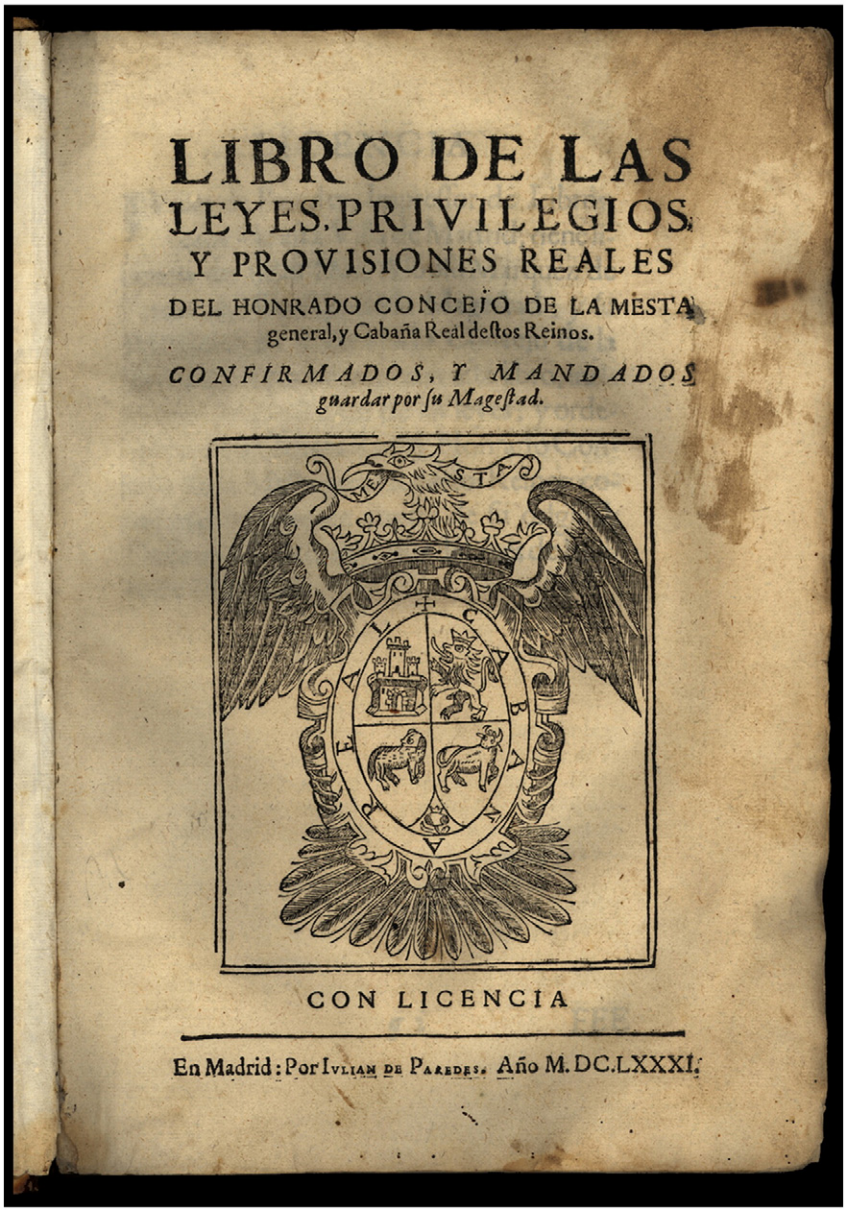
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Fig. 2. Cover of the Compilation of Laws and Ordinances of the Royal Stock and the Honorable Mesta Council. Volume of 212 pages printed in Madrid by Julián de Paredes in 1681. Note in the emblem that the sheep and the cow appear together with the castle, the lion and the pomegranate – the official symbols of Castilian Reign – surrounded by *Cabaña Real* (Royal Stock) and the imperial eagle. In its beak the eagle holds the caption *MESTA* (Photo: Luis Gil Sánchez).

The increasing transit of sheep herds to southern pastures during the winter created conflicts with growing numbers of towns and villages. These disagreements introduced huge logistic and political challenges for the rulers. A document from 1255 quotes the damage caused by transhumant shepherds in Ciudad Rodrigo: "a pine wood, a holm-oak wood and an oak wood […] they cut them down, they burnt and destroyed them" (Barrios García, 1988). Nevertheless, Castilian Kings favoured the shepherds' interests giving them privileges of transit and over pastures, not only in royal lands, but also in *baldíos* (common lands where ploughing was forbidden) and common woods. The favours are implicit in a privilege conferred by Alfonso X in 1273 which indicates that "all shepherds of my kingdoms […] shall receive neither damage nor evil" (Klein, 1914). These concessions were in contradiction with local *fueros* which traditionally held the right for growing crops on private lands and grazing local livestock in communal forests. The privileges granted to the *Mesta*, which prevented the enclosure of lands, caused the standstill of Spanish agricultural productivity during the Early Modern period as highlighted in 1834 by Alexandre Moreau de Jonnés in his *Statistique de l'Espagne*, translated by Pascual Madoz (1835). Especially from the 16th century onwards, when more than three million sheep transited the royal *cañadas* around the whole territory, the Crown of Castile used the *Mesta* as a tool to exert a centralized power. During the following centuries woodlands would be left at the service of the transhumant livestock (Fig. 3).

4. Shipbuilding and navy regulations: the Spanish Armada

Between the 15th and the mid 18th centuries, kings only managed to dictate scattered rules which, despite their number, neither prevented damages to forests nor promoted their restoration (Memoria, 1861). These were times of poor scientific knowledge to give advice on what to do with the forested land and of weak governmental bodies that could not keep any control over them. With the arrival of the House of Bourbon from France, the interest for timber increased in parallel with the importance of the Spanish Navy, which was required

Fig. 3. Alcalá Street in Madrid was, and legally still is a *cañada* ('cattle track') since the times of the *Mesta*. The right of passage of the transhumant herds is celebrated every year with a traditional sheep walk (Photo: Darío Valbuena Pradillo).

to protect the commercial routes between the peninsula and the Spanish territories in America. In 1694, the Spanish Navy had 10 vessels in terrible conditions; a hundred years later, the Spanish fleet was composed by more than 70 ships and about 50 frigates (Torrejón Chaves, 1997).

Two compiled Forest Ordinances passed in 1748 emulated French regulations (Memoria, 1861). The first group of Ordinances, published in January, regulated the forests close to the sea shores and navigable rivers. For this purpose the Keeper's Offices from Ferrol (north of Spain), Cartagena (east) and Cadiz (south) were created. The second Ordinances, which came into effect in December, concerned the rest of the forests. Two additional Keeper's Offices were created: the Inland Office, and the Thirty Leagues Office close to the Royal Court, which afterwards became the Twenty-five Leagues Office (Ayerbe Iribar, 2005; Ruiz Amado, 1872). The Ordinances established strict regulations for all woodlands, whether publicly or privately owned. The felling of trees marked by and for the Navy was forbidden. For each tree cut three new trees had to be planted by neighbours in public and royal woods and by the owners in private ones. Land could be confiscated to set up forest nurseries if it was suitable. Landowners had the duty to invest at least one third of the profit obtained from their forest land in forest treatments and reforestations. Furthermore, a license was required to sell the timber, prices of which were also regulated (Vicente Iglesias, 1994). This way, the Spanish Navy consumed more than 3 million of trees, among the best and the biggest ones, contributing to a devastation of thousands of hectares in numerous provinces (Merino Navarro, 1981).

Furthermore, pitch for caulking was as necessary as wood for shipbuilding, in order to preserve the ships and make them last (Fig. 4). Tar production, initially located in the Spanish Levant, was not enough

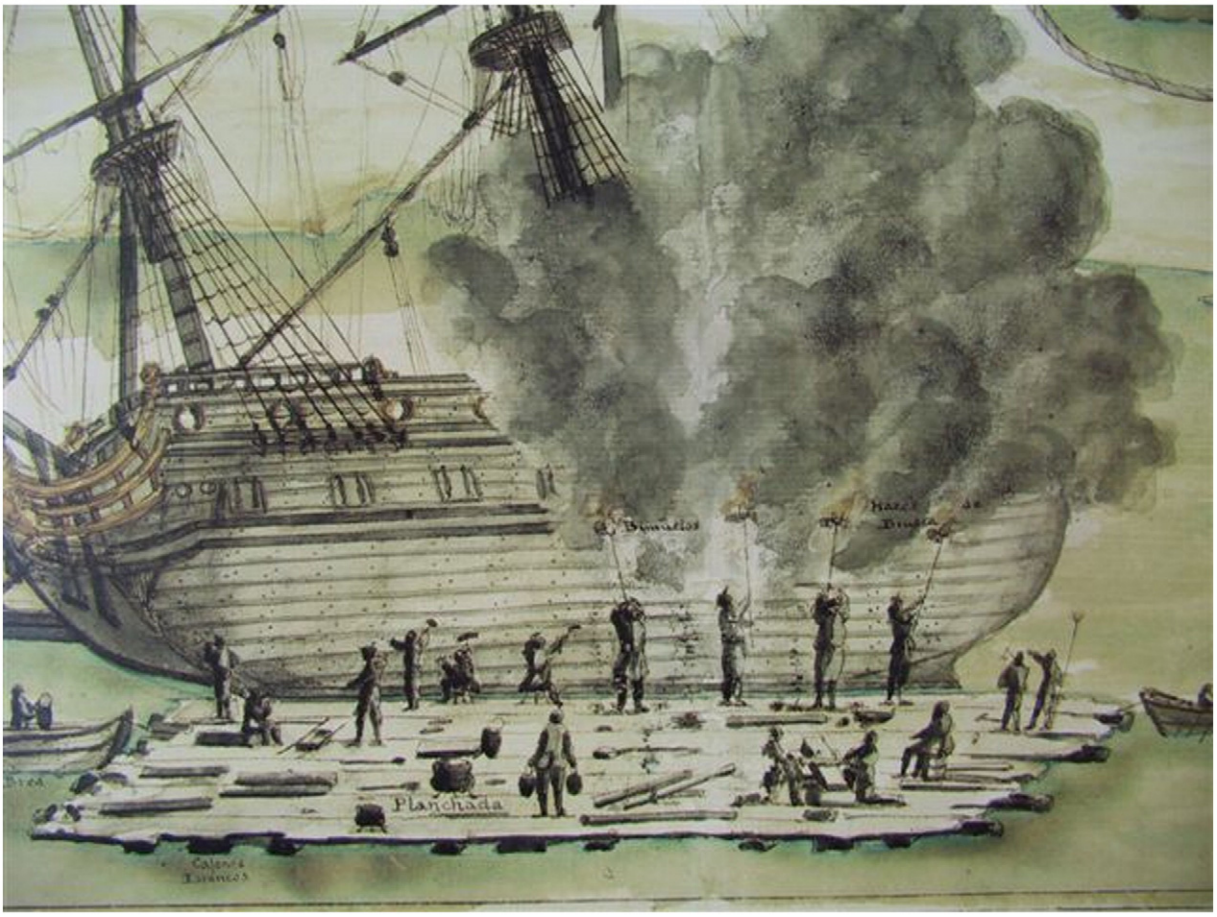

Fig. 4. Repair works and caulking of a wooden ship (Copyright: Museo Naval de Madrid).

to provide Navy requirements, so two new production centres were created in Castril (Granada) and Quintanar de la Sierra (Burgos). Such demands lead the Ordinance to extend the restrictions of wood exportation to tar products (Merino Navarro, 1981). Moreover, vegetal charcoal consumption in blast furnaces reached huge levels in order to build the cannons needed to arm the ships. Alcalá-Zamora y Queipo de Llano (1974) estimated that, for each cannon weighted 2 t, about 5 to 6 ha of coppiced forests were needed; through 200 years, 27,000 cannons were made in the blast furnaces of La Cavada (Santander). In order to reach such production, 10 million trees were logged and cut and over 50,000 ha in the area was devastated.

The abuse performed by the Ordinances was evident as it allowed the Navy to cut more trees than those that were needed, to keep the best and bigger ones, or to pointlessly ruin the forest due to the lack of knowledge or care (Martínez, 1855). Peasants, used to clearing, cutting and burning forests for cultivation or grazing, were unwilling to accept the Ordinances, which deterred any private initiative. Regrettably, the ban to any use that could damage wooded lands aroused a collective and deep-seated hatred for trees, "which still remains nowadays" (Navarro López, 1965). Fraudulent deforestations and pillage were the rule as a result. Contractors and corrupted *justicias* (constables) were those who profited most with these circumstances (Martínez, 1855; Ruiz Amado, 1872).

The situation was aggravated by the huge body of civil servants employed by the government. Martínez (1855) estimated that there were more than 800 Government Sub-delegate's Offices. During decades of an arbitrary use of the juridical and administrative competences given by the Ordinances, these often corrupt government employees reduced the effective implementation and enforcement of the law.

The Ordinances were restrictive and unfair for many people. From the very beginning there were complaints because the regulations were so broad that any actions from the peasantry were likely to be illegal. In their initial form, the Ordinances were flawed and were subject to numerous additions and clarifications in the following years. As a result, the knowledge and enforcement of the Ordinances diminished. The two Ordinances were modified to so such an extent that half a century after they were published, an auditor complained about the confusion existing between the January and the December Ordinances (Vicente Iglesias, 1994). Nonetheless, these Forest Ordinances represented the first attempt to create a forest organization and to promote the forests themselves.

5. The liberal disentailment of the woodlands

By the end of the 18th century, official statistics considered that the forests provided only 0.25% of the national income (Censo, 1803). However, the statistics failed to recognize the use of firewood for buildings or blacksmiths, or the role of woodlands in animal feeding. During the Enlightenment, the Navy Ordinances were fiercely criticized by the liberals, who considered that the privileges of the Navy and the *Mesta* and the wrongdoing of the *justicias* went against private property (Jovellanos, 1795). In 1803, new Navy Ordinances gave private landowners freedom to make use of their timber. However, these regulations were suspended two years later arguing that there were no topographic maps of the affected lands available (Gómez Ortega, 1805). The Navy Ordinances from 1748 were reinstated and in effect until 1812, when the Cadiz Constitution, following the Napoleonic invasion in 1808, was passed (Martínez, 1855). Two liberal decrees in 1812 and 1813, abolished regulations in

the Ordinances related to private forest lands, suppressed the Subdelegates, reduced the number of Navy employees, and put communal forests up for sale to increase town councils' capital and to promote agriculture and industry (Mangas Navas, 1984).

Throughout the first third of the 19th century liberal and absolutist governments alternated in power. The forest policies changed with each political swing: the Ordinances of 1748 were restored in 1814, abolished in 1820, restored again in 1823 and abolished once and for all in 1833 with the end of the last Absolutist monarch. The new General Ordinance of Forests represented a new direction in forest administration. A Forest Central Office was created for this purpose. The fall of the Ancient Regime in 1833 had other important consequences for the Spanish forests, such as the abolishment of the *Mesta* in 1836. The *Mesta* had been shaping the Spanish landscapes for five centuries. It was abolished to put an end to the conflicts between the owners of the big transhumant herds and local farmers (supported by the liberals). The decision was facilitated by the falling demand for Spanish wool, resulting from the introduction of the merino sheep in Australia during the Napoleonic War. However, a census from 1865 registered 22.5 million sheep, which were still grazing in non-ploughed territories (Censo, 1868). More than 80% of these sheep were non-transhumant which shows that overgrazing was in fact due to standing livestock. The number of domestic animals, in particular sheep and goats, reduced dramatically during the second half of the 19th century (Table 2). The total animal number did not recover until the implementation of the Common Agricultural Policy (CAP) that followed Spanish inclusion into the European Union in 1985.

This historical period was characterized by wars, colonies loss, liberal revolutions and counter-revolutions, and confrontations among political factions. During this time the most critical event for the fate of the Spanish forests was their privatization in the liberal disentailment processes. The Spanish liberal regime was characterized by the sale of land and by the protection of the wheat which favoured its cultivation in forest lands from 1820 to 1869. However, the disentailment had begun much earlier. It was an attractive option for every government due to its powerful characteristics: (a) economical, as new lands entered the market; (b) financial, new incomes for the Public Treasury; (c) social, empowering those that were able to buy the lands; and (d) political, creating lobbies supporting the promoting government (Rueda Hernanz, 1998).

The disentailment process started mildly with King Charles III (1766), continued with King Charles IV and his Prime Minister Godoy (1798), and extended up to the governments of Mendizábal (1836–37) and Espartero (1841), affecting Church and public corporations properties (Tomás y Valiente, 1978). More than 13 million ha were privatized (Table 3). Of these, 5.3 million ha corresponded to communal and privately owned properties which were distributed, colonized, fraudulently sold or ploughed, and whose vested status was finally legalized (Rueda Hernanz, 1998). Nearly one million landowners profited from this "invisible disentailment".

The Forestry School was opened in the second third of the 19th century as a consequence of the development of the forest science and the driving force of the *Sociedad Económica Matritense* (Madrid Economical Society), followed by the creation of the Forest Engineer Corps in 1854 (Gil, 2007). The Minister of Finance, Pascual Madoz, promoted the disentailment law of 1st May 1855 putting the public forests on sale. Fortunately, the few existing forest engineers managed to include an Article in the law which excluded those forests whose sale was considered not appropriate by the government. The article blocked any transaction until enough knowledge of the status of public forests had been obtained and a regulation of the disentailment procedure had been established. This fact started a battle for the defense of the public property of the forest (Casals, 1996).

A catalogue with the classification of the public forests was completed in 1859, allowing the sale of 10,872 forests with a total area of *ca.* 3.4 million ha (Clasificación, 1859). The forest engineers managed to exclude a total of 19,774 forests covering an extension of 6.76 million ha from the privatization. For the first time in history the forests had a monetary value. But they were sold at a bargain price. In 1862, the funding needs of the Ministry of Finance increased the number of forests on sale in the catalogue through a decree. Only pine, oak and beech forests larger than 100 ha (or smaller forests separated from one another by less than 1 km) were excluded. In the end *ca.* 23,000 forests covering 5.5 million ha were put on sale (Ruiz Amado, 1872). Many forests in extremely poor condition were not sold (for example, the mount "La Jurisdicción" detailed in Fig. 5); but some excluded forests were fraudulently sold. Between 1855 and 1924, when the Madoz disentailment process ended, a total of 5.2 million ha (more than the 10% of Spain's territory) was acquired by 260,000 private landowners. Most of the cork oak and holm oak woods were privatized. One exception was the holm oak forest of El Pardo (16,223 ha), a traditional hunting and resting woodland held in reserve for the Spanish Kings and located only a few kilometers from the Royal Palace in Madrid.

Overall, approximately 18.5 million ha (36% of the territory of Spain including 50% of the arable land) were privatized in about a century. However, the process failed to achieve the expected results by the enlightened philosophy. Many privatized forests were converted to pastures or arable land in order to obtain immediate profits, rather than waiting for decades to exploit their forest resources.

Some statistics of the public forests were published in the last third of the 1800s (Clasificación, 1859; Memoria, 1861). The new data enabled a development of some new legislation: the Forest Law in 1863 and its regulations (1865), the Public Forests' Reforestation, Development and Management Law (1877) and the Systematic Plan for the Reforestation of Watersheds (1888). The enforcement of these laws was assisted through the development of the Public Forests Management Services and their forest management Instructions of 1890, and by the National Forest Hydrological Service formed in 1901 (which brought together the ten Forest Hydrological Divisions)

Table 2
Evolution of the livestock (in thousands of animals).
Source: Annuals of Agrarian Statistics.

Year	Cattle	Sheep	Goats	Pigs	Horses	Mules	Donkeys	Total
1865	2967	22,468	4531	4352	680	1021	1298	37,317
1891	2218	13,359	2534	1928	–	–	–	20,039
1932	4164	16,471	4645	5048	803	1461	1164	33,756
1950	3112	16,344	4135	2688	642	1089	732	28,742
1965	3712	17,073	2196	4931	321	745	476	29,454
1978	4061	14,522	2283	10,496	257	253	232	32,104
1991	5063	24,625	2972	17,019	241	100	130	50,150
2005	6463	22,908	2842	24,884	–	–	–	57,097

Table 3
Disentailments from the late 17th century until the mid 1800s, according to Rueda Hernanz (1998).

Disentailment period	Period	Surface (ha)	Beneficiaries	Mean surface/ beneficiary
Jesuit's properties	1769–1798	100,000	5000	20.0
Godoy	1798–1808	2,300,000	150,000	14.7
Regular priest's properties	1821–1823	1,200,000	10,000	120.0
Mendizábal and Espartero (ecclesiastic)	1834–1854	4,400,000	130,000	33.8
Subtotal	1769–1854	7,900,000	295,000	26.8
Properties distributed, colonized, fraudulently sold or ploughed	1766–1855	5,300,000	800,000	6.6
Total	1766–55	13,200,000	1,095,000	12.1

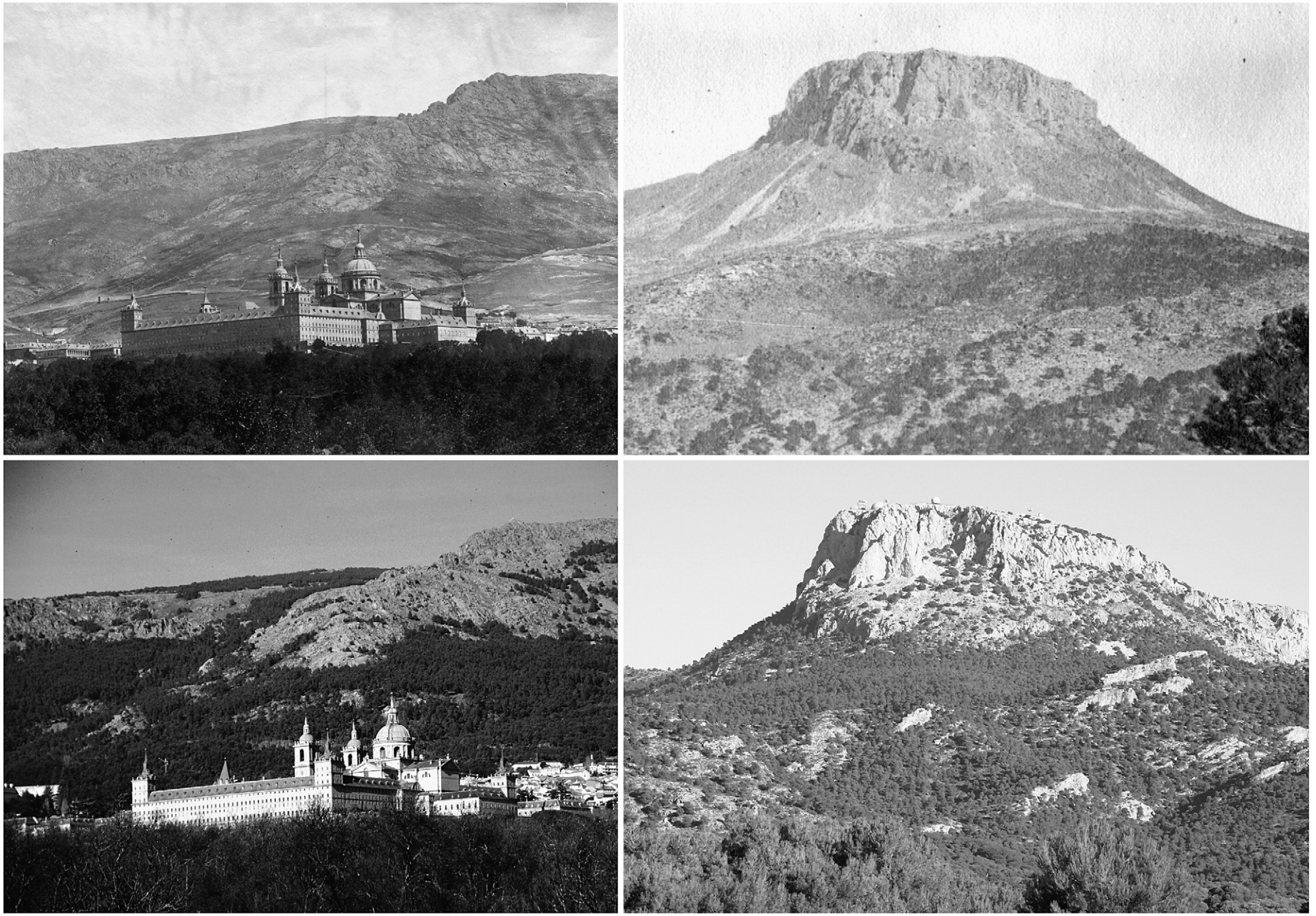

Fig. 5. Mount "La Jurisdicción" near El Escorial (Madrid) (left) in 1848 and Morrón de Espuña (Murcia) (right) in the second half of the 19th century (above) and nowadays (below). The contrast between the pictures illustrates the drastic changes that the Spanish landscape has experienced with the reforestations of the 20th century (Photos: J. Laurent; Dirección General de Patrimonio Natural y Biodiversidad de la Región de Murcia; Luis Gil Sánchez; Alfonso San Miguel Ayanz).

(Gómez Mendoza, 1992). These Services, carried out by the Forest Engineer Corps during the 20th century, focussed for the first time in Spanish forests history on the protection and restoration of denuded, arid and desolated landscapes. Unfortunately, allocation of budget for forest management was always scarce, as woodlands never provided economic profits and were expensive for the Treasury. Quoting the Finance Minister Juan Camacho (1881–1883), "they cost three times more than what they produce" (Guaita, 1951).

6. The reforestations of the 20th century

By the beginning of the 20th century the Iberian landscapes were drastically deforested. The forest cover regeneration was an urgent social need for Spanish authorities. The different administrations' economical efforts resulted, to a great extent, in the recovery of vegetation during the century (Fig. 5). Their achievements must be taken into consideration when the current landscape composition is analysed. According to their significance, three periods of reforestation can be distinguished.

6.1. 1901–1939

In the first third of the 20th century, the formation of the Hydrographical-Forest Divisions promoted reforestations for hydrological purposes. Since the 19th century, these plantations were the main tool used to regulate water flow in areas where periodic flooding occurred. Reforestation was also used to prevent landslides and to stabilize coastal dunes. Reforested areas dating from this period are nowadays mature forests distributed across Spain, from the Pyrenees to the Mediterranean region. Pine species were chosen for these reforestations. Lázaro e Ibiza (1886) described that conifers were the most suitable species to use in the reforestations "for their good conditions of vitality and development, preferably choosing for each area those that spontaneously grow on it. Cupuliferae and other native trees present worse abilities for the forests formation and slower development".

Sierra de Espuña (Murcia, SE Spain) is a paradigm of how reforestations from this period have transformed the landscape. By the end of the 19th century, Sierra de Espuña was considered a desert which suffered recurrent and destructive floods. A reforestation campaign began in 1891 in which Aleppo pine (*Pinus halepensis*) was chosen as the main tree species for the plantations. In 1917 Sierra de Espuña was included in the Catalogue of National Parks. In less than thirty years this region, previously almost deprived of any vegetation cover surrounded by a desert-like environment, became a greener area with high biodiversity richness and of important conservation value thanks to the reforestations with pines (Fig. 5). After being included in several protection categories, today Sierra de Espuña is part of the Natura 2000 network, an EU-wide network of nature protection areas, selected for their natural values and which priority aims are to preserve the biodiversity of species and habitats.

6.2. 1940–1983

The end of the Spanish Civil War was followed by a dictatorial regime which had to deal with the widespread hunger and unemployment of the population. In 1940, 51.07% of the labour force depended on the agrarian sector; the number of industrial workers had fallen by 7.6% since 1930 (Gil, 2008b). The dictatorship undertook an ambitious reforestation plan prepared during the II Republic. This decision was encouraged by the following statement by Elorrieta (1934): "reforestation is the most appropriate solution for unemployment because it does not need specialization for most of the workers, therefore, funding is almost totally employed in salaries".

In 1939, Ximénez de Embún and Ceballos wrote the *General Plan for the Reforestation of Spain* (Ximénez de Embún and Ceballos, 1939). This wishful document planned to use all terrains suitable for reforestation in Spain with the objectives of restoration and protection, recognizing the increasing productivity of forests with time. Despite initial economic limitations, the extraordinary budget assigned to the plan allowed the reforestation of 2.9 million ha in this period (11.34% of the Spanish forest surface). Merely in the first ten years of the plan 274,675 ha were reforested. After 20 years, 1.2 million ha had been planted; 37.2% of the area required the seedlings to be repositioned due to inadequate soil composition and adverse climate conditions (Memoria, 1961).

By 1975 nearly two and a half million hectares had been reforested. Almost 85% was planted with autochthonous pine species, and around 10% were reforested with *Populus* and *Eucalyptus* species (Table 4). The experience of previous decades justified the dominant use of conifers for protective purposes (Gil, 2008b). Pines were the only native species that could guarantee the success of the reforestations. Pines are frugal and colonizing species which have seeds that are easy to collect and that can be stored for years without losing their germination viability. The long-term preservation of pine seeds naturally occurs inside the serotinous cones of several pine species (Keeley and Zedler, 1998), which represent a natural adaptation to crown-fires. These serotinous can remain closed for decades only opening to release their seeds after a fire, when competing vegetation has been eliminated. In addition, pine forests enable further colonization by shade tolerant broadleaved species when silvicultural treatments are carried out (see for instance Rodríguez-Calcerrada et al. (2007)). Unfortunately, these treatments were not carried out because the entire budget during this period was used in reforestation measures, mainly with protective aims; the World Bank and FAO (1996) complained that only 20% of the plantations had a production purpose.

Pinus pinaster was the most used species, its natural distribution increased by 133%. The natural area of *Pinus halepensis* increased by 58% and the distribution of *Pinus pinea* increased 12%. Mountain pine species were also used, 552,973 ha were reforested with *Pinus sylvestris*, 378,542 ha with *Pinus nigra* (using both native provenances and the alloctonous subspecies *salzmanii*) and only 17,322 ha with *Pinus uncinata* (Table 4). These species were mostly planted in already existing state lands, plus 0.8 million ha bought by the State during this period, and public lands owned by local councils. In a few cases, private land was included in these reforestations through consortiums signed by the landowners and the State. Remarkably, in one of these private properties, which had been sold after Madoz´s disentailment law, nearly 4000 ha were planted with pines. Formerly a large agronomic-hunting state, this property became Cabañeros National Park.

Nevertheless, in most cases private owners used fast growing, exotic species such as Monterey pine (*Pinus radiata*) and several *Eucalyptus* species or commercial poplar cultivars. However, it is worth noting that these forest species are planted in agrarian soils and cultivated as agronomic crops. The main difference between them is the rotation period: 10–12 years for poplars and eucalypts and 30–40 years for *Pinus radiata*. The high productivity of the Monterey pine in Northern Spain resulted in nearly 164,000 ha being planted with it. In the Basque Country, it currently occupies 39% of the forest surface and has been a key element to prevent soil erosion (Michel Rodríguez, 2006). *Eucalyptus* species, which are the main raw material for pulp industry, were planted in 273,000 ha, although many of the plantations yielded lower productivities than expected. Poplars became one of the most planted species especially in the river plains, where they are highly productive; the planted surface increased by 25,000 ha during this period.

By 1982 nearly 3 million ha of previously barren lands had been restored as a result of the reforestations, mainly using autochthonous pine species. In the process the State increased its national wealth with the inclusion of almost 1 million ha. Due to the reforestation efforts some of these areas are now of high conservation value.

6.3. 1984–Present

The last 25 years Spain has undergone deep social and administrative changes. The transfer of landscape management actuations to

Table 4
Reforested surface in Spain during the dictatorship of General Franco (1940–1975), the democratic period before the competences transfer to the Regional Governments (1976–1982) and the Autonomic period previous to the Common Agricultural Policy (1983–1993).

Species	1940–1975			1976–1982			1983–1993		
	(ha)	(ha/year)	(%)	(ha)	(ha/year)	(%)	(ha)	(ha/year)	(%)
Pinus sylvestris	480,780	13,355	19.7	72,193	10,313	14.4	58,135	5285	13.2
Pinus nigra[b]	325,605	9045	13.3	52,937	7562	10.5	25,982	2362	5.9
Pinus pinaster	684,042	19,001	28.0	98,372	14,053	19.6	57,860	5260	13.1
Pinus halepensis	370,911	10,303	15.2	95,371	13,624	19.0	84,249	7659	19.1
Pinus pinea	149,064	4141	6.1	63,697	9100	12.7	49,742	4522	11.3
Pinus canariensis	22,537	626	0.9	4549	650	0.9	2123	193	0.5
Pinus radiata[a]	131,788	3661	5.4	32,025	4575	6.4	35,563	3233	8.1
Pinus uncinata	13,085	363	0.5	4237	605	0.8	–	–	–
Other conifers	15,417	428	0.6	6422	917	1.3	–	–	–
Overall (conifers)	**2,193,229**	**60,923**	**89.8**	**429,803**	**61,400**	**85.5**	**313,654**	**28,514**	**71.2**
Populus sp.[b]	18,102	503	0.7	7170	1024	1.4	22,770	2070	5.2
Eucalyptus sp.[a]	221,127	6142	9.1	52,410	7487	10.4	15,543	1413	3.5
Other broadleaves	9158	254	0.4	13,502	1929	2.7	88,495	8045	20.1
Overall	**2,441,616**	**67,823**	**100.0**	**502,885**	**71,841**	**100.0**	**440,462**	**40,042**	**100.0**

[a] Exotic species.
[b] Native species where a part of the used stock for reforestation came from exotic provenances.

the regional governments and the entry of Spain to the European Union conditioned wildlife conservation and forestry policies and subsequently vegetation recovery.

The administrative changes hamper the quantification of the extent of new reforested land during this period. The Spanish National Forest Service was totally responsible for the reforestation activities in the national territory until 1984. The Service was then divided among the 17 regional administrations of Spain, which were allowed to develop their own Forest Plans. The common agricultural policy (CAP) promoted the reforestation of agricultural terrain by financially supporting landowners that planted trees in cultivated land. In addition, Hydrographical Confederations and local councils have also promoted plantations in river plains and communal lands.

The lack of common criteria among administrations to assign new reforested areas makes the existing statistics hard to interpret. Frequently, only the number of plants used in reforestation is given, without differentiating between the first reforestation, second reforestation (dead plant repository) or the reforestation of barren lands. Seed source was, and in many cases still is, unknown. Politicians make promises to plant millions of new trees in an effort to gain votes despite knowing these targets are difficult to achieve in a term of office (four years). Moreover, many reforestation situations occur in burned reforested areas. Forest statistics show a significant increase of the reforested land since 1994 (MMA, 2006a) and more specifically 668,000 ha were reforested between 1994 and 2006 due to CAP subsidies. However, other sources show a 46% decrease in annually reforested land after the power transfer from the State to Regional Governments (Gil, 2008b).

Since 1983, the amount of newly reforested land planted with native broadleaf species (mainly *Quercus*) increased from less than 3% to over 20%, whereas the amount of pines has reduced from 85% to 71% (Table 4). The elected species change was driven mainly by two causes. Firstly, the political pressures exerted by urban conservationists who, without sound justifications, treated native pine reforestations and exotic eucalyptus plantations alike, considering both enemies for conservation. Secondly, success of plantations of broadleaf species increased through the use of good quality agricultural land and the improvement in nursery and planting techniques.

Fire is still the most common threat for forest ecosystems. From 1961 to 2005, almost 2.75 million ha were burned, representing 93% of the area reforested between 1940 and 1983 (MMA, 2006b). Most of fires which destroyed these forests were human caused (only 6% of fires are started by natural causes, e.g. lightning). The lack of appropriate silvicultural practices in many forests eased the spread of fires which go out of control and burn many hectares of shrub and forest land. The reduction of grazing pressure, resulting from depopulation of rural areas, allows vegetation to recover after fire. A large budget is allocated annually to forest fires extinguishing but unfortunately little is invested in fire prevention. Most of the pine reforestations dating from 1940 to 1983 remain unmanaged and could easily be destroyed by fire unless effective and economically viable preventive measures are implemented.

Nowadays, almost every regional government has approved a Forest Plan that complies with the EU Forestry Strategies and the Habitat Directive. These regional plans must be coordinated under the National Forest Plan of 2002. This bringing together of directives is the key element to achieve an integrated management of the forest landscapes by the State, which represents the regional administrations in the European Union. However, there is a lack of coordination among the different administrations, and the implementation of the forest plans is still to come, if sufficient economical resources are assigned.

7. Conclusions

In this review we have shown how the use of natural resources by humans has shaped the Iberian landscape through centuries in a degradation process initiated in the Neolithic. In comparison to many European countries most of the Spanish territory, except for the coast, is underdeveloped, although its present landscape is the result of a severe transformation of natural ecosystems. Ignoring these historical changes, current policies derived from modern conservationist and ecologist concepts that promote non interventionism in nature are leading to the preservation of *fossilized* woods, bushes and shrubs which are a result of degradation processes caused by hundreds of years of human activities.

Plant conservation strategies should take into consideration the degree of alteration our ecosystems have suffered and the historical causes of such modifications. In Spain, the lack of this analysis has often led to bizarre situations where shrub conservation is promoted at the expense of trees, or beech and oakwoods are considered better than pinewoods, or where human-induced *dehesas* are compared to dense, mature, and natural forests. Moreover, the increasing conservation value given to regional or local endemisms represents the current trend of promoting interspecific over intraspecific diversity of broadly distributed taxa, e.g. most tree species (Fig. 6). This perspective sets aside the fact that it is this intraspecific diversity that

Fig. 6. The decay of the hundred-year-old cork oaks in Doñana National Park. The shadow of the large nests and the bird faeces block the light on the leaves reducing the photosynthetic rate. Unfortunately, priority protection of these birds is killing the trees. The case of the cork oaks in Doñana illustrates the anthropocentric conception that matches life with movement, thus valuing animals higher than plants (Photo: Luis Gil Sánchez).

has allowed the adaptation of trees to the environmental changes occurred in the last glaciations.

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