



The image of a tamed landscape: *dehesa* through History in Spain

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Submitted: 25 July 2015. Accepted: 16 December 2015

ABSTRACT: This paper focus on the difficulty of applying an apparently clear and transparent concept that refers to an emblematic Mediterranean historical and cultural landscape: the *dehesa* agroecosystem. This agroecosystem, named *montado* in Portugal, is located in the southwestern area of the Iberian Peninsula. *Dehesa* is a very evocative word; it is a concept that, besides, shows a great capacity to contain social values and sensibilities pertaining to the modern world (respect for the environment, quality in the production processes, biodiversity, cultural heritage). Nevertheless, the concept of *dehesa* is situated in undefined and confusing spaces, due to the fact that its multifunctional nature involving forestry, agriculture and livestock farming prevents it from being understood by the strict dichotomous categories relating to regulatory, ecological or production aspects. In this sense, there is such disconcertion that any proposal aimed at solving the challenges of the *dehesa* should reach a previous consensus regarding a more adjusted definition thereof, continuing the evolution of this historical concept.

KEYWORDS: agroforestry system; ecosystem management; Mediterranean pasturelands; cultural landscapes.

Citation / Cómo citar este artículo: Guzmán Álvarez, José Ramón (2016) "The image of a tamed landscape: *dehesa* through History in Spain". *Culture & History Digital Journal*, 5 (1): e003. doi: <http://dx.doi.org/10.3989/chdj.2016.003>

RESUMEN: *La imagen de un paisaje domesticado: la construcción de la dehesa a través de la historia en España.*- Este trabajo presta atención a la dificultad de aplicar un concepto aparentemente claro y diáfano que hace referencia a un paisaje histórico cultural mediterráneo emblemático: el agroecosistema *dehesa*, que caracteriza el sector suroccidental de la Península Ibérica y es conocido en Portugal bajo el nombre de *montado*. La palabra *dehesa* posee una gran capacidad evocadora; manifiesta, además, una notable capacidad de acogida de valores y sensibilidades sociales propias de la modernidad (respeto por el medioambiente, calidad de las producciones, nicho de biodiversidad, patrimonio cultural). Sin embargo, la *dehesa* se sitúa frecuentemente en espacios de indefinición y confusión, víctima de algunas de sus virtudes y empantanada ante la imposibilidad de que su carácter multifuncional, forestal, agrícola y ganadero, sea adecuadamente entendido por las categorías dicotómicas de los conceptos normativos, ecológicos o productivos. En este sentido, las propuestas de solución para enfrentarse a la crisis de la *dehesa* deberán pasar por consolidar definiciones más ajustadas a la realidad que representan en el siglo XXI, continuando de este modo con la evolución de este concepto histórico.

PALABRAS CLAVE: sistemas agroforestales; manejo de ecosistemas; pastos mediterráneos; paisajes culturales.

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INTRODUCTION

The *dehesa* (named *montado* in Portugal) is a characteristic landscape of the south-western area of the Iberian Peninsula (Parsons, 1962). However, *dehesa* is not only a landscape, as well is an agroforestry system, a type of land use,

a farming system, a ecological entity, a kind of vegetation, a pastureland, an enterprise, and a legal concept (Joffre *et al.*, 1988; Plieninger, 2007; Moreno and Pulido, 2009; Rodríguez-Estévez *et al.*, 2012; Huntsinger *et al.*, 2013).

The word *dehesa* is a very evocative one. It is a concept that, besides, shows a great capacity to contain so-

cial values and sensibilities pertaining to the modern world (respect for the environment, quality in the production processes, biodiversity niches, cultural heritage). All these characteristics should facilitate the forging of social commitments and alliances in order to strengthen these agrosystems against today's socioeconomic and environmental challenges, at least in comparison with other agrosystems or agricultural, livestock or forestry production systems presenting poorer collective identification.

This, however, is not so. All too often, the *dehesa* is situated in undefined and confusing spaces. Indeed the *dehesa* is a victim—to a certain degree—of its alleged virtues, thwarted by the fact that its multifunctional nature involving forestry, agriculture and livestock farming prevents it from being well accepted by the strict dichotomous categories relating to regulatory, ecological or production aspects; there is such disconcertion that the proposals aimed at solving the crisis the *dehesa* is undergoing involve previous consensus regarding a definition thereof.¹

This is the basis of the present research: the difficulty involved in applying an apparently clear concept referring to a historical Mediterranean landscape when tack-

ling the challenges that the future poses to the idea this concept attempts to represent.

In order to situate this concept in the present time, there is a need to look at its history, emphasising the evolution of a term that has embraced the changes in the relationship between humans and nature and also in our conception of resource management.

DEHESA: HISTORY OF A CONCEPT

We are barely beginning to learn of the history of this eco-cultural landscape which at present is circumscribed to the confines of south-western Europe, in the vicinity of Hercules' columns, although in ancient times it likely formed a part of the landscapes of much of the continent. Indeed, the stereotype of the pigs feeding in the *dehesas* and *montados* of the Iberian Peninsula would be familiar to the Duke of Berry, whose servants fed the herds of pigs in the oak forests in the central region of France in the XIV century, or to Ulysses himself, whom Aphrodite made dress in rags on returning from Ithaca so that he would not be recognised, and who once he reached his home, the first person he met was his loyal pig herder, who tended his herd that fed on tasty mediterranean oak acorns.



PHOTO 1. Herds of pigs feeding in the oak park-like forests of Spain (*dehesas*) or Portugal (*montados*).

We lack any exact official figure of the extension of the *dehesa*, whatever that might be, as there is no such item in Spanish statistics. A national study carried out by the Spanish Ministry of Agriculture in 2008 gives the figure of 3515920 ha (quoted in Pulido and Picardo, 2010). Joffre and Rambal (1988) estimated that *dehesa* and its related *montado* systems cover over six million hectares in the southern Iberian Peninsula

The persistence of the *dehesas* throughout history and the story of the word *dehesa* had been studied before (Casa de Velázquez, 1986; Martín Vicente and Fernández Alés, 2006; Díaz *et al.*, 1997; Cabo, 1998; Joffre *et al.*, 1999; Lavado *et al.*, 2000; Linares and Zapata, 2003; Huntsinger *et al.*, 2013; Costa *et al.*, 2014). Etymologically, *dehesa* means “defended, fenced or protected”. There is some evidence which shows the use of the word *dehesa* since the early Middle Ages in the old Spanish code (the 7th century Visigoth Fuero Juzgo, a law protecting fields against free grazing). Other historical sources (Corominas, 1997; Ceresuela, 1998) pointed to its first use as dating from 924.

Ecologists and foresters understand the term *dehesa*, and its related system *montado* in Portugal, as describing a park-like landscape, with a sparse tree layer composed of oak trees (usually holm oak and cork oak), located in the south-western Iberian Peninsula, that provides browsing land for cattle, grazing for sheep and goats, acorns for pigs, as well as some forest income from natural cork, mushrooms, useful plants, wood for fuel and space for bee-keeping (Díaz *et al.*, 1997). *Dehesas* are typical of granite and metamorphic rocky land, where the soil is thin or absent, or

consists of sand granite; trees in areas of deeper or better watered soil have been eliminated, and these areas turned into arable crops, vineyards or olive orchards. Finally, cereal crops can be yielded between the trees. In short, the *dehesa* is a known reference model of an agroforestry or sustainable agrosilvopastoral ecosystem in the Mediterranean basin (Dawson and Fry, 1998; Pulido *et al.*, 2003).

This park-like *dehesas* had to be the result of the clearance of evergreen woodlands and their replacement by open-forest lands (Stevenson, 1985; Stevenson and Moore, 1988; Stevenson and Harrison, 1992) dating from the Neolithic period during the 4th or 3rd millennium BC (López Sáez *et al.*, 2007; Stevenson and Harrison, 1992). These *dehesas* were likely to be created by following the known process of reclaimed land: forest clearing (with the frequent use of fire, Aschmann, 1973), control of woody vegetation, establishment and improvement of pastures. This process evolved to other methods, including the totally man-made *dehesas* with the improvement and reproduction of the trees planted there.

The scientific definition of the *dehesa* has superceded its historical meaning, reducing its initial significance of pastureland to a specific tree-layered pastureland. However, no trees or vegetation, or its geographical distribution, are included in the historical definitions of *dehesa*. What has happened to make its non-specific definition shift to being quite a specific one? We argue that the present concept of *dehesa* recorded in ecological literature comes from an academic point of view coinciding with one of the local images of *dehesa* for Spaniards.



PHOTO 2. Local image of *dehesa* for Spaniards: flock of sheep.

In order to show the historical evolution of this concept, it is necessary to explain some major traits in the evolution of resource use, especially of pastures, in Spain. This story takes us from the early times of Castile (the ancient kingdom of central Spain) during the Reconquest up to the last century.

The commons in the early times of Castile

The frontier between Al-Andalus (the Islamic territory in the Iberian Peninsula) and the Christian kingdoms was by the course of the river Duero in the 10th century. According to the law of the *Siete partidas* (codification of law under the late thirteenth century king Alphonse X), all property won from the enemy was at the disposal of the king, who could distribute it at will. As these territories were practically deserted, the Castilian monarchs initially tried to attract settlers to the newly-conquered areas by creating huge municipalities and by offering generous land concessions to their chief military, ecclesiastic supporters and Military Orders (Mangas Navas, 1982).

In a first stage, the lands conquered from the Moslems by the Castilian-Leonese kingdom were divided into small municipalities and distributed between a large number of settlers. Conversely, the extensive territory further south, between the river Duero and the river Tajo, was largely vacant for a long time, having been depopulated as a result of warfare. From the 12th century, the Christian kingdoms moved towards the south; the territory was repopulated with a smaller number of settlers, granting the municipalities huge territories (Clemente Ramos, 2000).

The lands that had not been apportioned through royal grants remained as Crown property (crown lands or *tierras realengas*). These tracts were usually extensive lands of an inferior quality, often uncultivated, because the best lands were normally the first to be disposed of in royal grants. Managed lands tended to follow a ring-shape pattern, with the more intensively cultivated orchards located in the ring close to the settlements, followed by the extensive cereal fields, the grazing pasture lands and, finally, the woodlands.

The new settlers formed towns under royal (*realengos*) or seigniorial jurisdiction. The colonists used the lands individually as far as possible, but, often, a large land portion remained uncultivated (*baldíos*), free for a common use. The *baldíos* were typically woodlands (*monte*) of a varying density and had a variety of uses: pasture, wood, hunting, acorns and other wild fruits, and even arable agriculture. These lands were of an uneven quality, ranging from marginal areas to fertile soils and remained ownerless merely because of their low local population density or of their physical isolation (Vassberg, 1984).

The legal ownership of the *baldíos* was problematical from the very beginning since nobody held any legal titles to them. For centuries, they were often claimed by the monarch, by the municipalities and by the nobility. Normally, it was recognized that the *baldíos* were at the disposal of the monarch, although the use regulation of *baldíos* was assumed to be a competence of municipali-

ties. For instance, special permission for cultivation had to be obtained from the village government, whilst the residents were allowed the grazing and revenue collection (Argente del Castillo, 1991).

Apart from the lands owned by the Crown and the private properties, there were some community properties owned or used by the Castilian municipalities. These properties fell into two juridical categories: common property, set aside for the free use of the local residents (usually defined as *comunes* or commons, and, at some extent, with *baldíos*), and *propios*, i.e. lands or any other kind of property owned by the municipality as a juridical entity, which were treated as private property. The *propios* were usually rented out by the town council, using the income to pay for public works or local taxes. Common property (*comunes* or *baldíos*) was, at least theoretically, for the free use of the residents of the municipality. Nevertheless, land tenure categories in Spain constitute, in fact, a complex pattern: this difficulty in delimiting the significance of each item has led to continuous disputes throughout history. There is no chance of clearing up these concepts: *comunes* was a confused term that was used indiscriminately along with *baldíos*. These categories played a significant role in the shaping of rural landscapes in Spain because of the different intensities in resource use.

Dehesas and pasturelands in the Middle Ages

Medieval Castile was the most pastoral society in Western Europe. It has been calculated that, by the fifteenth century, two-thirds of the production land in Castile was devoted to grazing (Payne, 1973). More than two million transhumant sheep and an undetermined number of sedentary livestock grazed across the Iberian Peninsula (García Sanz, 1998). The Mediterranean-type climate, however, caused dramatic limitations for livestock; pastoralists had to constantly move around in order to prevent the exhaustion of their resources. Ecology and culture combined to make migration a compulsory feature of Iberian pastoralism.

Domestic grazing regimes took on different forms, which co-existed in the same village. The first was sedentary livestock rearing; secondly, transhumance, where the flocks roamed, usually in a bi-annual régime between summer pastures in the north and winter grazing lands in the south. Accordingly, high plateaus and mountain areas were reserve zones where transhumant herds could find forage, water and shelter from the scorching Mediterranean summer. This semi-nomadic system took advantage of the mountain pasturelands, which were at their best throughout the summer. Stocks could cross almost the whole of the Iberian Peninsula by means of an elaborate network of trails called *vías pecuarias*, the *cañada* being the best known of these pathways. However, most of the flocks remained near the villages, so it was necessary to devise a system to supply them with pasture resources.

Common municipal pastures were part of the solution for the herds, especially for local livestock. Municipalities possessed a complex set of lands that were used for pasture (Vassberg, 1974). The most widespread of

them were the *ejidos* and the *dehesas*. The *ejido* (derived from the Latin *exitus*, meaning exit) was a land area situated just outside the town reserved as pastureland for the local residents. The *dehesa* (from the Latin *defesa*, meaning fenced) was land that was fenced, at least theoretically, and usually destined for pasture. Though the term *dehesa* did not strictly suggest common or private property, it is probably to be originally conceived as a communal system of protection of grazing for residents, particularly for draught livestock, such as oxen. In time, a distinction was made between the *dehesas dehesadas*, subjected to strictly individual uses, and the *dehesas concejiles*, in which only certain uses, such as pastures, were privatised, the communal use of certain forestry resources being maintained, such as acorns and water (Clemente Ramos, 2005). One important feature characterizing this first *dehesa* is that, although a forest tree cover would frequently cover it, this was not an essential trait of its definition.

Much of the Spanish grassland was (and still is) located in woodlands, in *montes*. Unlike the juridical significance of the words *baldíos*, *comunales*, *ejidos* and *dehesas*, *monte* is a forest and geographical concept, which may mean either forest woodland or a mountain. Many of the pasturelands already described —*ejidos* and *dehesas*— should have been partly or even wholly in the *monte*, so there is no means of properly distinguishing one category from another. The *montes* provided a large number of outlets: not only was there pasture grass growing between the trees, but there was also a valuable pastoral resource in the leaves and small branches of certain trees and shrubs, and the holm oak acorns were a highly prized food, particularly for swine. The practice of *ramoneo*, whereby herders helped their animals to graze green shrub leaves by cutting down some branches, was widespread in the *montes* to complement pasture resources.

From June onwards, or even before, the wild pastures became dry and of little value for grazing. In order to complement grazing resources, there was another important pasture source, which was well-suited to the complementary relationship of traditional livestock husbandry and agriculture, the custom of stubble grazing, called, in old Spanish “*derrota de mieses*”. *Derrota* meant that when there were no crops growing, the fields, whether in stubble or in fallow, would be treated as common pasture. Accordingly, private rights to a field were limited to the period between planting and harvest. As the prevalent traditional farming system in Spain was not annual cropping, but biennial, triennial or usually longer fallowing rotation period systems, the total grazing-friendly area was relevant in each territory. This system led to the fresh stubble (*rastrojos*) and fallow (*barbechos*) of grain fields becoming valuable resources because this pasture contained harvest residues and spontaneous vegetation developed during the fallow period. In short, *derrota*, *baldíos* and commons (such as *ejidos* and *dehesas*) encouraged almost the entire territory of a village to become a continuous commons open to the local livestock, and even to that of outsiders.

During the Reconquest, the danger of Moslem raids in some areas made livestock a better investment than easily-destroyed crops and vineyards. Hence, ranching expanded a great deal in the new frontier settlements. The creation in 1273 of the powerful Honourable Council of the Mesta, an association of sheep owners is further evidence of the early strength of the livestock industry (Klein, 1920). The wool trade was the major source of wealth for Castile during the medieval period; it also had the advantage of being easily taxable. The advent of *merino* sheep in the fourteenth century increased high-quality wool production and the Mesta, exporting wool to textile factories in northern Europe, carried on a huge trade. The Mesta flocks could have grazed throughout Castile, only keeping them away from five preserved lands: cropping fields, vineyards, orchards, meadows, *ejidos* and *dehesas boyales*. *Baldíos* were open to the Mesta flocks in accordance with the earlier royal regulations, but as the term was ambiguous, some towns were able to assert their authority over these tracts, defending their use as commons.

The Crown was concerned about the necessity of fencing pastures: Alfonso X (1252-1284), at the peak of the Reconquest, allowed the use of three *aranzadas* of land per pair of oxen (roughly 1.8 ha) from the *tierras realengas*, as *dehesas* in each municipality. The population growth, the spread of arable land and local conflicts led to a proliferation of *dehesas*, which were established by the Crown via local government. This Crown protection was essential for municipalities and private properties, because grazing by transhumance herds was forbidden (Linares Luján *et al.*, 2003). However, the wool trade grew and became of outstanding importance to the royal economy, and the size of herds increased exercising their pressure upon the *baldíos* and putting a stop to fences.

There were different categories of *dehesa*. In the Medieval and Modern ages, every Castilian municipality had at least one common *dehesa*; in that case, those pastures were created for draught oxen, *dehesa boyal*, a fenced pasture reserved for plough oxen, which were the most frequent draught animals before the sixteenth century. When mules gradually replaced oxen as the most prevalent ploughing animal, they were allowed to share the use of the *dehesa boyal* (Vassberg, 1974). The *dehesa boyal* would usually be located near the village, in a site where there was pasture, shade and water. As a rule, this pastureland was reserved for the exclusive use of local animals; its integrity was frequently under menace, to the extreme that a law was issued in 1438 to prevent illegal livestock being taken into the *dehesa boyal*. Municipalities could own other *dehesas* that were not specifically *boyales* (Salomon, 1964). Some of these were open to all animals without any discrimination, while others were reserved for the exclusive use of certain types of animals (for instance, *dehesa yegual* o *caballar*, for mares and their young, and *dehesa carnícera*, reserved for butchers' herds in order to provide better, cheaper meat).

In the period between the xv century and the end of the xvi century in the municipalities in western Spain, one

could distinguish between an initial circle that included closed spaces and common lands/*ejidos*, a second sector of cereal crops, vines and collective spaces, and a third one for extensive livestock farming, with *dehesas*, marginal agricultural spaces and *monte*. The first circle contained the *ejidos* (land demarcated for use by communal livestock, intended for self-supply of residents or for use by the village as a whole, except for oxen, which had their own space) and fields for vegetable gardens and vineyards, which took the shape of a multicrop system with dispersed trees that gradually took over the land of the *ejidos*. The second circle included open fields, cereal croplands and vineyards without trees, together with the common lands: *dehesas boyales* (for beasts of burden – oxen and asses), *dehesa caballar* (for military use, found in villas and cities for use by the oligarchy) and different kinds of *cotos* or *dehesas de la carnicería*, spaces intended for animals for consumption. Cereals were grown following a rotation system of *año y vez* (two-yearly) that allowed communal use of stubble and integration of agricultural and livestock farming uses. In the third circle there was a predominance of the livestock farming and forestry uses including other *dehesas*: delimited private lands mainly used for rent of pastures for large herds of livestock, whether or not in transhumance.

The size, location, and local use of the *dehesas* differed in terms of their geographical and historical factors. It was probably desirable to have trees in the pastures because they provided protection from sun, wind and rain, and branches could be used as emergency forage during drought periods, but this was not a *sine qua non* feature of the character of *dehesas*.

Acorns constituted one of the major benefits of the *dehesas*, in the frequent cases that contained oak-trees. Acorns were not only used as food for animals, but in famine years they were also consumed by humans as acorn-bread. Not all *montes* and *dehesas* had oak trees, certainly, but those that were rich in these trees were prized for their acorns because a flourishing swine livestock could be maintained (Parsons, 1962). City and town councils usually supervised and regulated acorn harvests to guarantee maximum profits.

The *dehesa* was, therefore, in early times not strictly a pasture land with dispersed oaks. In fact, there was an old Spanish term for this, *monte hueco* (which could be translated as “hollow forest”), defined as land in which there were sparse oaks and other trees and from which, when looking down through their canopy, one could freely see to some considerable distance below (Grove and Rackham, 2001).

The *dehesas* during the Spanish Empire

The Spanish forest surface lessened continuously after the Middle Ages (Bauer, 1991). The need for more agricultural land increased deforestation, accelerating the loss of woodland. Deforestation was also carried out for construction, firewood and, notably, for shipbuilding. The woodlands suffered as well during the wars since they

could cover up enemy movements. As has been argued, the rise of the Spanish Empire took place against the background of an intensive environmental change (Braudel, 1975; Simmons, 1989).

The monarchs of Castile increased the Mesta privileges. A 1501 law (*Edicto de Posesión*) declared that all lands upon which the transhumant flocks had ever grazed were to be reserved in perpetuity for pastures and could never be used for any other purpose. In 1528, a royal regulation stipulated that local governments could not deny their commons to the Mesta flocks unless the Crown had reserved the land (Sánchez Salazar, 1988). Only in the late 15th century the Crown stopped favouring the organization and start to take into account the increasing anti Mesta movement. Its grazing rights were reduced, as a consequence of a change in Castilian economy.

The Mesta and the local peasants had an antagonistic relationship. Initially, this was not probably a typical arable-pastoral conflict, but a fight for the use of the same pasture resources between transhumant and sedentary livestock. The local municipalities and peasants wanted to defend their pastures for their own use and the protection of the *baldíos* under the legal concept of *dehesa* was a reliable method to obtain this. Later, with the expansion of cereals, vineyards and olive crops in the sixteenth century, the farmers put some pressure on traditional pastureland by invading transhumance lands such as *baldíos*, *cañadas* or *dehesas*. Any new cultivation in the *baldíos* generated legal battles between the Mesta and the farmers, a struggle that was reflected in the fluctuating laws during the sixteenth and seventeenth centuries (Lynch, 1964).

Spain's population growth resulted in increasing amounts of land being cultivated in the sixteenth century. This increasing demand was accompanied by an expansion of the food supply obtained through agricultural production by enlarging areas under cultivation rather than by raising agricultural productivity through intensive cultivation or through a qualitative transformation of the existing agrarian production forces, so that the agropastoral balance shifted in favour of cultivation. *Montes* areas underwent increasing damage caused by peasants, stockmen and city dwellers in search of fuel and timber. This tendency—expansion of arable lands to increase production at the expense of the pastoral sector—was the general trend during the next centuries, except in periods of population decline, such as in the sixteenth century.

An important technical innovation led to agrarian expansion: the gradual substitution of oxen for mules as the predominant draught animal. A mule could plough nearly twice as much land as an ox and this animal was more suitable in vineyards and orchards. However, mules usually ploughed shallower furrows and they needed a large amount of grain, which meant that a significant proportion of the land had to be oriented towards mule feed, whereas oxen could sustain themselves exclusively on the *dehesas* and other common pastures that were readily available. Also, to breed mules it was necessary to reserve pastures for horses, donkeys and mules were unproduc-

tive as meat for human consumption. As a consequence, mule husbandry required more *monte* and pastureland to be broken up to bring it under cultivation. Therefore, the use of mules probably unwittingly helped towards the rise in clearings and the conversion of grasslands and *dehesas* into arable lands.

In order to understand landscape transformation and land use change during the 16th and 17th centuries, it is necessary to emphasize one major economic factor. The royal economy was bankrupt so that the Crown and the municipalities had to devise alternatives to increase their incomes. One of them, with little success, was to sell enclosure privileges by denying access to the lands to any animals except those belonging to private owners. These newly-fenced areas were called a number of different names: *cotos redondos*, *términos redondos*, *cerramientos*, and also *dehesa*. However, soon after, the fencing system produced a strong resistance, and, in 1566, Philip II promised not to create any more enclosures (Vassberg, 1975).

Additionally, common rights were suffering aggressive attacks from usurpers. Individual landowners —not only nobles, but also peasants and ecclesiastics desirous of establishing full property rights— arrogated to themselves the right to declare their lands as being fenced and not subject to common rights such as the *derrota de mieses*. The *baldíos* were also appropriated by land users without any legal grounds for doing so.

Another element involved in the reduction in communal surface was the sale of *baldíos*. The Crown, from the last decades of the fifteenth century, had exploited this huge heritage. The *baldíos* had been initially sold, frequently to smallholders, to legalize lands that had been illegally ploughed, but, after a few years, the policymakers of the Royal treasury decided to adopt a more market-oriented attitude in an effort to increase its income (Calvo Poyato, 1990). Municipal lands were also sold by rural townships to buy up their obligations to their lords and to pay the increasing taxes required from the Crown.

Both the sale of *baldíos* and the enclosure movement (either by usurpation or authorized by municipalities and the Crown) reflected the expansion of individual ownership at the expense of the commons. These processes of selling the common heritage also led to an increase in the number and surface of large estates. Many *dehesas* had to be especially affected by this cultivation wave.

At that time, the *dehesa* still conserved its characteristic of being, in an ecological sense, exclusively pasture land, independently of its vegetation, which would be tree forested—in a more or less sparse fashion—, but also a shrubby or a completely afforested field.

Enlightenment and alienation

In Spain, the sixteenth century was characterized by a decline in population due to the joint action of disease epidemics, war consequences and socio-economic factors (Domínguez Ortiz, 1963). Agriculture decreased steadily, not only affected by the population crisis, but also be-

cause of the enormous impact of taxation on peasant agriculture, and the inflation rates. The result was a dramatic rural depopulation in large areas. A spontaneous recovery of forests occurred; it lasted until a demographic rise took place in the late seventeenth century, accompanied by a renewed clearing and cultivation of abandoned lands. From then on, the population steadily rose.

In the eighteenth century, agricultural production was stimulated by population growth, regulation changes and the rise in food prices, encouraging the growing of mainly grain crops, but also vineyards (Domínguez Ortiz, 1976; Herr, 1989). Sedentary livestock husbandry became comparatively more important than migrants; by the second half of the seventeenth century, the sedentary flocks numbered some nineteen million heads, whilst transhumance herds reached their peak, some three and a half million (Anes, 1994), despite the decline of the *Mesta*, which was finally abolished in 1836. At the same time, other regulations encouraged peasants to bring land under cultivation; as a consequence, many *dehesas* were more used as purely agricultural lands (Linares Luján and Zapata Blanco, 2003).

The mid-eighteenth-century Catastro of Ensenada, which was the first comprehensive statistical survey of the nation's resources, drawn up between 1750 and 1760, showed that towns and cities possessed some *dehesa boyal* or *dehesa del común* (common *dehesa*), but also a number of private *dehesas* or *montes adehesados*. The rights affecting these private *dehesas* used to be complex because the ownership of the land and of the trees was very often different. For instance, in the city of Baza, in south-eastern Spain (not in the currently defined ecological *dehesa* area, but in a more semiarid location), there were three *dehesas*: the first was a privately-owned *dehesa de pasto* (a grazing deforested one); the other two were *dehesas de monte* (meaning afforested), with the acorns belonging to two separate owners and the pasture was common property of the local community (Cano García, 1990). Another example is the case of Hinojosa del Duque, a town situated precisely in the present *dehesa* area in Sierra Morena (south-western Spain). The survey records a large number of *dehesas*: the town possesses as *proprios* one *dehesa boyal*, two *dehesas* with grass and acorns and another with grass, acorn and arable land; there was also one *baldío* covered by pasture, shrub land, oak woodland and arable land with the grass being the common property of the local inhabitants. The Duque of Béjar, a private landowner, had three *dehesas* with grass and acorn, and, finally, there were a number of *quintos adehesados*, a portion of land with a scattered layer of oaks (Torres Márquez, 1994); in short, a complex panorama that prevents us from coming to any sound conclusions.

According to the Dictionary of Authors of 1726, *Diccionario de autoridades*, at that time a *dehesa* was still a non-arable land oriented towards grazing. Although at this time a campaign against the commons had started, the enlightened reformists recognized the importance of reserved grazing areas. One of the most relevant politi-

cians, Pablo de Olavide, although complaining in his official reports in 1768 of the large amount of vacant land in Spain due to extensive grazing, when promoting new settlements in deserted areas of Sierra Morena, in the south, established the reservation of a piece of land as a *dehesa boyal* for the common grazing of local draught animals (Perdices Blas, 1993).

The Enlightenment age meant, actually, the definitive expansion of cultivated lands. Almost the only way of increasing production was to place under cultivation the under-managed lands, especially pasture and forest land of *comunidades* and *propios*. Some reforms affecting the distribution of commons and of church lands were formulated during the last decades of the eighteenth century in the context of a turbulent period, marked by European wars and invasion by Napoleonic troops. The impact upon the forest and pasturelands was dramatic: thousands of hectares of *montes*, *baldíos* and *propios* were broken up and brought into cultivation.

Although the sale of church lands had begun at the end of the seventeenth century, the definitive attack against the communitarian use of land and the conservation of *baldíos* and uncultivated land took place in the following century in the alienation period, based on the sale of public and church properties. The properties of the aristocracy were not affected, although the abolition of old rules such as seigniorial jurisdiction and the *mayorazgo* (whereby the properties could not be divided up) led to a great deal of land being placed on the market. Subsequently, as from the early years of the century, the municipal properties (*propios*) and other commons were forced to be distributed and sold. The purchasers were mainly middle class and wealthy landowners; in order to clear the forests for them to be turned into pasture lands, the new land-owners rented small pieces of land to peasants, who cleared the trees with the right to sow cereals during a number of years. This state-directed alienation process (*desamortización*) dramatically affected the communitarian land use system of many municipalities, involving a drastic rise in pasture and forest reclamation (Costa, 1898) (although to reduce the effects of this regulation on rural economy sparing the *dehesas boyales* from the sale was attempted).

The conversion of bush and forest ecosystems into cultivated land reached its maximum rate during the second half of the 19th century. The intervention of the recently created Official Forestry Department played an important role in conserving part of this heritage, although millions of hectares of pasture and woodlands were cleared and turned into arable fields (Bauer, 1991).

Spanish agriculture underwent considerable changes when the common fields were fenced into holdings belonging to private owners, because the land started to be used more intensively (Kondo, 1990). Between 1800 and 1860, the area under cultivation in Spain increased greatly, from 8500000 to 13000000 ha (del Moral, 1979). In spite of this general review, it is difficult to draw any firm conclusions about the *desamortización*: in some places the result was an enlargement of the estates owned by the

bourgeoisie, whereas in others there was a certain degree of fragmentation and distribution of land.

The lack of improvements in farming techniques prevented any increase in the productivity of grain per hectare. After some decades of expansion, in 1860 a period of crisis began which particularly affected wheat production. The marginal lands pressed into tillage during the earlier part of the century were relatively unproductive, and their yield could not compete with cheap foreign imports after 1882, so that these marginal lands were to be abandoned. Conversely, there was a great expansion of vineyards and olive groves during the second half of the nineteenth century because of a rise in exports (Zabramna, 1987; Guzmán Álvarez, 2004). From 1880 onwards, the vines suffered from phylloxera, with thousands of hectares all over Spain being abandoned. Some of these changes meant an intensification of land use and, therefore, many *dehesas* vanished, pushed out by the cultivated crops. But a great deal of these cultivated lands (it was previously either pasture land or woodland) was turned into *monte* a few decades later, when the crops and vines were in crisis; subsequently, landowners, using labour, pruned and formed oak seedlings into a sparse framework of promising trees. Consequently, many of the present day *dehesas* (characterized by an even-aged tree layer) come from the period from 1870-1920, in that renewal and creation phase of new *dehesas* (we should point that the first certain use of the modern term *dehesa* for a savannah-like landscape was coined at this time, by the French writer De Lawrence in 1889 in Extremadura, Grove and Rackham, 2001).

To sum up, there was not a single result of the *desamortización* process in the nowadays defined as *dehesa* area, because, depending on the practices of the new owners, the *dehesas* were intensified and even replaced by arable lands, or could have been conserved through fencing and the prohibition of common use (Hernández, 1995). One important factor determined the future of most of these territories: the soil fertility was insufficient for maintaining a cereal or olive yield for very long, so that clearing a whole field of trees was not considered to be a good alternative.²

THE *DEHESAS* IN THE 20TH CENTURY

Economic development has characterized twentieth century Spain (Simpson, 1996). In the 1960s and early 1970s, Spain was in the process of its transformation from an underdeveloped to a developed country. Between 1950 and 1980, agricultural production doubled and the traditional methods were replaced by highly technological ones (Naredo, 1996; Campos, 1983). As a result, the rural landscape changed in extensive areas of Spain following the general trend of an intensification in the most fertile soils and the abandonment of the less fertile areas (Naredo and Campos, 1980; Fernández Alés *et al.*, 1992).

The *dehesas* and the *montes* were not turned into arable lands when the soil was deficient, the slope was excessively high or when the specific socio-economic con-

ditions did not promote crop conversion. Many *dehesas* located in better conditions were broken up to cultivate cereals; if forested, their trees would be removed. Some years later, if cultivation was not profitable, the land could be shifted to pasture land or be abandoned when grazing was reduced. Hence, a piece of land could be affected by one or more of these destruction and restoration cycles.

The extinction of common rights and the consolidation of private ownership meant an important change in the significance of the *dehesa* concept. In many towns in Spain there are no longer any commons rights upon the land. However, the word *dehesa* still persists in the vocabulary and maps. Some of these map-*dehesas* are forested, most of them with oak trees, but there are also some completely deforested, in spite of being grazed. There are even some completely cultivated map-*dehesas* in an arable area context, far away from any trees.

Starting from the mid-twentieth century, and in some spheres of activity, the significance of the *dehesa* concept began to be restricted to a specific park-like pastureland, covered with a sparse oak tree layer. In fact, for a long time, this *dehesa* had been the *dehesa* par excellence for some people, especially in south-western Spain, just because it was the dominant landscape. Social factors such as land tenure and the forest regulations and ecological constraints from the extension of arable cultivation have led to tree conservation.

These properties in the west and southwest of Spain, located on the acid soils derived from the Palaeozoic rocks, were mainly devoted to extensive livestock raising (sheep, pig, cattle and goat) in a pattern described by different authors (Campos, 1984; Joffre and Rambal, 1988; Plieninger *et al.*, 2001, 2003, 2004; Moreno and Pulido, 2009; Standiford *et al.*, 2013). The clearing of woods to open up the canopy, in order to promote pastures, produced parkland like-*dehesas*. Forests were also cleared to exploit the charcoal, as they have been for centuries. In some areas, deforested tracts were replanted, creating newly forested *dehesas*, improving the trees through selection for the production of sweet holm oak acorns or, in other areas, planting cork oaks for cork production. The result of these processes is that it is difficult to establish exactly if the present day *dehesas* surface came from the clearance of the natural oak forest, from the regrowth and clearance of secondary holm oak shrub lands, grazed and cultivated for centuries, or from the planting of acorns. Oppositely, many *dehesas* had definitively lost their tree layer (perhaps centuries ago) and the trees have never been recovered. Or, in other areas, *dehesas* are still a tree cover landscape, but with the presence of other tree species such as holm oak (*Quercus robur*, *Quercus petraea*), wild olive tree (*Olea europaea*), carob tree (*Ceratonia siliqua*), ash (*Fraxinus excelsior*) or junipers (*Juniperus* spp.).

The last two centuries—with the exception of the post civil war decades with their self-maintenance regime—have seen a considerable shift away from the self-

sufficiency land use system. In Spain, industrial influence was relatively small until the 1970s. Iron ploughing machinery, chemical fertilizers and biocides all came in at various stages after the late nineteenth century. Major changes in the ecology of pastoralism also came with industrialization. In some areas, the transition from a traditional land use system to an industrial one happened quite late, and, moreover, the intensification process had not been a great success (Naredo, 1996). This is the case of the low-input livestock husbandry system in the southwest of the Iberian Peninsula, based on the exploitation of the local *dehesas* (Vacher *et al.*, 1985).

The park-like *dehesa*

As we have argued, the *dehesa* as a concept has changed throughout history. From its early times, *dehesa* meant a reserved land pasture often oriented towards local livestock grazing. Afterwards, as the importance of common rights declined and private ownership expanded, the significance of the term *dehesa* broadened and came to mean “a fenced land pasture”. This was still linked to the idea of reserved land not for free use; the difference was that private landholders took advantage of official sales and usurpations to configure their own *dehesas* by clearing the forests to convert them into grazing land.

In 1900, a *dehesa* was still described as a “*monte de pasto, esté o no esté acotado*” (Jordana and Morera, 1900). As we have explained, in Spanish the word *monte* means both “mountain” and “forest”, so this definition could be translated “as a forested pasture land, either fenced or not”. There is no vegetation in the definition, although in many regions there is an identification between the words *ahuecar* (to clear a woodland, conserving a dispersed tree layer) and *adehesar* (to make *dehesa*).

Nowadays, *dehesa* still means a pastureland, which is usually fenced, as it appears in the Official Spanish Dictionary (Dictionary of the Royal Spanish Academy of Language, 2014). No trees are involved in this definition: the *dehesa* is not (yet) a botanical or an ecological concept. For many people living in rural areas, a *dehesa* is simply a pastureland (or, oftenly, it was a pastureland because it has been modified), and even in many cases a *dehesa* is just a place name on a map, in a plot which is presently cultivated or urbanised.

The difficulty in defining *dehesa* lies in the fact that it is a social, cultural and historical category. It's a multi-meaning word (Lavado Contador *et al.*, 2000) which specific definition depends on the approach being adopted. There are several *dehesas*: the shepherd's *dehesa* and the ecologist's *dehesa*, the *dehesa* of a farmer and the *dehesa* of a bird-watching tourist. There are forested and deforested ones, although, originally, the majority of *dehesas* probably had to be forested. *Dehesas* can contain different species of trees. It's an agroecosystem, a pastureland, a landscape or a land use model. But for scholars and for administrative purposes, *dehesa* should be a concrete concept, should it not? The practice of science and the ap-

plication of laws requires definition; however, working with words has to deal with the fact that vocabulary sometimes has a slippery role to play (Huntsinger *et al.*, 2013).

Assuming that we need some clarity, let us be enlightened by our judges and lawyers, who need really precise concepts about which to argue. In the last decades there have been a number of definitions of *dehesa* in public regulations, each for a particular purpose. For instance, Law 1/1986 brought in by Extremadura (a region in the southwest of Spain), defines *dehesa* as a low-input pastureland of over 100 ha. The application of the agri-environmental scheme of the EU policy in Andalusia, in the south of Spain, defined it as an agrosilvopastoral system, usually derived from the clearing of a Mediterranean woodland, with a mainly purpose of stock-raising (*Order of 6 April*, 1999, Andalusian Regional Ministry of Agriculture).

A sound place to find a practical definition of *dehesa* may be scientific publications. The ecological concept of *dehesa* identifies it as an agroforestry system located in the south-western Iberian Peninsula characterised by the presence of a savannah-like open tree layer, mainly dominated by Mediterranean evergreen oaks (holm oak or *Quercus ilex* and cork oak or *Q. suber*) and, to a lesser extent, by the deciduous *Q. pyrenaica* and *Q. faginea* (Joffre and Rambal, 1993; San Miguel, 1994; Moreno and Pulido, 2009). It is characterised by a semi-arid Mediterranean climate, with annual rainfall ranging between 400 and 700 mm, dry, hot summers and cold, wet winters with a great variability between years. The soil usually consists of a thin, stony layer on top of the deep rock (schist and igneous rocks), which is easily erodible and poor in nutrients.

From this point of view, *dehesa* is characterised by: a) a particular physiognomy (a savannah-like or open park-like; b) a type of land use based on extensive (and game) livestock production; c) a basically two layered structure—trees and grass—; d) a particular geographical distribution. This *dehesa* narrowly coincides with the representation of the *dehesa* for the rural population of southwestern Spain because its pastureland can be described as a savannah-like landscape with an oak tree layer.

The change in its meaning has been favoured by the identification of the *dehesa* as a potentially well-adapted and economically viable multi-use agro-ecosystem suitable for promoting sustainable development in many farming areas of the Mediterranean basin. Therefore one of its historical meanings has gained a public relevance, mostly in academic and scientific works (Scarascia-Mugnozza *et al.*, 2000). For urban inhabitants, this *dehesa* has come to be the *dehesa* par excellence. Its balanced, park-like physiognomy might have contributed to this, fitting in perfectly with our widest aesthetic tastes. It would seem that an ecosystem in which grass, bush and tree species coexist and contribute to the feeding of livestock (sheep, cattle, pigs, goats and equines) and wildlife (including game species), and to the preservation of the environment

in an extensive regime is not merely a sort of ecologist's paradise but also the image of paradise for a great many humans.

A major key of this agroecosystem lies in its enclosed nutrient cycle. Compared to standardized Mediterranean agriculture, the flows of energy through the *dehesa* ecosystem are low, since *dehesa* outlets generally deflect only a minor part of the fluxes of the ecosystem towards themselves, whereas cropping systems change whole parts into crops (Naredo and Campos, 1980). Fertilizer and other energy surpluses are usually quite low. However, it should be realized that outputs are also scant.

The *dehesa*'s tree layer modifies environmental characteristics the same as in other savannah ecosystems (Scholes and Archer, 1997). The vegetation structure is made up of two main ecological components. The first is located outside the tree canopy and is composed of herbaceous plants; the second is composed of the oak tree and its associated herbaceous stratum. Tree canopy promotes a mosaic-like structure of herbaceous plant assemblages due to the shift in environmental conditions when comparing the situation under the tree and between trees (Puerto and Rico, 1988). Grass and crops take advantage of the shade provided during the hot periods; under the tree cover there is greater moisture and more organic elements in the soil from leaf shedding and animal excretion (Cerdá *et al.*, 1988; Joffre and Rambal, 1993). As a result, there is twice as much potassium, phosphorus, nitrogen and carbon as in soils in the same field not under the trees, so that some ecological attributes like diversity and productivity tend to increase (Marañón, 1986).

The pastures are characterized by their low production. There is a production peak during the autumn and spring, accompanied by a sharp decline in summer and winter; during these periods, livestock has to be maintained with forage. Cereal crops are still produced in *dehesas* with suitable soil conditions; however, this is not a generalized practise. When grown, the cereals are usually grazed by the stock or harvested for animal feed during the drought period.

Canopy density is maintained at 10-60 trees ha⁻¹, with the optimum ranging between 50-60 trees ha⁻¹. Holm oaks (*Quercus ilex*) have various values as fodder crop, providing acorns and leafy branches, whilst cork oak (*Quercus suber*) main resource is cork. Mature trees are pruned regularly during the life of the oaks to remove selected branches, broaden their canopy cover and increase acorn production. Other wood products such as timber, charcoal and tannin used to be collected, although, at present, forest pursuits have been almost only reduced to natural cork.

A variety of grazing animals are reared in the *dehesas*, including sheep, goats, cattle, bulls, pigs and deers. Swine production is of special interest, because a particular breed of semi-feral pigs grazes acorns (Rodríguez-Estévez *et al.*, 2012). Grazing exerts a powerful effect upon the flora and the system's sustainability de-

depends on carefully controlling it. When overgrazed or subgrazed, an inexorable shift towards inedible plants is likely to happen.

In the park-like *dehesas* are a number of endangered species such as Spanish lynx (*Lynx pardina*), black vulture (*Aegypius monachus*) and Spanish imperial eagle (*Aquila adalberti*), and several breeds of cattle, sheep, goats and pigs threatened with extinction have been conserved.

It has been pointed out that the *dehesa* shows a remarkable stability, biodiversity and sustained productivity (Bignal and Mc Cracken, 1996) as a result of its balanced two-tiered vegetation structure, incorporation of animal husbandry and botanically rich mosaic-like herbaceous plant layers. However, it has to be stressed that *dehesa* only maintains its equilibrium with sound human managing, keeping the woody and bushy vegetation under control, and relegating the shrubs to restricted areas.

In fact, when applying this modern *dehesa* concept, centred on an ecological and landscape approach, there is the risk of forgetting that its conservation depends on a particular land use management and that its peculiar physiognomy is due to a specific ecological key factor: its extensive stock-raising use. We should remember that, whatever it is, it is not a natural ecosystem but rath-

er an anthropogenic agro-ecosystem, a cultural man-made landscape (Silva Pérez, 2010). Therefore, the *dehesa* is in need of human actions in order to guarantee its continuation.

THE NEED OF A NEW APPROACH FOR DEFINING THE *DEHESA*

In the 1960s, the *dehesas* were still exploited in the traditional manner that was quite similar to the farming practices used one century ago (Acosta Naranjo, 2002). Invasion of their grazing layer by thicket, for instance, was controlled by manual uprooting and mule ploughing; in some cases, expert farmers still selected the most suitable acorns from the sweetest trees to regenerate the tree-layer (González Bernáldez, 1991). Afterwards, the *dehesa* agro ecosystem has suffered from severe problems (Campos, 1983; Campos *et al.*, 2003; Vacher, 1984; Huntsinger *et al.*, 2013; Costa *et al.*, 2014): abandonment and thicket expansion due to the decrease in agro-pastoral management practices; the lack of tree layer regeneration; local overgrazing and ill-management of the system; an increase in deforestation and clearing processes to extend cropping lands in more fertile areas; and, lastly, tree decline commonly named as *seca*.



PHOTO 3. The lack of tree regeneration is one of the most severe problems of the *dehesa* agro ecosystem.

Dehesa abandonment during the 1970s and 1980s had a lot to do with the system's inability to adapt to the new socio-economic conditions derived from the economic growth of Spain. During that same period, deforestation in order to extend mechanized cropping was a threat to the *dehesas* in some areas in the context of Spain's economic growth.

From the 1990s onwards there has been a recovery of the *dehesa* as a farming-system. The increasing quality awareness of the consumers and the environmental consciousness of modern societies brought about the reevaluation of the *dehesa* as a model of sustainability. Extra-quality hams and meat from the feral pig have become a reference in Spanish food, causing stock numbers to rise.

During the last decades, a number of influential changes have taken place, triggered by economic growth and the emigration of the rural population (Plieninger and Wilbrand, 2001). *Dehesa* pastoralism has practically disappeared in the form known to us. At the farm level, sheep have often been substituted for cattle and game-hunting species (Joffre *et al.*, 1988); these animals are more suitable for modern *dehesas* than the traditional flocks, because they require a smaller human labour force.

The private environmental income generated by the *dehesas* has also seen to be highly important, given the fact that some owners show a willingness to accept a moderate level of profitability, with even negative margins, in exchange for being able to maintain a lifestyle, legacy existence values and other options of family leisure. Research involving environmental economic appraisal highlight the fact that the negative evolution of income provided by the commercial exploitation of *dehesas* is on occasions offset by the greater margin provided by self-consumption of private environmental services (Campos *et al.*, 2009). Indeed, despite the fact that the main activity of *dehesas* is livestock farming, the private production generating the highest income can often involve the environmental services consumed by the owners themselves.

The present application of energy in modern *dehesas* comes in different ways: machinery, chemicals and technological knowledge are applied to the land. The higher productivity made possible by the addition of fossil fuel power has caused a number of shifts. Heavy ploughing cultivation may have contributed to soil degradation. Besides, the *dehesas* have become vulnerable to outside economic processes and have had to adapt quickly to such changes. Nowadays, the *dehesa* swings between solar-based systems and technified systems, depending on the energy imported and with an increasing dependence on food from outside sources but at a lower rate compared to more intensified livestock husbandry systems. It has been argued that the survival of the *dehesa* throughout the 20th century was based on its adaptation to economic conditions (Martín Vicente and Fernández Alés, 2006); nevertheless, its survival should be linked to its inability to be transformed and changed to another more productive system.

One of its major problems, the lack of oak regeneration is partly the result of the less intensive human labour:

farmers no longer have the time, the economical resources, or perhaps the know-how either, to take any care in the planting, guiding and protecting of the seedlings against animal browsing. The even-agedness of the oak stands in many *dehesas* is a weakness of the whole system if enough regeneration is not achieved (Díaz *et al.*, 1997; Pulido *et al.*, 2001). In fact, the regeneration challenge is inherent to the *dehesa* management because of the difficulties in combining grazing, cultivation, scrub clearing and oak regeneration.

Where abandonment occurs, the whole system may change. Forest or thicket recovery is beneficial for forest or shrubland-dwelling species, although it results in a habitat reduction for open habitat species. What will happen and what the trajectories of natural succession will be is not yet sufficiently known: there will probably be different scenarios depending on factors such as the degree of alteration and the vicinity to propagule sources.

From another point of view, thicket should not be considered as a "forbidden" element in the *dehesas*: it plays a role as a forage reserve for the livestock, reduces the risk of erosion on steep slopes and the regeneration of the oaks is enhanced by the presence of a certain degree of shrub cover.

Additionally, the climate change is likely to affect the *dehesas* (Eagleson and Segarra, 1985; Dale, 1997; Felicísimo, 2011). Currently, it is thought that the *dehesas* have started in some areas to show the consequences of climate change. In any case, there are thousands of hectares being affected by an oak decline disease, with evidence that a sound fraction of this decline is caused by a lethal invasive species (*Phytophthora cinnamomi*) (Brasier, 1992; Sánchez *et al.*, 2002, 2006).

The social and environmental impacts resulting from large-scale abandonment have not been explored in detail, but they are considerable. Counter-measures are being taken in terms of protecting the *dehesas* against their major threats related to the lack of economic and ecological sustainability through public investments and incentive programs based on the explicit or implicit recognition of the public services they provide. Although most livestock income depends on subsidies under European Union agriculture policies, it has been pointed out that there is a need for increasing the effective public support in order to contribute to maintaining the economic viability of the *dehesa* with its associated high biodiversity (Alagona *et al.*, 2013). For instance, agri-environmental regional aids have already been applied to *dehesas* in Spain by means of Regulations 2078/92, 1257/1999 and 1698/2005 (environment-friendly agricultural production methods and maintenance of the countryside). However, the application of EU agricultural and forestry aid schemes (direct payments and rural development) is problematic when applying to the *dehesas*, a multiple-use agrosystem characterised by extensive livestock grazing in forest land (according to national law definition of forest land in Law 43/2003, on Forestry), because EU regulations tend to distinguish rather sharply between agricultural and forestry subsidies.

In order to meet conservation demands in a changing social context, there is a need for updating the definition

of the *dehesa*. The park-like *dehesa*, falling within an ecosystem- and landscape-based approach is not useful because it is not an administrative-oriented definition and it does not highlight the man-made productive character of the *dehesa*. In this sense, Andalusia Law 7/2010, referring to the *dehesa*, includes a definition based on a farming approach. According to this law, a *dehesa* is a farm mostly comprising a *dehesa*-type formation, subjected to a system of land use and management based principally upon extensive livestock farming and making use of pastures, fruits and browsing, as well as other forestry, hunting or agricultural uses, being a *dehesa*-type formation a forestland occupied by a stratum of trees, with a tree cover percentage (area of land covered by the projection of the treetops) of between 5% and 75%, mainly comprising holm oak, cork oak, gall oak or *acebuche* – wild olive (*Olea europea*, *va. sylvestris*), and occasionally other tree species, enabling the development of an essentially herbaceous stratum (pastures), for livestock or hunting species.

Therefore, this XXI century *dehesa* is a land-use system that shapes a specific landscape characterized by scattered trees and annual grasslands; it is an agrarian and forest enterprise managed on a farming rather than on a plot scale, meaning that a *dehesa* farm is often composed of a large proportion of park-like land combined with plots of crop lands, afforested pasture lands and dense thickets and woodlands; the key factor of this system is domestic livestock or, less frequently, game-hunting spe-

cies such as deer; its income does not exclusively come from stock-raising; there may be agricultural and forestry yields such as cereals, cork or firewood.

CONCLUSIONS

The influence of rural history on the shape of the Mediterranean basin landscape has led to an extreme heterogeneity these days (Blondel and Aronson, 1999). In this heterogeneous environment, the importance of the historical, cultural and geographic dimension of ecology is often underestimated (di Castri, 1981). Centuries of pastoralism have brought considerable changes to the Mediterranean ecosystems. Sheep and goats are said to have had the most widespread impact on Mediterranean ecosystems through grazing and browsing (Seligman and Perevolotsky, 1994). The park-like *dehesa* is thought to be a good example of how human activities can be beneficial to many components of biological diversity (Pons and Quézel, 1985) and of how Mediterranean biodiversity depends on the conservation of the cultural landscape, assuming that the countryside's environmental, natural and social problems are related to each other (Phillips, 1988; Bennett, 1996).

Dehesa is a farming system coming from the past with the need of updating its management practices to provide enough tree regeneration to be sustainable in the long-term, reverting the decline of density and cover of oaks (Carruthers, 1993; Plieninger, 2007; Alagona *et al.*, 2013).



PHOTO 4. Management practices to provide enough tree regeneration in the *dehesa*.

Although the changes of *dehesas* landscapes are reported to be explained by a complex set of social, economical, political, technological and natural drivers (Costa *et al.*, 2014), responsible grazing remains in any case fundamental. Through over-grazing, tree renewal will be limited and aridization processes will increase; through under-grazing or grazing abandonment, dense woodland and shrubland ecosystems will develop, vanishing most of the socioeconomic and ecological values linked to the *dehesa*.

Well-managed *dehesas* are an outstanding model of agroforestry that provides economic incomes and ecosystem services (Lundgren, 1982; Rigueiro-Rodríguez *et al.*, 2009; Marañón *et al.*, 2012). The park-like *dehesa* is the result of a long historical record and we are being challenged to preserve this heritage. We may also participate in the evolution of this word through the design of the new *dehesas*. As shown above, in first instance there was a fenced pasture land. After that, a tree-layered pastureland mostly composed of the *Quercus* genus stands. Subsequently, there was a savannah-like landscape located in the southwestern Iberian Peninsula. Finally, a farm approach is emerging in order to recognize the essential link between socioproductive and ecological factors. Now is time to benefit from the *dehesas* approach: an integrated land-use system with grazing as the key management factor, useful for environmental care purposes and for increasing food quality.

At present, there is a wave of promoting agroforestry systems as a sustainable type of farmland (Herzog, 1998; Rigueiro-Rodríguez *et al.*, 2009). The *dehesa*, with its set of economic products and non-commercial environmental services, could play an important role in the Mediterranean region. *Adehesar*, making *dehesas*, is one promising tool for managing Mediterranean lands (Parsons, 1962): the management of open forests through grazing would contribute to maintaining the overall biodiversity, fragmenting the landscape, generating rural amenities and reducing the risk of fire; it could also be an instrument for reducing the effect of the climate change on other types of vegetation as pine forests, abandoned olive or lentisk fields, which could be *adehesados*. However, for this purpose we need livestock and Mediterranean pastoralism, which, in fact, is an ecological and productive factor threatened with extinction.

ACKNOWLEDGEMENTS

The author wants to thank Dr. Javier Sanz for the invitation to write this paper, giving the opportunity (and the challenge) of conceptualizing the implications of updating ecological and historical concepts arising from the past. The text is indebted to the ideas, conversations and work carried out related to the *dehesas* in the Regional Ministry of Environment and Spatial Planning and the Regional Ministry of Agriculture, Fishing and Rural Development of Andalucía and in the framework of the Life Project BIODEHESA (Life 11/BIO/ES/000726) with many colleagues and Friends. I am indebted as well with Guillermo Ceballos Watling, who read carefully the text and made sound suggestions.

NOTES

- 1 Conclusion of Spanish Senate Report on Dehesa ecosystem conservation, November 2010.
- 2 Martín-Vicente and Fernández-Alés (2006) have quoted the personal diary of Frago de Sequeiros, a Portuguese member of the Enlightenment, who proposed the turning of the oak shrub land of the Alentejo, a region in the southwest of Portugal, into open oak parkland, in order to favour cultivation, in combination with animal husbandry, taking advantage of the acorns for nourishing pigs.

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