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MONTADOS and DEHESAS as High Nature Value Farming Systems: implications for classification and policy support

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Goals of the Conference

The Montados and Dehesas have long been acknowledged as a land use systems of high value both in natural and in social terms, due to its diversity in vegetation and land cover, the required balance between the forestry and the grazing uses, and of both these with the constraining environmental conditions of the Mediterranean region where they are found, and also the particular character of the resulting landscapes.

Nevertheless, in face of the current pressures for intensification or extensification of land uses, in order to secure a management which respect the system balance and guarantees the maintenance of the above mentioned values, there is an urgent need to set up priorities in policy making, considering the Montado and Dehesas as complex and unique systems. The High Nature Value concept can be the required pathway for the overall classification of these systems and for promoting their specific consideration in policy making, at the various scales of governance.

For this, and in order to identify which Montados and Dehesas do really secure the non-production values that are valued by society today, there is an urgent need to identify criteria and select adequate indicators or other tools that make the identification and monitoring a straightforward task.

But also, to guarantee the balanced management of these systems, specific consideration should be defined in policy design, both at European and at national and/or regional level. The often conflicting goals and tools of sectoral policies, together with fluctuating markets for some of the products issuing from the Montados and Dehesas, results in a tension for land managers and in unforeseen results in the future balance of these systems. In 2013, the application at national level of the policy orientations defined for the CAP 2013 will be under preparation, and a discussion in the start of that year will make it possible to draw guide-lines that could be a contribution for a better targeting of the future measures and schemes.

Aiming to gather the experience and knowledge already developed by different teams in Spain and Portugal, and other Mediterranean countries, dealing with these complex silvo-opastoral systems, the present conference will thus address these two topics: the classification and the policy implications. Expected direct results are 1) the identification of the best adapted classification tools, based on a clear set of indicators, and 2) orientations for policy design at the national or regional levels, within the framework of the CAP post-2013.

Furthermore, and following the Green Book of the Spanish Dehesas already existing in Spain, the organizers of this conference expect to hereby launch, together with all those involved and working with the Montado, the process of definition of a Green Book of the Portuguese Montados, as a characterization and awareness raising document on the values, potentialities and threats of this system.

Invited Presentations

Session 1 - Management and classification criteria

Progress in identification of HNV farming systems and peculiarities of Mediterranean systems

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Biodiversity usually is higher on farmland that is managed at a low intensity. A more intensive application of machinery, fertilisers, biocides and livestock reduces the opportunities for wildlife on cropped and grazed land. At the same time, intensive use of farmland tends to eliminate features such as field margins and uncultivated patches.

At the lowest end of the farming intensity spectrum, the productive land itself supports a range of wildlife species, especially when it includes a high proportion of semi-natural1 pasture. Low-intensity farming of this sort covers extensive areas of Europe's more marginal regions.

The term "High Nature Value (HNV) farming" was established in the early 1990s to describe these low-intensity land uses and to promote understanding that the conservation of biodiversity in Europe depends on the continuation of low-intensity farming systems across large areas of countryside. A fundamental shift in the distribution of CAP funds away from more intensive farming was recommended, in order to target support towards these beneficial land uses. With the exception of a minority of Member States, this shift has not yet occurred.

EU policies incorporated HNV farming as a priority several years ago. In 2006 the EAFRD2 regulation Strategic Guidelines3 on rural development established *the preservation and development of high nature value farming and forestry systems* as one of three priorities for Axis 2 of Rural Development Programmes (RDPs).

At the same time, *HNV farmland* was introduced as a biodiversity indicator for RDP monitoring under the Common Monitoring and Evaluation Framework (CMEF). National authorities are required to produce an estimate of the total extent of HNV farmland in the programme area of their RDPs, and to monitor trends in the extent and condition of this farmland.

There are thus two different terms in play within EU rural development policy (HNV farming systems and HNV farmland), which have lead to some confusion. Our interpretation is as follows:

HNV farmland refers to farmland characterised by the presence of particular land cover types and patterns (especially semi-natural vegetation and low-intensity crop mosaics) which indicate that this farmland is valuable for nature conservation. The presence of populations of particular wildlife species may also provide this indication.

HNV farmland may exist at different scales, from the individual parcel to an entire landscape.

HNV farming system refers to both the land cover (farmland) and the way it is managed for production by a particular farming system and practices. The term implies that the system as a whole (e.g. at farm or even landscape level) is of high nature value, whereas HNV farmland may be limited to only one parcel in an otherwise intensive farming system.

The term *HNV farming* is used in this paper to refer to the overall concept without distinguishing the farmland from management system.

Not only are there two terms in use, there are also two different policy requirements: to "preserve and develop" HNV farming, and to monitor the extent and condition of HNV farming. The tools required for these two tasks are not necessarily the same. The purposes are different, and the data requirement are also different, although with common considerations.

[1] Semi-natural vegetation is naturally occurring (not planted) grass, scrub or woodland that is grazed and/or cut on a regular basis, resulting in a state that mimics natural habitats. See section below for more details.
[2] Regulation 1698/2005 establishing EAFRD
[3] Council decision 2006/144 on Community strategic guidelines for rural development (programming period 2007 to 2013)

To date, the guidance emerging from the EU institutions has focused mainly on the monitoring question. The European Evaluation Network for Rural Development (EENRD) Help Desk has produced guidelines for the application of the HNV indicators for RDPs (Beaufoy and Cooper 2008), and an important follow-up document in March 2010 (Lukesch and Schuh 2010). These are intended to help Member States to assess the baseline situation of HNV farming and to monitor how it evolves over time.

Because data on farming practices are extremely limited in most countries and regions, most of the work to identify the extent of HNV farmland has had to focus on land cover and species data, leading to very approximate maps of the distribution of semi-natural farmland, and of farmland within sites such as Important Bird Areas (Paracchini et al, 2008). Effective monitoring may depend on sample surveys rather than on comprehensive country-wide data (see Chapter 5.8 in Oppermann et al 2012), but the sample survey approach is not applicable for targeting measures to support HNV farming.

Member State authorities have found that attempting to map HNV farmland at the national or regional level is problematic, whether for monitoring purposes or as a basis for targeting policy support. However, by focusing in on a specific farming system or land cover type, things perhaps start to become more feasible.

How would it work for dehesas/montados? These are broadly-speaking semi-natural landuses, and would be considered automatically as HNV farmland under national mapping exercises – if an area appears as dehesa/montado on a landuse map, then it would be counted as HNV farmland.

But of course when you zoom in closer, you find a wide range of situations. Dehesa/montado pastures range from heavily over-grazed with no tree regeneration, to under-grazed parcels suffering extreme scrub encroachment. And what about dehesas/montados with continuous arable cultivation under the tree canopy? When are these considered HNV farmland, and based on what criteria?

Clearly the first step must be to consider, and if possible to define, when is a dehesa/montado HNV, and when is it not. This will provide the basis for establishing a system for monitoring trends in dehesa/montado HNV characteristics, and/or for designing policy instruments for targeting and preserving these characteristics.

The HNV farming concept proposes some broad criteria or characteristics that we can explore at the level of a parcel, farm holding or a larger area, including for example:

Land cover:

- types of land cover (e.g. semi-natural pasture, sown pasture, arable crop, fallow land, landscape elements)

- diversity of land cover types

Farming practices:

- overall livestock density

- grazing patterns, cropping patterns

- tree management (pruning, regeneration practices)

Biodiversity:

- presence of habitats and species of conservation concern (regional, national, EU)

Socio-economic:

- net income at holding level

- threat of abandonment or change of use

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The forest component in the Montado: Requirements for sustainability

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The cork oak (Quercus suber L.) woodland production system value is closely related with sustained production from its components and from the valuation of current goods and services provided by the ecosystem in a multifunctional management approach. Considering this fact, cork oak woodlands are vulnerable with respect to soil loss, crown cover reduction and lack of regeneration. Ruptures in the balance between the agro-silvo-pasture components can result in tree high mortality risk by lack of fire protection or increased grazing intensity. System vulnerability is closely related with the last five decades changes occurred in the forest management of cork oak stands. Hand labor reduction combined with increasing mechanization power, created a new set of risk factors to the production system sustainability. Of all risk factors, soil loss, crown cover reduction and lack of regeneration are responsible for the increased system vulnerability and the installation of degradation processes

The vulnerability control of these forest structures is closely related with the continuous crown cover management and soil protection therefore the success of natural or artificial regeneration is the driver for system resilience and elasticity.

In the present work it is proposed the use of new stand structure control indices in simulation studies in order to regulate the cork oak woodland system vulnerability by controlling the timing and intensity of the regeneration regimes. For that purpose new developments the cork oak tree spatial growth simulator CORKFITS are used to simulate system response to a set of natural regeneration timing and intensity combinations in order to find the solution for vulnerability control in even-age and uneven-age initial stand structures.

In addition a new computer-assisted vulnerability assessment system is used to evaluate risk, define critical thresholds with respect to stand stability, and established consistency in providing goods and services and hence the economic viability of these managed systems. For that purpose new index for vulnerability as function of erosion risk index, soil limitations class, stand structure index, and crown cover stability index is presented. These new developments the cork oak tree spatial growth simulator CORKFITS are used to simulate system response to a set of natural regeneration timing and intensity combinations in order to find the solution for vulnerability control for cork oak stands area in the region of Alcácer-do-Sal (Southwest Portugal) in a 100 year simulation period.

The present study has particular relevance especially for forest planning at large scale, due to the enhanced capacity diagnose the current situation, evaluate the expected forest dynamics and anticipate management actions to control vulnerability.

Keywords: Simulation, vulnerability, cork oak woodland; decision support system; growth modeling.

Key factors for nature value in Dehesas

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Dehesas are pasturelands where scattered trees are purposely retained and managed, and thus can be seen as anthropogenic savannas. But dehesas can be also seen as an assemble of agricultural systems and farming practices, that in conjunction with the evolution and use of regional livestock breeds and crops and complemented by the climate and geography of the area, have resulted in the development of distinctive "cultural landscapes" from "natural" environments.

Orography, low soil fertility and climate constraints have hampered the development of large-scale agriculture in many Mediterranean regions, where extensive ranching has predominated among land uses (Pardini 2007). These landscapes are viewed as semi-natural landscapes and they contribute importantly to the high rate of biodiversity of Mediterranean Basin, which is considered a biodiversity hotspot at global scale (Myers *et al*. 2000). Indeed, most of the extensive pastoral systems in the Mediterranean region were included in the first map of High Nature Value farming in Europe (Paracchini *et al*. 2008) provided that they are low-input farms, managed at low intensity and retain a certain amount of semi-natural vegetation (Oppermann *et al*. 2012). However, these landscapes have been gradually shaped by grazing practices, included periodical fires and progressive deforestation (Grove and Rackman 2001), reinforced by the fact that grazing mostly cancels opportunities of tree regeneration (Pulido *et al*. 2010). Now, most of them are treeless territories.

Some of these landscapes are still dominated by scattered trees, being dehesas and montados the most outstanding example of silvopastoralism in Europe (Rigueiro *et al*. 2009). The presence of scattered trees has been interpreted as a driving-force of biodiversity (Marañon *et al*. 2009). Trees increase the spatial heterogeneity of resources (water, nutrient, temperature …), forming a fine mosaic of microhabitats (Moreno & Pulido 2009). This microhabitats mosaic associated to canopy-caused gradients is ever present in dehesas and result in very high β biodiversity, verified for herbaceous plants and mesofauna (Díaz *et al*. 2003; Marañon *et al*. 2009). Mosaics of habitats are also identified at higher spatial-scale, caused for instance, by unevenly distribution of trees and shrubs and the existence of singular elements (e.g. linear features) (Diaz *et al*. 2003).

Although grazing intensity and nitrogen and energy use (in short, farming intensity) are interpreted frequently as factors causing a loss of biodiversity (Herzog *et al*. 2012), this has not been confirmed for dehesas, where certain increment in land use intensity could be operating positively in terms of biodiversity below certain threshold (Moreno *et al*. 2012). At the low range of land use intensity, land use increases habitat diversity, and consequently biological diversity. In the context of EU FP7 project BioBio (Biodiversity Indicators for European Farming Systems), dehesas showed the highest scores of environmental quality among the 14 faming systems studied, explained by the low rates of mineral fertilizers and energy used by unit of land (Herzog *et al*. 2012).

BioBio project has also demonstrated that (Moreno *et al*. 2011): (i) dehesas have large number of habitats and linear features, defined according to the European protocol of habitat mapping (Bunce *et al*. 2011); (ii) dehesas have high richness of plants, bees, spiders and earthworms, measured at farm level; iii) in each biological group, only some species are very abundant, while most of the species only were found in few farms; (iv) the high rate of biodiversity found in dehesas is partially explained by the existence of a scattered tree layer (tree pasture) but mostly by the existence of intimate mix of tree and treeless pastures (e.g., while spider species are higher in tree pastures, plants and bees are marginally higher in treeless pastures); (v) plant and animal biodiversity is strongly related to the existence of a wide mosaic of habitats (a high proportion of species (around 40%) were found only in just one habitat per farm, supporting that biodiversity depends strongly of the diversity of habitats; more habitats higher diversity); (vi) secondary habitats (non-productive habitats + linear elements + water bodies) harbor a

disproportionate high number of species compared to the low surface occupied; (vii) semi-natural habitats harbor a high number of exclusive species, which depends on the maintenance of those non-productive habitats. Further analyses are needed to check which habitat types are redundant and which ones are more exclusives at both farm and landscape level, and to check if the spatial arrangement of main and secondary habitats is relevant for biodiversity of both categories of habitats and the whole farm.

Overall, dehesas constitute a unique contribution to the world heritage of biodiversity. Indeed, dehesas usually present higher biodiversity that surrounding arable farms and forests (Diaz *et al*. 2003) and dehesas territories also highlight in terms of biodiversity among Mediterranean regions (Derneği 2010). And biodiversity conservation is more likely to be effective on farmland that already is managed at low intensity and that retains a certain amount of seminatural vegetation (Kleijn *et al*. 2011).

A major challenge that dehesas will face in the coming decades is the need to provide sustainable pasture yields while conserving ecosystem services. However, dehesas are currently facing both environmental and economic threats that might compromise their long-term persistence. Changes in the technological and socio-economic conditions, current agricultural trends and policies are imposing a loss of traditional empirical knowledge, a continuous decrease of profitability of dehesas and their products, and system degradation and simplification (Pereira *et al*. 2004). Dehesas, and other extensive silvopastoral systems, need, therefore, of specific policies to solve those threats and reinforce their economical, social and ecological roles. Explicit long-term strategies should be designed to promote management practices that ensure their conservation. For instance, studies focusing the conditions under which net balance of trees is positive (facilitation) or negative (competition) for pasture understory are still needed. Similarly, the optimal tree density of SPs under different uses and ecological constraints (namely water shortage) has not been adequately afforded yet. The analysis of consequences and opportunities of woody encroachment of extensive pastoral systems and landscapes also deserve more attention. Shrub encroachment could be favorable for dehesa tree regeneration, but it is doubtful whether shrub encroachment would keep stand functioning (e.g., hydric and nutritional tree status, biodiversity) and profitability (e.g., livestock carrying capacity). Comprehensive scientific evaluations of environmental services, as reducing forest fires, C storage reinforcements, control of water loss and quality, and biodiversity preservation, under different environmental and management context are also needed.

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Key factors for nature value in Montados

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Extended abstract

Montados and dehesas are Iberian parkland forested areas of anthropogenic origin dominated by cork oak (*Quercus suber*) and/or holm oak (*Q. rotundifolia*). They are derived from natural Mediterranean forests, where the use of woodland products (timber, charcoal and cork) is combined with cereal crops and livestock grazing in the understory (Blondel and Aronson 1999). These use often result in a singular savannah like structure where the land cover pattern is particularly important for the biodiversity associated with farming and forestry systems (Canteiro *et al*. 2011; Godinho and Rabaça 2011; Simões *et al*. 2012). As a result of the mosaic created by this dynamic heterogeneous landscape which forms a wooded matrix with open areas, scattered woodlands and undisturbed patches of Mediterranean forest and scrublands, montados can harbour a high biological diversity (Díaz *et al*. 1997, 2003; Blondel and Aronson 1999; Tellería 2001; Tellería *et al*. 2003; Harrop 2007). According to Tellería (2001) bird richness increases in woodlands southwards along the Iberian gradient, with montados and dehesas showing the higher scores. This pattern is due to an increase in bird species of edge and open area habitats which appears to compensate the lost of forest birds. Because of these trade-offs, birds can have an important role in the assessment of montados as HNV and the scientific community has given particular attention in the last decades to the different roles that birds may play in montados. These have included, for instance, management options and breeding bird communities (*e.g.* Camprondon and Brotons 2006; Godinho and Rabaça 2011, Leal *et al*. 2012; Pereira *et al*. 2012a; Pulido and Díaz 1992), the influence of cork extraction on birds (Godinho and Rabaça 2011; Leal *et al.* 2011), the relevance of habitat diversity in agroforestry matrices (Leal *et al*. 2011; Pereira *et al*. 2012b). Birds can actually be used to gather systematic information that allows landowners, technicians and other stakeholders to improve management actions in montados, and monitor the status of the ecosystem through reliable indicators (*e.g.* based on species, communities and guilds). Currently, some of the key questions that can be asked using birds to assess the value of montados are: (1) which are the best indicator species to assess the conservations status of Portuguese montados? (2) which are the ecosystem services provide by birds? (3) how can birds improve the HNV of montado? (4) what is the role of birds in the forest certification process? (5) how can a man-made system be managed to allow economical sustainability and high biodiversity values? In this paper we will make a comprehensive review of the work done with birds in these ecosystems in order to define the key factors for nature value in montados.

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Constraints and assets for managing the grazing pressure in the Montado

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Mediterranean oak woodlands (Montado, called Dehesa in Spain) are a human shaped ecosystem, characterized by open canopy woodlands with an undercover of semi-natural grasslands. Other than cork harvesting, the economic viability has been achieved by low intensity and large scale traditional grazing systems, based on biomass natural resources grazed by indigenous livestock breeds. There is a growing recognition that the continuation of such low-intensity farming systems across large areas of countryside, compatible with undisturbed habitats that allow opportunities for wildlife to prosper, are strategic to the conservation of biodiversity in Europe.

The concept of High Nature Value (HNV) farming emphasise this crucial link between biodiversity and agricultural practice. Montado is an example of a well succeeded, ancient and sustainable system that harbour a great part of HNV farmland in Iberian Peninsula. Unfortunately, these formations are threatened with degradation, either through intensification, or extensification of their usage, both of which are potentially deleterious for the resilience and productivity of the system. Livestock is part of the Montado system, and as such, both part of the problem and of the solution for the maintenance of the HNV of Montado. However, managing grazing is always a complex task, because grazing may be affected by any of the following factors: (i) grazing pressure – an instantaneous measurement of the animal-to-forage relationship; (ii) time - the seasonality, timing, duration, and frequency of grazing; (iii) space— the distribution and density of animals, related to the distribution of landscape features; and (iv) animal behavior—the interactions of individuals with social and biophysical environments (Provenza, 2012).

Grazing pressure is a powerful tool to manage land resources and in this presentation we will focus on the main constraints and assets for managing grazing in the Montado. First however, to ensure clear communication, we will define terms of relevance used in grazing management (Allen et al, 2011). Stocking rate refers to the relationship between the total number of animals and the total area of the land, per unit time. Carrying capacity is used to define the maximum stocking rate that will achieve a target level of animal performance, in a specific grazing system that can be applied over a defined time without deterioration of the grazing land. Grazing pressure describes the ratio between animal live weight and forage mass per unit area being grazed at any one time. This last is a dynamic multifaceted process, involving the intensity of grazing, its timing and its distribution.

In the Montado an effective control of grazing pressure may be impaired by several constraints being the most important: (i) temporal and spatial diversity; (ii) lack of data to support management decisions; (iii) rapid changes in support payment schemes from the EU that may drive stakeholders to change productive objectives.

To illustrate constraints induced by variability in the Montado system two different management strategies are presented in Fig. 1. Conservative and tracking stocking strategies are two different ways of dealing with fluctuating forage supply caused by variable rainfall. A conservative stocking strategy can be defined as one that maintains a relatively constant stocking rate over time. In a tracking strategy, stocking rates are altered to track temporally variable forage supply. While stocking rate is constant in the conservative strategy grazing pressure fluctuates (high in dry years and low in wet years) (Fig.1.b) and generally remains constant in a tracking strategy (Fig. 1.a). (Campbell et al, 2006). When the stocking rate is higher than the grazing capacity overgrazing occurs with a negative impact, both in the vegetation and in the animal productivity. We hypothesize that such scenario is also present in the Montado grasslands which are characterized by pronounced patchiness of vegetation communities and marked seasonality of plant and animal biological cycles.

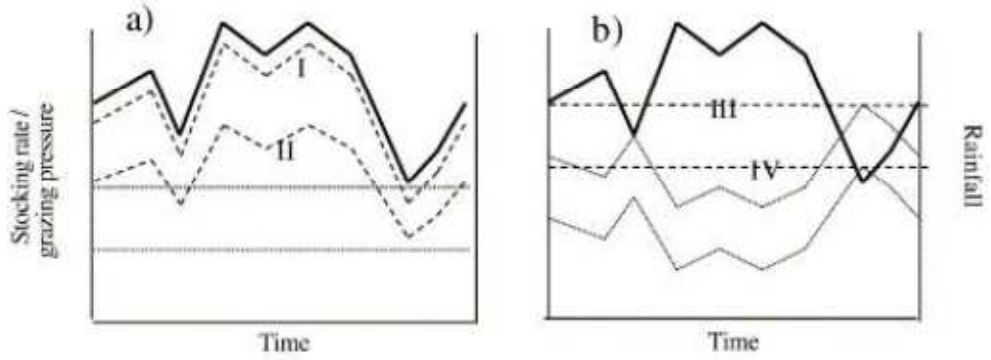

Fig. 1. Tracking (a) and conservative (b) stocking strategies (dashed lines) against rainfall (solid line). Grazing pressure (dotted line) is constant (a) or variable (b). I and III are high stocking rates. (Campbell et al, 2006).

Another important constraint is the lack of adequate data to support management decisions. For instance, carrying capacity includes the effects of variables that are not easily measured (e.g. forage production, animal intake and animal preferences) or whose impacts are not readily forecasted (e.g. rainfall and animal distribution). Knowledge of the historical stocking rate data and management are frequently absent or difficult to obtain. Moreover, available data are both site and time-specific, resulting in a limited-scope of application. Nevertheless the availability of appropriate data is mandatory for grazing management in order to provide useful predictions of both animal population and vegetation dynamics. Suitable indicators must be quantitative, repeatable, have minimal measurement error, be easily understandable and yet affordable.

Constraints related to stakeholder decisions are linked to rapid changes in support payment schemes from the EU. Those represent an increased risk for an effective management. For instance the changes in the production support payment schemes were responsible for a 2.5 times increase in Montado's cattle population in only 16 years (INE, 2006).

Although difficult the targeted management of grazing in the Montado provides essential benefits: (i) avoid shrub encroachment that reduces the value of the land for pasture production; (ii) allows a better identification of restricted areas under threat; (iii) promotes regional-scale environmental management plans.

In order to develop efficient management monitoring is crucial. That implies the simultaneous assessment of the available vegetation (biomass production; vegetation cover, nutritive value and patchiness) and the foraging strategies of grazing animals (diet composition; voluntary feed intake; bite rate; animal spatial distribution).

Novel concepts and tools for monitoring both vegetation and animals has greatly increased beyond the classical methods, with the recent improvements on cameras, computers, global positioning systems and image analysis software. Those represent an opportunity for obtaining larger amounts of data across larger areas of interest, allowing a more cost-effective and uniform sampling. Continued inattention to the pivotal role of monitoring in land management will jeopardize the sustainability of the system. To support HNV farming is essential to ensure the continuation of livestock reared at appropriate levels of intensity.

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Sardinian agro-silvo-pastoral systems: management and constraints

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1. Environment:

Sardinia is located in a central position of the Western Mediterranean area, and is the second island of the basin, with a surface of about 24,090 km2. Sardinia has a Mediterranean climate, characterized by hot and dry summers and mild winters, with precipitations concentrated in autumn and spring. However, the rainfall distribution shows a marked intra- and inter-annual variability, and the dry season can extend for 4-5 months. The rainfall and the mean annual temperature vary from 400-500 mm and 17 °C along coasts and 1,000-1,200 mm and 12-13 °C in the inland peaks, respectively. The island has a prevailing mountainous and hilly territory, with the highest peak in the Gennargentu relief reaching 1,834 m a.s.l., although the mean altitude is relatively low, 380 m a.s.l. The soils derived from very different lithological types (metamorphic, granite, limestone, acid and basic volcanic rocks) and have a variegated constitution, but in general they are poorly developed. About 90% of the territory is considered as disadvantaged areas, following the lines of Measure E – rule (CE) n.1257/99. The forest cover is what remains after the extensive deforestation that occurred in the second half of the nineteenth, when timber was required for the railways construction and the extensive sheep breeding started. Forests occupy about 5,800 km2, mainly within the hilly and mountain areas of the island. About 2,000 km2 are public and managed by the Regional Forestry Office. Adding the "Other wooded areas", Sardinia has now the largest forest-covered surface among the Italian regions (1,213,250 ha, about 50% of total regional surface).

2. Description and management of sylvo-pastoral systems:

Sardinian rural landscape is a mosaic of extensive cereal-farming systems and agro-sylvo-pastoral systems at different level of complexity and integration. In the sylvo-pastoral systems, livestock graze during all year different feed resources like grasses, shrubs and trees, sometimes in common lands, sometimes in mixed grazing (sheep or goats and beef cattle, in less extent pigs). Sylvopastoral systems are characterized by the associations relative to *Quercus* spp: holm oak, cork oak and deciduous oak. The holm oak woods dominate the forest landscape of Sardinia, because *Quercus ilex* has a wide ecological amplitude on the island, ranging from sea level to above 1,400 m. Regarding the forest vegetation of *Q. súber*, Sardinia alone has 90% of the Italian coverage of these woods, with about 100,000 ha. Deciduous oak woods (*Q. pubescens*) are diffused on carbonated substrata of Northern Sardinia, non carbonated substrata of central-northern Sardinia; on basalts, metamorphites and granite in Central Sardinia.

Sardinian sylvo-pastoral areas are mostly under private ownership, in agro-sylvo-pastoral conditions with cereals, pastures and forage crops, like in cork oak farm or in wooded pastures. . In the public sylvo-pastoral areas, farmers share grazing rights and agree on the partitioning of the grazing area. Subsidies (e.g. *subsidies* for compensation of *natural handicaps*), have so far kept most systems viable even if at low-income conditions. The regional government provides consulting services and financial support (low grazing-fees in public lands), but private cheese making and cheese marketing co-operation is a main driver. Sylvo-pastoral areas in some cases can be under pressure of overgrazing, due to some interacting conditions: long-time retention of grazers all over the seasons; increased size of the flock; agronomic and physical marginality of the areas; uncorrect management in common lands. Moreover, some other constraints such as recurring wild fires, climate change, human settlement and abandonment of agricultural lands expose several areas at the risk of environmental degradation.

3. HNV territories:

Sardinia is considered a hotspot for plant diversity in the Mediterranean region. Plant biodiversity emerge from the interaction between ecological factors and agro-pastoral management, grazing activities being considered as a tool for the sustenance of biodiversity. Sardinian flora includes 2,400

taxa, 10.6% of which are endemics, 5% are exclusive of the island, 4% are common to Sardinia, Corsica and some Tyrrhenian areas. The evergreen tree formations and the "Mediterranean maquis" are of a great ecological importance, an ideal habitat for many animals, including insects and other invertebrates. The insularity of Sardinia allowed the differentiation of a peculiar fauna, including endemic species; between them, the moufflon (*Ovis musinon*), the white donkey (*Equus asinus* L. var. albina), the Sardinian deer (*Cervus elaphus corsicanus*), the golden eagle (*Aquila chrysaëtos*), the griffon (*Gyps fulvus*), the peregrine falcon (*Falco peregrinus*).

Even if a definitive map of EU HNV still does not exist, preliminary studies show that in Sardinia such areas cover roughly 50% of Utilized Agricultural Area, mostly represented by grazed grasslands and rangelands. Available EU HNV map refers about 1,200,000 ha for Sardinian HNV farmland area, equal to the 65.4% of the agricultural land, one of the higher percentage of all the Italian regions, only lower of some Italian Alpine regions. The 30% of Sardinian forests (176,450 ha) can by considered HNV forest areas, on the basis of the guidelines provided by the European Evaluation Network for Rural Development, which is consistent with the National Forest Inventory data.

4. Regional Policy:

The Rural Development Programme (RDP) 2007-2013 drawn up by Sardinian Administration allocated 37% of the budget (586 million Euro) on the first axis, aimed to improve competitiveness of agricultural and forestry sector, and 45% on the second axis (about 700 millions Euro), whose specific goals aim to achieve the protection and expansion of agro-forestry systems with high natural value, the safeguard of the environment and the improving of the animal welfare or intend to reward farmers working in mountainous and disadvantaged areas. Nevertheless, the requirements of forest policy applied in Sardinia are very restrictive of grazing in the woods. Grazing is allowed from 15 April to 15 July, in order to reduce the fuel and the fire hazard, for max. 3 sheep / ha and 0.5 cow / ha. In the remaining periods, grazing is allowed for max. 1 sheep / ha and max 0.2 cow / ha. Grazing is prohibited in the woods of new planting or subject to full or partial cut, or burned by fire, and in any case until the development of the young plants and new shoots is likely to avoid any possibility of damage; also, is prohibited in the old woods too thin, until it is ensured their reconstitution. In the woods belonging to the municipalities, grazing may be exercised in compliance with the above cited rules and after the approval of the concerned municipality. Moreover, in the woods and in the lands covered by shrubs with protective function, grazing by goats is prohibited. The Autonomous Region of Sardinia has also approved on 2007 a Regional Forest and Environment Plan (Piano Forestale ed Ambientale della Regione, PFAR). It is an important tool that designs strategies for the promotion, protection and enhancement of its forest resources, placing at the center of the action the sustainable forest management. The PFAR faces many challenges, related to the forestry sector: soil protection, fire prevention, sustainable agricultural practices, protection of biodiversity. The agro-forestry and pastoral interventions represent, for the PFAR, a compelling address that relates to the protection of biodiversity in agro-forestry landscapes. Such areas can not be classified only as areas with distinctly naturalistic connotations, but also they rely on a strong cultural and landscape value and economic-productive relevance. The regulation seems to be more clearly related to the wooded pastures with prevalence of cork oaks, and to the cork oak forest. For these contexts renewal of the tree component has to be maintained. The PFAR, at present, is only a document of good intentions that will never find full application, until specific measures which support the environmental role of pastoralism in forest areas will be introduced in the RDP of the Region and in agreement among the different stakeholders.

High Conservation Value Forest and High Nature Value Farmland: Crossing paths towards the conservation of cork oak landscapes

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The High Conservation Value Forest (HCVF) is a framework allowing standard identification of areas important for the conservation of biodiversity and of ecosystem services in forest ecosystems. HCVF also explicitly considers the needs of local human populations. The concept is based on the recognition of six High Conservation Value Attributes (HCVAs). HCVAs related to biodiversity imply to assess an area for its potential to host "significant concentration of biodiversity values", such as endemic or endangered species (HCVA-1); to evaluate if an area is part of a "nationally significant large landscape-level" region hosting viable populations of most species (HCVA-2); and to determine if an area contains "rare, threatened or endangered ecosystems", such as classified habitats (HCVA-3). Attributes related to ecosystem services (HCVA-4) imply assessing if an area "provides basic ecosystem services", such as watershed protection or control of soil erosion; attributes focusing on the needs of human communities (HCVA-5) imply considering how important is an area to meet "basic needs of local communities", such as subsistence or health; and attributes related to cultural aspects (HCVA-6) involve considering how relevant is an area for the "traditional and cultural identity" of the community. The HCVF concept moves beyond biodiversity to explicitly include ecosystem services and human needs in a conservation framework.

The HCVF concept was initially developed under the Forest Stewardship Council (FSC) certification - a voluntary certification scheme under which forest landholders must comply with forest management practices (third party audited) respecting environmental and socio-economic principles and criteria. The HCVF concept falls under one of the FSC environmentally related principles (Principle #9 "Maintenance of high conservation value forests") which requires landholders to "maintain or enhance the conservation value" of HCVF areas identified within their properties. The concept however has moved beyond forest certification and can be extended to land-use and conservation planning, advocacy, or for developing of responsible purchasing and investment policies in forest and non-forest ecosystems. Although the concept is standardized internationally it is adapted nationally and regionally through public participation of stakeholders. Participation of stakeholders in the "national interpretation" of the concept increases the power and legitimacy of using HCVF as a conservation tool. In Portugal, the national interpretation of HCVF, involved participation of multiple stakeholders in public meetings and has been used as a framework to identify, at the regional level, important areas for the conservation of biodiversity and ecosystem services. In particular, the concept has been applied to cork oak (*Quercus suber*) landscapes, especially those that were FSC certified and for which HCVF areas were mapped and identified (presently there are in Portugal 80.000 ha of cork oak stands FSC certified from a total area of 736.000 ha of cork oak cover).

An initiative among the Technical University of Lisbon (School of Agriculture, Centre for Applied Ecology "Prof. Baeta Neves") the Mediterranean Program of the World Wide Fund for Nature (WWF) and Faunalia (a small GIS software company), was set to apply the HCVF concept, at the regional level, to southern Portugal. Information on biodiversity and ecosystem services (HCVA 1 to 4) was collected, gathered in a geographic Information System (GIS) and made publicly available through an online WebGIS platform. This WebGIS platform, denominated HABEaS, acronym for Hotspot Areas for Biodiversity and Ecosystem Services, has been used mainly by landholders for forest certification purposes. A case of Payment for Ecosystem Services (PES) in cork oak was also build using HCVF information generated by HABEaS.

HCVF has a strong potential to be extended to other cork oak areas of the Western Mediterranean Basin. HCVF can be used to build conservation portfolios and generate information for voluntary market PES and investment schemes in these areas. Such approach may generate revenues contributing to

reverse mismanagement or straight ward abandonment of the socio-economic and conservation valuable cork oak landscapes.

HCVF framework can be used together with the High Nature Value (HNV) farmland classification to enhance the conservation of cork oak landscapes. HNV farmland systems are typically low-input, extensive farming systems that generate habitat hosting species of conservation concern. Abandonment or mismanagement of such systems implies loss of habitat and of species of conservation value. The cork and holm oak (*Q. rotundifolia*) agro-silvo-pastoral systems of Iberian Peninsula, *montados* and *dehesas*, are typically classified as HNV farming systems. Applying the HCVF concept to *montados* and *dehesas* will add the "ecosystem service" and the "human need" dimensions to the HNV farmland classification. This, in turn, may contribute to generate economic incentives, through PES and other conservation schemes, incentivizing the sustainable use and conservation of these systems

Criteria for identifying HNVF: experience from a WWF Pilot Project with special reference to Dehesas

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Introduction

Spanish dehesas are among the best preserved low-intensity, semi-natural grazing systems in Europe and are usually considered of High Nature Value for their recognized biodiversity and cultural heritage (Díaz et al., 1997). Nevertheless their conservation status is diverse as a consequence of the type and intensity of management practices developed under varying environmental factors (soil, relief, microclimate, etc.). These interactions result either in the abandonment or intensification of the system, with a gradient of realities between both extremes and with distinct impacts on its natural and cultural values (Peco et al., 2001). In order to prevent further deterioration of HNV farming systems, there is an urgent need to identify criteria and select proper indicators that make identification and monitoring a straightforward task (Beaufoy et al., 2012).

The attribution of HNV to dehesas, as for other potentially HNV systems, implies different scale-dependent analyses: for large scales (e.g. Iberian Peninsula) the use of distribution data of plant, vertebrate and invertebrate species (10x10km), together with land covers, agricultural and forestry statistics and climatic and topographic variables, could be an adequate strategy (Olivero et al., 2011). For small scales (e.g. farm-level) field information on specific management practices (livestock types and stoking rates, grazing and pastures management, cropping, etc.) and data on species' presence and abundance, are essential. For meso-scales (e.g. municipalities, counties) where species data is in most cases of poor quality and information gathering on management practices is unaffordable, the calculation of landscape metrics on available detailed digitized cartography of land uses is probably the most suitable approach to reveal to some extent the degree of naturalness and human impact in these systems.

Here we propose a methodology for identifying and valuing potential HNV agro-forestry systems at a meso-scale level and present preliminary results on the case of dehesa systems of Valle de los Pedroches y Alto Guadiato region (Córdoba province, Andalucía).

Data

The following free-available thematic datasets were used:

SIGPAC, the Spanish Geographic Information System of Agricultural Parcels (FEGA 2010, 1:10.000 scale), is based on the European Land Parcels Information System (LPIS). This provides high spatial resolution of agricultural land uses.

SIOSE, the Spanish Land Use and Land Cover Information System (IGN 2005, 1:25.000 scale), is based on the CORINE Land Cover project and the European INSPIRE Directive 2007/2/EC. It offers great spatial consistency in the identification of land covers.

VFA, the Map of Land Uses and Land Vegetation Covers of Andalucía (REDIAM 2007, 1:25.000). This cartography indentifies forest species (dominant and secondary species) and distinguishes among different forest units (riparian forests, dehesas, plantations, etc.).

Methodological workflow

1. Integration of different free-available maps to obtain improved land-use cartography

The lack of concordance detected in land covers, spatial units, geographic projections and file formats between SIGPAC, SIOSE and VFA forced us to integrate them into new-improved land use cartography.

SIGPAC polygons were adopted as the basic spatial units for the analyses. However dehesas were mainly identified according to SIOSE data, as this source has a specific *dehesa* land cover type and includes the proportion of arable crops (non-irrigated and occasionally irrigated), pastures, scrubland and woodland inside each unit. The resultant cartography follows a hierarchical model of seven categories and four levels of disaggregation.

2. Application of GIS map generalization techniques to delimit potential HNVF systems.

Cartographic generalization was applied to alter map spatial resolution obtaining new spatial units of larger size (Brassel & Weibel, 1988) by the aggregation of contiguous polygons of identical land cover and the removal of polygons of less than 10ha, which were ascribed to neighbors. The new spatial units are defined by the dominant land use and retain inside them the structure and shape of the original land parcels. The resultant typology of potential HNV farming systems is: Dehesas of pastures, cultivated dehesas, pastures, arable crops, permanent crops, natural forests, plantation forests and scrublands.

3. Characterization and valuation of landscape structure and composition within the generalized spatial units

The natural value potential of the spatial units in the land-use map was quantified through several landscape metrics related to the intensity of land use, and the presence of semi-natural features, land use mosaics and man-made infrastructures. On the basis of a scientific review and expert knowledge and the constraints of available data, the following indexes were calculated grouped in two categories (Table 1):

Table 1: Landscape metrics used to assess the natural value of Dehesas. Higher values in Structural Diversity Indexes (SDI) represent higher natural value, while higher values in Impact Indexes (II) represent lower natural value

Type of index	Description
Structural Diversity	Proportion of riparian forest (bushes and tree species)
	Proportion of water sources (rivers, streams, wetlands, irrigation ponds)
	Proportion of habitats included in Habitat Directive (92/43/EEC)
	Proportion of priority habitats included in Habitat Directive (92/43/EEC)
	Proportion of natural forest (native species)
	Proportion of pastures
Impact	Proportion of roads and urban uses
	Proportion of irrigated crops
	Proportion of herbaceous crops

4. Automatized weighted integration of particular indexes and quantification the natural value of the spatial units

Each index was re-scaled in five categories (0-4) taking into account the whole range of values for the study area (Jenks, 1967), although in some cases the number of classes was reduced to avoid aberrant results or to decrease the weight of indexes of lower relative importance. Finally DSI on the one hand and II on the other, were integrated separately, resulting on a scale of five classes, ranging from low natural value/low impact to high natural value/high impact (figure 1).

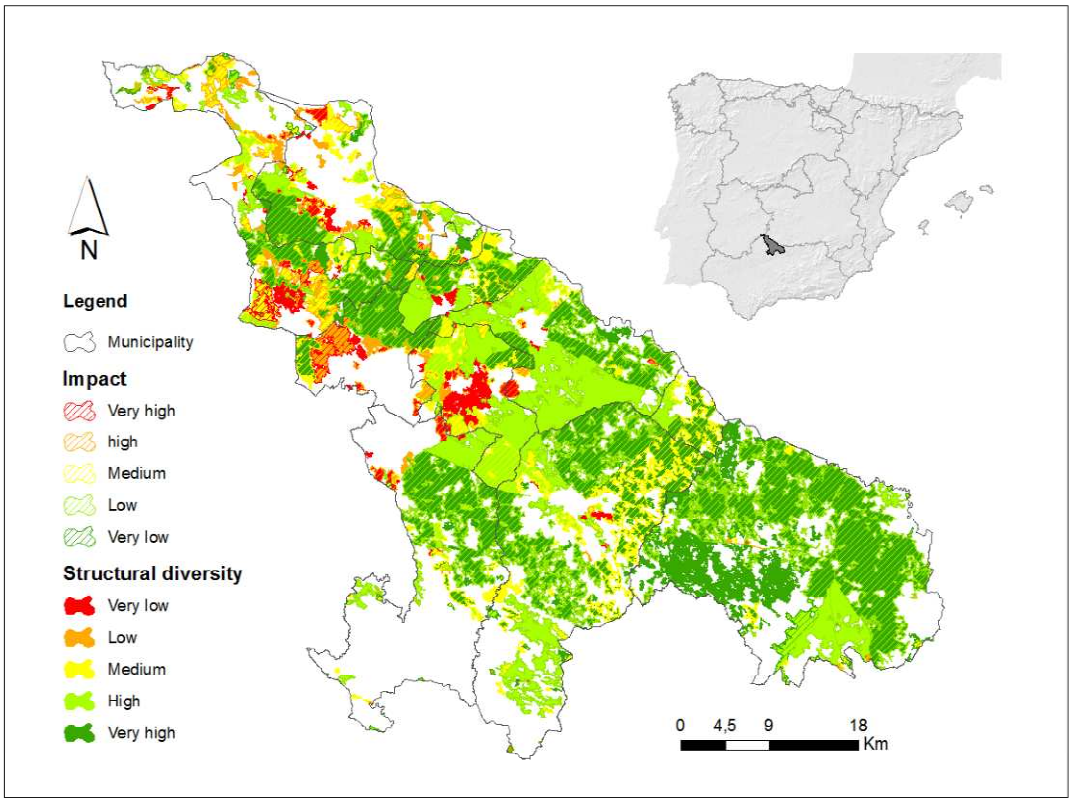

Figure 1: Illustration of identification and valuation of Dehesa systems in Valle de los Pedroches y Alto Guadiato region (Córdoba province, Spain). Integrated Structural Diversity Indexes and Impact Indexes are presented separately in five classes.

Conclusions

Identification and valuation of HNVF systems through GIS analyses allow us to draw some conclusions: (i) an integration of available cartographic sources is needed, since none of them is fully useful independently; (ii) this integration implies heavy workload with GIS and programming, given the lack of concordance between sources in land covers, spatial units, geographic projections and file formats; (iii) the meso-scale analysis performed represents a viable starting point, although the lack of information on agricultural and livestock management practices in the cartographic sources still implies that this information should be collected at farm level; (iv) the identification of HNV gradients, from very low to very high, could be more useful than the mere yes/no approach as to the definition and implementation of actions to improve these systems; (v) these efforts could be also benefited from the use of structural diversity indexes and impact indexes as distinct HNV components.

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Tentative identification procedure for HNV Montados

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Abstract

The silvo-pastoral systems of Iberia, the Portuguese Montados and Spanish Dehesas, are widely recognized today as being hotspots of farmland biodiversity and exponents of landscape multifunctionality **(Pinto-Correia et al., 2011).** These are wooded pastoral systems derived from Mediterranean forest ecosystems, where livestock grazing is combined with woodland production, resulting in a singular savanna like land cover pattern, particularly significant for the biodiversity associated with both farming and forestry **(Canteiro et al., 2011; Godinho & Rabaça 2011; Simões et al., 2012)**. Such systems are fully dependent on agricultural management, thus its natural value and environmental qualities are closely related, not only to the high variability of the system components, but also to the pressure of different farming practices. In the last decades, these silvo-pastoral systems have been subject to different pressures which have resulted in multiple trends: intensification, through increased livestock density and increase mechanization, and also extensification, through lower grazing density and lower shrub control, both simplification of the land use generally. This means mainly that these are not stable systems, but systems where the balance between the various components is always challenged by human practices. The triggering factor is the grazing management, depending on the type and intensity of livestock associated with shrub control, and grazing is prone to many fluctuations depending on market and policy changes and the overall strategy of each land owner. It is not always adapted to the reliance capacity of the system. The extreme management orientation may lead to the decay in the balance of the system and permanent loss of the natural and landscape values.

Iberian silvo-pastoral systems are broadly classified as High Nature Value (HNV) systems, according to the classification proposed by the European Environment Agency. The concept of High Nature Value has been evolving in the last two decades in Europe aiming to integrate biodiversity and environmental concerns in the agricultural sector **(Beaufoy & Cooper, 2008)**. Hence, this concept recognizes that the maintenance of specific farming systems, especially where agriculture is less competitive, may have a positive impact on the preservation of biodiversity and wildlife value of farming areas. The HNV classification, which emerges today as central in the negotiation of the agri-environment and rural areas support on the CAP post-2013, is applicable across all Europe and aims to define objective criteria for the system functioning and for the ecosystem services associated with it (**Andersen et al., 2003**). This classification must consider different types of farming systems, and specially connecting with management options in different contexts, in order to assess not a static situation, but the dynamics of the system and its long-term sustainability, resulting from managing practices and strategies.

In Alentejo region, southern Portugal, where Montado areas are dominant **(Figure 1)**, several types of Montado in different natural conditions (soils, climate, and topography) and in different management contexts over time, can be identified. The differentiation of a complex reality in such a wide territory is thus an assumption and the challenge today, given the various types of threats affecting the Montado, is to promote its sustainable management, in order to maintain its specific production, but at the same time, guaranteeing the public goods and services valued by society. Therefore the high variability underlying Montado systems, both in biophysical and management contexts, can result in different impact levels concerning the sustainability of the system and thus, on its natural values. Given this, a question may be raised: can all Montados be classified as HNV farmland?

Figure 1. Spatial distribution of agro-forestry systems in Alentejo region, Southern Portugal. (data from Corine Land Cover 2006)

There is so far not much work developed on the HNV assessment of Mediterranean silvo-pastoral systems, even if those are considered as one of the most significant examples of a fruitful relation between farming and conservation. In this paper we will present a methodology aiming to contribute to the integration of the HNV concept in the context of Mediterranean silvo-pastoral systems. The overall aim is to develop a methodology for a systematic approach able to facilitate the identification of HNV Montados. This work will focus on producing and testing indicators having the landscape as the basis of a spatial approach. This approach will merge the approaches commonly used in other Member States for the identification of HNV farmland and will explore the diversity of *Montados* and its relationship with the landscape patterns resulting from the combination of management practices, biodiversity and land cover.

Considering the complexity of the Montado system, and the diversity of public goods it supports, the sustainable management definition implies the integration of different dimensions, and different scientific perspectives. Thus, it is necessary to consider innovative approaches, crossing disciplines and including joint methodologies. The project here presented considers the landscape as the basis for a spatial approach and aims to produce knowledge contributing to identify, in different types of Montado, (i) which type and intensity of management practices best fit the system sustainability and (ii) the conditions in which Montado can be considered a high nature value farming system, in order to benefit from the support of the agri-environment and rural development measures.

With this methodology, still in progress, two main results are expected. First, the identification of the HNV Montados and definition of thresholds, related with management practices (between high HNV

status, in one extreme, to low HNV – the HNV level). This approach will be based in integrated spatial and statistical analysis procedures that best evaluate the relationship between Montado management variables and biodiversity values. Second, the definition of landscape based HNV indicators. The landscape indicators expected to emerge from this study should increase the possibility of identifying HNV areas through sensitive analysis of aerial photographs and thus with no or reduced need for field data collection. Since little work have been developed so far in the application of the HNV concept in Portugal this exploratory study will also contribute with new data and knowledge towards the identification and monitoring of HNV farmland. This exploratory development will be applied to the main Montado types in the region of Alentejo. Later, application to other areas is also foreseen, so that the methodological achievements can be generalized.

Keywords: High Nature Value, Montado silvo-pastoral system, Extensive grazing, Landscape indicators.

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Invited Presentations

Session 2 - The policy implications

Assessment and improvements of the existing CAP measures for the Montado

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The Montado and its dominant species, which characterize it, the cork oak and the holm oak, are protected by law1, and is not allowed to convert them unless in exceptional cases, which require authorization by competent authorities. It is therefore recognized, on a National level, its importance as an agriculture, forestry and pastoral system that has to be protected and, at the same time, has to be valued both economic, social and environmentally2.

In Alentejo3, Montado represents almost one third of the total geographic surface (867.335 hectares (ha) – forest settlements in which the cork and holm oak are the dominant species under the NFI54) thus indelibly marks the regional identity. This condition has substantiated the application for the World Heritage status, by UNESCO, as a natural landscape, promoted by the Regional Tourism Organization of Alentejo

Alentejo has three Sites of Community Importance (SCI) from the network Natura 2000, where Montado is the main element with a total area of 129.108 ha, about 15% of the Alentejo's Montado total area. There are other SCI in Alentejo, which include areas with more or less Montado however have other more representative elements.

Its inclusion in the concept of system with High Nature Value from the Environmental European Agency emphasizes the recognition of its environmental value

The Montado managed in a rational and sustainable way, can perform multiple functions from production: forestry, agro-pastoral, wild berries and mushrooms, aromatic and medicinal plants, apiculture; to other purposes including environmental protection and nature preservation as well as recreational (hunting and fishing) and leisure activities.

Despite this recognition, at multiple levels and scales, the Common Agricultural Policy (CAP), in its national implementation, does not gives a particular attention to the Montado, manifested by some misunderstanding, more pronounced at European level, of the potential of its agro-forestry and pastoral systems. The policy measures that affect it, are generally fragmented, sometimes contradictory and have perverse effects, undermining the coherence and sustainability of the system.

From the wide range of policy measures affecting the Montado options were to do, selecting only some considered more important, and limiting the analysis to some of its effects in order to make the communication more effective.

In the selection of policy measures, the emphasis has been given to the second pillar of the CAP, which integrates rural development policy embodied in the Rural Development Programmes, in this particular case ProDeR (Portugal / Mainland).

First were selected three measures / actions with goals that already seek some integration approach for the agro-forestry-pastoral systems, though incomplete:

1. Multifunctional management (included in the measure Promoting Forestry Competitiveness);

2. ITI - Integrated Territorial Intervention, Zones of the Network Natura 2000 in Alentejo (included in the measure ITI for Natura 2000 areas);

[1] Legislation act n.º 169/2001, May 25th
[2] Ditto. Resolution of the Assembly of the Republic n. 26/2007, published in the Journal of the Republic 1st Series, n. 118, de 21st June of 2007.
[3] NUT II Alentejo Geographic localization prior to 2002 (NUT III Alto Alentejo, Alentejo Central, Baixo Alentejo e Alentejo Litoral)
[4] NFI 5 - National Forest Inventory www.ifnb.pt

3. Diversification of activities on the agricultural holdings (included in the measure Diversification of the Economy and Job Creation);

After the first selection, four more measures were chosen with more partial objectives, at the forestry or agro-pastoral level, which have or can have a higher incidence in the system:

4. Improving productivity of forest stands (included in the measure Promoting Forestry Competitiveness);

5. Installation of forest systems and agroforestry systems (included in the measure Management of the Forestry and Agroforestry Areas);

6. Environmental enhancement of forest areas (included in the measure Management of the Forestry and Agroforestry Areas);

7. Protection of domestic biodiversity - indigenous breeds (included in the measure Upgrading of Production Methods).

The exploratory analysis, presented here, describes synthetically the objectives of the selected measures, the degree of adhesion in number of projects and amount of investment approved, the types of beneficiaries and the impact of investments in the period from 2007 to 20115. Where possible some physical indicators, surfaces and effective livestock, were mentioned to better evaluate the effects of measures.

The findings highlight the very limited effects of the first three measures, which were considered more integrated, due to the poor adhesion of the potential beneficiaries, with some differences depending on the greater or lesser extent of the novelty of the measure. The reasons may be the design and commitments that oblige, conditioning or hindering other functions not covered.

Regarding the measures with more partial objectives, the degree of adherence is more significant, however its application clearly favours the production function, forestry or agro-pastoral, sometimes contradictory and with perverse effects, which undermine the coherence.

[5] www.proder.pt

Assessment and improvements of CAP measures supporting the Dehesas in Spain

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The *dehesa* is a system of multiple use with important environmental, cultural and ethnographic value. The main production of the *dehesa* is livestock (sheep and cattle combined with Iberian pigs) but it also supports common arable crops in long rotations, forest products, such as firewood and cork, and hunting. Extensive livestock production systems such as those developed in the *dehesa* have various advantages (eg animal welfare or low external input). In addition, they are of great importance for land management, since grazing is a tool for maintaining habitats and landscapes of high natural value that would otherwise evolve into denser, less accessible habitats more vulnerable to fire. Local livestock breeds, valuable to Spain's heritage, are frequent in the *dehesa* and have been adapted to make effective use of the natural resources of the *dehesa*, the environment in which they have been developed. Commonly, the *dehesa* features a low density of *Quercus* trees to encourage the production of pasture and acorns, the main food sources for livestock. Nevertheless, the *dehesa* has been subject to changes and productive reorientations throughout its history, causing significant changes in the resulting landscapes.

Andalusia has a Dehesa law (Law 7/2010, of 14 July) representing a new policy to promote integrated management and conservation of farms of this type. It also aims to simplify administrative procedures affecting farmers.

Given that extensive livestock is the main use, direct payments under the first pillar represent an important income for *dehesa* farmers. Crop payments have had some relevance only in *dehesas* with arable land and, in certain areas, this aid has shifted traditional forage crops and the common practice of cropping (shortening of fallow cycles). Since 2006, CAP reforms have led to the decoupling of production and in 2010, payments were completely decoupled. As with other livestock systems, farmers have had to meet the statutory management requirements (SMRs) relating to public health, animal welfare, identification and registration of animals and animal health, and good agricultural and environmental conditions (GAEC). For *dehesa* farming, GAEC focused on two main elements: (i) the maintenance of ecological structural elements (vegetation on boundaries and slopes, retaining terraces, islands and small patches of natural vegetation, rocks; riparian vegetation, ponds, lakes and natural water holes, dry stone walls) and (ii) the maintenance of habitats (prohibition of discharges). Monitoring of GAEC has been unequal, and the criteria for evaluation have sometimes been unclear.

Aware of the need to manage the *dehesa* using an integrated approach, the Andalusian government has paid special attention to this system since the beginning of agri-environmental policy. Two regional programmes have been developed: the first in 1999 (1999-2003) (EC 2078/1992), and the second in 2004 (2004-2008) (EC 1257/1999). Both programmes were articulated into two sections: (1) a basic annual payment (over five years) for maintaining the farm according to agricultural and environmental standards, and (2) additional payments when specific actions were implemented at farms. Farmers could choose actions to be implemented in their farms from a specific list, according to *dehesa* needs and problems.

Despite the similar structure, some clear differences existed between programmes. The first programme was a bottom-up proposal from the Andalusian government, which included measures and actions related to the main environmental problems detected in *dehesa* systems in this region. It was the only agri-environmental programme concerned with the *dehesa* at a national level. In contrast, the second programme was designed by the national government with a top-down approach, in order to ensure that farmers would have equal access to all measures. As a result, the flexibility and adaptability of the *dehesa* programme decreased and the additional measures were simplified. There was also a significant difference between programmes in the concept of the *dehesa*. While the first programme emphasized land use (livestock) as a key element of the system, the second one focused on vegetation type, taking

into account areas of open woodlands with pasture understory exclusively. These facts, together with differences in maximum stocking rates and some specific requirements for additional measures, (e.g. density of seedling for tree regeneration), meant that farms involved in both programmes were different. In addition, the way in which the maximum payment per farm was set in the second programme caused less equity in aid distribution.

The *dehesa* has also benefited from measures aimed at the promotion of organic farming within agri-environmental programmes of RDP. While in the first programme, the *dehesa* system had been considered as a crop, in the second a distinction between agricultural and livestock systems was made. Three types of livestock production systems were established: forage and stubble, *dehesa* and permanent pasture. Incompatibility between agri-environment schemes (organic farming and *dehesa* in this case) led some farmers to choose the organic farming approach instead of the programme developed for the *dehesa* system.

Practices and Policies for the Agro-silvo-pastoral areas in Greece

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Nature of ASPAs

Agro-silvo-pastoral areas (ASPAs) that function as agroforestry systems cover more than two million hectares in Greece, but they are not as homogeneous and distinct as dehesas and montados in Spain and Portugal respectively. About half of these areas are found on state forest land and the other half on private agricultural land. Those on forest lands are dominated by various tree species, chiefly deciduous oaks and pine trees. They are actually open to very open forests with a very rich understory composed of herbaceous and woody species. The most important system in this group is dominated by valonia oak (*Quercus ithaburensis ssp. macrolepis*), a semi-deciduous oak species. Systems with evergreen oaks similar to those of the Iberian Peninsula are only represented by kermes oak (*Quercus coccifera*), but the area they cover is limited. Among pines, the dominant species are Aleppo (*Pinus halepensis*), Turkish (*P. brutia*) and European black (*P. nigra*) pines.

Agroforestry systems on agricultural land are dominated by various forest and fruit tree species. Among the forest trees the most common species are deciduous oaks, such as *Q. pubescens*, *Q. frainetto* and *Q. trojana*, poplars (e.g.*Populus thevestina*) and cypress (*Cupressus sempervirens*). Among the fruit trees, the most common species are walnut (*Junglans regia*), olive (*Olea europaea*), almond (*Prunus amygdalus*) and chestnut trees (*Castanea sativa*). Under all these trees various crops are grown such as cereals, vegetables, forages, industrial crops, and vineyards.

Practices

ASPAs on forest lands are mainly used as grazing lands for domestic animals (sheep, goats and cattle). They are classified as rangelands together with natural or permanent grasslands and shrublands and constitute the national grazing lands of the country. Their grazing management is done in a communal way which often results either in overgrazing that prevents tree regeneration or in undergrazing that leads to shrub encroachment and forestation. Secondarily, they are used for other products such as firewood, fodder, fruits, tannins and resin depending on the particular species.

ASPAs on agricultural lands are mainly used for commodity production from both trees and crops and secondarily for livestock grazing, usually after the crop harvest. There are two trends in these areas. One involves the removal of trees by farmers either to facilitate the use of agricultural machines or, more frequently, to increase the cropped area. This trend has prevailed in the most productive areas, mainly located in the plains, and led to intensively managed crop monocultures. The other trend involves the abandonment of ASPAs due to the high labor cost that these systems require in order to ensure an income to the farmer. This trend has prevailed in marginal areas mostly located in the hilly and mountainous zone where rural depopulation due to socio-economic changes has led to labor scarcity and eventually to ASPAs degradation. Livestock grazing still remains as a practice but it is not as regular as in the past.

Policies

ASPAs are not considered as a separate land use in Greece and, consequently, no specific policies are applied for their management. ASPAS on forest lands are managed according to the forest law.

Specifically, the right of using these areas as grazing lands has been transferred to the Municipalities which are responsible for allocating this right to the local livestock owners after developing the appropriate grazing plan. In exchange, shepherds are obliged to pay to the Municipality an annual fee per animal capita as a tax. Forest law does not allow tree cutting and conversion of these areas to another land use (e.g. arable land), except to a forest, usually by tree plantation, that is followed by prohibition of livestock grazing. In ASPAs on agricultural lands, on the contrary, only forest trees are prohibited to be cut by the forest law, not the fruit trees. However, since the areas are privately-owned the forest law is not usually enforced.

CAP policies have not affected ASPAs on forest lands so far. They did affect though ASPAs on agricultural lands where many farmers have rushed to cut the trees in their farms in order to increase the eligible area for subsidies. This has been mainly happened in the most productive arable lands thus converting them into crop monocultures. The new CAP for the period 2014-2020 is going to affect ASPAs on both forest and agricultural lands. This is because the "single payment scheme" of the current period based on historical references is going to be replaced by the "basic payment scheme" in the new period that will enforce a uniform payment per hectare in all Member States. For the ASPAs on forest lands, which are communal areas, this new policy suggests that they should be split out among farmers so that each of them declares a grazing land parcel and receives a subsidy. However, in order for this parcel to be considered as permanent grassland and, consequently, eligible for payment it must have less than 50 trees per hectare indicating that a considerable part of these areas may be left out if they have denser tree canopies. For the ASPAs on agricultural lands, this tree density limit may force their owners to cut the trees. However, some of these trees may be saved if they are included in the "ecological focus area" that the farmer will be obliged to maintain in his farm.

As far as the rural development of the second Pillar of the CAP is concerned, Greece is not implementing the agri-environmental measure 222 related to the establishment of new agroforestry systems on agricultural land in the current period. There are prospects to be implemented in the next period 2014-2020. However, Greek farmers are reluctant to plant trees in their farms because they are relatively small in size and are afraid of losing income if part of their farm is planted with trees. For this reason, our priority in Greece is not to establish new agroforestry systems but to preserve the traditional ones by providing incentives (e.g. subsidies) for their management.

Aims and contents of the Green Book (Libro Verde) of Dehesas: towards a joint Iberian strategy for working oak landscapes

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Spanish dehesas are historic ranching systems of outstanding value for biodiversity conservation in Europe. However, intensification and abandonment trends currently threat these cultural landscapes. In 2010 the University of Extremadura and the Environmental Agency of Castilla y León (western Spain) triggered a series of meetings of the relevant Spanish scientific institutions (including 19 individual researchers) aiming at producing a synthesis on the evolution, values, and current economic and environmental factors threatening dehesas. After being presented in June 2010, the report was transferred to a commission of the Spanish Senate which in turn incorporated the main conclusions into an institutional report in November 2010 (http:\\www.acionporladehesa.com).

Under the definition of dehesas as ranches with 5-60% cover of oak trees, the Green Book aimed at unifying the policy criteria for the creation of a national inventory of dehesa ranches involving several thousands of states within a range of ca. 3.5 million hectares in 1500 municipalities. As an accompanying work, a group of stakeholders has developed the Libro Blanco de la Trashumancia (published in 2012), a traditional activity strongly linked to dehesa management. This report includes a comprehensive diagnosis of the societal services of transhumance and specific proposals to mitigate the current decline.

Dehesas are currently facing a crisis due to low profitability and associated land degradation. As a result, landowners and other stakeholders claim that there is an urgent need for an integrated response of academic and policy-related institutions. This effort should conciliate the profitable exploitation of dehesa ranches and the conservation of natural and cultural values. The report presents a friendly synthesis of the environmental risks faced by ranches according to their main components (soil, grasslands, trees, and biodiversity). In addition, the factors limiting the profitability of the main (livestock and cork) and the secondary commercial products from dehesa ranches are addressed.

Finally, an economic account of dehesa ranches as multifunctional economic entities is presented.

The following conclusions were derived from the previous analyses:

a) Environmental issues:

1.- Tree regeneration must be ensured to allow the persistence of the whole system. A systematic plan for regenerating dehesa ranches is urgently needed according to a priority ranking reflecting the degree of regeneration failure.

2.- A coordinated research program should be developed to mitigate the effect of current tree diseases, especially oak sudden death caused by different exotic pathogens.

3.- Degradation of soils and grasslands is taken place in a significant percentage of ranches. Practices such as grinding of thin wood debris from pruning, minimum tillage, and avoiding excessive browsing of woody vegetation must be promoted.

[1] The Libro Verde de la Dehesa is authored by: Pablo Campos (CSIC), Juan Carranza (Universidad de Córdoba), José Miguel Coleto (Universidad de Extremadura), Mario Díaz (CSIC), Elena Diéguez (Federación de Asociaciones de Ganado Extensivo Autóctono de la Dehesa), Adrián Escudero (Universidad Rey Juan Carlos), F. Javier Ezquerra (Junta de Castilla y León), Lurdes López (Universidad de Extremadura), Pilar Fernández (Universidad de Córdoba), Gregorio Montero (INIA), Gerardo Moreno (Universidad de Extremadura), Leopoldo Olea (Universidad de Extremadura), Álvaro Picardo (Junta de Castilla y León), Fernando Pulido (Universidad de Extremadura), Sonia Roig (Universidad Politécnica de Madrid), Esperanza Sánchez (Universidad de Córdoba), Alejandro Solla (Universidad de Extremadura), Juan de Dios Vargas (Universidad de Extremadura), and Álvaro Vidiella (Universidad de Córdoba).

4.- Biodiversity conservation of dehesas depends on multi-functionality and associated

landscape elements such as vegetation mosaics, stone buildings, seasonal ponds or drove ways. Low-input extensive management provides the basis for maintaining a high diversity of life forms.

b) Economic issues

1.- The unique products from dehesas must be valued according to their inherent quality and the environmental benefits they provide as a result of extensive practices.

2.- The profitability of Iberian pig ranches is hindered by the wrong application of official regulation concerning the quality of hams. These regulations should recognize the added value of extensive feeding with acorns as compared to intensive production.

3.- There is a growing interest in big game as a mean for increasing the profitability of ranches, but this also represent an additional threat if states are not managed within sound ecological criteria.

4.- Concerning the sustainable use of cork resources, increasing quality and certification, together with the search for new products linked to environmentally friendly practices.

5.- Investments in industrial cork processes should be linked to a long-term planning of cork extraction in the field.

6.- As related to livestock feeding under increased stocking rates, new crops of high productivity can be relevant in soils allowing cultivation.

7.- Dehesa ranches offer new ways for product diversification, mainly bioenergy through woody plant biomass and agrotourism. Land owners might increase profitability by offering touristic services within their ranches.

c) Regulations for sustainable use

1.- A formal definition of “dehesa” is needed to facilitate official registration of ranches, to improve the availability of official data, and to mitigate the problems caused by complex and overlapping regulations.

2.- The lack of specific regulations often lead to land overexploitation with livestock. European regulations should develop mechanisms that allow differentiation between intensive and extensive production.

3.- As future public incentives will be partly based on the contribution of dehesa ranches to environmental and cultural values of public interest, economic information on representative dehesa types is urgently needed.

4.- Existing tools for technical support to landowners should be improved to allow a rapid dissemination of scientific results and their application in decision making.

5.- The development of long term integrative plans including threshold stocking rates, tree regeneration, and viability is strongly recommended.

Proposal for a New Rural Development Strategy in Spain

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The current rural development strategy in Spain is appearing inefficient to face the challenges still ahead. This strategy is focused on supporting the development of major infrastructure (mainly for irrigation) and agribusiness, meanwhile it's not achieving the generational change, the sustainable use of the natural resources neither the desired improvement in the quality of life in our rural areas, among others. But Spain, with a significant area of Natura 2000 or a broad typology of High Natural Value Systems (HNVS), has much more to gain by proposing a new strategy for the rural areas. Thus, WWF, along with other organizations such as SEO/BirdLife, propose a new Common Agriculture Policy based on the principles of "polluter pays" and "public money for public goods." Designed in a plural and transparent way, with the plenty involvement of all the stakeholders. Concretely to face the new European Agricultural Fund For Rural Development (EAFRD) programming, we propose a radical shift in the use of these funds, focusing on:

• Rebalanced budget between both CAP pillar, looking for 50% of the funds for the pillar 2 (EAFRD)

• Ensure 50% of funds devoted to measures with clear environmental objectives (agroenvironmental, Natura 2000, Water Framework Directive (WFD), organic farming or non-productive investment measure)

• Increased co-financing ratio for horizontal measurements (applicable throughout the whole country) and for regions "in transition" (as it's established for other European funds).

• Creation of a National Programme coexisting with the regional programs.

• Development of thematic sub-programmes for HNVs and organic production.

• Establish an adequate funding for farms in Natura 2000, as determined by the Priority Action Framework.

• Strengthening the advisory and training measures, which have not yielded the expected results in the current programming period.

• Transfer of risk management measures to Pillar 1, because these are considered as income or market measures.

• No use of funds to create new irrigated areas against the objectives of the WFD and ensure that the investment in modernization of irrigations is achieving a real water saving devoted to the good status of the water bodies (public good)

• In terms of measures for the organization of the food chain, give priority support to local markets, short chains and direct sales and other measures that can ensure a fair price to producers.

• Focus innovation measures in agroecology topic.

It is also necessary to strengthen the Common Monitoring and Evaluation Framework, through the inclusion of real indicators of impact and outcome, beyond the surface and the amount of investments. And establish a new method to calculate the payment for environmental measures (as Agroenvironmental, Natura 2000 or WFD measures) which goes beyond "loss of income" methodology. On the other hand, the targets set for rural areas could be hardly achieved if there is no a depth change of other aspects of the CAP. This means a reinforcement of the cross compliance scheme and its control, including requirements under the Water Framework Directive or regarding the Sustainable Use of Pesticide Directive.

In addition, it's urgent a redistribution of the Single Payment scheme through a new approach for the Basic Payment if we pretend to maintain the activity in those farms with higher natural and social values. A strong greening aimed at promoting crop rotation, maintenance of 10% of Environmental

Focus Areas at the farm and the preservation of permanent pastures is also necessary. Other innovations, such the measures for young farmers, areas with natural handicaps or coupled payments may be employed to enhance the generational renewal in High Nature Value Systems or Natura 2000 areas, now under serious risk of disappearing. Finally, other more or less novel figures should be explored, as land banks, land contracts or land stewardship agreements. And the use of EAFRD should be complemented with other tools, such as the Spanish Law for Sustainable Rural Development or even a new proposal for a green taxation law. There is no doubt that many of these proposals are already discarded for the new programming period, seen as the debate is progressing. For example in those concerned to the redistribution of the budget between pillars. However, other ideas depend on the willingness of the Spanish Ministry for Agriculture and the Regional Authorities, so there is still room for hope.

More information:

www.wwf.es/que_hacemos/agua_y_agricultura/nuestras_soluciones/nuevo_desarrollo_rural/parc

Poster Presentations

Session 1 – System Management

Assessing the effects of transhumant grazing on the regeneration and vegetative status of holm oak in Dehesas

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The generalized lack of regeneration of the tree layer in dehesas has been acknowledged as a problem that compromises the long term stability of these systems. In order to improve oak regeneration in dehesas, several alternatives have been proposed, such as reductions in grazing intensity or temporal grazing abandonment. Dehesas were traditionally the wintering areas for transhumant herds, but the last decades have seen a remarkable decrease in transhumance, due to multiple causes. However, to date no study have tested the effect that non-continuous grazing practices such as transhumance have on the regeneration status of the tree layer in dehesas. In this study, performed in southern Spain, we compared the values of several indicators of holm oak regeneration and condition of dehesas under transhumant grazing with those of dehesas under permanent grazing. Our results indicate that oak juveniles in transhumant estates suffered a much lower browsing pressure than in permanently-grazed estates. This resulted in a much higher area covered by the canopies of oak juveniles in transhumant estates and in a median density of saplings more than four times higher in transhumant than in permanently-grazed estates. Even though the stocking rate across the year is necessarily lower in transhumant estates, the models that best explained the condition and density of holm oak always included the timing of grazing. Our results suggest that the lack of oak regeneration in dehesas can be caused not only by the increases in stocking rates, but also by the recent abandonment of traditional grazing practices like transhumance. We propose the recovery of seasonal grazing regimes based on transhumant pastoralism as a measure to improve the conservation status of dehesas.

Comparative effects of management practices on Quercus suber L. Regeneration

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Traditional management of montados in Alentejo (Southern Portugal) is an example of integration of sustainable land-use and biodiversity conservation. These days, the whole system sustainability is threatened by the intensification of soil tilling to control shrub invasion and promote pastureland, being absence of tree natural regeneration one of the most outstanding threats. We compared the effects of harrowing every 3-4 years with those of shrub clearing with a shredder every 5-7 years on cork oak (Quercus suber L.) regeneration near Évora, southeast Portugal. Cork oak density of both study areas was 70 trees ha-1 and the stocking rate was 0.25 LSU ha-1 (cows). In each area we surveyed and measured a sample of mature oak trees to determine the stand size and age structure, and all cork oak seedlings, juveniles and saplings to assess recruitment and regeneration. Ecological characteristics of the dominant micro-sites were also recorded. The distribution of mature oak trees by age classes showed prominent gaps and approximated a bell shape in the harrowed areas and a continuous reverse-J shaped distribution in the shredded areas. Recruitment bottleneck was observed under harrowing (high recruitment for seedlings, low for juveniles, and null for saplings), while in shredded areas all stages were comparatively well represented and often associated with shrub occurrence. By maintaining shrub patches and their protective effect against the grazing impact, shredding seems to promote cork oak regeneration. Thus, management should include a balance between practices to improve the system heterogeneity, sustainability, and natural value.

Does the extraction of cork affect the birds of Montados?

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Montados are widely recognized as systems with an excellent balance between socioeconomic development and biodiversity conservation. The economic viability of cork oak (Quercus suber) montados depends to a great extent on the extraction and commercialization of cork. The cork is mostly used for production of bottle stoppers but producers of competing synthetic stoppers have argued that its extraction affects montados. This study evaluated the impact of cork extraction on biodiversity, using birds as indicators. A comparison between bird assemblages of montados with recently extracted cork and older cork demonstrated that only two species of insectivorous bark gleaners and two of barkfoliage gleaners had lower densities in recently debarked areas. This may be due to a reduction in the abundance of prey for these species in the first years after cork extraction, as suggested by the results of our arthropod sampling. Focal observations of birds confirmed that the four affected species were those that foraged mostly on cork. However, we found that bird richness and the density of the great majority of species were unaffected by debarking, and that at the landscape level even the four referred gleaners had potentially stable populations. Pressure from the synthetic bottle stopper industry may affect the economic viability of montados which may thus be replaced by land uses with lower biodiversity value. Showing that cork extraction is compatible with the maintenance of the great ornithological value of montados, our results indicate that this economic activity should be maintained, also for the benefit of biodiversity.

Integration of Nature 2000 into sustainable management of agrosilvopastoral land use systems (Montados) in Portugal

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Mankind is increasingly aware of the importance of biodiversity to human well-being. Other than overall biodiversity, endemic plant species is also important natural assets of a given territory. Within that context the EU Member states have created the NATURA 2000 Network in order to insure the protection of its most relevant natural habitats and species. Aiming to pursue this objective a study was undertaken in order to promote the conservation of Thymus capitellatus, a plant species listed in Annex IV of the EC Habitats Directive, endemic of south western Portugal. The study was implemented in the cultural landscape of a Montado area within the cattle and farmstead property of Companhia das Lezírias, located 20 km southeast of Lisbon. The major issue investigated in the study was to determine the compatibility of the Montado management system with the ideal habitat conditions for T. capitellatus. Several populations were surveyed, within stands exhibiting different stages of succession and different management regimes, in order to understand differences of growth and vitality considering the different stand types and their management strategies. Results showed that the studied species is adapted to open areas and disturbed sandy soils, whereas Montado areas have usually less disturbed topsoil, making it difficult for T. capitellatus to persist in Montado areas. Moreover, results may serve the purpose of improving the protection of T. capitellatus through the adoption of economically and ecologically reasonable Montado management strategies, to be tested in a near future on the property of Companhia das Lezírias.

Montado´s biological sustainability: macrofungal communities under different soil managements

Santos-Silva, Celeste & Louro, Rogério

The soil fungi communities play a crucial role in balancing carbon and mineral cycles, thereby promoting plant species growth, protecting them from pathogens and contribute to soil protection. An improved knowledge of the diversity and structure of fungal communities can lead to a better understanding of their roles in soil ecosystems and be crucial to ensure biological sustainability. The Mediterranean area is a biodiversity hotspot that is increasingly threatened by intense land use. Several management practices in Montados – soil mobilizations, grazing, fertilization, etc. - affect the establishment and maintenance of fungal communities, contributing to its development or, conversely, decreasing soil fungal biodiversity. Our study aims to contribute to clarify this question. Since 2007, macrofungal surveys were carried out in MontadoÂ´s areas (Herdade da Mitra, Valverde), in plots submitted

to initial different soil and understory managements. Experimental treatments were performed in 1998: three sets of four plots (50 m x 14 m each), (a) non-mobilized soil, (b) nonmobilized soil and plant biomass deposition, (c) mobilized soil and complete plant biomass removal and (d) mobilized soil and plant biomass incorporation.

Differences in macrofungal diversity were observed between plots, with higher values for nonmobilized soil and lower values for mobilized soil. The lowest macrofungal diversity values were found in mobilized soil and complete plant biomass removal.

Pasture digital image analysis as a support tool for grazing management in montados: a preliminary approach

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The knowledge of vegetation land cover over time is essential for an appropriate grazing management in any free range animal production system. Ground vegetation has traditionally been monitored using visual methods that produce estimates of percentage covered/bared soil, green/senescent vegetation and also grasses/forbs occurrences. Visual methods are extremely time consuming and prone to observer bias. The use of digital image to evaluate and monitor ground vegetation has increased in recent years. These techniques allow a more cost effective data collection over larger areas, avoiding the need of judgement-based choices of representative areas.

The aim of this work is to test the applicability and robustness of simple image processing techniques to monitor ground vegetation in Montado. The set of images were collected using a GoPro HD HERO2 digital camera, facing down, mounted on a stand at constant distance above ground.An application of threshold segmentation techniques to a set of digital images is presented. A procedure to calibrate the threshold value is proposed. Some results are presented and analyzed for different lighting conditions, type of vegetation, as well as percentage of Montado vegetation cover. Montados are characterized by a pronounced patchiness of vegetation communities and should benefit from such an approach.

The “montado”: determinant factor affecting the carcass characteristics and the quality of dry cured-hams of Alentejano pig

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The objective of this study was to assess the effect of the finishing system (under montanheira or with commercial feed) on carcass characteristics and dry cured-ham of Alentejano pigs.

24 pigs were fattening until 130 kg LW under montanheira and 24 pigs were fattening with commercial feed. Carcasses of pigs fattened under the montanheira system were slightly heavy (98,38 vs 96,13 kg), with significantly higher (P>0,01) dressing percentage (79,55% vs 78,11%), backfat thickness (6,09 vs 5,34 cm), percentage of fatty cuts (32,06% vs 30,44%) and weight (21,92 vs 19,77 kg) and percentage of adipose tissue (51,65% vs 47,71%). Percentage of lean cuts (50,03% vs 49,07%), bone cuts (19,53% vs 18,87%), weight (14,91 vs 13,77 kg) and percentage of lean (36,04% vs 32,54%), lean:bone (3,21 vs 3,01) and lean:fat (0,76 vs 0,63) ratios were significantly higher in pigs fed commercial feed. The content of ether extract in lean+fat was significantly higher (63,7% vs 60,41%), in pigs fattened under the montanheira system, while the content of crude protein (7,57% vs 8,41%) was significantly higher in pigs fed commercial feed. Energy retained was higher in pigs finished under montanheira (231,7 vs 217,0 Mcal). The dry cured hams from pigs fattened on acorns were more mono-unsaturated and less poly-unsaturated, especially on subcutaneous fat. It can be concluded that the fattening on pasture and acorns under the oak canopy is considered to be crucial for the quality of the raw material and meat products, as dry cured-ham.

key words: Montado, Alentejano pigs, carcass characteristics, dry cured-ham

What we (do not) know about cork harvesting

Augusta Costa & Graça Oliveira

Cork oak (Quercus suber L.) woodlands are ecologically sensitive, human-supported areas which strongly rely on the high market value of cork for their sustainability. Cork harvesting is a silvicultural practice specific to this Mediterranean evergreen oak, whereby the bark (cork) is periodically removed from stems and branches over the whole tree lifetime. This poster discusses the available information on the effects of this practice on cork oak and on its associated woodlands.

Upon each harvesting, the tree faces important losses of water, released from the suddenly exposed living cells, and of cork. Immediate responses relate to stem healing mechanisms, leaf stomatal closure and prompt production of new cork layers by the restored phellogen. Further tree strategies to compensate for water and cork losses are poorly known, but they possibly include prolonged reduction of leaf transpiration, increased water uptake from the soil, use of reserves and changes in whole-tree energy allocation to support cork regeneration. Cork harvesting is therefore a strain factor for the tree, particularly because it is performed during the most stressful time of the year, and also because stripped oaks become more vulnerable to pathogens and environmental hazards such as wildfires.

Tree resilience to this practice is a crucial issue to enable improved stand management strategies and to ensure adequate conservation actions in these sensitive forest systems.

Poster Presentations

Session 2 - System structure and functioning

Carbon sink strength: the role of a shrubby understory in a montado ecosystem

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Highly competitive and opportunistic shrubs are increasing in many decaying montados. Very rapidly these shrubs become dominant in the understory. Without adequate silvicultural control measures, these areas are prone to severe and recurrent wildfires. However, there are evidences that allowing a certain level of shrub recruitment is not necessarily detrimental and can in fact enhance biodiversity in Mediterranean forests. In very nutrient depleted sites it can enhance the quantity and distribution of soil and plant carbon and nitrogen pools and increase net ecosystem productivity. We have quantified the contribution of the understory shrubby vegetation to ecosystem carbon assimilation in a pure cork oak woodland in centre Portugal during the summer and autumn recovery of 2011. We used closed dynamic light and dark chambers to measure CO2 gas exchange in the dominant shrub species: Cistus salviifolius, Cistus crispus and Ulex airensis together with plant physiological and morphological measurements. A hyperbolic light response model constrained by vapour pressure deficits was fitted for up-scaling shrubs photosynthesis to the ecosystem level. The data was compared, on a daily and daytime basis, with gross primary productivity estimates from ecosystem eddy-covariance flux measurements.

The shrub understory contributed, on average, 21% to the total ecosystem CO2 uptake during summer and autumn recovery. The results reinforce the theoretical hypothesis that allowing a certain level of shrub recruitment may increase forest mitigation importance in a climate change context.

Economic and environmental indicators of Mertolenga beef cattle and Serpentina goat farms in Montado areas

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The present study is based upon technical and economic data collected, in the years 2010-2011, in several farms joining the ACBM (Mertolengos Cattle Breeders) and APCRS (Serpentina Goats Breeders) associations. It considers data sets collected at four farms of each of the above mentioned species, all farms sharing 'Montado' as a food resource. The identification, technical characterization and economic evaluation of the resources used in the Mertolenga and Serpentina production farms, as well as their income (livestock sales, subsidies and other supports, etc,) allowed for assessing the economic and environmental farm indicators. Several economic results are accounted namely gross value added, gross and net income, entrepreneurial income, profit and, additionally, land income, capital income and labor income. For environmental impacts it is accounted the energy intensity in animal husbandry namely on suckler cows farms and goats farms is essential to assess environmental impact of farms agricultural systems and to provide recommendations for sustainable agricultural practices. The determination of energy intensity for suckler cows farms and goats farms includes direct and indirect energy inputs by using a methodology integrating the whole farming process, considering all energetic aspects within animal husbandry and plant production. Direct energy is used in the form of fuel oil, e.g., diesel fuel and electricity. The indirect energy includes the energy input for resources, manufacturing machines and technical equipment (e.g., fertilizer, feed-mixer wagons) and animal housing and storage facilities.

Effects of environment, land management and spatial variables on the recent montado land cover change in southern Portugal

Sérgio GODINHO; Nuno GUIOMAR, Rui MACHADO; João Paulo FERNANDES, Pedro SANTOS, Nuno NEVES, Paulo SÁ-SOUSA, Teresa PINTO- CORREIA

The montado/dehesa changes are driven by a combination of several factors, usually acting in synergy, but also in some cases with conflicting pressures. Quantitative studies of the relationship between montado land cover changes and their drivers are important because they provide a better comprehension of the impacts of environmental and human factors on the montado cover trends. In this study a statistically and spatially explicit approach, combining numerical data bases, cartographic sources and GIS, was used to assess the relative contributions of selected environment, land management and spatial factors in the recent montado cover changes (1990-2006). The study hypothesize that land management factors play a major role in observed montado changes, when compared with environmental factors. During the period under analysis, most of the change in montado cover was attributable to the loss process, where the montado gain values observed was insignificant throughout the study area. Therefore, the analysis of recent patterns of montado cover change focuses primarily on the loss process. Results indicate that most of the variance in the large-scale distributions of the recent montado loss values in southern Portugal is explained by land management, alone or combined with environmental and spatial effects.

Considering only the pure fractions, the land management variables still explained the major part of this variability in montado loss values. This study showed that different grazing intensities are the determinant land management variable determining the montado loss.

High carbon sequestration in a certified pure Cork oak montado

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The montado is a heterogeneous savanna-type ecosystem, with evergreen scattered trees and a shrubby and herbaceous ground layer, where woodlands, pastures and agricultural cultivation coexist in the same area. Data on carbon sequestration in this particular ecosystem, with pure cork oak, is lacking. We have evaluated through eddy-covariance methodologies the montado seasonal and interannual variability in net ecosystem exchange (NEE) in relation to the Mediterranean climate from 2009 to 2012.

The experimental site is located in a certified montado with sustainable management in center Portugal. The climate is Mediterranean with long-term (1961–1990) mean annual temperature 15.9 ºC and average annual precipitation ca. 642 mm. The tree density is about 90-177 trees per ha. Average tree height is 7.9 m. In the studied period this montado was a strong sink for carbon with annual NEE ranging between -130 and - 424 g C m-2 year-1, in close relation to total annual precipitation. Noticeably, independently of dry or moist years, the summer drought effect did not lead this pure cork oak montado ecosystem to a carbon source to the atmosphere. In fact, all summers from 2009 to 2012 showed to be a sink for carbon rather than a source as observed in dry years of low tree density montados (Q. rotundifolia), improved pastures and a eucalyptus forest in similar climatic conditions. In general, this well managed montado growing in its ecological fitted area was resilient to environmental stresses, showing an efficient use of the available resources for carbon assimilation and sequestration.

Microbial symbioses as bioindicators of “montado” soil fertility and cork quality

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The economic dimension of the “montado” ecosystem has a unique profile in the Portuguese economy, where the cork gives it a dominant position in the whole process. The cork-oak enjoys of good adaptation to different environmental conditions, including different types of soil, which translates into different types of quality cork.

In these ecosystems the nitrogen fixation by bacteria and legume symbioses is a major process of providing nitrogen to the soils being these symbioses an important component of a strategy for increasing their productivity and sustainability, allowing the recovery of these ecosystems and helping to control diseases, pests and weeds. Also, mycorrhizal symbiosis plays a determinant role on “montado” ecosystem functioning, benefiting the growth of trees in low nutrient availability, increasing uptake of phosphorus and nitrogen, and also contributing to organic matter turnover and nutrient cycling.

The objective of this work1 was to evaluate soil fertility parameters of Quercus suber “montado” in different sanitary and vegetative states in Grândola hill (Southern of Portugal) and correlate these parameters with those evaluated in cork samples (such as porosity, humidity and density) and also with the diversity and abundance of natural rhizobial population and ectomycorrhizal fungi. Rhizobial population was studied not only for nitrogen fixation potentialities but also for other activities which can also increase the vegetal development, such as siderophores production or phosphate solubilization. Using statistical analysis relationships have been established with diversity and abundance of microbial symbioses, soil chemical characteristics and cork quality, allowing delineation of management practices that contribute to sustainability of this ecosystem.

Plant-beneficial bacteria associated to annual ryegrass in the "montado" ecosystem

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The use of plant-growth promoting microorganisms is emerging as an important component of the integrated nutrient supply system of several important crops. Plant-beneficial microbes may colonize the rhizospheric soil or internal plant tissues and participate in key processes, such as nutrient cycling and availability, seedling establishment, or biological control of plant pathogens. The ability of crops plants to obtain nitrogen from associated nitrogen-fixing microorganisms has long been recognized, the best studied case being undoubtely the symbiotic association between rhizobia and legume plants. Some cereals, such as rice, maize or wheat, were also recognized as having the ability to establish associative interactions with nitrogen-fixing microorganisms, and microbial inoculants for these crops start to be envisaged as a plausible way of supplying a significant part of their nitrogen requirements.

Annual ryegrass (Lolium multiflorum) is a forage crop that is extensively used in poor-productive areas in southern Portugal dedicated to "montado". In this work, we evaluated the occurrence of nitrogen-fixing bacteria associated with this plant in different soils (granite, schist, and sand) from natural pastures in "montado" ecosystems. Population sizes were evaluated and an assortment of bacterial isolates from both the rhizosphere soil and plant tissues was constituted. These isolates were taxonomically identified and assayed for plant-growth promoting activities, such as solubilization of mineral phosphate, production of phytohormones, formation of siderophores, or hydrolysis of plant polymers. Several isolates showing enhanced plant growth-promoting activities were selected for subsequent plant inoculation assays. The long-term objective is to achieve an improvement in overall growth of annual ryegrass and significant reductions in the needs for chemical fertilizers.

Recent dynamics of Mediterranean evergreen oak woodlands in Southwestern Iberia

Augusta Costa, Manuel Madeira, José Lima Santos & Tobias Plieninger

In the Southwestern Iberia, the Mediterranean woodland landscapes with evergreen oak (Quercus suber L. and Quercus ilex ssp. rotundifolia Lam.) are traditional human-shaped landscapes. The vulnerable agricultural economy in this region has led to management abandonment or policy-driven grazing intensification and to some changes from multifunctional agroforestry structures to mono-functional specialization, which included a consistent woodlands loss, clearance and fragmentation, with unknown negative effects on biodiversity and range of ecosystems services.

These issues have been of major worldwide concern and interest, and the European Union invested time and money in oak afforestation policies since the early 1990s, to reverse these dynamics. Two options exist, however, to reverse these negative trends in evergreen oak woodland landscapes: invest through afforestation of new areas where oak woods disappeared long time ago; or to conserve existing oak woodland landscapes through appropriate management, with oak natural regeneration playing a major role. In a scenario of increasingly stressing climate change, the effectiveness of the first option may be open to question, while the second option may still count with the resilience of existing wooded ecosystems which can be reinforced through management.

This poster aim at identify and discuss the major environmental and socio-economical driving forces of landscape dynamics of Mediterranean evergreen oak woodlands in Western Iberia in the last five decades as well as the main consequences on landscape mosaic of woodland, open farmland and shrubland, based on observed results from contrasting selected case-studies.

The importance of groundwater access to the sustainability of evergreen oaks in montados

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Mediterranean evergreen oak woodlands characterize the landscape of extensive areas of the Iberian Peninsula. The dominant tree species, *Q. suber* and *Q. ilex*, need to withstand hot and dry summers as well as recurrent droughts, predicted to increase due to climate change. We hypothesized that under these conditions, tree survival might rely on the use of reservoirs of deep soil water and groundwater. Research was undertaken in three oak woodlands in southern Portugal based on the long-term monitoring of stem and root sap flow, predawn leaf water potential and groundwater table level, as well as on root excavation and the analysis of stable isotope (deuterium and ^{18}O) composition in xylem, soil and groundwater. All evidences have shown that: (a) the roots directly accessed the groundwater table; (b) the isotopic signature of water transpired at the end of summer was similar to that of groundwater and; (c) the trees were able to transpire at high rates during the summer drought in spite of the lack of rainfall. In all cases the water table was found to be shallow at the end of summer (4, 5, and 13 m depth) and within the reach of roots. Results highlighted the role of groundwater as an important source of water for trees in semiarid landscapes when surface soil water is functionally depleted and unavailable to plants. A comprehensive and integrated understanding of the ecological (ecosystems) and human uses (drinking and irrigation) of groundwater is critical to mitigate possible conflicts on its use.

Poster Presentations

Session 3 - Multyfunctionality and ecosystem services

Are Land Managers on the way to Multifunctionality? Application to a case study in Southern Portugal

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A great number of land managers in Europe, witness today the decrease of farm income due to the rise of input prices, the progressive cuts of production subsidies and the fluctuations in the prices of agricultural products. At the same time, in the context of the Common Agricultural Policy reform, the need to maintain European agriculture's competitiveness in global markets, ensuring high production standards and responding to the new demands for non-agricultural goods and services, is indeed reinforced. The question which arises is whether land managers will be enterprising and dynamic enough to face the challenges imposed by such uncertain political, market and public demand context. Although there is literature backing up a transition of rural areas, from productivist towards post-productivist, in central and northern European contexts, evidence of such phenomena occurring in the Mediterranean context is still lacking. The hypothesis proposed to be tested is whether the municipality of Montemor-o-Novo is in a process of transition from productivism to post-productivism, in which land managers no longer see agriculture exclusively from a production perspective, and progressively consider other functions such as environmental protection and the provision of non-agricultural goods and services (hunting, tourism, etc.). For this purpose surveys were applied to 119 land managers in Montemor-O-Novo. Different types of land managers were identified based on their attitudes about agriculture system and behaviors on their farms. The results demonstrate that, although environmental protection and production of non-agricultural goods and services in agriculture are widely recognized by society, land managers still hold, in general, a productivist identity and therefore a multifunctional transition taking place at the farm level in this study area is currently not evident.

Building the knowledge about HNV potential of Meriagos (Dehesa) in Sardinia: a systematical review

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The recent Italian Map of Nature (ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale) identify among others the Sardinian *Dehesa* as semi-natural habitat. Even if the regional and sub-regional peculiarities of land-use and land-cover vary, this Habitat\land use could be considered like Portuguese *Montado* and Spanish *Dehesa*, here called by locals *Meriagu*. In the name the function: from the Sardinian verb "meriai" (to lie) reporting on the usual sheep flocks habitude to lie during the summer under the spot trees shadows of pasture lands. Woody coverage density per hectar could vary depending on the land use: high densities are registered for oak stands of *Quercus ilex* and *Quercus suber*. When extensively grazed, the multifunctional land use of cork oak stands could be considered an interesting study case of High Nature Value *Meriagos*, clustering meantime ecological services, low input agro-forestry (extensive grazing contribute to forest fire risk reducing, cork extraction increase the CO2 absorption potential as well as having economic value. *Meriagos* represent also one of the big expression of the traditional Sardinian landscape, landmark of the connected agricultural economies of Sardinian pecorino cheese and cork. Even if HNV concept has not yet acknowledged by the Regional Rural Development Programme, starting to assess the concept from Meriagos habitat of oak stands could be a chance in the next CAP greening measures to highlight environmental and ecological values and also the slow economies connected.

Developing multi scale indicators for gauging High Nature farming systems in Europe

Sonia Carvalho Ribeiro, Teresa Pinto Correia, Maria Luisa Paracchinni

The rural development policy community is calling for new transdisciplinary approaches to convey meaningful measures (e.g. indicator sets, indices) for assessing High Nature Value farming systems at different spatial scales (IEEP, 2009).

At broader spatial scales there has been huge efforts for example by IRENA (Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy) in developing a set of agri-environmental indicators at the European scale (Paracchini et al., 2010). Another European scale initiative was the High Nature Value farming project which worked on developing High Nature Value Farming area indicators. In parallel, there is a rich literature reporting local case study data on high nature value farming systems throughout Europe. Nevertheless, transforming the local case study data on a local level indicator set is yet far from being accomplished. Furthermore, is still missing cross scale work on integrating European and local scale high nature value farming indicators.

Land cover patterns, being dynamic landscape components, are essential features in High nature value systems. Thus, one promising avenue for devising indicators that bridge the agri-environmental and social spheres at different scales of analysis is that of land cover (vegetation structures such as grass, glades and forests) (Wiggering et al., 2006). However, landscape structure and composition will alter with changes in scale, and also across regions throughout Europe, and land cover patterns will also shift accordingly. Therefore, it is likely that the metrics/indexes framed at the European scale will not be transferable across scales in a straightforward way. There is thus the need to explore what are the set of indicators(including but not exclusively land cover)that can be framed in a comprehensive methodological approach for upscaling and downscaling HNV farming indicators (EEA, 2010). This paper particularly focuses on methodological issues in the light of the state of the art methodological approaches. It finishes by pointing out the challenges ahead for progressing on the development of multi scale indicators for gauging High Nature farming systems in Europe

Emergy Synthesis as a tool to Montado Value Evaluation

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Due to its semi-natural character, the montado provides many outputs (goods and services) with high-efficient use of renewable and non-renewable resources. The Emergy Evaluation Method or Emergy Synthesis, developed over the last thirty years, is an ecological-economic methodology that quantifies relationships between economy, environment and culture. This methodology will be used to apply a new system approach that enables a more integrated vision of the montado. It does so by identifying all relevant components and fluxes in a system including goods, services and information, systematizing then in a diagram of the system, converting those components to a common unit basis (solar emergy Joules – sej), therefore making them comparable. This allows knowing, amongst others, i) how does energy flow through the ecosystem and so evaluate its health; ii) the energetic efficiency of outputs production; or iii) the points where the ecosystem may become more efficient. The Emergy Evaluation Method applies with special property to farming systems, where the natural/human interface is more evident, at multiple spatial and temporal scales. This method does not inform us about "good" or "bad" management practices, but will tell us what systems and management styles will prevail under different resource availability scenarios. While internalizing externalities it overcomes some weaknesses of economic analysis approaches, acknowledging other services of the montado usually not accounted. Furthermore, the method provides a set of indices to planners and managers for policy design. The work will be empirically grounded in a case-study aiming to a better understanding of the method's applicability.

HNV farmland and green infrastructures: a way forward to foster policy integration in Municipal Master Plans?

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The urban/rural devide, that marks the planning paradigm, has shown to create constrains in pursing an integrated landscape approach in municipal master plans. The decision on the publication of a GI strategy at European level emerged recently the context of the target of stopping the loss of biodiversity by 2020. Nevertheless, coming from nature conservation perspective, it has been recognised that even though the EU has no mandate for legislating on spatial and land use planning, it seems the only way to achieve this target. To overcome this constrain, eventually Member States will be asked to implement the GI strategy in their spatial plans by using different sources of funding provided within EU agriculture, structural or cohesion policies. Since spatial planning has focused on urban and infrastructure development, planning practice is foremost based on zoning and regulations - spaces for the GI will need to be identified and categorized, and specific rules for land use have to be defined. Even though this is quite straightforward with urban areas it becomes less evident how to implement in rural areas. In this context, the HNV concept is considered useful in both in terms of identification of priory areas by selecting those using farming practices that favour GI objectives, but also, in its management, notably when supported by specific policy measures under CAP. In this context, the present poster aims to contribute to the ongoing discussion by presenting the issues at stake in the case of the Municipal Master Plan Tomar (Portugal).

Identifing HNV systems in the threatened historical rural landscape of Sorrento Peninsula and Amalfi Coast

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A research project has been developed in the study area of Sorrento Peninsula and Amalfi Coast. The rural landscape was classified on the aim of HNV concepts to provide insights for management policies. This worldwide amazing geographical and historical context, has been recently characterized by major land abandonment and heavy urbanization.

Associated to an assessment of land-use mosaic of rural area, the HNV systems were identified to calculate appropriate HNV indicators. Starting from this, a landscape preference analysis will target the resident and tourist population, with the objective of investigating the social and cultural dimension of particular traditional farming systems. This elicits the economic value of social benefits provided by such systems, to society.

Final results will highlight the most valuable HNV farming systems existing in the area. The main management and conservation issues, could have to deal with the policy makers and propose a "bottom up" approach to planning, that would take into account the important social and economic role played in the area, by HNV landscapes. Finally, the estimated economic values associated with the different degree of value, will provide a reference for efficient design incentive systems, aimed at preserving precious rural systems in the area.

Management of Multifuncionality in Montado ecosystem

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The technique, economic and environmental management of the Montado ecosystem will be balanced by using the implementation of ***Montado Crop Rotation*** (Potes & Babo, 2003). It is based in an adequate design of parcels in each farm, endowed with indispensable infrastructures for the efficient grazing management, used in extensive animal production systems. The crop rotation is implemented through the following cultural operations:

Cleaning operations → Forage Crop → Pasture (**n** years)

When starting for the control of shrubs, to practice in Spring, always and when the development of the shrubs justifies it, is possible the installation of the forage crop, formed by high protein grain species and forage cereals in the end of the Summer, before the beginning of first autumnal rains. With the emergency of this forage crop at the beginning of Autumn, it will be possible have a first graze in the end of the Autumn, beginning of the Winter (invernadouro), basic to complement the Feeding Scheme of Extensive Animal Production Systems (Potes, 2008). Therefore it prevents problems of erosion in the soil, after the operation of cleaning and before the high rainfall and frequent precipitation occurrence in the autumnal period.

In the third year of the rotation crop begins the process of improvement of pastures, which is based in the trilogy: Phosforus→Legumes→Grazing (Potes et al, 2005). Building a Bank of Seeds rich in legumes for the Permanent Pastures of Mediterrannean Type that characterizes the herbaceous stratus of the Montado ecosystem, it is possible increase the extensive animal production, that using adjusted stocking rates, leads to the balance of pasture, delay of shrub growth, increase productivity by using natural resources and mainly, to recover the productive capacity of soil.

The stabilization of an efficient and productive grazing system allows to widen the rotation, that is, to increase the variable **n**, meaning a controlled shrub stratum and a vigorous tree stratum, because supported by rich and balanced soil. The necessity of about 10% of the area of the farm with the annual forage crop, for the purpose of optimizing the Feeding Scheme of Extensive Animal Production Systems, could be obtained with the introduction of this crop through the non tillage technique by direct sowing.

From the environmental point of view, it is obtained the most efficient recovery of the soil, through the pasture, that also has a positive effect in the hydrologic cycle, increasing the capacity of water storage in the soil and decrease of the drought effect. The fire prevention will be guaranteed by the control of shrubs and the Carbon sequestration will be maximized through the annual production of pasture. The maintenance of high level of animal and vegetal biodiversity in the ecosystem is from itself an intrinsic characteristic of the Montado ecosystem (Potes, 2011).

Valuing the Montado 'Natural Externalities': Trends and Tendencies

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Most ecosystems are dependent on interactions between the natural environment and man-made factor; hence the many sub definitions of ecosystems which include urban ecosystems, grassland ecosystems, woodland ecosystem etc. Such is the case for managed forests, like the Cork Oak (*Quercus suber*) Montado, a 'Directive habitat' which forms its own unique ecosystem delivering many important ecological services. Recent efforts to quantify and valuate Ecosystem Services (ES) have been seen as vital in order to conceive of appropriate conservation and protection strategies in the long-term. This is urgently needed given that many ES are public goods and common resources with no private ownership or management can be poorly visible and thus falsely assumed or have no market values and tend to be underprovided. But in fact, according to some reference authors, the Montado effectively exports a large number of ES to the public systems, both tangible and intangible. Especially in small areas like farms, parklands and estates, it is very important to link mechanisms like payment for ES and green EU agro-forestry subsidies or promote an extended environmental fiscal reform in order to provide non-market solutions. The present work pretends to explore the state of the art in terms of externalities like biodiversity, ecosystem services and landscape valuation approaches and methods and explore possible pathways for solving market and non-market economic failures in terms of recognition of sustainable supply of public services.

Poster Presentations

Session 4 – Biodiversity

Biogeography and ecology features of breeding bird communities in cork oak forests

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The Portuguese montados are parkland forested areas of anthropogenic origin dominated by cork oak (*Quercus suber*) and/or holm oak (*Q. rotundifolia*). These agro-silvo-pastoral systems combine the use of woodland products (timber, charcoal and cork) with cereal crops and livestock grazing in the understory. This dynamic and multifunctional use forms a heterogeneous landscape of wooded matrix with open areas, scattered woodlands and undisturbed patches of Mediterranean forest and scrublands, allowing these areas to support a high biological diversity. Birds are well adapted to this system, showing even a tolerance to cork debark. Additionally, in Montados the increase presence of edge and open area birds it appears to compensate the loss of forest species. In order to evaluate the influence of (1) geographical and altitudinal features, (2) woody vegetation and (3) occurrence of insect pests in breeding bird communities of cork oak forests, we selected four different areas to conducted the study. These areas were Serra de Grândola (Southwest Portugal), Companhia das Lezírias (Center), Serra de Monfurado (Southeast) and SIC Romeu (Notheast).

Dehesa ecosystems: development of policies and tools for biodiversity conservation and management

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The project Life bioDEHESA aims to promote the sustainable and integrated management of dehesas in order to improve the situation of biodiversity through the dissemination of demonstrational actions that address the main challenges related to the conservation of dehesas, occupying about 1 million hectares in Andalusia.

Specific objectives:

1. Strengthen the capacity of dehesas in Andalusia to respond to their deterioration, ageing and

vulnerability to climate change.

2. Demonstrate the feasibility of integrated dehesa management that respects the conservation of this habitat and promotes biodiversity.

3. Transfer the best available knowledge and the latest technical innovations to the entire dehesa area.

4. Support institution building to promote integrated dehesa management.

5. Contribute to human capital formation aimed at the integrated management of dehesas.

Actions and means involved:

1. Compilation of best available knowledge and finalization of horizontal systems, methods and protocols to foster sustainable management of dehesas.

2. Creation of a Pilot Dehesas Network, which will be composed by a representative selection of dehesa farms to be proposed by project partners. Prior to taking any specific action in the selected dehesas, an integrated management plan will be drawn up.

3. Implementation of specific conservation actions in the Pilot Dehesas Network.

4. Monitoring, evaluation and transfer of results throughout the dehesa territory.

Project duration: 2012-2017.

Effects of shrub patches on plant diversity and cork oak regeneration in *montado* ecosystem

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Sustainability of the *montado/dehesa* ecosystem depends on natural cork oak (*Quercus suber* L.) regeneration and resilience to stress conditions. However, a decline in natural regeneration has been observed in many *montados*. Although this *Quercus* species is well adapted to drought, the likely increase in severity may compromise its tolerance capacity. To understand the role of shrub patches on the sustainability of cork oak *montados*, we evaluated the effect of environmental conditions (e.g. light and soil water availability) promoted by shrubs on: plant biodiversity, cork oak recruitment and physiological young tree status, in three areas differing in shrub density. An area with high and dense shrubs (MAD), an area with low and dense shrubs (MBD), and another one with low and sparse shrubs (MBE) were selected. We also evaluated the sap flow density and leaf water potential of young cork oak trees in both shrub presence and absence. Plant diversity was higher in MBE than in MBD and MAD. Cork oak regeneration was greater in MBD than in MBE and was absent in MAD. Young cork oaks showed better physiological conditions (higher leaf water potential and sapflow density values) in the absence than in the presence of shrubs. Shrub patches seem to favour cork oak recruitment and seedling survival, but might be detrimental to young trees performance.

Key-words: Leaf water potential, *Montado,* Natural Regeneration, Plant biodiversity, *Quercus suber*, Sapflow, Shrubs

Importance of the vegetation associated with rock outcrops for Montado birds

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Montados host a rich bird fauna but their vegetation is usually quite homogeneous. It is therefore important to understand the role of landscape elements that may increase the ecological diversity of Montado regions. This includes the rocky outcrops that are common in some regions, and are often covered by dense native vegetation. They usually cover from a few hundred to several thousand square meters, and are not cleared because the presence of rocks limits access by machinery and cattle. Our objectives were (i) to evaluate the importance of these "rock outcrop islands" for the diversity of birds of Montado landscapes, and (ii) to understand the factors that make them differently suitable for various species of birds. To answer these questions we carried out winter and spring bird point counts at sites with and without outcrops, and at outcrops with different characteristics. Preliminary results demonstrate that a few bird species highly successful in Montado are somewhat less abundant in the areas with outcrops. However, the presence of outcrops, especially of those with dense vegetation, benefited birds usually uncommon in Montados without developed a shrub layer, such as Robin, Blackbird, Wren, Song Thrush and Blackcap. This result is likely to be a consequence of the diversification of the habitat and of an increase in the availability of wild fruits. Other animal and plant species are likely to benefit from the vegetation clumps on rocky outcrops, which may thus play an important ecological role in Montado landscapes.

Influence of grazing intensity on foraging opportunities for birds in *montados*

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Montados are bird rich ecosystems often used for livestock grazing. It is thus important to understand how grazing influences birds, especially those that feed on the ground. Our objectives are to (i) identify the characteristics of sites chosen by groundforaging birds; (ii) determine how grazing influences those characteristics; (iii) quantify the effect of grazing on levels of habitat use by ground-feeding birds. In the long term we intend to propose grazing management strategies to preserve bird diversity in *montado*.

We evaluated the effect of three levels of sheep grazing – no grazing, light and intensive grazing – on the foraging activity of birds in 12 fenced plots (Herdade do Freixo do Meio). We counted foraging birds along transects in those plots, and used GLMM to compare the results in the three grazing levels. In addition, we located the sites where birds were observed feeding on the ground and characterized them (vegetation height, abundance of invertebrates, dung and acorns, bare ground, revolved soil and dead leaves). We used conditional logit models to determine which characteristics are preferred by feeding birds.

Grazing influenced ground level habitat and is an important determinant of where birds forage. All ground-foraging bird species fed mostly where grassy vegetation was lower than average and most preferred sites with high arthropod abundance. However, different species tend to choose areas subjected to different grazing intensities to forage. Therefore, it is important to maintain a mosaic of grazing regimes, to maintain foraging habitat for a wide variety of bird species.

Insect predation by birds in *montados* and its importance in the control of forest pests

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The recent decline of the *montado* is related to insect pests. Current pest control strategies are ecologically sound but the contribution of natural enemies, such as birds, is not understood. Our project, as presented here, will evaluate the diet of insectivorous birds in *montados* and, in a multidisciplinary manner, assess their role in pest control and their impact in the community of beneficial insects. During the nestling rearing season we will analyse the diet of aerial-feeding and tree-foraging insectivorous birds and compare it to insect abundance. We will also estimate bird numbers in different sorts of *montado* and observe how the foraging of insectivorous birds can relate to the damaging activity of pests, described through a list of variables recorded on individual trees. Insect contribution to ecosystem sustainability through pollination is unquestionable, hence, in order to better comprehend the ecological function of insectivorous birds, we will identify the most important pollinators in the *montado* and how their predation can affect flowering plants. Simultaneously, we will evaluate the effect of pheromone traps, a currently used pest control strategy, on non-target species. It is of most interest to identify insectivorous birds as ecosystem service providers and to understand their ecological function in the *montado* as an appropriate management of their populations may be a useful tool for the future of this ecosystem.

The use of soil nematodes in a *montado* ecosystem as a measure of disturbance

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The *montado* is an agro-silvo-pastoral system characteristic of southern Portugal, with scattered tree cover dominated by evergreen oaks (cork oak, *Quercus suber* L., and holm oak, *Quercus rotundifolia* Lam.). The *montado* harbours a high and unique biological diversity and has therefore qualified to be preserved within the EU Habitats Directive (92/43/EEC). Soil nematodes offer great potential for use as indicators of biodiversity and for assessing the soil condition. We hypothesized that differences in management strategies affect nematode community structure. This hypothesis was tested seasonally in three areas (dense *montado* with shrubs, open *montado* and cork oak forest). We classified nematodes into trophic groups: bacterial-feeding, fungal-feeding, omnivores, predators and plant-parasitic nematodes (PPN); and nematode community structure was characterised by the maturity index for free-living taxa (MI), maturity index for plant-parasitic taxa (PPI) and nematode channel ratio (NCR). The presence of cattle in winter significantly increased the abundance of freeliving nematodes (bacterivores, fungivores, omnivores and predators). The abundance of certain PPN genera was significantly higher in "dense *montado* with shrubs", where they seem to associate with shrubs (mainly *Cistus* spp.). MI was highest in "cork oak forest" maybe due to vegetation nutrient uptake and conversion. Resource utilization by plants is far from optimal in the three areas considering the high PPI/MI-ratios.

Using Biodiversity Action Plans to Manage High Conservation Value Areas in Portuguese Natura 2000 Network

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A Biodiversity Action Plan (BAP) is a management tool that a) evaluates and monitors wildlife and habitats with regional/local interest, with conservation status (IUCN/ICN Red Book) and included in EU Directives, b) evaluates species with importance in crop protection and soil conservation; c) defines biological indicator groups to assess and monitor the performance of pro-Conservation practices and c) target both crop areas and surroundings, including woodlands, wetlands set-aside areas, inter alia, for proper habitat management. BAP focus strongly in the concept of High Conservation Value Areas (HCVA). HCVA are landscape level units with important natural values, i.e., habitats, fauna, flora, and frequently occur in agroforestry scenarios. The first BAP began in March 2006 and by now AmBioDiv manages more than 40 BAP, with high incidence on Natura 2000 Network sites. The BAP main goal is to establish a Biodiversity baseline which will allow the definition of management guidelines towards Biodiversity no net loss or net positive gain. The results from the Habitat Approach are to be presented and discussed. The Habitat Approach method was based on the analysis of plant communities (Braun-Blanquet, 1979). The most relevant habitats were: Oak Montado forests, mixed woodlands, streamsides, scrublands, meadows, aquatic communities. Here we are going to present some of the Montado areas that we have worked in.

Keywords: High Conservation Value Areas, Montado, Biodiversity Action Plan