

GUIDELINES FOR SUSTAINABLE MANAGEMENT OF MEDITERRANEAN OPEN FOREST



Patrocinadores:



Socios:



Colaboradores:



AUTHORS

CARLOS SANCHEZ MARTINEZ (COORDINADOR)

DIEGO BENITO PEÑIL¹

IRENE BARAJAS CASTRO¹

NOELIA MARTÍN HERRERO¹

CARLOTA PEREZ RUIZ¹

JOSÉ SÁNCHEZ SÁNCHEZ²

JOSÉ ANGEL SÁNCHEZ AGUDO²

DAVID RODRIGUEZ DE LA CRUZ²

EDUARDO GALANTE PATIÑO³

MARIA ANGELES MARCOS GACRIS³

ESTEFANIA MICÓ BALAGUER³

This Guidelines are carried out within the LIFE project 07 NAT/E/000762 "Conservation of biodiversity in Western Iberia; Campanarios de Azaba Reserve", implemented by Fundación Naturaleza y Hombre in collaboration with the Centro Hispanoluso de Investigaciones Agrarias (CIALE) of the University of Salamanca and the Centro Iberoamericano de la Biodiversidad (CIBIO) of the University of Alicante.

Financial support has been provided by the UE's financial tool LIFE, MAVA Foundation, Natural Heritage Foundation, the Spanish Ministry of Agriculture, Food and Environment, Fundación Biodiversidad, Obra Social Caja Madrid (Bankia), Cementos Portland Valderrivas, Red Eléctrica Española and Rewilding Europe.



Patrocinadores:



Socios:

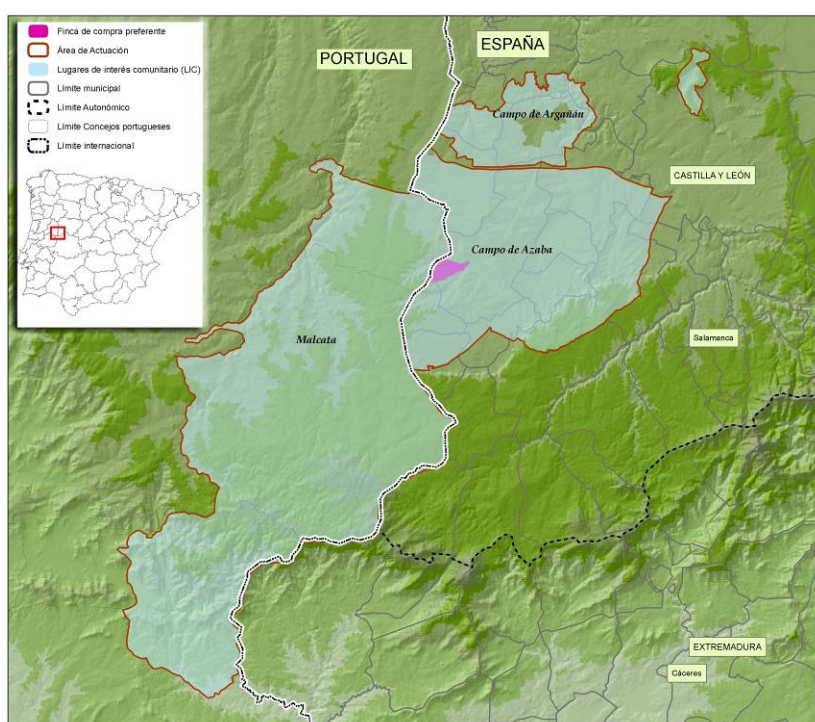


Colaboradores:



1. 1. Background

This document is a product of the LIFE-Nature project " Biodiversity Conservation in Western Iberia: Campanarios de Azaba Reserve", implemented by Fundación Naturaleza y Hombre as the main beneficiary, and the Centro Iberoamericano de la Biodiversidad (CIBIO) of the University of Alicante (specialized in entomological studies and activities) and the Centro Hispanoluso de Investigaciones Agrarias (CIALE) of the University of Salamanca as partners, between the years 2008 and 2012. Its main goal has been fostering biodiversity in a territory of about 132.600 hectares of the Natura 2000 sites Campo de Azaba, Campo de Argañán in Spain and Malcata in Portugal, in which open Mediterranean forest of quercineas with livestock use (*Dehesa*) are the dominating ecosystems.



Location Map

This general improvement in the status of biodiversity has been achieved preferably through intensive intervention on the area of Campanarios de Azaba, a reserve with a surface of 522 hectares (less than 0.4% of the whole), located in the center of this large territory, in which a comprehensive and active management in favour of species with a high dispersal effectiveness (birds, insects and plants) has been developed. One of the main problems is the lack of transversal permeability, being mostly constituted by closed private properties intensively exploited with pruning, pastures, hunting, plough, *montaneras* (period in which the iberian pig feeds out of acorns mainly -but also bulbs and pastures- in the Dehesa), etc.; all of which entailed a bad condition of the area, despite its excellent landscape. This permanent reserve area is currently the only space of the territory not subject to hunting and acts as a place for breeding, feeding, resting and has a biomass spill-over effect in terms of biodiversity towards the rest of the large area network Natura 2000.



Air View of Campanarios de Azaba Biological Reserve_Staffan Widstrand

This main goal in turn, was fulfilled conditioned to achieving the following three specific objectives:

1) Improved conservation status and increased population levels of 5 bird species from annex I of the Birds Directive: Black Vulture (*Aegypius monachus*), Black Stork (*Ciconia nigra*), Iberian imperial Eagle (*Aquila adalberti*), Golden Eagle (*Aquila chrysaetos*) and eagle owl (*Bubo bubo*) as well as two species of insects belonging to annex II of the Habitats Directive (*Cerambix cerdo* and *Euphydryas aurinia*).

(2) Increased surface and improved conservation status of 7 habitats listed in annex I of the Habitats Directive: Habitat 6310- Evergreen pastures (*Dehesas*) of various species of *Quercus*; Habitat 3170- Mediterranean temporary ponds; Habitat 4090-Oromediterranean heaths with aliaga; Habitat 91B0-Thermophilic ash forest of *Fraxinus angustifolia*; Habitat 92A0- Gallery forests of *Populus alba* and *Salix alba*; and Habitat 91E0- alluvial forests of *Alnus glutinosa* and *Fraxinus excelsior*.

(3) Development of biodiversity evaluation indicators, habitat quality indexes and protocols for sustainable management of habitat 6310 (Evergreen pastures - *Dehesas*), by developing predictive models that can be applied in other areas of Mediterranean open forests of *Quercus* in any country of the European Union.

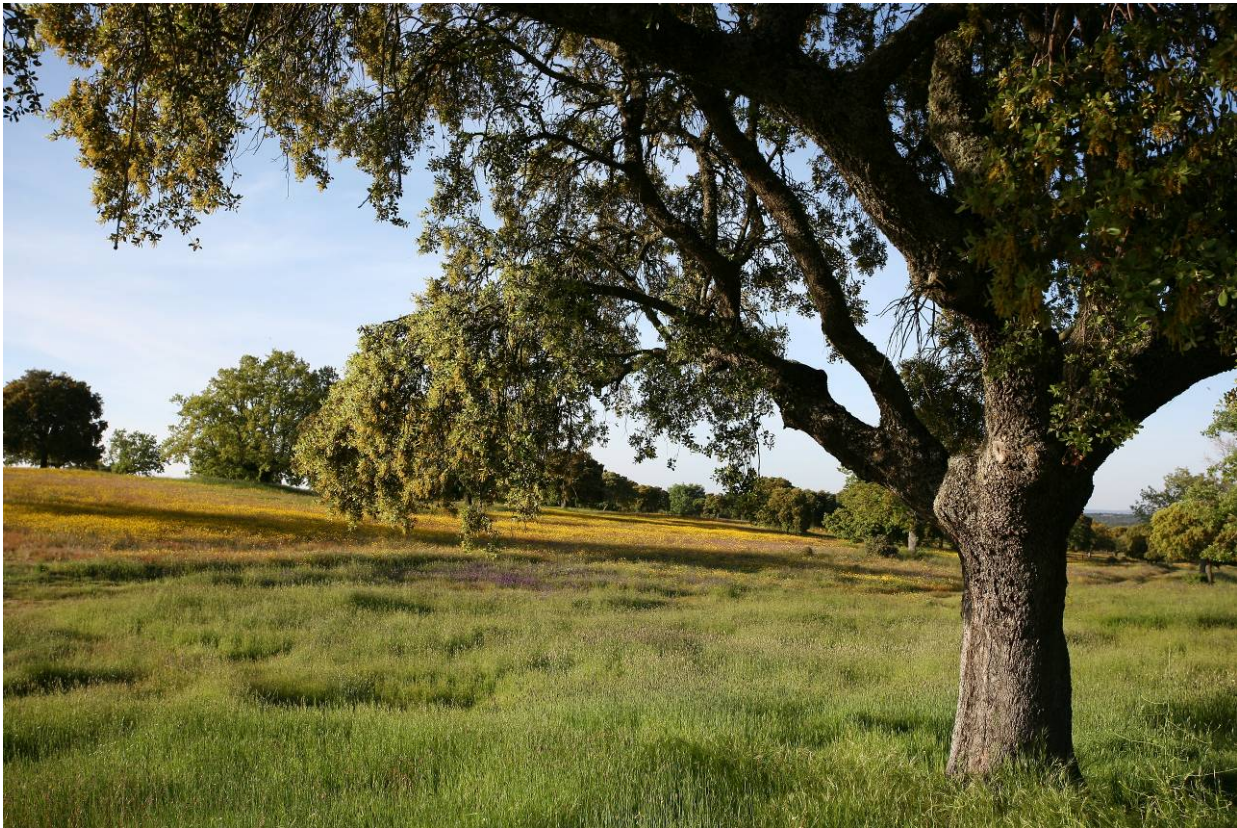
All these specific objectives at the same time, were achieved through the implementation of several specific conservation actions in the above-mentioned biological reserve, which will be described and analysed in detail later in this Guidelines, and that have been aimed at the protection of priority flora and fauna species for the European Union in the framework of the Natura 2000 network. In this way, the experience gained in the implementation of conservation actions, could be replicated in other areas of the Mediterranean area with similar features to those that can be found in this area southwest Salamanca, where the project is located.

The main support of the project has been the European Commission through its financial instrument LIFE-Nature. The fund was initiated in 1992 in order to financially assist in the activities for the conservation of the Natura 2000 network. In this way, and because of the global -but also European- trend towards overexploitation of natural resources, in 1992, the Commission supported the protection of areas of natural importance and established the Natura 2000 network, which tried to combine in a net all the areas conservation interest for the biodiversity of Europe with the aim of ensuring a long-term survival of the most vulnerable and threatened species and habitats. This initiative is administratively governed by the Habitats Directive EC 92/43 which established the areas to be protected.

Precisely within this European framework emerged the LIFE financial tool, being LIFE Nature the component which refers to promoting management planning and demonstrative best practice projects on management of habitats and species within the Natura 2000 network. This financial tool of the European Commission which is currently the only fund exclusively dedicated to the Natura 2000 network, works as co-financing facilitation component of nature conservation projects in Europe which is known to be one of the greatest sponsors for the preservation of wild areas.

One of the most important natural habitat to preserve in Europe, from the point of view of the number of species and threatened habitats having part of its surface within the Natura 2000 network, is the *Dehesa* and the *Montado*, as a model of typical Mediterranean mature open forest modified by human beings many centuries ago in their livestock farming combining the typical agricultural, livestock and forestry exploitations of this part of Europe with the conservation of the natural values. In this way, the *dehesa* is widely considered as a textbook example of balance between the use of a variety of products and resources and the maintenance of environmental values and ecologically-mature ecosystems managed by humans.

However, the *dehesa* also has many other management problems that may put an end to all those positive values and balance held for hundreds of years, mainly due to overexploitation of natural resources and the change in land use and agroforestry practices.



The Dehesa is one of the most biodiverse hábitats. Campanarios de Azaba_

Because of all this, in 2007 Fundación Naturaleza y Hombre (www.fnyh.org), a non-governmental organization dedicated to the conservation of nature, came up designing an innovative LIFE project of biodiversity conservation in the SPA for birds of Salamanca in Campo de Azaba, Campo de Argañán y and the portuguese SCI of Malcata, whose area can be found one of the best examples of pasture in the Iberian Peninsula. This project envisioned the de-escalation of the dehesa for the conservation of its natural values. Thus arose the LIFE project "Biodiversity Conservation in Western Iberia", of which, the present Guidelines is one of its products.

1.2. Object, scope and structure of the present document

This Guidelines for Sustainable Management of Mediterranean open forests is intended to be a tool for the management of a dehesa or Mediterranean open forest that combines a sustainable and feasible livestock farming and forestry management with biodiversity and natural heritage conservation.



4. Livestock is one of the modeler factors of the Dehesa. Iberian pig_

The dissemination of best practices in the management of this environment as a result of the experience gained, in the framework of the LIFE project "Biodiversity Conservation in Western Iberia; Campanarios de Azaba Biological Reserve", will allow achieving greater and more ambitious conservation goals in partnership with the landowners and best practices which can be replicated in ecosystems with similar land uses throughout Europe. Thus, these Guidelines emerged after 42 months of development of the project and implementation of management programmes as a tool for outreaching and disseminating lessons learned in its implementation by FNYH and its partners of the University of Salamanca and the University of Alicante.

The completion of this Guidelines also intended to offer tips and guidelines that can be used by any manager, public or private, that wants to carry out management and conservation actions of this ecosystem. Thus, in the section of "Best practices" one can find some basic recommendations we believe essential to make a good combination of traditional forestry and traditional hunting with the conservation of natural values and biodiversity of the dehesa.

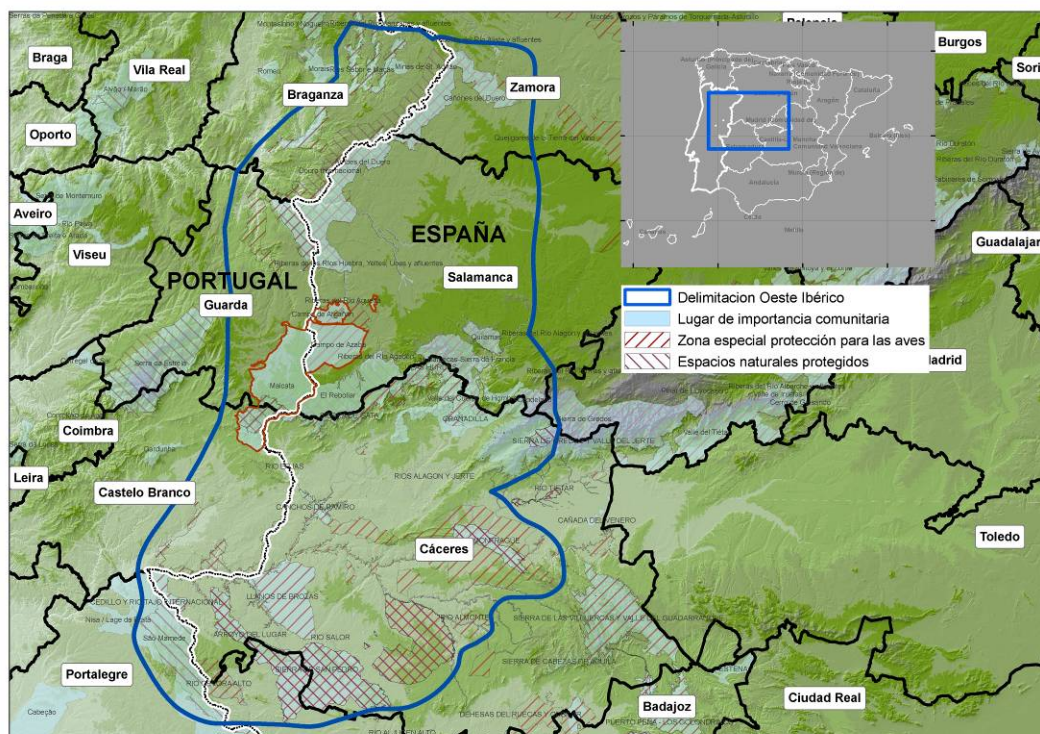
Basic conservation actions that have been conducted in Campanarios de Azaba's Reserve and that are shown in these Guidelines, are all those actions directly related to the improvement and restoration of habitats and populations of target species of the project, referred to in the preceding paragraph. These actions provide an overview of all aspects to be taken into account from the point of view of the manager of the territory towards the maintenance of a good quality habitats in the areas managed, as well as protected species. Studies for the development and elaboration of quality bioindicators of the dehesa through the study of fungi and insects that allow to know the ecological status, have also been conducted.

Hence, this document includes a section that conceptualizes Western Iberia as a transnational ecological continuum. It also includes a summary of the biological characteristics of Campanarios de Azaba, the area in which these actions are developed. It next includes the main actions developed in the project, their characteristics, problems found and achieved outcomes. The document is closed with a section in which, based on best practices, management actions for this type of areas are suggested.

2. Western Iberia as a transnational ecological continuum

2.1 Geographic scope

The LIFE+ Nature project "Biodiversity Conservation in Western Iberia" arises from the finding of the existence of a large transnational territory between Spain and Portugal that we have defined as Western Iberia, a large area whose epicenter has as its central focus the portuguese-spanish border in the section between the axis *Cáceres-Castelo Branco* to the South and *Salamanca-Guarda* to the North encompassing areas such as *Campo Charro*, *Sierras de Gata*, *Malcata*, *Peña de Francia*, *Las Batuecas*, the *Arribes del Duero*, Tagus international, etc. The entire area would reach a continuous surface of about 4 million hectares, most of them of high natural value, even though it's central area has over one million hectares and there is where we develop the main activity.



5 Location of the huge area of Western Iberia

It occurs within the medomediterranean and supramediterranean bioclimatic floors, in both cases with wet ombrotpe. This area alternates, on both sides of the border, pastures with mature Mediterranean forest, rocky cliffs grasslands, field crops, riparian habitats and medium mountains covered with oaks and shrub. Due to its extension and conservation status, this area is one of the best in Western Europe and the Mediterranean basin when referring to its natural values.

Iberian areas of Mediterranean mountains as the analyzed area make up one of the most important biodiversity reservoirs of the Iberian Peninsula. The regular use of the resources of these areas by its inhabitants has historically transformed them into human eco-cultural areas, binding their natural characteristics to traditional uses of the territory. Thus, in Western Europe and the Mediterranean basin there aren't untouched areas which still remain, for example, in some tropical forests or in the Northern tundra, but on the contrary, the territory

and the landscape are a result of the interaction between the natural values and an intense human activity that, for instance, has developed high-impact activities to the territory such as agriculture or farming for over two thousand years.

In summary, the preservation of biodiversity in the landscape does not imply a framework of non-intervention, but it entails also the development and implementation of management protocols for human activities under the criteria of sustainability; which is precisely what this document aims to contribute.

From the biogeographical point of view, the area of operation belongs entirely to the chorological provinces *Luso-Extremadurensis* (around the South side of Sierra de Gata and the South Portuguese area) and *Carpetano-Iberico-Leonesa* (Batuecas, Peña de Francia, North of the Sierras de Gata and Malcata and Campo Charro), both in the Mediterranean biogeographic region.

In general, the mature Mediterranean forest occurs in the study area in semi-open, not very dense forest, generally of quercineas, either sclerophyllous as the holm oak (*Quercus ilex* subsp. *ballota*), or the Cork oak (*Quercus suber*), or marcescent (*Quercus faginea*), and the Pyrenean oak (*Quercus pyrenaica*) which are distributed throughout the country according to its specific bioclimatic conditions (altitude, orientation, soil type, etc.). The wettest areas, are dominated by the Cork oak, while the mountain areas are more conducive to the establishment of Pyrenean oak, portuguese oak and other deciduous, in particular, the chestnut tree (*Castanea sativa*).



Holm oak. Campanarios de Azaba. *Quercus ilex* subsp. *ballota*

On the riversides of streams and ponds scattered around these mountains; ash trees (*Fraxinus angustifolia*) and willows (*Salix alba*, *Salix salvifolia*, *Salix atrocinerea* and *Salix neotricha*) appear. In areas of lower continental influence, the chestnut forests of *Castanea sativa* occupy large areas.

Shrubs, which play a key role in the structure of this ecosystem, are dominated by rockroses (*Cistus ladanifer*, *Cistus laurifolius*, *Cistus salvifolius*), brooms (*Cytisus multiflorus*, *Cytisus scoparius*, *Genista florida* and *Retama sphaerocarpa*). French lavender (*Lavandula stoechas*) is also present, which facilitates the survival of a large number of insects while blooming that will be the basic feeding resource of several species of fauna.



French lavender (*Lavandula stoechas*)

Nowadays, this territory is one of the best examples of the combination of Mediterranean mountain and open forest in good conservation status that can be found in the Iberian Peninsula, and that combined with the river canyons; conforms one of the major biodiversity hot spots globally.

Within this large natural area of Western Iberia, the project focused on Natura 2000 areas Campo de Arganan, Campo de Azaba and Malcata, adding all together some 132,000 hectares.

2.2 Natural values

2.2.1 Species of conservation interest

All this large natural area is home to a number of species of the maximum conservation interest at different levels: global (Iberian lynx, Iberian imperial Eagle, Egyptian vulture), European (Black Vulture, Black Stork) or national in both countries (Golden Eagle, eagle owl). The population level of these species and habitats is founded below:

Species of global conservation interest

Iberian lynx: not being an object of this study, it may be indirectly benefited by the habitat restoration and, especially due to the prey species population improvement. In Sierra de Gata and its surroundings, six specific studies have been developed in the last 10 years, both the Portuguese and the Spanish zone: Ordiz y Llaneza (2004), Tracani (1998), Blanco y Barrios (1997), González y González (1996), Castro y Palma (1.996) y González-Oreja (1998) on this species included in the national catalogue of endangered species (CNEA - Royal Decree 439/90) in the category of "In danger of extinction" (which means that it must be subject of active conservation measures described in restoration plans), in IUCN's Action Plan (Nowell and Jackson 1996), where it is considered as the most endangered feline in the world, and finally the Red Book of the vertebrates of Spain (Blanco y González, 1992) considers it "endangered" as well as the Livro Vermelho dos Vertebrados of Portugal (Cabral *et al.*, 1990). IUCN's Red list classifies it as critically endangered. The work of González y González (1996) shows a regressive trend of the populations of these species due to fragmentation, issues that threatened the future of the species in Sierra de Gata. These authors confirmed the category of "low density" given to this areaby Rodríguez and Delibes (1992), in its work at national level, which described the existence of four population cores. Gonzalez-Oreja (1998) stressed the non-natural mortality of the Lynx in the area. Blanco y Barrios (1997) accepted a stability of the population, pointing out that if there is a decline, this cannot be detected with common sampling methods. The work of Tracani (1998) found evidence of Lynx in the area, but nothere was no certainty in the determination of their origin. Castro and Palma (1996) recognized four populations of Iberian lynx in Portugal, one of them in Malcata. Finally, Ortiz and Llaneza (2004), couldn't estimate specifically the status of the Lynx in the study area, while they considered a very small number. The fact is that the area is fully integrated in the Iberian lynx distribution area and due to this and considering its conservation category; it must be taken into account in future projects of reintroduction of the species.



Iberian Linx (*Lynx pardinus*)

Iberian imperial Eagle (*Aquila adalberti*)



Egyptian vulture (*Neophron percnopterus*)

Black vulture (*Aegypius monachus*)



Black stork (*Ciconia nigra*)

Aquila adalberti: Iberian endemism, with just about 200 couples. Currently within the study area, it only breeds in international Tagus (1-2 couples on the Spanish side and 0-1 on the Portuguese side) and especially in Monfragüe (12 couples); though individuals are easily seen, especially juveniles searching new territories to the north, to Campanarios de Azaba. Much of Western Iberia presents good habitats for the settlement of this species, currently suffering an expansion process from the Southwest. It is listed as in danger of extinction in the CNEA.

Neophron percnopterus: Listed in annex I of the Birds Directive. It is present in spring and summer, during the breeding season. Species declared "endangered" in IUCN's Red List. It mainly breeds in Monfragüe (30 couples), Arribes del Duero (about 90 couples), Vale de Coa (6 couples), El Rebollar, Sierra de Gata (1 couple), and Tagus

International (about 30 couples if both sides of the border are added). The population is schart, but there are still threats identified for the species. Listed as vulnerable by the CNEA.

Species of conservation interest at European level

*Aegypius monachus**: listed in annex I of the Birds Directive, being also a priority species. The main settlements of the area are Monfragüe's National Park, with about 350 couples, and El Rebollar and Sierra de Gata, with a pool of individuals that exceeds 300 couples among adults and juveniles. Europe's estimated population does not exceed 1300-1700 couples, being Spain the main reservoir of the species with some 1300 couples. The Black Vulture is listed in Spain as of special interest (national catalog of threatened species, CNEA), vulnerable in the Red Book of the birds of Spain. At the regional level it appears as sensitive to the alteration of its habitat in Extremadura (Regional catalogue of endangered species of Extremadura), where conservation plans exists. It is also present in the Tagus international, preferably on the Spanish side (about 40 couples in the SPA), but also on the Portuguese side, in Tejo international Erges e Ponsul (3 couples on holm oaks).

Ciconia nigra: Annex I of the Birds Directive. Present while breeding, only in spring and summer. Present in Tagus International (18 couples in Portuguese side, six in the Spanish side), Campo de Azaba (10 couples, 1 of them nesting in Campanarios de Azaba or its immediate area, depending on the year), Monfragüe (about 30 couples) and Vale do Coa. There are also 5 couples in Las Batuecas-Sierra de Francia and other 17 in the North of Cáceres. Some couples breed outside the Natura 2000 network. There is no register of new couples at regional scale, which makes conservation of this species a big concern in the area. Listed as vulnerable in the CNEA.

Species of conservation interest at the national level (in both countries)

Aquila chrysaetos: Annex I of the Birds Directive. Resident. Five couples in Vale of Coa, about 15 couples (adding both sides of the border) are known in Tagus international, six in Monfragüe, one in Gata and 1 in El Rebollar (in the Riscos del Águeda). The population is schart but with low productivity levels, probably due to a shortage of rabbits, its main prey.

Bubo bubo: Annex I of the Birds Directive. Resident. Present in Tejo International, Vale do Coa, Malcata, Monfragüe and Campo de Azaba. Altogether, there are about 35 couples. Also with productivity problems.

Cerambyx cerdo: Species included in annex II of the Habitats Directive. Considered vulnerable by IUCN and included in the Berne Convention (annex II) as strictly protected. Although currently it is not threatened in the Iberian Peninsula, their populations are affected by the reduction of *Quercus* forests and mainly by indiscriminate and little controlled use of pesticides and other agrochemicals. The presence in the area of operation is confirmed, though in undetermined number.



Golden Eagle (*Aquila chrysaetos*)



Cerambyx cerdo

Eagle owl (*Bubo bubo*)



Euphydryas fritillary (E. aurinia)

Euphydryas fritillary: species of butterfly included in annex II of the Habitats Directive and as strictly protected in the Berne Convention (annex II). It is a species that is considered not to be threatened in the Iberian Peninsula. It feeds mainly on Honeysuckle (*Lonicera spp.*), being a characteristic of well preserved understorey highly affected by incorrect forestry work, especially the clearing of the spiny bushes. The transformation of the Habitat by agricultural intensification is also one of the causes of the decline in many localities of the populations of this species. The presence in the area of is confirmed, though in undetermined number.

2.2.2. Sites of Community Interest

The project conducted its work on the following habitats of conservation interest, included in annex I of the Habitats Directive.

Habitat 6310, Evergreen pastures of Quercus spp.: Annex I of the Habitats Directive. It is, with no doubt, the habitat of greater extension of the area and one of the most original of the Iberian Peninsula. It is the most representative and socially-binding habitat in the whole of Western Iberia. Its extension is of 26,800 hectares, in the SCI's of Campo de Azaba and Campo de Argañán, representing more than 50% of its surface. It is also very well represented in the SCI Malcata. In Campanarios de Azaba, comes to occupy roughly 380 hectares. While visually it may seem that the habitat is well preserved, the reality is quite different: periodic plowing, disproportionate livestock loads, fencing of the different properties and increasing desertification simplify this habitat, reducing the most demanding and rare species and disrupting the structure seriously.

Habitat 3170, Mediterranean temporary ponds: Annex I of the Habitats Directive; due to its nature, this habitat does not occupy large areas. The estimated joint surface in the 3 SICs of the project is 5-7 hectares with an indeterminate surface in Western Iberia as a whole, with a negative conservation status, because when they occur, they are subject to intensive exploitation from livestock that use them for watering and as a bath area.

Habitat 91B0, thermophilic ash forests of Fraxinus angustifolia: Annex I of the Habitats Directive. Located on the riverbanks of the lower areas of rivers and streams, this habitat occupies approximately 1,000 hectares, with good conservation status, between the 3 SICs.

Habitat 92A0, Gallery forests of Populus alba and Salix alba: Annex I of the Habitats Directive. They occupy approximately another 1,000 hectares, with good conservation status.

Habitat 91E0, Alluvial forests of Alnus glutinosa and Fraxinus excelsior: Annex I of the Habitats Directive. It is the largest riparian forest in the study area, with about 2,700 hectares between the 3 SICs. Its conservation status is good.



Temporary mediterranean reservoirs



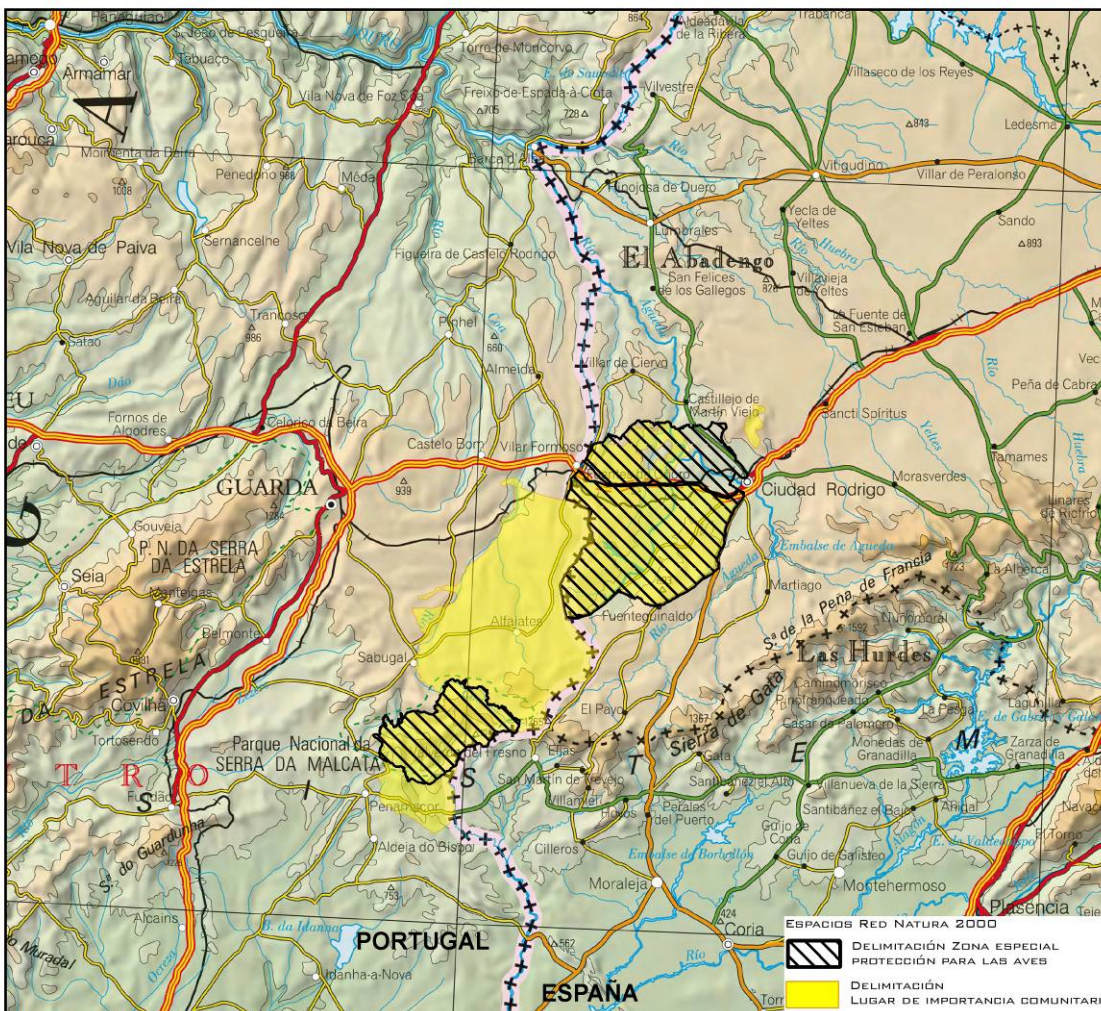
In this great corridor coexist evergreen pastures of *Quercus* sp with *Fraxinus* forest and gallery forest of Black poplars (white *Populus*) and willows (white *Salix*)

2.3 Natura 2000 Network

Natura 2000 is an ecologically comprehensive network of declared areas and managed at European level. The regulatory framework is subject to the Directive 92/43/EEC on the conservation of natural habitats of wildlife.

In the Spain, the area under the direct influence of the Natura 2000 network rises up to 21.147.812 million hectares, which represents 41.9% of the Spanish territory. In the province of Salamanca, the area directly influenced by the Natura 2000 network totaled 279.267 hectares distributed in 11 SPAs and 13 SCI, which corresponds approximately to 23,27% of the territory of the province.

The Natura 2000 network areas on which Fundación Naturaleza y Hombre project's efforts are focuses are Campo de Azaba, Campo de Argañán in Spain and Malcata in Portugal.



Location Map of the Natura 2000 areas object to the study_FNYH

Of all the hectares protected by the Natura 2000 network in the province of Salamanca, only a percentage close to 24% of those acres are found in areas of pasture or dehesas; which means that a total of 297,687 hectares of pasture remain outside the network and therefore unprotected against attacks referred to in these European directives of conservation, entailing a global biodiversity loss.

Taking into account that the province of Salamanca has 86% of the dehesada surface of the autonomous community of Castilla y León and approximately 25% or more of the pastures of the Spanish territory, it can be concluded that Salamanca is an area of great importance for this habitat. This implies that major efforts must be carried out to ensure the maintenance and conservation of the species of flora and fauna associated with this ecosystem.

If we refer to Western Iberia, a total of 103 natural areas have been declared belonging to Natura 2000, 47 SPAs and 56 SCIs. Both categories are listed in the following charts, sorted by area of greater to lesser. Overall, there are a total of 934,235.20 hectares of SCI and 951,186.65 hectares of SPAs. The amount cannot be added up, since some areas are simultaneously SPAs and SCIs.

SPA for birds	Surface (Ha)
Monfragüe y las Dehesas del Entorno	116.151,42
Sierra de San Pedro	115.032,07
Arribes del Duero.	107.042,00
Llanos de Cáceres y Sierra de Fuentes	70.021,74
Llanos de Alcántara y Brozas	51.200,50
Douro Internacional e Vale do Águeda	50.788,76
Rios Sabor e Maçãs	50.687,89
Campo de Azaba.	36.495,90
Batuecas	30.182,90
Las Batuecas-Sierra de Francia	30.182,90
Hurdes	26.982,49
Tejo Internacional, Erges e Pônsul	25.775,33
Canchos de Ramiro y Ladronera	23.119,55
Vale do Côa	20.607,35
Río Tajo Internacional y Riberos	20.271,26
Nacimiento del Río Gévora	20.024,15
Sierra de Gata y Valle de las Pilas.	18.522,51
Cañones del Duero	17.374,00
Campo de Argañán.	17.304,00
Serra da Malcata	16.347,79
Magasca	10.846,44
Quilamas	10.263,00
Río y Pinares del Tiétar	9.888,20
Embalse de Gabriel y Galán.	8.401,68
Riberos del Almonte	8.363,02
Embalse de Alcántara.	7.648,00
Embalse de Valdecañas.	7.459,17
Embalse de Talaván.	7.303,22
Candelario	7.067,06
Pinares de Garrovillas	2.574,64
Riberas de los ríos Huebra y Yeltes	2.194,70
Río Alagón	2.147,12
Embalse de Borbollón.	946,42
Riberas del Río Águeda	934,28
Embalse de Arrocampo.	686,57
Embalse de Aldea del Cano.	108,95
Complejo de los Arenales.	85,45
Colonias de Cernícalo Primilla de Garrovillas.	41,82
Colonias de Cernícalo Primilla de Albuquerque.	41,71
Embalse de Brozas.	29,90
Colonias de Cernícalo Primilla de Brozas.	25,06

Colonias de Cernícalo Primilla de la Ciudad Monumental de Cáceres.	15,72
Charca Arce de Abajo	11,28
Embalse de Vegas Altas.	8,16
Colonia de Cernícalo Primilla de Casa de la Enjarada	6,44
Colonias de Cernícalo Primilla de Saucedilla.	3,24
Colonias de Cernícalo Primilla de San Vicente de Alcántara.	3,14

Total surface of SPAs in Western Iberia

951,186.65

SCIs	Surface (Ha)
Sierra de San Pedro	115.032,07
Arribes del Duero.	106.398,00
Serra da Estrela	88.291,70
Malcata	79.079,19
Sierra de Gredos y Valle del Jerte	74.269,32
Llanos de Brozas	51.200,50
El Rebollar	49.811,10
Douro Internacional	36.186,73
Campo de Azaba	36.064,60
Rios Sabor e Maçãs	33.482,11
Las Batuecas-Sierra de Francia.	31.801,90
Granadilla	24.429,53
Las Hurdes	23.887,03
Monfragüe	18.396,49
Sierra de Gata	18.057,08
Sierras del Risco Viejo	13.830,04
Cañones del Duero	13.611,20
Cedillo y río Tajo Internacional	13.263,49
Morais	12.877,82
Quilamas	10.651,00
Campo de Argañán	9.272,49
Río Almonte.	8.730,01
Candelario	8.193,06
Canchos de Ramiro	6.933,29
Valle Cuerpo del Hombre	6.549,34
Río Tiétar	6.226,59
Gardunha	5.935,39
Romeu	4.768,59
Riberas de los Ríos Huebra, Yeltes y Uces.	4.743,37
Minas de St. Adrião	3.495,48
Río Gévora Alto	2.720,92

Ríos Alagón y Jerte.	2.593,08
Riberas del Río Tormes y Afluentes.	1.834,49
Arroyos de Barbaón y Calzones	1.797,40
Riberas del Río Alagón y Afluentes.	1.721,49
Río Erjas.	1.164,43
Riveros de Gata y Acebo	1.088,84
Arroyos de Patana y Regueros.	951,18
Riberas del Río Águeda	934,28
Ríos Arrago y Tralgas	761,17
Rivera de Aurela	497,28
Rivera de Membrío	436,31
Río Salor	390,89
Riveras de Carbajo y Calatrucha	372,08
Arroyo del Lugar.	354,67
Río Esperabán	346,09
Riveras de los Molinos y la Torre	306,73
Embalse de Lancho	163,71
Embalse de Petit I	154,63
Riberas del Río Agadón	86,55
Embalse de Arce de Abajo	54,03
Laguna temporal de Corrales	12,86
Laguna temporal de Valdehornos	12,83
Mina de la Aurora	4,88
Mina de la Rivera de Acebo	4,88
Mina de la Paloma.	1,00
Total surface of SCIs in Western Iberia	934.235,20



Panoramic View of Monfragüe National Park



The Gata Saw. Robledillo of Gata and Cadalso mountains, area of great importance for the black vulture *Aegypius monachus*.



The international Tajo-Tejo is an otherone of the most valuable cross-border spaces of the Iberian West. Very important area for the Imperial eagle *Aquila adalberti* and the black stork *Ciconia nigra*.



Valley of The Batuecas, from the monastery. One of the most evocative landscapes of the Iberian West.

The Arribes shape the most extensive fluvial and pronounced canyons of Europe. Mansion of a spectacular community of stone friend lads. It's one of the special values of the Iberian West



2.4 Threats and conservation challenges

This continuum of Western Iberia, with a huge surface area, natural values of highest conservation interest and a widespread presence of Natura 2000, is threatened by a series of conservation challenges, common to many other Iberian territories and of the rest of Mediterranean Europe, which can be structured in the following way:

- 1) Scarcity of trophic resources for the superpredators and, in particular low rabbit, partridge and pigeon population levels, which represent an essential trophic resource for the maintenance of Mediterranean forests. This species are the main prey of a large number of predators, including target species of the project such as golden eagle, Bonelli's eagle, black vulture, imperial eagle, eagle owl, etc. With the spread of myxomatosis and viral hemorrhagic pneumonia, rabbit populations have decreased alarmingly setting risk of extinction to

specific predators. Currently their populations in Western Iberia are irregular; existing relatively good populations and others where it is absent.



European rabbit (*Oryctolagus cuniculus*).
Widstrand



European rabbit (*Oryctolagus cuniculus*), Staffan

2) Overexploitation of *Quercus* meadows. The most representative habitat which occupies also the largest surface is subjected in many cases to overexploitation and changes of land uses, which is characterized by an increase of pruning to produce charcoal, short of the stem branches to facilitate mechanical work, intensification of agricultural production affecting the foot of the trees, periodic plows which impede the normal development of vegetation, livestock loads higher than the productive capacity, hunting, very intensive pruning to increase the production of acorn during the *montanera*, fences, etc.



Bad pruning practiced, Staffan Widstrand.

3) Declining water levels, clearing shrubs, trampling and, especially, eutrophication affect equally Mediterranean wetlands (natural eutrophic ponds with Magnopotamion or Hydrocharition vegetation, ponds and natural dystrophic ponds, * Mediterranean temporary ponds), and riparian formations (gallery forests of *Salix alba* and *Populus alba*, * alluvial forests of *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*), and galleries and thermo riparian shrubs (*Nerio-Tamariceteae* and *Securinegion tinctoriae*), causing a small area in inappropriate conditions, that adversely affects a large number of species that depend on them.



Temporary pond covered by invasive species in Campanarios de Azaba, FNYH

4) The Seca is currently the phenomenon that puts at greater risk the great forests of Iberian quercineas. Two ways of “drying” have been found: one produces a sudden death of the tree in a few weeks and another produces a slow decay drying outlying branches to finish drying the whole tree. The process is complex and of unclear origin, fungi being implicated as *Diplodia sp.*, *Hypoxylum mediterraneum* and *Phytophthora cinnamomi*. Climatic factors also seem to influence and, according to some authors, an improper management of *Quercus* forests. At the moment there is no effective solution, taking into account the particularities of these trees growing very slow and distributed in large masses, affecting hundreds of thousands of hectares in the Iberian Peninsula.

5) The fragmentation of habitats between Natura 2000 areas and within each space is one of the biggest problems of the area, which also has a growing trend.

6) Abandonment of traditional livestock and agricultural activities and the application of insecticides and chemicals that affect very negatively for various reasons different groups of animal and plant species.



Holm oaks affected by la seca. Tagus International, FNyH



The abandonment of a traditional lifestyle is a tangible reality, Staffan Widstrand

7) Hunting overexploitation: the absence of proper hunting management in certain game reserves in the area, particularly in the area of Tajo international, on both sides of the border, has caused a decrease in prey species (*Alectoris rufa*, *Oryctolagus cuniculus*, *Lepus capensis*, *Columba palumbus*), essential to ensure the stability, among others, of the populations of *Aquila chrysaetos*, *Aquila adalberti* and *Hieraaetus fasciatus*. The main reasons include excessive catch quotas, absence of improvements to strengthen game species populations, little control of viral diseases of the rabbit (*Oryctolagus cuniculus*) and poor control of predators. Special vigilance should be taken with the methods used for the control of populations of predators (especially *Vulpes vulpes*), avoiding the use of non-selective methods of capture. There is a need to avoid the cases of use of poisons which seem to be reappearing again. The decrease in the populations of *Oryctolagus cuniculus*, *Lepus capensis*, *Alectoris rufa* and, to a lesser extent, *Columba palumbus*, has a direct impact on the reproductive success of the numerous couples of birds of prey in the area. The decline of preys on the usual hunting, conditions the occupation of territories and the settlement of new couples.

8) Inappropriate management of forests. During the breeding period some birds (*Aquila adalberti*, *Aquila chrysaetos*, *Aegypius monachus*, *Hiraaetus fasciatus*, *Ciconia nigra*, *Neophron percnopterus*) suffer frequent discomfort caused mainly by forestry activities such as clearings of bushes, pruning, repairing trails, etc. Since some of these birds soon start its reproductive cycle, the incubation phase coincides with the period in which numerous forestry work is authorized. This activity can affect both the wildlife that uses the tree and the fauna in the surroundings; both finding inconveniences during the development of this work. The impact depends largely on the distance between the nest and the place where the work is carried out, as well as its duration. Among forest activities, clearings have the greatest impact on the habitat and are long-lasting. Management (pruning, logging, etc.) means the use of machinery with consequent fauna inconvenience arising from the transfer of staff, noise and general lack of silence in the area.

9) Lack of thropic resources for scavengers and other birds of prey due to the effects of the legislation for the "mad cow" crisis with negative consequences for their survival in the medium term.

10) Forest fires: droughts in summer combined with the abandonment of extensive livestock poses a serious threat to Mediterranean ecosystems.

11) Discomfort by human activities poorly managed as hunting, forestry or hiking can harm the most sensitive species in the fixation of new couples of birds as well as causing the abandonment of the nest, reproductive failure or abandonment area by the species. Nautical activities can heavily affect the fauna associated with watercourses and the cliffs next to them, in those areas where the River is encased. Some species nest in these areas, characterized by the presence of rocky environment which commonly make them inaccessible areas, uncontrolled navigation can have a special impact. Some very sheltered spots can be accessed from the ground when navigation closes. Is in these places where species who seek quiet and protected areas – such as *Ciconia nigra*- nest; that will move of perturbed, losing the area its natural value. Fishing may also have a high incidence, not as a direct impact but indirectly due to noise involving quiet areas that may be used as breeding or feeding areas for wildlife. The management method that is to be implemented, as well as all the conservation actions, will minimize this aspect.

12) Distrust and suspicion of the local population, especially hunters, farmers and herdsmen, towards nature conservation policies, are sometimes felt as a brake to economic development of the area. The low value given to valuable natural resources available to the area by the local population is also to be considered. The lack of infrastructure for public use which facilitates and makes pleasant the visit to wild areas is related to this underestimation and widespread ignorance of the natural values.

13) Land concentrations: with the opening of new tracks and improvement of existing ones, the elimination of hedges and walls and increased human flow to sensitive areas, increase of discomfort to endangered species.



The loss of traditional closures on the dehesa is growing, FNyH

All these threats justify the actions developed with project, which were initially those that put at risk the preservation in the medium and long term of the biological reserve of Campanarios de Azaba and which, for the most part, have been neutralized by the management as detailed in the following pages.

3. Reserva Biológica Campanarios de Azaba

Campanarios de Azaba Biological Reserve is property of FNYH, purchased in the framework of the project LIFE "Biodiversity Conservation in Western Iberia", in 2009, consisting of an ecosystem of Mediterranean open forests with some 522 hectares, located southwest to the province of Salamanca, in the SCI and SPA Campo de Azaba bordering with Portugal. Most of the actions and practices that are detailed in later sections of this guide have been developed in this property.

Before purchased, the property had intensive agricultural and livestock use, which had greatly harmed the conservation status of its habitats. Thanks to the management developed since then, it has become a shelter area for flora and fauna, which, without time limit, will provide biodiversity to the whole of the Natura 2000 network in the area of Salamanca and which is formed of 132,600 hectares for the whole area comprising Campo de Azaba, Cammpo of Argañán and Malcata.



In addition to its role as a haven ensuring in the long-term the survival of the species of flora and fauna object of the project and its main habitats; the reserve is a research and dissemination

centre for all those scientists, fans and lovers of the Dehesa who want to study and enjoy the Mediterranean species which you can watch within the reserve

3. Reserva Biológica Campanarios de Azaba

This area, southwest to Salamanca, is characterized mainly by having one of the largest representatives of Mediterranean dehesa of all Western Iberia in the Iberian Peninsula, where the breeding of Iberian pigs for the elaboration of Iberian products which, in addition to being the main attractive, is also the main livestock activity along with the breeding of cattle and sheep.

Management of habitats have been heavily influenced by these farming activities, occurring hundreds of years ago, mainly in the Mediterranean forest with all species of flora and fauna, being agriculture and forestry the most important modelling factors of these territories. These cultural activities have contributed over centuries of management to what today we know as dehesa or Mediterranean open forest.



The name of this biological reserve comes from the naming of the soft orographic elevation on top of which lies the mountain chain of Campanarios. This mountain chain, with smooth landscapes, is located in the hydrographic basin of the Azaba River which also gives its name to the valley formed during its course to its junction with the Águeda River in the vicinity of the region of Ciudad Rodrigo.

GUIDELINES FOR SUSTAINABLE MANAGEMENT OF MEDITERRANEAN OPEN FOREST



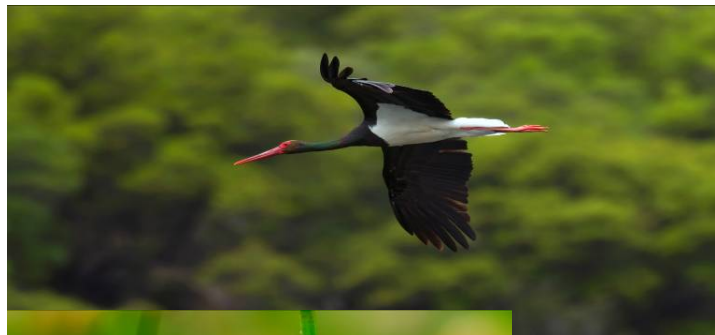
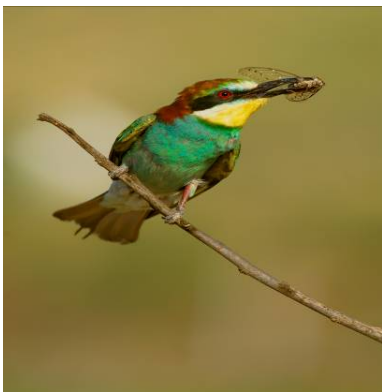
in

o

As relevant and important species from the point of view of its serious conservation threats, it should be noted the almost continuous presence of Black Stork, Egyptian vulture and Black Vulture who find inside the reserve a place for breeding, feeding and suchart rest. Other unique species present like toed or golden eagles and mammals such as the roe deer, wild boars and foxes, among others, are easily watched.

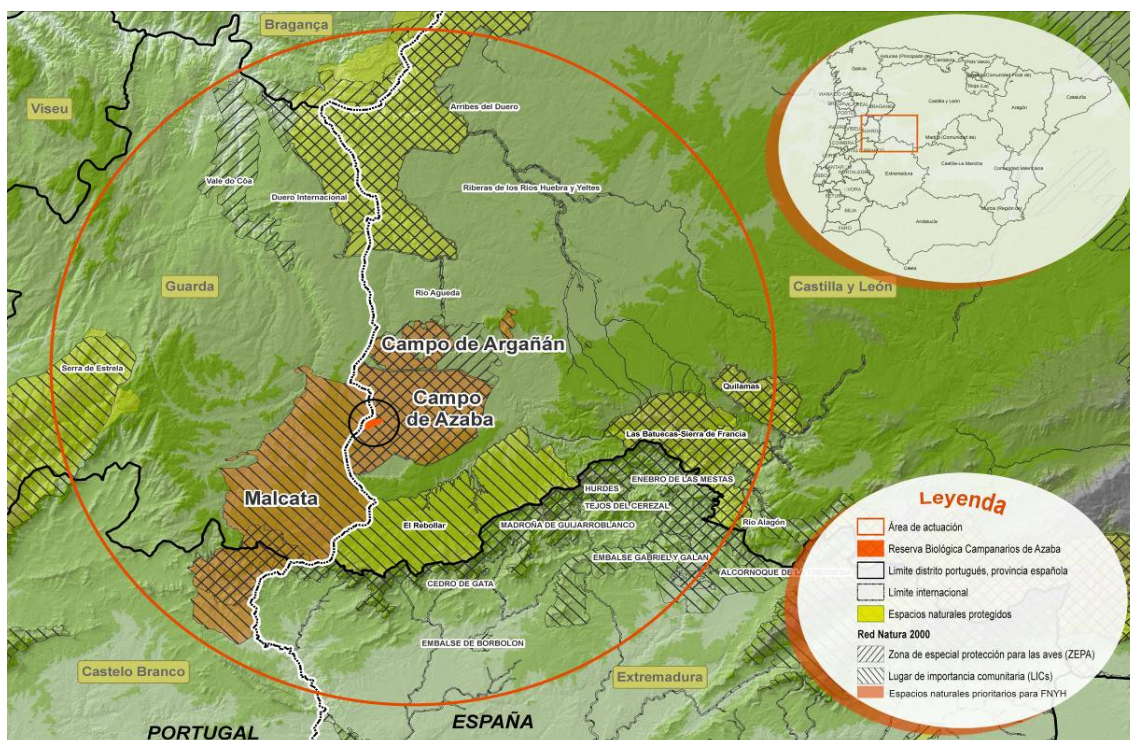
The reserve is open to public use, regulated by a public use management program. It describes the number of people or groups visiting the reserve, a series of paths or interpretation tracks inside the reserve aimed at developing guided tours for interested individuals or groups and thus be able to teach and learn first-hand the importance of the Dehesa and its ecological processes.

Campanarios de Azaba aims to be an international reference in the protection and conservation of the dehesa and the Mediterranean open forests which aim to become a management model that can be applied in any Mediterranean area willing to implement a similar experience.



3.1 Location

Campanarios de Azaba Biological Reserve is located in the municipality of Espeja, in the region of Ciudad Rodrigo, in the southwest of the province of Salamanca. Autonomous community of Castilla y León, Spain.



Map of protected areas in Campanarios and its surroundings_

This reserve, bordering with Portugal, limits with other private properties of similar surface to the North and East on the Spanish side which also belong in the municipality of Espeja. The southern boundary of the reserve is established by several private small landowners belonging in the municipality of La Alamedilla (Salamanca). The western boundary is the border between Spain and Portugal itself where many small properties managed very differently to the traditional use in the dehesa are found, which produces an entirely different landscape dominated by scrub and regenerated Pyrenean oak.

3.2 Environmental characterization

3.2.1 Legal considerations

Mediterranean forests lands included in Natura 2000 within Campo de Azaba are mostly private and its natural values are in irregular condition, as a result of many years of management with traditional agricultural and livestock purposes.

The ownership of the property in Campanarios de Azaba Biological Reserve, includes plots 38 and 39 from polygon 8 of the municipality of Espeja, Salamanca, and is held by Fundación Naturaleza y Hombre (FNYH).

The purchase of Campanarios de Azaba Biological Reserve has resulted in the acquisition of a number of legal rights by FNYH. These rights are entirely related to management tasks, such as for example, hunting rights that are also owned by FNYH.

In terms of its administrative situation, Campanarios is located within Campo de Azaba - included in the Natura 2000 network. This area is listed in the Natura 2000 network as a site of Community importance (SCI) and special protection area for birds (SPA).

3.2.2 The Environment

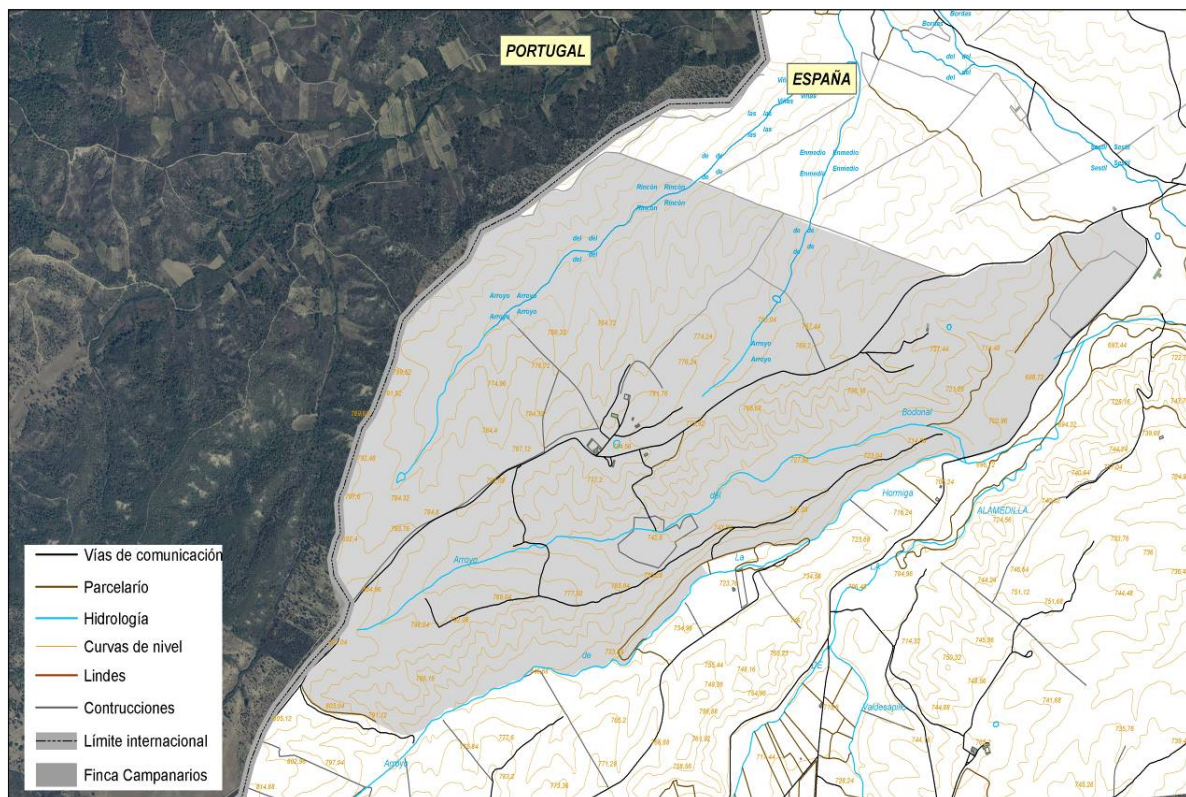
3.2.2.1 Climatology

Local climate

Local climate in the region of Ciudad Rodrigo presents the characteristics of the **continental mediterranean climate**; with cold, rainy winters and dry summers. The average annual rainfall is 531 mm, being most abundant in spring and autumn. Mists and night frosts are also common; dropping temperatures to - 5 °C. In summer, temperatures often exceed 30 °C during the middle of the day.

Climate in the natural area

The climate in Campanarios of Azaba corresponds to the characteristic climate of the province of Salamanca - **continental climate**, with cold winters and hot summers. As a general rule, maximum rainfall happens during the cold season; while during the warm season rainfall is very low, presenting a marked dry component. Average annual rainfall is less than 800 mm. Average annual temperatures is around 12 °C, being slightly higher than the temperature of eastern areas since those have a more pronounced continental influence.



Topographic map of Campanarios de Azaba_FNYH

3.2.2.2. Topography

Local topography

The main geographic features differentiated in the province of Salamanca are the dehesa (Campo Charro), the mountains (Sierras de Gata, Francia and Béjar), the field crops (mainly in La Armuña and el Campo de Peñaranda), extensive irrigation (Las Villas) and river canyons of the arribes of Duero, the Tormes, the Uces, the Huebra and Águeda (in the regions of La Ribera and El Abadengo).

Salamanca's location in the southwestern part of the region makes the province a great contributor not only to the typical Castilian landscape of the sedimentary plain, but also that a good representative of even landscapes in the region: the peneplain, both granitic and slatey; and the high peaks that close the Duero basin and pave the way to other basins; being the Sierras de Béjar, Francia and Gata in Salamanca.

Topography of the natural areas

Campanarios de Azaba is located 800 meters level and its topography goes from mild to wavy landscapes. It is divided mainly into 3 small valleys that formed by temporary water courses.

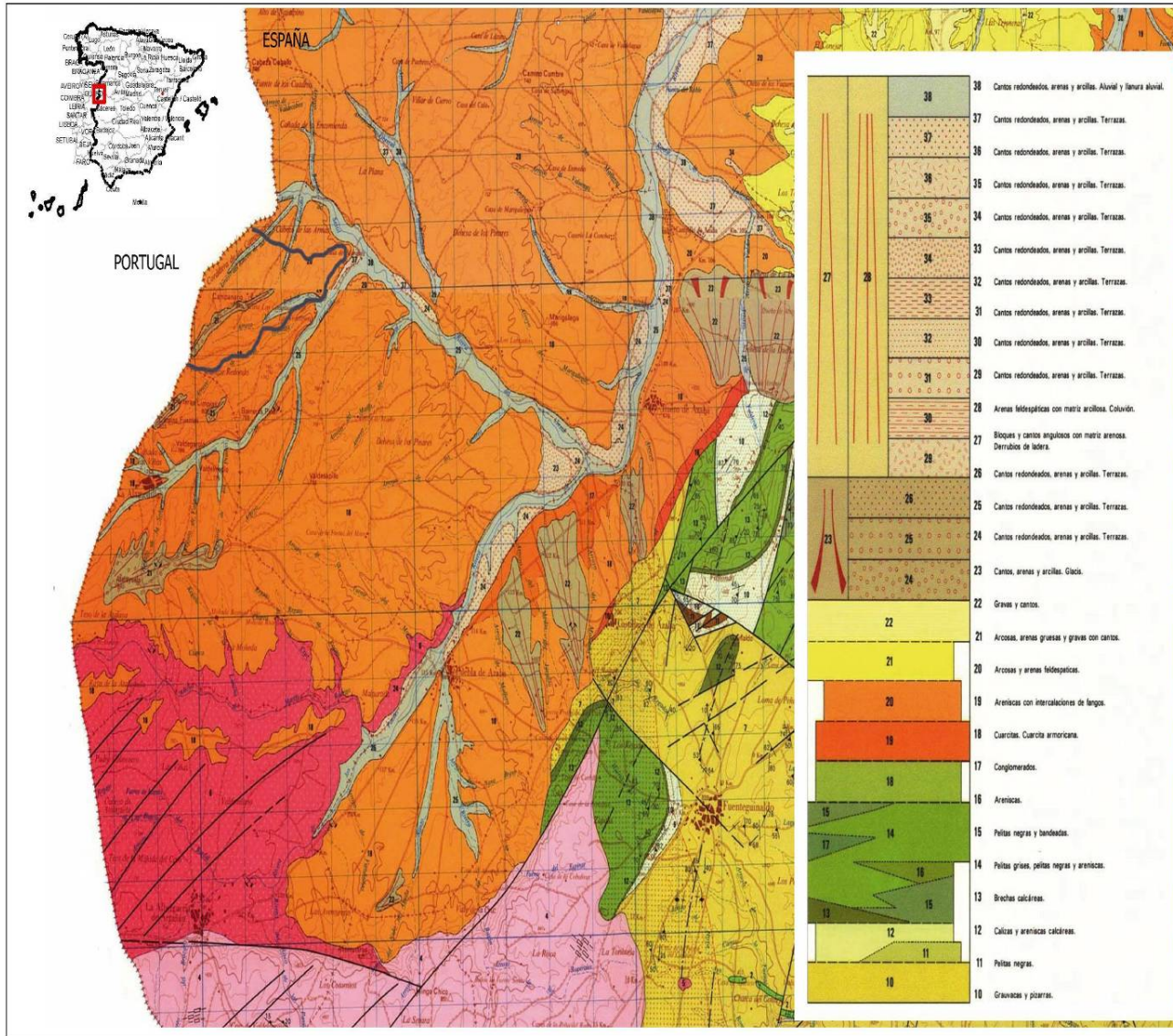
3.2.2.3. Geology and Edaphology

Local geology and edaphology

Ciudad Rodrigo's region is located within the **Variscan Domain**.

The characteristics of the rocks of the **Hesperian Massif** differentiate several areas in a cross North-South section. This geological feature was described for the first time by a German geologist, Lotze, in 1945

The geological bases for this zoning are diverse, including stratigraphic, paleontological, tectonic and magmatic criteria. Most geologists accept the division into areas that, from the initial work of Lotze (1945), was proposed by Julivert *et al.* (1972) when the Tectonic Map of the Iberian Peninsula was developed. These authors divide the Hesperian Massif in five areas which, from North to South, are the following:



Geological map of Campanarios de Azaba Biological Reserve_FNYH

- Cantabrian Zone

- West Astur-Leonese Zone
- Centroibérica Zone
- Ossa-Morena Zone
- South Portuguese Zone

Soils of Mediterranean domain: More complex, quite problematic due to its diversity and because they don't often appear in the natural environment, very transformed by man entailing erosion processes. Two types are remarkable: Red Mediterranean soils appear on limestone and siliceous areas, one of its features is that its B horizon shows a layer of accumulation of clays, named argillic horizon, originating the reddish tone common in Andalusia, Castilla - La Mancha and Castilla y León. It's A/B/C profiles make it excellent for crops. The second type is the southern brown soil; very common in large slate extensions within the siliceous Spain. The dehesa is located within this soil type hosting holm oaks, pastures and cereal. The profile is A/(B)/C.

Geology and edaphology in the natural area

The studied area is located in the tertiary basin of Ciudad Rodrigo, a NE-SW pit filled with sediments contemporary to the Duero basin, whose disposition in apophyses responds to fractures and paleoreliefs that bring in contact the tertiary sediments with Villar del Ciervo-Bañobárez's batholith to the North and with the Paleozoic in the southern mountains of the province of Salamanca.

As referring to soils, most Campo de Azaba is brown soils over sandstones associated with relict Braunlehm. Dominated by thin, sandy or clay-sandy soils, with a predominance of coarse sand; poor in organic matter; very eroded, as a result of the differences in depth and texture; support large amounts of rain without pooling, though they dry fairly quickly. There is a marked predominance of physical erosion and therefore great similarity between the soil and the sandstone, varying the nature of the soil with the constitution of the rock. Sandstone is coarse and impregnation of hardened and unweathered clay can be appreciated.

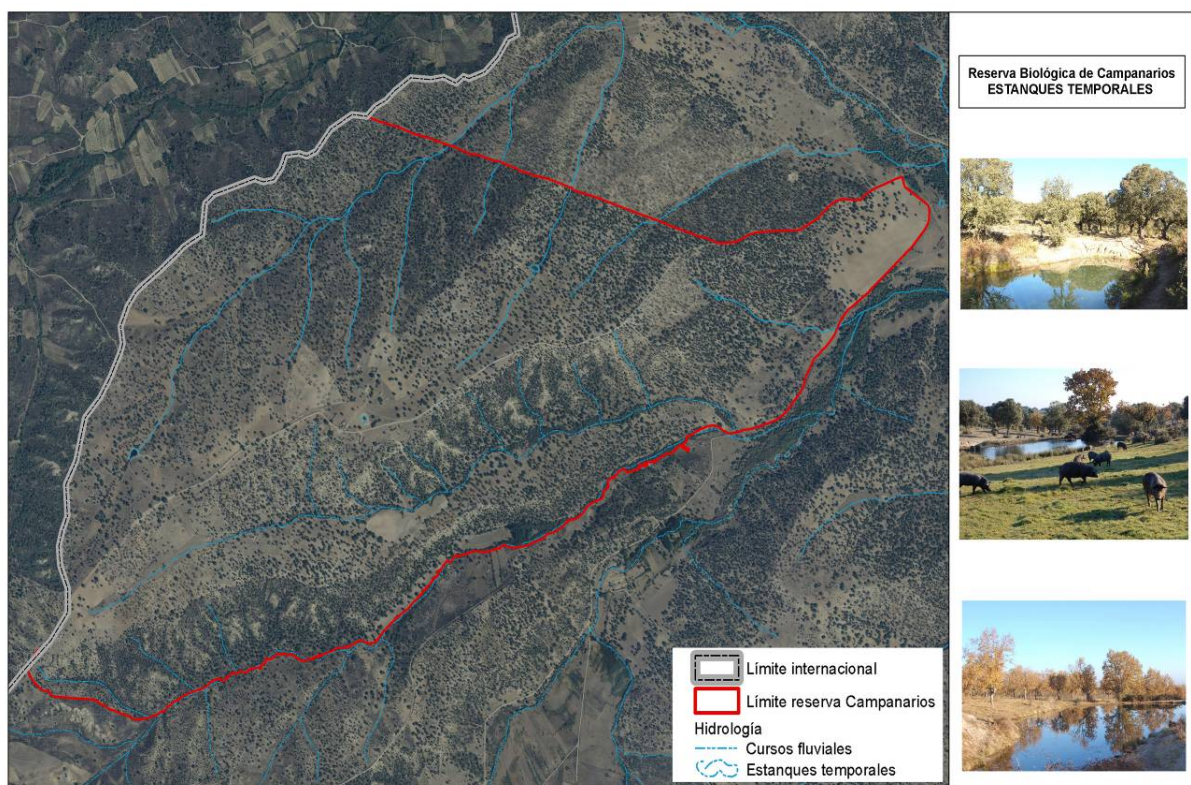
These soils have a moderately acid pH (close to 6.0), which increases with depth. They are poor in nitrogen, phosphorus, potassium and calcium. There are patches of relict Braunlehm. Broadly, the soil's depth can vary due to the differences in landscape with rocky outcrops, although overall the depth is small or medium; easily tilling; draining quickly, so they remain dry most of the year in tillable and organic matter-depleted areas. There is a marked dominance of sandy fractions, mainly coarse sand. Physical erosion is intense due to the high thermal oscillation and the consistence of granites.

3.2.2.4. Hidrology

Local hidrology

The study area belongs to the Duero basin. On the Spanish side, this basin is a vast network of rivers and streams, which provides about 83,200 Km of channels with different features including the Duero River with 957 km (744, in Spain). The Duero River is the main draining channel network of the basin, with a length of 572 Km from the Fuentes del Duero in Duruelo (Soria) to the Portugal border at its confluence with the Águeda River, in Spanish territory. The initial section of the Duero, 73 Km, runs through the steep valleys of the Iberian Mountain chain, where the Mesozoic covers the Paleozoic core that finds its way out in the massif of the Picos de Urbión. The average slope of this riverhead's section, from the Fuentes del Duero to the city of Soria, is 14.8 m/Km. It runs through soft soils formed by tertiary sediments along 499 Km from Soria to the Portuguese border, with an average slope of 1.0 m/Km. The international section, which forms the border at the confluence with the Águeda River, runs through the canyons of the Arribes, opened by the current in the hard granitic formations of crystal stratum that outcrop there and which shape the zamorano-salmantina peneplain's eastern edge of the plateau. The average slope on this border of 112 km section is 3.7 m/km.

On the other hand there's the Águeda River, a tributary of the Duero, which runs south-north in the West of the Iberian Peninsula. It's riverhead is in the heart of Sierra de Gata, in the spring of Puente de los Llanos, between the Cerros Las Mesas and Peñas Gordas, belonging to the municipality of Navasfrías, very close to Portugal. The River takes advantage of a void in the same direction as the Sierra de Gata (SW-NE), where it closes shaping the landscape known as the cliffs of Águeda. It receives several small tributaries on the righthand that have their origin in Sierra de Gata, until its waters are retained about 12 km before Ciudad Rodrigo, in the dam of the Águeda. From this point the River takes NW direction, acting its lower section as a natural border with the neighboring country. It flows into the Duero in Barca D'alva's left bank, on the border with Portugal. In its 133 Km long, it covers a basin of 2,353 km², with an average contribution of 720 Hm³/year; running across the regions of Campo de Azaba, Campo de Argañán and El Abadengo, until its waters are delivered to the Duero.



Hydrological map of Campanarios de Azaba

Hidrology of the natural area

Campanarios de Azaba Biological Reserve is crossed by 4 major streams, most of which fully deplete its volume during the summer months. These streams are called "Arroyo de la Hormiga", "Arroyo del Bodonal", "Arroyo de En medio" and "Arroyo El rincón de las viñas". These in turn lead to the riverbanks of the arroyo Sestil and go end at Azaba River downstream to join the River Águeda on its way to the Douro.

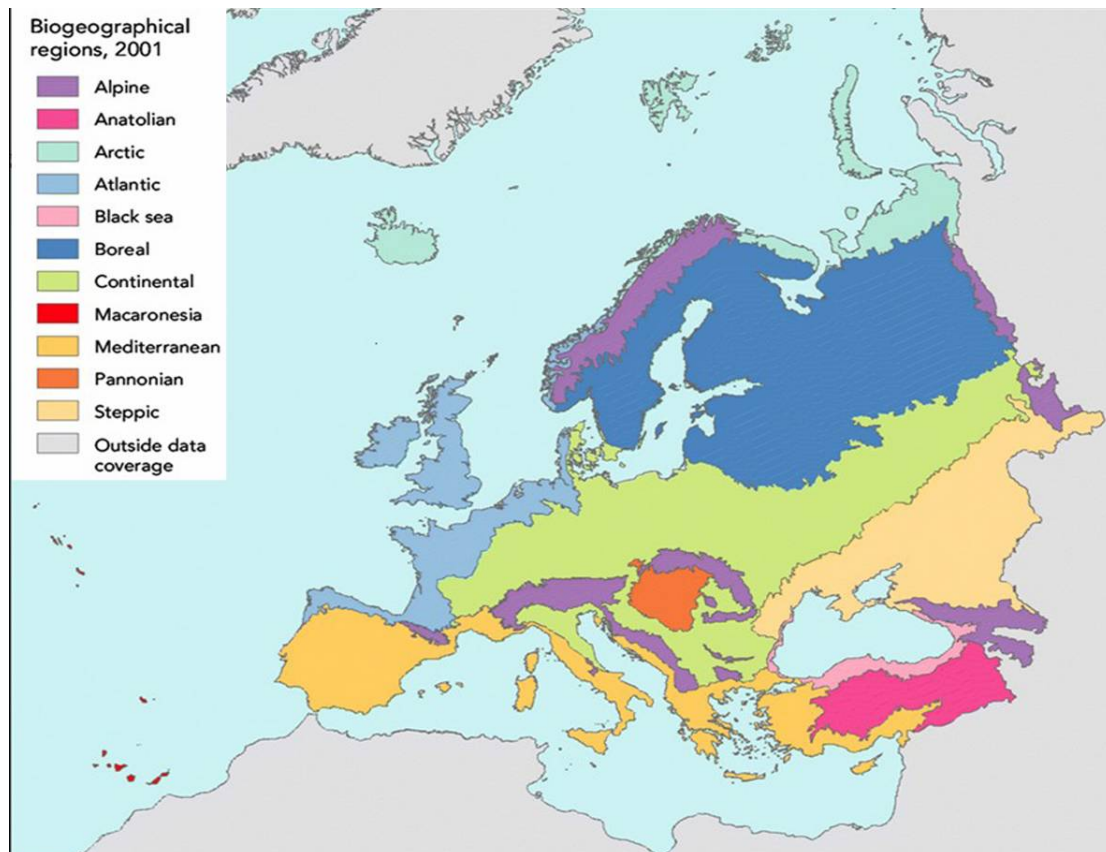
Fourteen ponds or artificial ponds that have been used for watering domestic livestock can be found in reserve. These ponds are temporary and most dry during summer while 4 of them hold water all year since they were built in a few outcropping or spring upwelling areas that provide water naturally.

3.2.3. Biodiversity

3.2.3.1. Ecosystems, Vegetation and Ecological Processes

The edapho-climatic characteristics and its comparative position with the Sun, originate the precise conditions for three registered bioclimatic regions in the Iberian Peninsula. The following

image shows the delimitation of the twelve European biogeographic regions. Specifically, when observing south-west Europe, one can distinguish the Mediterranean Region, a wide region covering all Portugal and that runs southern to the Cantabric Mountain Range and the Pyrenees to the Mediterranean coast; the Atlantic Region, north to the Cantabric Range into the Atlantic Ocean; and the Alpine Region, located in the Pyrenees. Finally and without influence on the Iberian Peninsula, but yet in Spain, there are the Canary Islands within the Macaronesian Region.



Biogeographic regions_European Environmental Bureau

The Mediterranean biogeographical region is mainly featured by the existence of a more or less noteworthy summer drought period, but always with clear influence. Areas which don't reach 350 mm of precipitation per year are included together with others which may exceed 1,500 mm/year. It presents typical forests of evergreen and hardened leaves: holm oaks, cork oaks, will olive trees, juniper trees, etc. Riverbanks and soils with high groundwater offset mitigate with soil moisture the summer drought periods, allowing deciduous forests to appear. These are elms, poplars, ash forests of *Fraxinus angustifolia*, willow groves and mixed forest composed of different clusters of these trees.

Salamanca lies within the West-Mediterranea-iberian phytosociological province, which is formed of the Western areas of the Iberian Peninsula under Mediterranean climate -except for the southern part- and includes the oldest Iberian ranges (*Sistema Central*, *Montes de Toledo*, *Sierra Morena*, as well as the valleys between them).

As regarding the phytogeography of the Mediterranea-Western-Iberia province the northern areas, cold and continental, are differentiated from the southern ones, warmer and with a milder climate (*Carpetano-Leonesa* subprovince). The *Montes de Toledo*, *Sierra Morena* and the Extremadura plains are the warmest subunit (*Luso-Extremadurensis* subprovince).

Campanarios de Azaba biological reserve is located on the southwestern edge of the *Carpetano - Leonesa* subprovince. This subprovince is highly continental, increasing from West to East. It includes the silicated Iberian central massifs (*Ayllón*, *Guadarrama*, *Gredos*, *Béjar*, *Estrella*), as well as the plains of Zamora, Salamanca and León. It includes important peaks sometimes exceeding 2,000 meters. Eight sectors are recognized within this subprovince: Guadarrama, Bejarano-Gredense, Salmantino, Estrellense, Lusitano-Douro, Orensano-Sanabriense, Lions and Iberico-soriano; with very vegetation (see rich chart 1).

Salamanca's sector, in which the reserve is located, is a supramediterranean granitic territory of Iberian influence (continental), dry to sub-humid. Holm oak forests (*Genisto hystrix-Quercetum rotundifoliae Quercetosum rotundifoliae* or *Juniperetosum excedri*) and the respective catenary vegetation dominate the landscape. *Stipa gigantea* grasslands (*Arrhenathero baetici-Stipetum giganteae*); hydric-offset compensated forests (*ortadas*) of *Quercus pyrenaicae-Fraxinetum angustifoliae*; spiny bushes -"cushion-alike" due to exposure to windy conditions- in steep rocks of *Genisto hystrix-Echinopartetum lusitanicae* and dry meadows of *Festuco rothmaleri-Juncetum squarrosi*, are common

Ombrotype	Termytype			
	Mesomediterranean	Supramediterranean	Oromediterranean	Alpine
Dry-Subhumid	<ul style="list-style-type: none"> ● <i>Junipero oxycedri-Quercetum rotundifoliae (E)</i> ● <i>Genisto hystricis-Quercetum rotundifoliae (W)</i> 			
Humid		<ul style="list-style-type: none"> ● <i>Luzulo forsteri-Quercetum pyrenaicae</i> 		
Hiperhumid		<ul style="list-style-type: none"> ● <i>Galio Rotundifoliae-Fagetum sylvaticae</i> 	<ul style="list-style-type: none"> ● <i>JuniperoCytisetum purgantis (Guadarrámico)</i> ● <i>Cytiso-Echinopartetum barnadesii (western Gredense and Peña de Francia)</i> ● <i>Cytiso-Echinopartetum pulviniformis (western BejaranoGredense and Peña de Francia)</i> ● <i>Genisto sanabriensis-Junieperetum nanae (OrensanoSanabriense)</i> 	<ul style="list-style-type: none"> ● <i>Hieracio myriadeni-Festucetum indigestae (Guadarrámico)</i> ● <i>Agrostio rupestris-Armerietum bigerrensis (BejaranoGredense)</i> ● <i>Teesdaliopsio confertae-Festucetum indigestae (OrensanoSanabriense)</i>

- The management of the reserve is determined by the different types of habitat hosted. A brief description of the habitats in the whole of the three LICs (Campo de

Azaba, Campo de Argañan and Malcata) can be founded below. Habitat 6310: evergreen Mediterranean open forests of *Quercus spp.*

The dehesas of *Quercus spp.* Form the biggest habitat in the area and one of the most original of the Iberian Peninsula. In both SCI of Campo de Azaba and Argañán, it occupies approximately 26,800 hectares, more than 50% of the surface. It is also very well represented in the Malcata SCI. In the reserve, it comes to occupy about 380 hectares.

Dehesas are well represented in the western half of the community, especially in the south-western sector, in the provinces of Salamanca, Zamora and Ávila. It's a livestock and agricultural system enabling a variety of uses. The viability of the dehesa requires keeping the traditional exploitations that have allowed their formation, mainly extensive livestock and the associated cultural component. Extensive livestock finds an ideal support in these systems allowing the combination of bush and tree grazing, the use of acorns and grazing of grasslands established between and under the trees.

While visually it may seem that the habitat is well preserved, the reality is quite different; regular plowing, disproportionate livestock loads, fencing of the different properties and increased erosion processes produce a very simplified habitat, reducing the most demanding and rare species and seriously altering the structure of the landscape.

- Habitat 3170: Mediterranean temporary ponds

Mediterranean temporary ponds are shallow pools as well as slight depressions likely to flood, who have a marked seasonal nature or suffer intense water level fluctuations throughout the year, located in areas of continental Mediterranean climate. They are typically Mediterranean shallow wetlands, developed in flat areas with permeable soils, basically fed by seasonal rainfall that allow a water layer from late autumn to early spring and is commonly completely or partially lost in a progressive way due to evaporation, when spring and summer hot become more intense

Due to its shallow depth, seasonality and that they sit on little permeable and insoluble substrates in the majority of cases, these wetlands present a low productivity when compared with permanent. These habitats are developed under very peculiar ecological conditions and in a way they can be considered extreme. Its characteristics foster the development of highly specialized biotic communities, with adaptations and vital mechanisms that allow them to live flooded during part of their lifecycle and on soil more or less moist but free of flooding.

Plant communities related to seasonal wetlands have a remarkable originality and host a high diversity. Very specialized plants, basically small therophytes and geophytes with helophyte behavior dominate in these communities. These plants develop their life cycle very quickly, in just a couple of months, since weather and soil moisture conditions –which are a limiting factor to their development- are only kept in a short period.

- Habitat 4090: Oromediterranean heaths with aliaga

Shrubland dominated by occasionally spiny brooms, often endemic and sometimes with a very restricted distribution area that can appear both on siliceous or basic substrates, mainly in mountain areas. Much of the formations included in this habitat can generally be called brushwood groves, given they are dominated by broom fields.

Almost all these communities have a pioneering role and appear on the occasion of the forests degradation, more or less often as a result of the colonization of pastures, crops or open areas in general. Some formations, mainly brooms, have been strongly favored by humans through regular use of fire that prevents the forest from developing.

It covers an area on the whole of both Spanish SCIs of 850 hectares, with an irregular conservation status.

- Habitat 91B0: Thermophilic ash forest of *Fraxinus angustifolia*

Ash forests grow on fresh or moist soils but not linked directly to rivers. It's a dense deciduous forest transformed into pastures or dehesas to profit from the rich pastures and the canopy for feeding the cattle. It's common that ash trees are accompanied by pyreneic oaks (*Quercus pyrenaica*). Copses accompanying these ash forests are typically spiny, entailing *Rubus* spp., *Rosa* spp., *Frangula alnus*, *Prunus spinosa* and *Crataegus monogyna*.

When well preserved, these ash forests are multi-layer, of very difficult traffic due to the abundance of creeping plants and also because shrub borders that create closed hedges.

Located on the banks and low areas of rivers, this habitat is to occupy approximately 1,000 hectares, with a good conservation status, between the 3 SICs

- Habitat 92A0: Gallery forests of *Populus alba* and *Salix alba*

Riparian forests which set on the edges of rivers in Mediterranean environments and are dominated by different species of salicaceas (black poplars and willows). This habitat includes a complex array of forests structured depending essentially on the influence of water in the soil. In addition, the existence of frequent natural disturbances as a result of floods that periodically occur during spring, introduces another source of heterogeneity.

It approximately occurs in 1,000 hectares in the three SICs, with good conservation status.

- Habitat 91E0: Alluvial forests of *Alnus glutinosa* and *Fraxinus excelsior*.

Riparian forests dominated by alder (*Alnus glutinosa*) occurring on riverbanks, also in oligotrophic stagnant waters, on washed siliceous and calcareous substrates, both in the Mediterranean and the Atlantic territories of Castilla y León.

Very wet soils are their main requirement. In not excessively wide water courses, the tops of the alders on both sides come in contact forming a continuous canopy that provides dense foliage on the water. Alders are able to survive on very poor soils fixing atmospheric nitrogen thanks to

bacterial symbionts found in its root nodules with this capacity (actynorrhizim nodules). Dense shade conditions do not appear to pose an impediment for showing a complex stratum of creepers and a shady herbacious stratum which includes several species of *Carex* depending upon the riverbed.

This habitat, along with other representatives of riparian communities has great importance for the stability of the banks of watercourses. In addition, the well-preserved alders favor the good quality of the waters while minimizing the risk of eutrophication.

It is the largest riparian forest in the study area, with about 2,700 hectares between the 3 SICs. Its conservation status is good.

Inside Campanarios de Azaba, we find the following Sites of Community Interest. . (EN EL PDF APARECE MAL SITUADO. DESPUÉS DE LAS FOTOS)

From the biogeographical point of view, Campanarios de Azaba belongs entirely to the chorological province *Carpetano-iberico-Leonesa* in the mediterranean biogeographic region and occupying mesomediterranean and supramediterranean bioclimatic floors, in both cases with wet ombrotype.

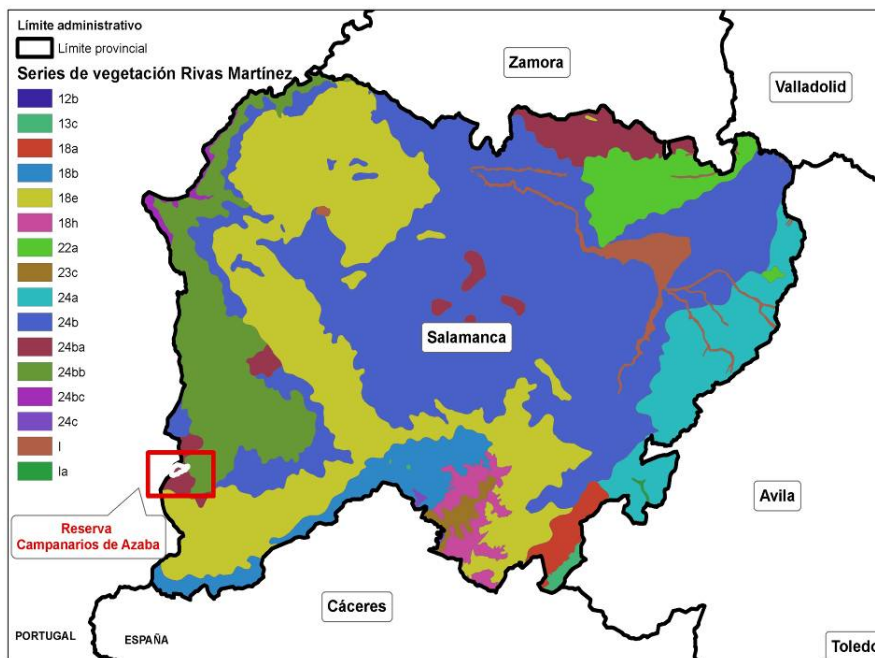
The biogeographical province sectorization presents the following series of vegetation.

Campanarios de Azaba biological reserve is characterized by a high diversity of habitats: 83.5% of the land consists of an open sclerophyll forest – marcescent, dominated by Holm oaks (*Quercus ilex* subsp *ballota*) and oaks (*Quercus pyrenaica* and *Quercus faginea*). With respect to the coppice, its presence is scarce in the central area of the property due to livestock exploitation. However, in the troughs of the most remote areas to the buildings, there is french lavender (*Lavandula pedunculata*), white broom (*Cytisus multiflorus*), sticky rockrose (*Cistus ladanifer*), thyme (*Thymus mastichina*), etc., that provides lots of food to pollinating insects. It is an herbaceous stratum dominated by grasses with leguminous and compound plants.

Almost 14% of the reserve's area is formed by riparian vegetation that occurs in the surroundings the streams in Ricón de las Viñas, de Enmedio, Bodanal and Hormiga. Riparian vegetation consists mostly of ash trees (*Fraxinus angustifolia*), black poplar (*Populus nigra*) and alders (*Alnus glutinosa*). Regarding shrub vegetation, white hawthorn (*Crataegus monogyna*) is remarkable, wild rose (*Rosa canina*) or blackberry (*Rubus ulmifolius*).



Habitat 92A0 Gallery forest of *Populus alba* and *Salix alba*_



Vegetation series in the province of Salamanca_

The species listed in the flora catalogue of Castilla y León which are present in the area are the following:

<i>Chaetonychia cymosa</i>	<i>Lythrum thymifolia</i>
----------------------------	---------------------------

<i>Daphne gnidium</i>	<i>Pinus pinaster</i>
<i>Galium parisiense</i> var. <i>parisiense</i>	<i>Quercus ilex</i> subsp. <i>ballota</i>
<i>Isoetes hystrix</i>	<i>Rumex conglomeratus</i>
<i>Lathyrus hirsutus</i>	<i>Serapias cordigera</i>
<i>Linaria incarnata</i>	<i>Silene inaperta</i>
<i>Lobelia urens</i>	<i>Spiranthes aestivalis</i>
<i>Lothus pedunculatus</i>	<i>Succisella carvalhoana</i>
<i>Lotus uliginosus</i>	<i>Teucrium scordium</i> subsp. <i>scordium</i>
<i>Lythrum hyssopifolia</i>	<i>Verbascum virgatum</i>

Two of the most interesting taxa are highlighted in bold, *Spiranthes aestivalis* which is a typical orquidaceae of xerophytic pastures included in annex IV of the Habitats Directive 92/43/EEC and *Succisella carvalhoana*, endemic to the center and central-west of the peninsula associated with wetlands and that is listed as Vulnerable in the catalogue of Flora of interest and endangered in Castilla y León as described in the Decree 63/2007 of the Junta de Castilla y León.

3.2.3.2. Fauna

Fauna

Campo de Azaba is outstanding for being an area within the Natura 2000 network as SPA (special protection area for birds).

A series of charts with information on species from different taxonomic groups that can be observed in the reserve, as well as some species considered of interest or priority species are found below. The data collected is based on previous studies, data from the Junta de Castilla y León relative to the corresponding Natura 2000 area, and in our own expertise. Threat categorization for vertebrate species is based on the Red List of endangered species developed by the International Union for the Conservation of Nature (IUCN).

3.2.3.2.1. Insects

Insect communities present a great richness in Campanarios de Azaba. Given the large number of species found in this area, studies have focused on two functional groups: saproxylic and coprophagous insects, which are excellent indicators of the conservation status of habitats. The analysis of diversity and abundance of all species of both

communities has allowed us to read into the environment's conservation status and the measures that should be introduced for the proper management and conservation of habitats.

3.2.3.2.2. Fish

A single species occurs in the Mediterranean temporary ponds of Campanarios de Azaba Biological Reserve, the tench: *Tinca tinca*.

3.2.3.2.3. Amphibians and reptiles

The following chart includes the species of herpetofauna occurring in Campanarios' Biological Reserve, as well as its threat category.

Species' scientific name	Threat category
<i>Alytes obstetricans</i>	Least Concern (LC)
<i>Triturus marmoratus</i>	Data Deficient (DD)
<i>Bufo bufo</i>	LC
<i>Epidalea calamita</i>	LC
<i>Discoglossus galganoi</i>	LC
<i>Pelobates cultripes</i>	LC
<i>Triturus boscai</i>	LC
<i>Hyla arborea</i>	LC
<i>Salamandra salamandra</i>	Rare
<i>Acanthodactylus erythrurus</i>	LC
<i>Chalcides bedriagai</i>	Near Threatened (NT)
<i>Coronella girondica</i>	LC
<i>Elaphe scalaris</i>	LC
<i>Lacerta lepida</i>	LC
<i>Lacerta schreiberi</i>	LC
<i>Malpolon monspessulanus</i>	LC
<i>Emys orbicularis</i>	Vulnerable (VU)

<i>Natrix natrix</i>	LC
<i>Psammodromus hispanicus</i>	LC
<i>Psammodromus algirus</i>	LC

3.2.3.2.4. Birds

The autonomous community of Castilla y León is one of the transit and migratory areas for birds following Northern Europe and African routes. It is therefore an area where different species can be watched, depending on the season. Thus, we find some species that use it as wintering site, others coming during the summer period in its reproductive stage, from Africa and others that are only visible while migration during autumn and spring. On the other hand, you can see sedentary species that remain in the area throughout the year.

Among the target species of the project, the black stork is the only migrating species; its phenology defined in the chart below.

PHENOLOGY	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DIC.
Wintering												
Prenup migration												
Courtship display / Bredd												
Postnup migration												

Other target species such as Black Vulture, Golden Eagle, imperial Eagle or eagle owl, are sedentary. Its approximate phenology is reflected, in the following chart.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
Black vulture (<i>Aegypius monachus</i>)										
Golden eagle (<i>Aquila chrysaetos</i>)										

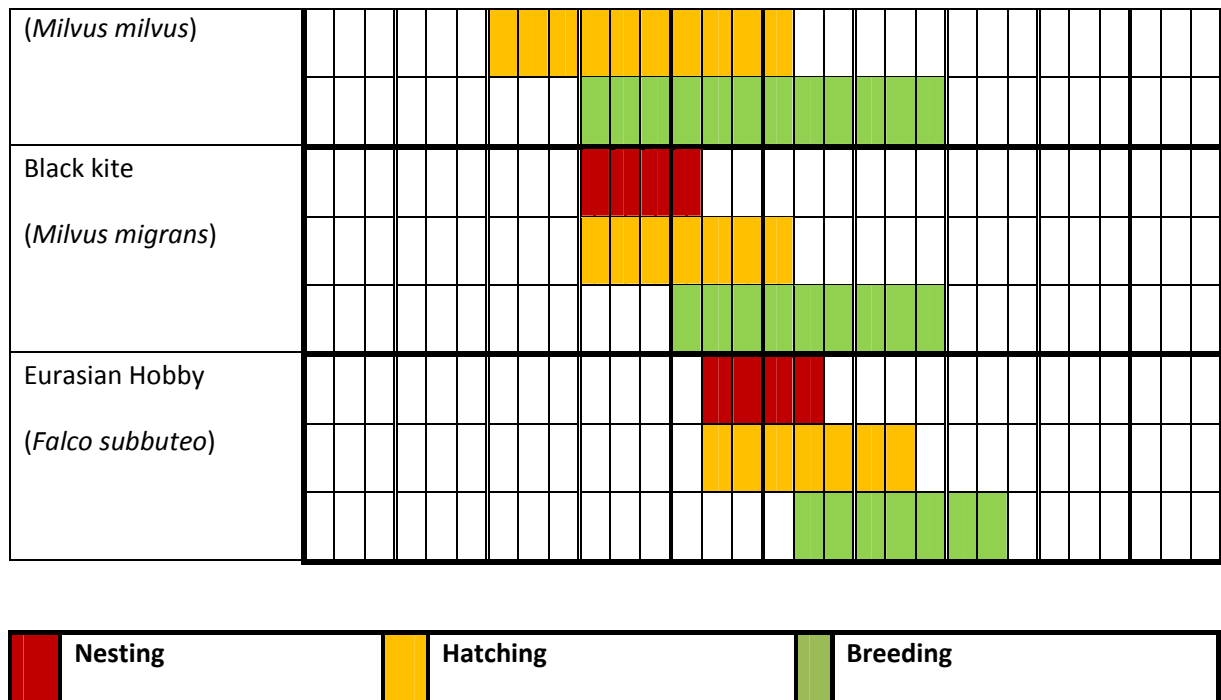


Chart. Breeding periods of main diurnal raptors present in the Mediterranean open forests. Data: Guidelines for the sustainable management of the Andalusian dehesa. Source: Own elaboration.

Management of uses and resources in the reserve will therefore depend on the presence of birds at one or another stage of their annual life cycle; being the breeding stage the most sensitive.

BIRD SPECIES IN CAMPANARIOS DE AZABA BIOLOGICAL RESERVE

COMMON NAME	SCIENTIFIC NAME	RED BOOK	APRIL	JUNE
Little Grebe	<i>Tachybaptus ruficollis</i>	NE	-	-
Grey Heron	<i>Ardea cinerea</i>	NE	YES	YES
Black stork	<i>Ciconia nigra</i>	VU D1	YES	-
White stork	<i>Ciconia ciconia</i>	NE	-	-
Mallard	<i>Anas platyrhynchos</i>	NE	YES	-
Short-toed eagle	<i>Circaetus gallicus</i>	LC	YES	YES
Booted Eagle	<i>Hieraaetus pennatus</i>	NE	YES	YES
Red kite	<i>Milvus milvus</i>	EN	YES	-

COMMON NAME	SCIENTIFIC NAME	RED BOOK	APRIL	JUNE
Black kite	<i>Milvus migrans</i>	NT [VU C1]	YES	YES
Buzzard	<i>Buteo buteo</i>	NE	YES	YES
Eurasian Sparrowhawk	<i>Accipiter nisus</i>	NE	YES	-
Common Kestrel	<i>Falco tinnunculus</i>	NE	YES	-
Red-legged Partridge	<i>Alectoris rufa</i>	DD	-	YES
Common Quail	<i>Coturnix coturnix</i>	DD	-	-
Common Moorhen	<i>Gallinula chloropus</i>	NE	YES	YES
Great Bustard	<i>Otis tarda</i>	VU A4c	-	-
Common Sandpiper	<i>Actitis hypoleucos</i>	NE	YES	-
Common Wood-pigeon	<i>Columba palumbus</i>	NE	YES	YES
Rock Pigeon (domestic)	<i>Columba livia var. domestica</i>	NE	YES	-
European Turtle-dove	<i>Streptopelia turtur</i>	VU A2acd	YES	YES
Common Cuckoo	<i>Cuculus canorus</i>	NE	YES	YES
Common Swift	<i>Apus apus</i>	NE	YES	YES
Eurasian Hoopoe	<i>Upupa epops</i>	NE	YES	YES
European Bee-eater	<i>Merops apiaster</i>	NE	YES	YES
Great Spotted Woodpecker	<i>Dendrocopos major</i>	NE	YES	YES
Lesser Spotted Woodpecker	<i>Dendrocopos minor</i>	NE	YES	YES
Eurasian Wryneck	<i>Jynx torquilla</i>	DD	YES	YES
Eurasian Skylark	<i>Alauda arvensis</i>	NE	YES	YES
Thekla Lark	<i>Galerida theklae</i>	NE	YES	YES
Wood Lark	<i>Lullula arborea</i>	NE	YES	YES
Barn Swallow	<i>Hirundo rustica</i>	NE	YES	YES
House martin	<i>Delichon urbica</i>	NE	YES	YES
Tree Pipit	<i>Anthus trivialis</i>	NE	YES	-

COMMON NAME	SCIENTÍFIC NAME	RED BOOK	APRIL	JUNE
White Wagtail	<i>Motacilla alba</i>	NE	-	YES
Winter Wren	<i>Troglodytes troglodytes</i>	NE	-	YES
European Robin	<i>Erithacus rubecula</i>	NE	YES	YES
Common Nightingale	<i>Luscinia megarhynchos</i>	NE	YES	YES
Black Redstart	<i>Phoenicurus ochruros</i>	NE	YES	YES
Common Stonechat	<i>Saxicola torquata</i>	NE	YES	-
Song Thrush	<i>Turdus philomelos</i>	NE	YES	YES
Mistle Thrush	<i>Turdus viscivorus</i>	NE	YES	YES
Eurasian Blackbird	<i>Turdus merula</i>	NE	YES	YES
Blackcap	<i>Sylvia atricapilla</i>	NE	YES	YES
Orphean Warbler	<i>Sylvia hortensis</i>	LC*	-	YES
Sardinian Warbler	<i>Sylvia melanocephala</i>	NE	YES	YES
Common Whitethroat	<i>Sylvia communis</i>	NE	YES	YES
Subalpine Warbler	<i>Sylvia cantillans</i>	NE	YES	YES
Dartford Warbler	<i>Sylvia undata</i>	NE	YES	YES
Cetti's Warbler	<i>Cettia cetti</i>	NE	-	YES
Melodious Warbler	<i>Hippolais polyglotta</i>	NE	YES	YES
Bonelli's Warbler	<i>Phylloscopus bonelli</i>	NE	-	YES
Iberian Chiffchaff	<i>Phylloscopus ibericus</i>	NE	YES	YES
Common Chiffchaff	<i>Phylloscopus collybita</i>	NE	-	YES
Firecrest	<i>Regulus ignicapillus</i>	NE	YES	YES
Great Tit	<i>Parus major</i>	NE	YES	YES
Blue Tit	<i>Cyanistes caeruleus</i>	NE	YES	YES
Crested Tit	<i>Lophophanes cristatus</i>	NE	-	YES
Long-tailed Tit	<i>Aegithalos caudatus</i>	NE	YES	YES

COMMON NAME	SCIENTÍFIC NAME	RED BOOK	APRIL	JUNE
European nuthatch	<i>Sitta europea</i>	NE	YES	YES
Short-toed Treecreeper	<i>Certhia brachydactyla</i>	NE	YES	YES
Red-backed Shrike	<i>Lanius collurio</i>	NE	YES	YES
Southern Grey Shrike	<i>Lanius meridionalis</i>	NT A2bc	YES	YES
Woodchat Shrike	<i>Lanius senator</i>	NT A2a	YES	YES
Azure-winged Magpie	<i>Cyanopica cyanus</i>	NE	YES	YES
Eurasian Jay	<i>Garrulus glandarius</i>	NE	YES	YES
Carrion Crow	<i>Corvus corone</i>	NE	YES	YES
Common Raven	<i>Corvus corax</i>	NE	YES	-
Spotless Starling	<i>Sturnus unicolor</i>	NE	YES	YES
Eurasian Golden Oriole	<i>Oriolus oriolus</i>	NE	YES	YES
House Sparrow	<i>Passer domesticus</i>	NE	YES	YES
Eurasian Tree Sparrow	<i>Passer montanus</i>	NE	YES	YES
Spanish Sparrow	<i>Passer hispanolensis</i>	NE	YES	YES
Rock Sparrow	<i>Petronia petronia</i>	NE	YES	YES
Eurasian Chaffinch	<i>Fringilla coelebs</i>	NE	YES	YES
Eurasian Linnet	<i>Carduelis cannabina</i>	NE	YES	YES
European Goldfinch	<i>Carduelis carduelis</i>	NE	YES	YES
European Serin	<i>Serinus serinus</i>	NE	YES	YES
European Greenfinch	<i>Carduelis chloris</i>	NE	YES	YES
Hawfinch	<i>Coccothraustes coccothraustes</i>	NE	YES	YES
Cirl Bunting	<i>Emberiza cirlus</i>	NE	YES	YES
Rock Bunting	<i>Emberiza cia</i>	NE	YES	YES
Corn Bunting	<i>Miliaria calandra</i>	NE	YES	YES

The Habitats Directive (92/43/EEC) established in 2000 Campo de Azaba’s area as a zone of special protection for birds (79/409/EEC) given the rich landscape and fauna of the area. The main fauna interest lies in the presence of Black Stork (*Ciconia nigra*), highlighting the presence of 11 couples in the area, which is 4% of the total national population. For this reason the area was declared as critical area to the Black Stork in 1998, within the Recovery Plan for this species in Castilla y León (Decree 83/1995, of 11 May).

The presence in the area of study of other species of annex I of the habitats directive such as the Lesser Kestrel (*Falco naumanni*), the Little Bustard (*Tetrax tetrax*) and the Black-bellied Sandgrouse (*Pterocles orientalis*) on their migratory routes, may also be highlighted. Other abundant species that use this reserve as feeding area are the Black Vulture (*Aegypius monachus*) and the Griffon Vulture (*Gyps fulvus*) being individuals from nearby colonies, or dispersive juveniles (immature adults). Throughout the year, Golden and Bonelli’s eagles can be regularly watched (immature adults in dispersal process and adults from nearby territories). The occasional presence of the Spanish Imperial Eagle (*Aquila adalberti*, whose area usually reaches Sierra de Gata) using the area as a hunting territory by immature adults, and the eagle owl (*Bubo bubo*) full fill the description of the local avifauna of major conservation interest. Common crane is also seen, at least during migration stops.

3.2.3.2.5. Mammals

A chart with the observed mammals in the biological reserve of Campanarios de Azaba is founded below:

Especie		Categoría de amenaza
Nombre científico	Nombre común	
<i>Talpa occidentalis</i>	Iberian Mole	Data Deficient
<i>Neomys anomalus</i>	Southern Water Shrew	Least Concern
<i>Crocidura suaveolens</i>	Lesser Shrew	Data Deficient
<i>Crocidura russula</i>	White-toothed Shrew	Least Concern
<i>Arvicola sapidus</i>	Southwestern Water Vole	Vulnerable
<i>Microtus lusitanicus</i>	Lusitanian Pine Vole	Least Concern

<i>Microtus duodecimcostatus</i>	Mediterranean Pine Vole	Least Concern
<i>Microtus arvalis</i>	Common Vole	Least Concern
<i>Microtus cabrerae</i>	Cabrera's Vole	Vulnerable
<i>Microtus agrestis</i>	Field Vole	Least Concern
<i>Apodemus sylvaticus</i>	Long-tailed Field Mouse	Least Concern
<i>Rattus rattus</i>	House Rat	Data Deficient
<i>Rattus norvegicus</i>	Brown Rat	No evaluado
<i>Mus domesticus</i>	House Mouse	Least Concern
<i>Mus spretus</i>	Western Mediterranean Mouse	Least Concern
<i>Eliomys quercinus</i>	Garden Dormouse	Least Concern
<i>Erinaceus europaeus</i>	Western European Hedgehog	Least Concern
<i>Herpestes ichneumon</i>	Egyptian Mongoose	Data Deficient
<i>Martes foina</i>	Stone Marten	Least Concern
<i>Meles meles</i>	Eurasian Badger	Data Deficient
<i>Mustela putorius</i>	European Polecat	Data Deficient
<i>Mustela nivalis</i>	Least Weasel	Least Concern
<i>Oryctolagus cuniculus</i>	Rabbit	Least Concern
<i>Sus scrofa</i>	Wild boar	Least Concern
<i>Vulpes vulpes</i>	Fox	Least Concern
<i>Genetta genetta</i>	Common Genet	Least Concern

Chart: Species of mammals found in Campanarios de Azaba. IUCN's Red List category.

Due to its conservation value, the historical presence of the Iberian lynx (*Lynx pardinus*) in the area is outstanding; currently classified as "Endangered species", according to the Spanish Red Book of vertebrates. Malcata's SCI, partly bordering the reserve, is a possible reintroduction area in Portugal. Trophic resource scarcity is the main threat to this species; in particular, the low population levels of rabbit, because it represents its main trophic resource. With the spread of myxomatosis and viral hemorrhagic pneumonia, rabbit populations have alarmingly decreased putting pressure on specific endangered predators.

Previous uses

3.3. Soil uses

3.3.1. Previous uses

Initially, Campanarios de Azaba was a communal or public mountain, belonging to the municipality of Fuentes de Oñoro and in which little intensive agricultural and livestock work was conducted. This land was bought 35 years ago by a farmer from the aforementioned town and was devoted to different uses, mostly semi-intensive pig and cattle uses, until its purchase by FNYH in 2009. This activities carried out at the area has resulted in the current habitat’s structure of what can be found in a typical Mediterranean dehesa in which the human factor has induced an anthropized natural landscape.

As far as agro-forestry is concerned, the following chart shows the different type of land occupation and the surface found in the biological reserve of Campanarios de Azaba after all these years of use of the natural resources.

Type of land occupation	Surface
Holm oak dehesa with agro-forestry use	380.5954
Oak dehesa	36.9056
Oak forests	31.9407
Grasslands and meadows	21.4843
Riparian forests	11.8658
Rainfed crops	9.8810
Irrigation crops	1.6272
Pastures	1.5024
Unproductive	0.8948

Currently the only activity performed by FNYH, as owner of the biological reserve, in terms of farming, are sowing of cereal and leguminous plants to increase food supply and availability for the species basein the of the food chain such as rabbits and partridges.

There are data for 35 years by which cited that Campanarios de Azaba came to withstand a pressure of livestock density of more than 1,200 goats as well as other livestock. At the time of the landpurchase by FNYH, the stocking rate was of 70 cows and 250 pigs.

3.3.2. Current uses

3.3.2.1. Livestock

Currently there is a minimum stocking with *garrano* horses, *retuerta* horses, *sayaguesas* cows, Castilian black sheep and Iberian pigs in Campanarios de Azaba; contributing to the maintenance of open grasslands between the trees; preventing the forest from closing. The total number of animals never exceeds fifty. All of them are endangered local breeds, following FNYH's vision towards the conservation of endangered breeds and varieties, knowing they feature specific adaptation models to this environment.

Local herds of sheep, have been occasionally used, never exceeding 250 individuals.



Toro in Campanarios de Azaba_

The current agro-livestock activity carried out by Fundación Naturaleza y Hombre generally small throughout the year, being the *montanera* (time in which acorns fall from holm oaks) the time of the year with more heads of cattle found in the reserve. The *montaneras* carried out since the FNYH is the owner of Campanarios have taken place following conservation criteria, so the number of cattle and has never increased 100 pigs at the same time –only during 3 months- less than half of the stocking rate of previous years.

3.3.2.2. Forestry uses

Regarding forestry, two types of pruning were performed previously: the *olivado*, consisting of a mild pruning that removes part of the '*chupones*' (very vigorous but unproductive growth in branches) and the *desmoche*, which deprives the tree of much of its canopy, leaving the main branches in order to obtain a hemispherical treetop as widest as possible (increasing acorn production). Currently in Campanarios de Azaba, forestry works such as pruning and tree trimming works in areas that most need a general opening, from the phytosanitary point of view. These cleaning, called "*olivados*" do not necessarily mean a mechanism consisting of the typical tree of the dehesa but that it's a canopy cleaning mechanism that benefits the tree in terms of weight loss in its branches and the continued presence of possible pathogens in those dead branches decaying in the aerial part of the tree. In parallel, reforestations of *Quercus ilex*, *Quercus suber*, *Quercus faginea*, *Quercus pyrenaica*, *Fraxinus angustifolia*, *Salix atrocinerea*, *Populus alba*, *Pinus pinaster* and *Pinus pinea* are taking place.

Binding riparian tree tops has also been completely abandoned in the reserve.

3.3.2.3. Hunting

With regard to hunting activity, Campanarios de Azaba used to be a small-game field. It is currently the only area not subject to hunting. In this way, it intends to act as a breeding, feeding and resting area for different species, becoming an area of shelter for biodiversity, which is supplied to the rest of Natura 2000 thanks to the biomass spill-over effect of the reserve. However, to ensure the management control, the figure of small-game field has been maintained.

3.3.2.4. Public use

Regarding public use, the reserve allows a maximum capacity of 50 people per day, in 2 groups of 25, one in the morning and the other in the afternoon, allowing consistent conservation initiatives with the possibility to showcasing the reserve to visitors who require it. Exceptionally school tours may exceed the number, but the visit focuses on low-disturbance areas for wildlife and consists on games, group dynamics and activities. Walking guided tours are focused on two topics: the LIFE project and its different actions and the structure and functioning of the elements that form Mediterranean open forest ecosystems. The trails have a path that in any circumstances causes discomfort to the species occurring in the reserve, with paths far away from the most sensitive areas, and, in every case, its use is restricted according to the reproductive seasons of different species that inhabit the area. There is also a programme of environmental education and public use where different educational activities (thematic field work, volunteering, workshops...) are proposed either with schools and the local community or with other interested stakeholders.





Biological Station

The permanent presence of FNYH inside the reserve has been achieved through the creation of a multi-purpose building, with the consequent creation of a biological research and project management station in the reserve. This building, in addition to its use as a Research Center for scientists and permanent office of the FNYH, is also used as a reception centre from where guided tours depart. The presence of this biological station will represent an international reference for the study and conservation of the Mediterranean dehesa

Ecotourism in protected areas is one of usable tools considered to achieve self-financing of such nature conservation projects. In this case, the reserve's capacity of generating economic income to continue the conservation work within it is of great value because that contributes to the long-term survival of these conservation projects. In this sense, FNYH is working on the idea of combining ecotourism with the conservation of the area. The lodge "los Campanarios" combines staying overnight inside the reserve with educational activities and Wildlife observation.

3.3.2.5. Nature Conservation

Without doubt the predominant use of the reserve currently and it gives meaning to the entire project is the conservation of habitats and species.

Conservation is another applicable to the territory, one more use. And this can be exercised looking for the compatibilization of traditional uses or making conservation the main use. In this case, eco-tourism is a strong and interesting partner Manager or the owner with a view to their economic sustainability

The activities carried out in this field are precisely which are determined in the following section of the Guidelines.

4. CONCRETE CONSERVATION ACTIONS

Once described the necessary information to place the reader of this manual in the cultural, administrative and geographic scope of the project LIFE 07 NAT/E/000762 "Biodiversity Conservation of Western Iberia; Campanarios de Azaba Biological Reserve" implemented by *Fundación Naturaleza y Hombre*, *Centro Hispano-Luso de Investigaciones Agrarias* of the University of Salamanca and *Centro Iberoamericano de la Biodiversidad* of the University of Alicante; concrete conservation actions carried out during the project, work performed and achieved outcomes are described in this section.

However, it should be first noted that, in addition to conservation actions that are described elsewhere in these guidelines, the project included a series of actions that, because of their nature, cannot be included in a best practice guidelines. These are:

- Development and implementation of a management plan for the entire reserve; key to set an integrated and coordinated management taking into account the global perspective.
- Land purchase to create Campanarios de Azaba Biological Reserve. Campanarios changed hands from a local farmer to a non-profit conservation organization (FNYH) thanks to the LIFE project:



- Public use management program: Public use has been arranged and planned through a wooden building that is used as multipurpose center, building trails, limiting access to up to 50 people daily, publication of posters and brochures and conferences between local population.

- The Mediterranean Mountain Biological Station is a multipurpose wooden building that is used as an interpretation center, office for the project's management and development and research center. Made of wooden modules, is perfectly integrated into the landscape of the dehesa, located on the perimeter of it to minimize inconveniences.

- Environmental education program: structured in three areas: schools of all three SICs (working both in the schools and in the reserve), adult population of all three SICs, and graduate students in environmental studies (volunteering work with collaborative work and volunteering in which they have been able to learn conservation techniques).

- Plus other project management activities such as audits, monitoring, dissemination of outcomes and outreach in congresses (<http://www.fnyh.org/proyectos-life/reserva-campanarios-azaba/introduccion-campanarios-de-azaba.html>).

-

De-intensification

Being a conservation project based on a cross-cutting action as de-intensification, it is necessary to transmit data about the evolution taking part in the reserve as a whole.

The project aims to the de-intensification of 1% of the SPA in Azaba and Argañán, representing 0.4 % when considering all target zones, including Malcata in Portugal.

The land used to be exclusively dedicated to livestock use. The project has enabled to turn biodiversity conservation into its preferred use leaving any other activity subject to the first one.

Actually all the described actions transmitted direct improvements on biodiversity, although none of them includes what has happened with the initiative as a whole in Campanarios.



The effects of the ending of plowing have caused an increased enrichment of flora and Lepidoptera communities, fostering the recovery of species of reptiles, whose increase has been evident and obvious. The Ocellated lizard, *Timon Lepidus*, and the Montpellier snake, *Malpolon monspessulanus*, have experienced a significant increase in population.

The *montaneras* were performed in a low livestock density of 1 in 3 hectares and even 1 per 4 hectares, only in 60% of the property, banding pig snouts towards ensuring they eat acorns and other food from the surface, avoiding or reducing the general lifting of the soil.

This lifting and aeration never stops occurring since the colonization of wild boar and wild horses continues in this role, but not on the scale that is done by pigs.

Natural pollinators have recolonized all habitats having no artificial competitors. The natural waspnests have proliferated widely. The case of *Vespa cabro* is especially significant.

Odonata now have a diverse and abundant population in several restored ponds.

Amphibians have experienced the same phenomenon, much more diversified in number of species and abundance.

Campanarios has become a game shelter, where after a couple of years without hunting, species have increased exponentially. The pigeon has multiplied by 20 its wintering individuals, recovering a promising roost of over 1,000 doves by 2011-2012 in Campo de Azaba.

The Hare *Lepus granatensis* has tripled its population, the wild boar *Sus scrofa* has started to be more abundant in the entire reserve, as well as the Roe deer *Capreolus capreolus*, throughout the different valleys.

These are just some examples of what is happening in the reserve. As a whole, it is complying with the main objective of the project:

- Improve biodiversity status in a territory of 132,600 hectares, within the following Natura 2000 sites:
 1. Campo de Azaba
 2. Campo de Argañán
 3. Malcata
- Manage a 500 hectares reserve (1% of the SPA Campo de Azaba, approximately 0.4% of the whole), located in the center of the area.
- Comprehensive and active management, with direct benefit on the most dispersive efficient species (birds, insects and plants).

Improve cross permeability for species, in this space.

Create a reserve without intensive use and not subject to hunting

1. Creating a resting and breeding area for species.
2. Providing biodiversity to the rest of the large Natura 2000 area.

4.1. Development of methods to identify quality indicators for Habitat 6310 (evergreen pastures of *Quercus sp*) based on functional groups of insects

4.1.1. DESCRIPTION OF THE ACTION

For the development of methods to identify quality indicators of Habitat 6310 (evergreen pastures of *Quercus sp*) two functional groups of insect indicators were used:

- Saproxylic species (species that depend on, during at least part of its life cycle; wood or its remains, fungi or other organisms associated with such environment). They are a functional component of the ecosystem, since they ensure degradation and addition of nutrients to the environment.

In this way, saproxylic insects make up a community of insects that depend on senescent, dying or dead trees whose wood is in various stages of degradation at some point in its life cycle. Saproxylic community encompasses a wide range of species that includes different functional groups linked to dead wood or in process of senescence. Among them are those that feed directly on the wood -which depend on fungi associated to it-, on sap exudates, or even those who prey on other saproxylic organisms. This group of saproxylic invertebrates constitute the highest diversity percentages of diversity in land ecosystems, being Coleopteran and Dipterans, the best represented insect groups. This group of insects are abundant and highly diversified in grasslands where they have a relevant role in the ecological processes contributing to the fragmentation of wooden materials, both for its mechanical action as indirectly through endosymbiotic relationships with fungi and other microorganisms that contribute to degradation of wood.

Many species of saproxylic insects are considered rare or threatened at European level, being under several protection figures and included in protected species lists of different countries. Saproxylic insects are excellent bioindicators of the conservation status of forest ecosystems, hence their study is a useful tool to identify those natural areas that must be protected and to establish monitoring protocols of the conservation status of protected forest habitats.

- Coprophagous species: mainly scarabs (decomposer insects, involved in the removal of organic waste and the incorporation of nutrients into the soil). Grassland ecosystems are characterized by the recycling of plant biomass, being grazing an ecological process of great importance to speed up the recycling of biogeochemical elements continuously from the environment. The importance that decomposer insects have on the ecosystems of the dehesa is easily inferred, if we take into account that one of its main components is livestock, real craftsman -with humans -of the existence of an open Mediterranean forest. When disturbances

occur in grazed ecosystems as the dehesa, the communities of these insects are affected causing a lack of manure decomposition.

There are several groups of insects that contribute to the destruction of droppings from domestic large herbivores, contributing significantly to the maintenance of fertility and good conservation status of these grassland ecosystems, keeping thus the proper functioning of ecological processes. The most important coprophagous insect groups for their impact is scarab beetles both in its larval stages and as adults, representing the largest group, whose presence is constant and abundant in well preserved pastures. The monitoring of their populations provides us with valuable information not only about the conservation status of the dehesa, but also about the effectiveness of the management plans and improvement process of habitats.

Both selected communities of insects, saproxylic and coprophagous, are excellent indicators by analyzing diversity and abundance of species from both communities; allowing an interpretation of the conservation status of the environment and guidance on which measures should be introduced for the proper management and conservation of habitats.

This LIFE project started out with the hypothesis that these two functional groups, saproxylic Coleopterans and Dipterans and coprophagous beetles, are ecosystem descriptors whose richness depends directly on the conservation of the forest on the one hand (saproxylic) and of the structure and heterogeneity of grassland, tree and shrub vegetation (coprophagous).

Therefore the aim of this action was to demonstrate that both selected functional groups may serve, by analyzing the species, as indicators; considering the community as bioindicator, not a concrete species.

Through the knowledge of the dynamics of these selected biological communities (saproxylic and coprophagous), a methodology was developed to infer about the evolution status of the ecosystem and start, correcting where appropriate, best-suited management programs for the conservation of the environment.

4.1.2. EXPECTED RESULTS/OUTCOMES

Biodiversity assessment indicators of Habitat 6310 developed as from the evolution of saproxylic and coprophagous functional groups.

4.1.3. WORK CONDUCTED

Saproxylic insect populations were estimated by:

- Indirect sampling: in order to make the comparison between samples in and out of the selected biodiversity observatories, used windowtraps designed to capture of flying beetles that flock to the trunks. It's the trap model more used for the capture of saproxylic beetles for greatest effectiveness against other indirect methods of capture.

Saproxylic beetles were also studied using emergency traps which were situated in the hollows of large trees from which adult stages of these insects emerge from its larvae, developing inside the tree.

On the other hand, Malaise tramps were complementary used to control spreading of different groups of insects. These interception traps made of dark fabric, collect insects that move between different areas of the reserve.

- Direct sampling: this method was mainly used to track populations of saproxylic Dipterans living primarily in the tree hollows during their larval stages. This sampling method has also provided data of interest of some species of saproxylic beetles. In all cases, well known taxonomic groups relatively easy to identify to species level, were found allowing larvae identification without having to nurture them to adults. In order to standardize the sampling method, a direct search was conducted in order to study larval stages in a total of 10 randomly selected deciduous tree hollows and 10 samples from dead wood on the ground. Sampling was carried out matching with peak of activities, May- June and October-November, in the Iberian Peninsula.

Coprohagous were estimated by indirect sampling. Three plots of one hectare were selected and geo-located to allow sampling each year. Three baited traps were placed in each plot. Cow droppings were used as bait, due to its availability in the reserve; though some more baited with sheep excrements. Once the type of droppings is selected, it should always remain the same to avoid possible bias. A possible method to adopt could be to dispose a mix of different excrements, which can increase the effectiveness of the trap to some extent.

Selected traps

Windowtraps: window traps formed by 3 layers of transparent plexiglass, 60 cm long and 40 cm of width, against which insects collide in their routes. Plexiglass layers rest on a funnel to catch the beetles that impact with the layers and fall into a small container, with propylene glycol as a preservative, at the base of the funnel. This type of trap doesn't provide accurate information about the microhabitat for larvae development (unlike

direct sampling or emergency traps) but is however very efficient to conduct a quantitative assessment of the communities and to establish comparisons between the sampling sites. This type of trap is very effective for the monitoring of populations of flying insects that live and find their resources in the wood of the trees.

Windowtrap_

Emergency traps: Formed by a black mesh sitting on the tree hollows, sealed on the edge. This mesh has an opening connected to a collector vial in which the insects are collected. This type of trap is being used in various countries of Europe to monitor saproxylic insect populations that occur in tree hollows during their larval stages. They are captured when they emerge and start the dispersion flight by the attached collecting vial. Its advantage is that they allow a direct association between the collected species and their habitat.

Pitfall traps: Baited traps with cattle and sheep droppings. This type of traps consist of containers of 30 cm in diameter and 15 in depth which are buried in the ground up to its edge, placing a mesh on which the excrement is deposited. Coprophagous insects wanting to reach the droppings fall to the receptacle containing ethylene glycol to 50% as preservative.

Pitfall traps_

Malaise traps: Consisting in a tent with a vertical black panel, fitted with two side walls and covered by a roof. Insects in flight hit the panel and, diverted by the side walls, tend to fly up ending on the roof, which has a funnel ending in a collector vial at one vertex. This trap is effective for capturing flying insects.

Field work and sampling

Sampling points in the dehesa of Campanarios were selected during January and February 2010.

Between January the 12th and 16th, a general coordination meeting involving all parties was held, as well as a field visit to Campanarios de Azaba, selecting large areas in which the work was to be conducted.

During March, all researchers moved into the reserve in order to select the exact sampling points in accordance with the agreed protocols, geo-locating sampling points and trees selected for further spatial analysis.

A total of 15 sampling points were selected (location map, saproxylic points) in areas of gall oak (*Quercus faginea*) with Pyrenean oak (*Quercus pyrenaica*) and holm oak (*Quercus*

rotundifolia). These points are 500 m apart one from each other and were classified according to the density and tree composition of the sectors. Seven points were located in the area with 50% shrub cover and eight points in areas with a greater degree of bush closure. Thirty window traps, thirty two emergency traps, four Malaise traps and 40 pitfall traps were placed in accordance with the established protocol. All the traps were installed during April 2010, when biological activity of the insects begins; all CIBIO researchers participated together with interns of the LIFE project.

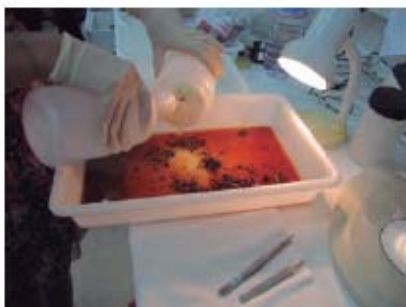
Sample treatment

Window and emergency traps for the capture of saproxylic insects were active from April 2010 to February 2012, having collected the samples on a monthly basis.

Pitfall traps for coprophagous were placed from April 2010 to April 2012. They were baited with a mixture of sheep and cow droppings and collected each month every 4 days over the last two weeks (3 samples, monthly).

Malaise traps were also collected each month from April 2010 to February 2012.

From April 2010, all samples collected in the study area were processed monthly in the labs of the CIBIO (University of Alicante). This process was carried out mainly by interns of the project under the supervision and participation of researchers. Insects were monthly separated by species, counted and recorded. Saproxylic coleopterans and Syrphids as well as coprophagus beetles were later identified; identified by 15 experts from different European countries which have contributed externally to the project.



4.1.4 ACHIEVED_OUTCOMES

Obtaining very accurate data on the communities of these two groups of insects as bio-indicators of the conservation status of the dehesa, is a result to highlight from the project. Hence, the basis to allow future comparisons of the evolution of the environment, have been placed, which will allow to have available information of a changing community over time; enabling to know whether the observed changes are due to deterioration or improvement of habitats.

Important results on the conservation status of habitats based on the study of bioindicators of saproxylic insect (Coleopterans and Dipterans) and coprophagous beetles. These data have also provided scientific basis for the development and implementation of management plans of the biological reserve Campanarios de Azaba which should serve as a model for the conservation of other dehesa ecosystems.

One hundred thirty-one species of Saproxylic beetles, fourteen species of Syrphidae Dipterans and eleven species of scarab coprophagous beetles have been found.

It should be noted that the analysis of saproxylic insects has given us valuable information about the importance that traditional forestry practices have on the habitat of these species. As habitat quality indicators, they comprise a useful tool in identifying natural areas that should have a higher level of protection.

- **SAPROXYLIC INSECTS**

Saproxylic beetles

As indicated, this group has shown to be very sensitive to the type of forestry management applied, therefore the species of this group of insects are considered in many countries of the European Union as excellent indicators of well preserved forests and with high ecological value. Analysis of these communities give us valuable information about forestry practices that best preserve habitats and its inhabitant species.

Studies carried out in the Iberian peninsula on saproxylic beetles are very scarce, being the results obtained within the framework of this LIFE project, the first data from open Mediterranean forest ecosystems (dehesa).

In the biological reserve of Campanarios de Azaba, 131 species of Saproxylic beetles have been registered, distributed in 36 families, representing the highest known diversity of this group in the Iberian Dehesa. In paragraph 3 -description of the reserve and its natural values- a complete chart is included.

Is also noteworthy that the presence of *Cerambyx cerdo* and *Limoniscus violaceus* has been confirmed, species included in the Habitats Directive. *Limoniscus violaceus* had not been included in the project LIFE proposal given that there were no previous quotes of the presence of this species in the Western Iberia.



Cerambyx cerdo, F. Turmo.



Limoniscus violaceus, N. Rahmé.



Eupotosia mirifica, E. Micó.



Eupotosia mirifica, A. Ramírez Hernández.



Amorphacephala coronata, A. Verdugo.



Ischnodes sanguinicollis, T. Németh.

On the other hand, the number of species with some threat category of the IUCN included in lists of species to protect according to the Red Book of invertebrates under threat of Spain and European Union lists; have risen, highlighting *Protaetia (Eupotosia) mirifica* (VU), *Amorphacephala coronata* and *Ischnodes sanguinicollis* (VU) in addition to the aforementioned *Limoniscus violaceus* listed as endangered species(EN)

Saproxilic shyrpid dipterans (Diptera, Shyrpidae):

These dipterans larvae develop in trees hollows; adults feeding on pollen and nectar from flowers, thus participating in the pollination process.

The richness of this group of insects has been recorded from emergency (ET) and window (WT) traps. A total of fourteen species have been caught, tracking their larval cycle which allowed setting the basis for managing its populations in relation to forestry.



Mallota dusmeti-J.I. Pascual.

Altogether, the data logged from saproxylic syrphids in the biological reserve of Campanarios de Azaba indicate the richness of this area of Western Iberia, given the singularity of quotes existing for many of the species as of other areas of the Iberian Peninsula. The importance of Campanarios de Azaba is that it hosts many species considered rare that find its western distribution limit in this area.

Most adults of these species emerge at the beginning of spring and can be seen feeding on flower resources as pollen or nectar, hence being part of the pollinator entomofauna of many plant species that grow in the grassland.

It should be noted that 70% of the abundance of *Syrphidae* collected Campanarios de Azaba corresponds to only two species, *Mallota cimbiciformis* with 103 individuals and *Mallota dusmeti* with 56 individuals.

Among the recorded species, the presence of *Myolepta difformis* and *Myolepta obscura* is remarkable as it's a priority species for conservation in Europe, classified as "Endangered" at UE scope. It is also important to highlight the abundance of *Mallota dusmeti*, considered as "Vulnerable" in the Red Book of the invertebrates of Spain. The high abundance of this species in this reserve, confirms the importance of Campanarios de Azaba as a biological reserve for the preservation of endangered saproxylic species in Europe.

Achieved outcomes emphasize the community of saproxylic insects is, as a whole, an excellent indicator tool of the conservation status of the habitat. The high diversity and abundance of the species in this community indicate the good biological conservation status existing in the reserve of Campanarios de Azaba.

On the other hand the use of saproxylic insects, referred to in the framework of the action " quality indicator of habitat 6310 from data obtained from the functional groups", has contributed to the establishment of forest management programs and confirm that the established forest management plan is the most appropriate ("**development of methods for identification of quality indicators of habitat 6310 (evergreen pastures of *Quercus sp.*) from functional groups of insects**").

Saproxylic insects' data analysis has allowed differentiating two areas that must be managed differently in the reserve of Campanarios:

- A zone with remarkable shrub regeneration. Its traditional management was probably abandoned some years ago.
- A typical meadow area with more open vegetation, less shrub and which is the result of having been subject until recent times to a traditional agricultural and livestock management.

Data analysis shows that saproxylic species listed as vulnerable are better represented in this second area, which indicates the importance the traditional management of the pasture has for the conservation of these groups of threatened insects. Hollows located in the trunk to an average height of 170 - 200 cm in *Quercus pyrenaica* and *Q. lusitanica* represent their preferred microhabitats. These cavities are the result of little aggressive pruning and *olivado* of the trees, and host the largest number of endangered species. Therefore, the establishment of a management plan for the forest area based on selective pruning of branches through *olivado* has been proposed.

- **COPROPHAGUS SCARAB BEETLES**

European coprophagous beetle fauna mainly occurs in habitats with herbivore activity, open or semi-open grassland ecosystems and forest areas with little shrub vegetation. Grassland ecosystems have a long history of agricultural and livestock activity that has transformed the landscape over thousands of years, by removing and clearing the Mediterranean forest through herbivores (livestock use). It is precisely this activity from cattle, horses and sheep which has structured and maintained a characteristic landscape consisting of large areas of patchwork grasslands with isolated *Quercus* having developed an open forest structure over thousands of years. The dehesas, due to the above-mentioned characteristics, are very rich in diversity and abundant in coprophagous insects which are linked to the degradation processes of herbivores' droppings. When ecological herbivory processes are altered, a rapid process of homogenization occurs entailing grassland loss, plant species replacement and closure of the environment due to the increase of shrub areas. This process causes a rapid loss of diversity and abundance of

species of coprophagous beetles; therefore they can be used as bio-indicators of the management and conservation status of meadow ecosystems.

Twelve species from 3 families of scarab beetles were found within the biological reserve of Campanarios de Azaba (see chart included in the chapter on insects within the description of the reserve), representing a fairly low diversity, taking into account the data published for other pastures in the province of Salamanca, exceeding 40-50 species in average. This lower richness of species of coprophagous beetles in habitats from Campanarios de Azaba, is interpreted as a reflection of the negative impact caused by a little sustainable livestock management during the years preceding 2009, year in which the LIFE project began, with areas subject to overgrazing and others in which this activity was of low intensity.

APHODIIDAE	GEOTRUPIDAE	SCARABAEIDAE
<i>Aphodius ghardimaouensis</i>	<i>Typhaeus typhoeus</i>	<i>Bubas bubalus</i> <i>Caccobius schreberi</i> <i>Chironitis hungaricus</i> <i>Copris hispanus</i> <i>Euoniticellus fulvus</i> <i>Onthophagus furcatus</i> <i>Onthophagus opacicollis</i> <i>Onthophagus punctatus</i>

Species of beetles in Campanarios de Azaba

A structure of very dense vegetation with pastures heavily altered –with high vegetation and vast areas occupied by bushes- was found in the initial state of the project. This situation was reflected in the low diversity and abundance of coprophagous beetles as already indicated.

Data obtained through the study of coprophagous insects in Campanarios de Azaba reserve have made clear the success of the implementation of controlled introduction of *Retuerta* horses and *sayaguesas* cows, due to the need to activate the processes of herbivory.

4.2. Development of biodiversity assessment indicators and protocols for sustainable management of habitat 6310 from fungi populations.

4.2.1. DESCRIPTION OF THE ACTION

The following activities (sub-actions) were developed:

- Elaboration of a mycological catalogue:
 - o In situ data collection, photography in their natural environment and habitat of all those important characters for the correct identification of different taxa.
 - o Individual labeling in the laboratory, logging the organoleptic, macroscopic and microscopic features, photographing certain characters under identical lighting conditions and drying with electric stove for its subsequent storage.
 - o Realization of taxonomic work in the laboratory, avoiding times of increased abundance of fruiting bodies, analyzing individuals both macroscopic and microscopically. Use of different reagents and dyes for the correct perception of features, with particular attention to the microscopic structures.
 - o Identified fungi were deposited in the Herbarium of the University of Salamanca and in an own Herbarium in the reserve. Description of all species macro and microscopically, with drawings in white camera, microphotographs with phase contrast or differential contrast as well as studies of spore ornamentation through scanning electron microscope according to current taxonomic techniques.
- Assessment of the conservation status of different habitats and the ecosystem health according to the relative proportions of saprophytic fungi, mycorrhizals and phytopathogens.
- Analysis of diversity and distribution by Geographic Information Systems that allow to properly study the information by integrating it with different environmental variables (weather, altitude, soils, forests, etc.), and the habitats present in the environment.
- Preparation of reports and proposals that would allow a proper management and sustainable use of Mycological resources and, therefore, of the habitats in which they develop.

The completion of a mycological catalogue is a continuous work that requires a good number of years, to avoid the negative impact that certain adverse weather conditions of one or more years, might have in the life cycle of these organisms. This fact should therefore be highlighted as a greater number of years devoted to its realization will contribute to draw up a more exhaustive and complete inventory; though throughout this project, a catalogue that reflects the fungal biodiversity of the reserve has been accomplished.

The catalogue allows to not only know the fungal biodiversity of the reserve, but it also provides information on the conservation status of the most important tree vegetation formations and which, in turn, determine the most important features of this area of environmental interest. The assessment of the health of the different habitats that are located in this area is possible thanks to the discrimination of different taxa of fungi in each of these habitats, and within these, estimating its form of nutrition, whether saprophytic, symbiotic or parasitic. The relative proportion of them, either in the whole of the reserve or in the different main types of vegetation, has allowed us to determine its level of conservation from Mycological terms.

This kind of Mycological studies have been supplemented and implemented with the application of geographic information systems (GIS), because the latter allow you to combine information across different physiognomic units in the reserve and therefore obtain a detailed reflection of the situation in different parts with regard to their conservation status.

4.2.2. EXPECTED OUTCOMES

Developed biodiversity indicators of habitat 6310 and management protocols transposable to other areas of Mediterranean open forests.

4.2.3. WORK CONDUCTED

Over the period 2009-2012 a mycology catalogue has been elaborated through sample collection in the biological reserve "Campanarios de Azaba", considering within these annuities the months of autumn and winter in the years 2009-2011, and the months of spring of the years 2010-2012, since these times are the most conducive to the development of fungal fruiting bodies that in turn, are tremendously useful for quantifying and identifying the different species present in this area.

All the data and samples collected were analyzed in the CIALE (Centro Hispano Luso de Investigaciones Agrarias) laboratories in the University of Salamanca.

4.2.4. ACHIEVED OUTCOMES

4.2.4.1. Elaboration of a mycological catalogue

A mycological inventory involves making a series of visits to the territory occupied by the biological reserve, exploring mainly the fruiting bodies of the different fungal taxa, regardless their development status. The development status is in fact an important aspect that must be taken into account, as it determines its identification. This fact explains that not all specimens found can be correctly identified from the taxonomic point of view, since the fruiting bodies poorly developed prevent from observing certain characteristics that typically define such specimens, not only at the level of species, but also at the level of genus and even family.

For the identification of the collected material, i.e. fruiting bodies in a good state of development of fungal species, in addition to taking photographs of the specimens in situ, which subsequently help identification, organoleptic characteristics were also collected which can be evaluated at the site and time of the collection. Later, in the laboratory of the Group of Palynology and plant conservation (*Grupo de Palinología y Conservación Vegetal* - GPCV) from the CIALE (University of Salamanca), classical techniques in Mycology were used, analyzing both macroscopic and microscopic features, using a LEICA microscope attached to a LEICA DC100 camera and endowed a program of treatment and analysis of image LEICA Qwin. In the same way, different chemical reagents have been used. Identification of different taxa has been realized by the use of different general and specific bibliography; while the CABI Index Fungorum (2008) has been used for nomenclature, taking, in some cases, more traditional scientific names, provided they are synonymized with the names recommended by the scientific community. It should be noted that the condition of synonyms, gives validity to any of the names who acquire that status.

Specimens were dried in an oven with controlled aeration and temperature in a range of 42-45 °C for a variable time depending on the characteristics of the fruiting body, normally between 2-3 days. After the desiccated specimens were stored in air-tight plastic bags perfectly tagged, in some cases, a freezing process at -20°C underwent for a period of 1-2 days if there is any indication or risk of presence of insects. After freezing, samples were subjected to drying to remove possible traces of water that could have been generated by the freezing. Exsiccatæ were deposited in labeled plastic bags and stored in cardboard boxes in alphabetical order by genus and species.



Laccaria laccata, CIALE.



Scleroderma polyrhizum, CIALE.



Torrendia pulchella, CIALE.



Hericum erinaceus, CIALE.

The whole area of the reserve was sampled from autumn 2009 to spring 2012, identifying up to 151 different species. However, and as noted above, the completion of a mycology catalogue is more accurate with a greater number of years of study, thus minimizing the negative effects that would have an abnormal year in weather conditions, on the development of fruiting bodies and, consequently, on the discrimination of the fungal diversity. As a result, and as a compilation, a list of identified species throughout the annuities studied is included.

Among these registered species, it should be noted, as well as different species of ecological importance, two species included in the red list of threatened fungi in Europe (Dahlberg & Croneborg, 2003; as *Hericum erinaceus* (Bull.) Pers. and *Torrendia pulchella* Bres. (**Chart Mycological fungi species included in the red list of threatened fungi in Europe**). At national level, so far, there is a draft document named the "Red List of fungi to protect of the Iberian Peninsula", which presents a list of 67 taxa include *Hericum erinaceus* (Bull.) Pers. In any case, it is a preliminary document, bearing in mind the existing document at European level.

The first of these, commonly known as goat's beard (*Hericium erinaceus* (Bull.) Pers.) was found parasitizing two large-sized Pyrenean oaks, one in a mixed oak forest dominated by Pyrenean oak (UTM 29TPE8785, 12/11/2011), and one in an mixed oak forest dominated by holm oak (UTM 29TPE8684, 22/01/2010). It is considered a rare species, mainly because it fructifies on fagaceae specimens, as various species of oaks and beeches, relatively mature, which as a result of various factors, are also scarce. It should be noted that the habitat included in Natura 2000 detailed in the **Chart of mycological species included in the Red List of threatened fungi of Europe** correspond to typical euro Siberian habitats, not Mediterranean, the area in which Campanarios de Azaba is located; representative of Habitat 9230 "Galicio-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica*". It is a parasitic species, the conservation measures that should be initiated would be related to the conservation of the oldest examples of Pyrenean oak (*Quercus pyrenaica* Willd.) occurring throughout the analyzed area.

As for *Torrendia pulchella* Bres., it's a saprophytic species that grows in sandy soils of different formations such as holm oak, cork oak or even pine forests. In the area under study, it was found only in an oak forest with scattered oaks (UTM 29TPE8685, 05/12/2009), probably because its location is conditional upon development of fleeting fruiting bodies. It could also be ascribed too, as well as those habitats included in the **Chart of mycological species included in the Red List of Threatened Fungi in Europe**, in the habitat "*Quercus ilex* and *Quercus rotundifolia* (Code 9340)", typical of the Mediterranean area, more conducive to the development of this species. Any initiative to promote the conservation of this species would be linked the preservation of forests that thrive in their fruiting bodies, although the degree of threat posed in the Iberian Peninsula is still under discussion.

Species	Presence in countries (EU 15)	Location number	protected areas (%)	Nº of National Red Lists	Frequent Natura 2000 Habitat
<i>Hericium erinaceus</i> (Bull.) Pers.	13	435	29%	15	9110 Beech forests of <i>Luzulo-Fagetum</i> 9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the <i>Carpinion betuli</i>
<i>Torrendia pulchella</i>	3	110	55%	3	9230 Galicio-Portuguese oak woods with <i>Quercus</i>

Bres.	<i>robur</i> and <i>Quercus pyrenaica</i>
	9330 Mediterranean evergreen oak woodland

Chart of mycological species included in the Red List of Threatened Fungi in Europe (Dahlberg & Cronenberg, 2003). It indicates the number of countries and towns where it is quoted in Europe, and the percentage of these locations present in protected areas, the number of national red lists in which it has been included, and frequent Natura 2000 Habitat.

4.2.4.2. Assessment of the conservation status of different habitats.

The assessment of the conservation status of the various habitats that occur in Campanarios de Azaba was preceded by a theoretical and practical definition of the reserve, according to its physiognomic and ecological criteria by major plant formations, with reference to the primarily tree type. Therefore, holm oak woods have been considered as major habitats or major vegetation units: dominated by holm oaks -*Quercus ilex* L. subsp. *ballota* (Desf.) Samp-), different ratios of mixed forest of holm oaks with Pyrenean oak -*Quercus pyrenaica* Willd.- and grasslands of different type and composition, where different formations hygrophilous ascribe. In the last case, it should be noted that in the area studied tree formations are linked to water courses of varying importance which suffering a sharp summer drought, among which are various trees and shrubs such as poplar (*Populus alba* L.), ash tree (*Fraxinus angustifolia* Vahl), several species of willow (*Salix* sp.), hawthorn (*Crataegus monogyna* Jacq.) and blackthorn (*Prunus spinosa* L.), although in many cases they are very degraded pastures giving way to wet meadows, which is why they are included within a general type known as "prairies". It should be equally mentioned that the several ponds of natural or artificial origin are not included in this generic synthesis of vegetation types, given that they have been found not to develop any nature fungal fruiting body, except in the case of an herbaceous component in their boundaries, being therefore assigned to the type "prairies". In any case, the assignment of the vegetation units defined synthetic and generically in different habitat types listed in European legislation (Directive 92/43 EEC) that each of these units could present is shown in **Chart of synthetic vegetation units described in the Biological Reserve "Campanarios de Azaba"**.

VEGETATION UNITS	EU HABITAT'S DESCRIPTION	EU CODE	PRIORITARY
Holm oak woods	Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	6220	*
	Thermo and pre steppe shrublands	5330	Np
	Holm oak Woods of <i>Quercus ilex</i> and <i>Quercus rotundifolia</i>	9340	Np
Holm oak-Pyrenean oak forest	Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	6220	*
	Thermo and pre steppe shrublands	5330	Np
	Holm oak Woods of <i>Quercus ilex</i> and <i>Quercus rotundifolia</i>	9340	Np
	Galicio-Portuguese oak woods with <i>Quercus robur</i> and <i>Quercus pyrenaica</i>	9230	Np
Pyrenean oak- Holm oak forest	Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	6220	*
	Humid meadows of Mediterranean tall grasslands of <i>Molinion-Holoschoenio</i>	6420	Np
	Thermo and pre steppe shrublands	5330	Np
	Holm oak Woods of <i>Quercus ilex</i> and <i>Quercus</i>	9340	Np

VEGETATION UNITS	EU HABITAT'S DESCRIPTION	EU CODE	PRIORITARY
	<i>rotundifolia</i> Galicio-Portuguese oak woods with <i>Quercus robur</i> and <i>Quercus pyrenaica</i>	9230	Np
	Mediterranean temporary ponds	3170	*
	Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>	6220	*
Grasslands	Humid meadows of Mediterranean tall grasslands of <i>Molinion-Holoschoenio</i>	6420	Np
	Thermophylic ash forests of <i>Fraxinus angustifolia</i>	91B0	Np
	Riparian forest of <i>Salix alba</i> and <i>Populus alba</i>	92 ^a 0	Np

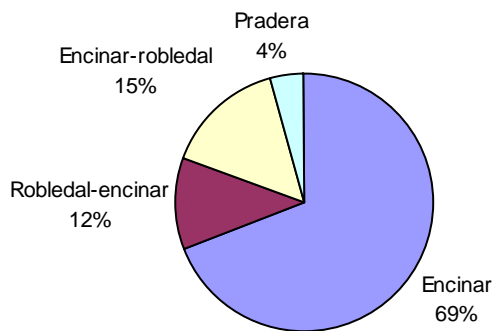
Chart Synthetic vegetation units described in the Biological Reserve "Campanarios de Azaba" and habitats defined by the EU (Directive 92/43 EEC) that can be placed in the same, with their code and whether they have a priority character (marked with an asterisk "*").





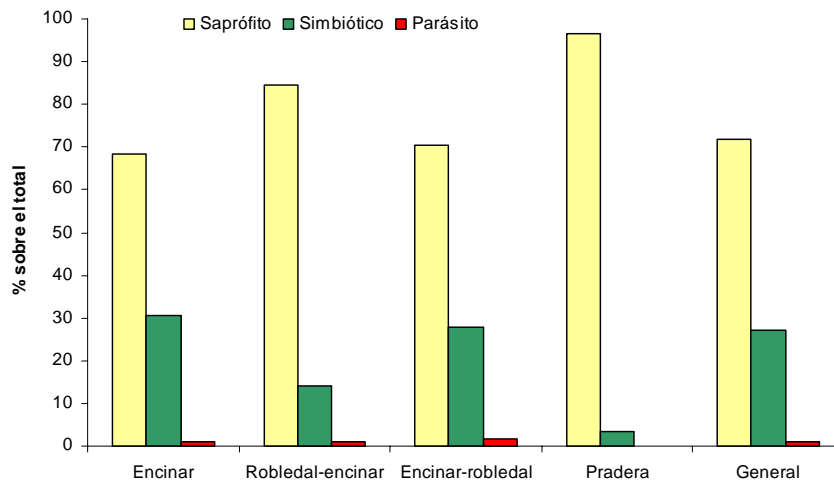
Fungal biodiversity was assessed in all these habitats, and within the taxa identified, also considering nutrition mechanisms, in order to assess the conservation status of the environment. At this point, we have considered three main types of nutrition for the different species of fungi, traditionally associated with this group of living beings, separating them as saprophytic or decomposer species; symbiotic or mycorrhizal with plant species either trees, shrubs or grasses; and various parasitic plant taxa, and given that this strict classification of each taxon is controversial for some experts. The proportion of these three types gives adequate information to assess the health status of the vegetation units and habitats that which host them.

With the data obtained in the period covered by this action and, overall, the whole project with the features already mentioned, we found a greater number of individuals in holm oaks (69% of the total), followed by holm oak-Pyrenean oak, the Pyrenean oak-Holm oak (15 and 12%, respectively) and grasslands (4%). It should be mentioned a factor that may have influenced a location less specimens in the grasslands, is the high development of herbaceous species following the abandonment of agricultural use, that could even have negatively conditioned the appearance of various fructifying bodies, along with livestock load, as many of the fruiting bodies are removed, damaged or even ingested by livestock.



Distribution of fungi taxa in 2009-2012 according to the different habitats located in the reserve "Campanarios de Azaba".

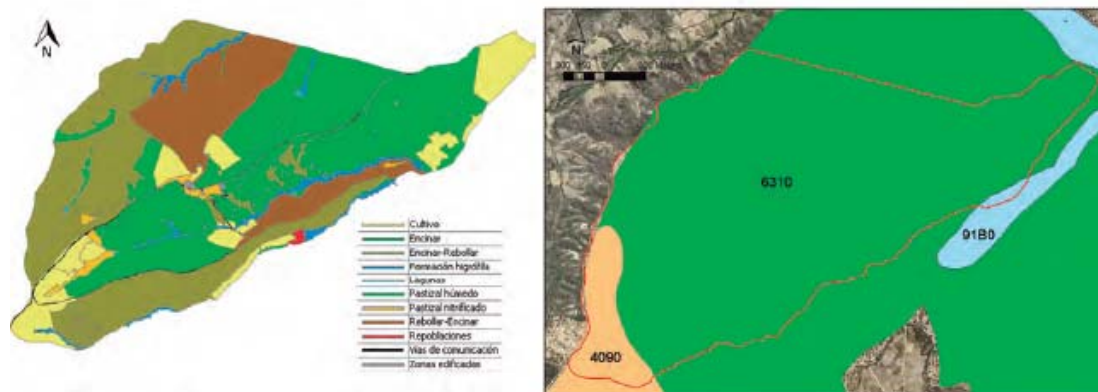
In each of these vegetation units, and thanks to the data obtained with the mycological inventory and the discrimination of the nutritional mechanisms, we evaluated the percentage of saprophytic, symbiotic and parasitic taxa in these environments, as shown in the following chart.



Percentage representation of the different nutritional forms considered within the major habitats located in the territory under analysis (2009-2012).

Centenary extensive livestock use, especially intense in the years prior to the project, could condition the large percentage of saprophytic taxa present in all habitats considered, especially in meadows where cattle use was, if possible, even more abundant. Therefore, this high percentage, close to 70% just in holm oaks, is probably associated

with the high content of organic matter derived from this activity, and whose decomposition would allow a number of saprophytic species.



Parasitic species have been found mainly in Pyrenean oak specimens, which may be due to two main reasons, which are probably complementary. The first refers to the distribution limit of Pyrenean oak in the area, usually appearing in north-facing hillsides and /or at places with higher soil moisture. The notation of a number of years or decades of continued decrease in the total amount of rainfall or even its seasonal distribution may have influenced a weakening of the trees, hence the appearance of these parasite organisms. This negative effect is also due, to some extent, to the different uses arising from open Pyrenean oak forest formations and in particular excessive and/or unsuitable pruning. Also, the worst conservation status that, based on data and diverse livelihoods of located fungi, is generally shown in mixed Pyrenean oak-Holm oak woods, is also reflected in a lower degree of symbiotic species (14%), which establish mycorrhizal mainly with these tree species, with respect to the other forest, holm oaks (31%) and holm oak-Pyrenean oak (28%).

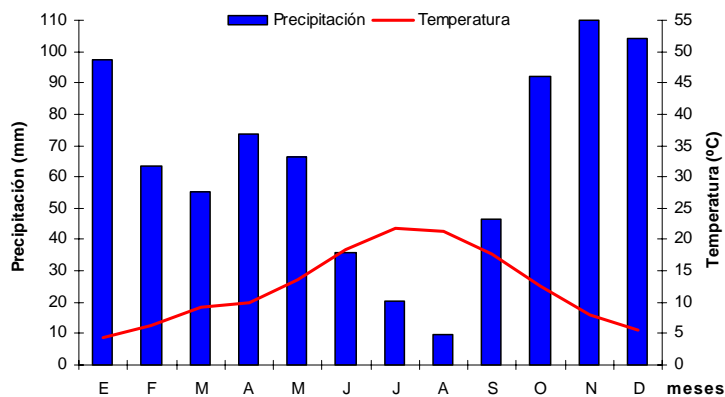
Mycological indicators analyzed in the Reserve show a large percentage of saprophytic taxa with respect to the values (51% saprophytes, 47% and 2% symbiotic parasites) that indicate a good conservation status in Mediterranean open forest ecosystems (Moreno, 1996) . Extensive livestock use, especially intense in the years before the beginning of this action, could condition the large percentage of saprophytic taxa present in all habitats considered, especially in meadows where cattle use was, even more abundant. Therefore, this high percentage is probably associated with the high content of organic matter derived from this activity, and whose decomposition would entail certain saprophytic species. However, it should be noted, the abundant presence in the last year of the project of specimens of primary mycorrhizal fungi species: fungal species pioneer in establishing symbiotic relationships with the roots of different tree species and shrubs

indicating good regeneration, such as *Pisolithus arhizus* (Scop.) Rauschert, or various species of the genus *Laccaria* or *Scleroderma*, mainly in Holm oak dehesas. As in the previous activity, a higher number of years in the study of different fungal species and their abundance, unequivocally would lead to a better understanding of the conservation status of generic vegetation units and their habitats.

4.2.4.3. Analysis of the diversity and distribution using Geographical Information Systems.

Through various software packages that work with GIS, ArcView and gvSIG fundamentally, physiognomic delimitation of different vegetation types occurring in the biological reserve Campanarios de Azaba has been performed at 1:1000 scale, together with an assignment of the resultant plots or tesserae resulting from predefined vegetation units. This work was intended to combine this information with environmental data provided by several interested administrations, such as data related to climatology, habitats or forestry.

In the first case, the absence of a comprehensive climate station in the Reserve, led to a search of temperature and rainfall data in similar stations in neighbouring communities, finding available data for the town of Fuenteguinaldo (Salamanca), through the Agricultural Geographic Information System (AGIS) of the Spanish Ministry of Agriculture, Food and Environment; developing a climate diagram. Through this climogram, we can infer climate trends for the study area; as a pronounced summer drought period may be, or a larger number of rainfall occurring during equinoxes, especially in the autumn. This fact, jointly with moderate monthly average temperatures during these autumn months, makes this season to be considered as the best time for the development of fruiting bodies, although there are differences along each annuity that can modify this general pattern.



Climate diagram of Fuenteguinaldo (Salamanca). Developed through data provided by AGIS.

Data obtained from the Spanish Forest Map at 1:200,000 scale, reveal a unique sclerophyllous forest dominated by Holm oak for all the area within the Biological Reserve. This consistency contrasts with the vegetation units described established in the synthetic vegetation map units present in the biological reserve "Campanarios de Azaba" in which also two types of grasslands (humid and nitrified) are discriminated; and hygrophilous formations within the unit designated as "grassland", as well as ponds, crops and reforestation, and built-up areas and roads. These data showed the dominance of Holm oak, considered as a vegetation unit, as almost a third of the tesserae analyzed area (31%) were ascribed to this unit, followed by grasslands (21%), that includes the different types of grassland discussed and hydrophilic formations of (12%) and Pyrenean-Holm Oaks (3%). The other third of the plots obtained are considered together as areas with a high degree of human intervention, such as crops and reforestation (15%), ponds (11%), and roads and built-up areas (7%).

For administrative information concerning the habitats of Community interest of Annex I of the Directive 92/43/EEC, available at 1:50.000 scale, with which a **Map of habitats of Community interest in the Biological Reserve "Campanarios de Azaba"** has been developed showing an habitat inventory for the study area. Habitat 6310 "Dehesas with evergreen *Quercus spp*" can be ascribed to intervened formations of habitat 9340 "Oak woods of *Quercus ilex* and *Quercus rotundifolia*", because in the area of the Reserve, and given the different uses that it has had over time, differentiating both habitats is a complex task. Habitat 4090 refers to bushes whose definition "oromediterranean heaths with aliaga" which does not correspond to any shrub vegetation type present in the

analyzed area, but could be ascribed to scrub formations of various species of legumes, *Cistaceae* or *Rosaceae*. As in the previous case, differences in scale and habitat codes, plus the fact that the plots in which the land was divided, may present several habitats, motivated that shrub layer was not estimated when performing the evaluation of the different plots.

These habitats are included in Annex I of Directive 92/43/EEC which are as follows: 4090 (oromediterranean heaths with gorse), 6310 (Dehesas with evergreen *Quercus spp.*) and 91B0 (thermophile ash woods of *Fraxinus angustifolia*).

The assessment of the conservation status of different plots was carried out according to three parameters, first estimated separately, and then together, in order to define the degree of conservation for each. Within this estimate plots ascribed to interned environment were dismissed, whether they are crops, reforestation areas, buildings or trails, as well as temporary pools, for not being a suitable environment for the development of fungal fruiting bodies.

Health status of each of the plots physiognomically delimited was estimated taking into account each species' livelihoods, as explained in the previous section. So, the percentage of saprophyte, symbiotic and parasite taxa was taken into account, assessing in each case its proximity to the proportion reported by Moreno (1996), as a good health indicator of such structure (51% saprophytes, 47 % symbiotic and 2% parasites). The score assigned is observed in the following chart, being higher as there are higher percentages resembling to that ratio.

Score	Health status
3	Optimal
2	Adequate
1	Favorable
0	Inappropriate

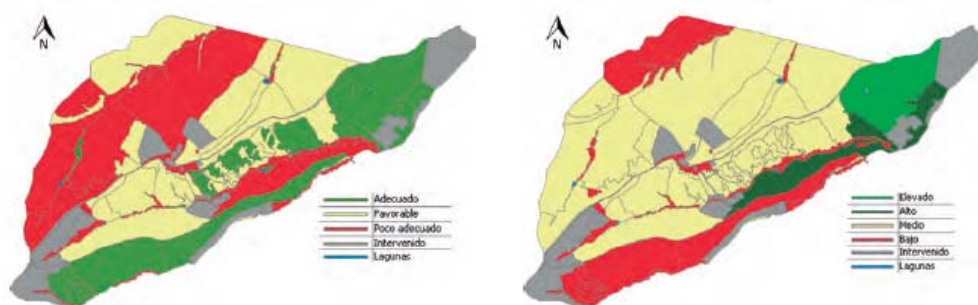
Yet a map showing the health status of each of the plots has been produced, in which the study area was divided (**Map. Health status of different tesserae defined in the Biological Reserve "Campanarios de Azaba" according to the percentage in the livelihoods of fungi species found**), based on the proportion of different livelihoods. Thanks to the results provided by the software packages associated with GIS, it was

estimated that just around half of the plots of the Reserve presented an adequate or favorable health status (42.5% overall), with inappropriate status being slightly lower than the fourth part of these plots (23.4%). At this point, it should be noted that no tesserae is cataloged with an optimal state as it didn't present appropriate percentages as previously reported; Holm oaks were, in general, the vegetation units with a more suitable health status.

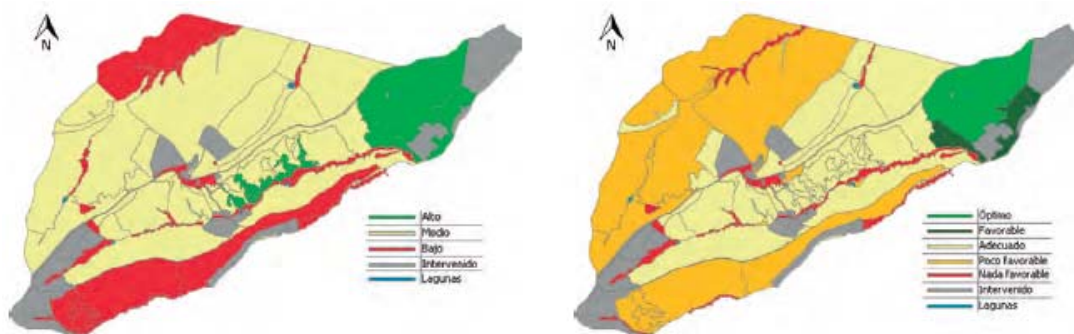
The number of fungal species or taxa identified along the project was also a parameter to be considered when proceeding with the assessment of the conservation status, as it is estimated that greater species richness leads to better state of preservation of the various plots that are part of the study area. Thus, the chart below shows the score given according to the number of species located and identified in each plot.

Score	Number of species
3	Very high
2	High
1	Medium
0	Low

A map showing mycological diversity of each of the parcels on which the study area was separated, based on assigned scores and GIS software, (**Map Number of fungi species identified in the period 2009 - 2012 within the different plots defined in the Biological Reserve "Campanarios de Azaba"**). This map also indicated that only 4.3% of the plots had a very high or high number of species, being the percentage of plots with medium (35.8%) and even low score (25.8%), significantly higher. This showed that most taxa richness was found mainly in the eastern sector of the reserve.



Map. Health status of different tesserae_CIALE Number of fungi species identified_CIALE



Map. Number of fungi specimens found_CIALE

Map. Conservation status of different defined tesserae_CIALE

As a last parameter, the number of specimens counted in each of the plots of the Reserve itself has been considered, setting a score, shown in the following chart, but in this case with a range between 0 and 2, as it is estimated that the amount of fruiting bodies did not have as much impact on the conservation status as the other two parameters.

Score	Number of species
2	High
1	Medium
0	Low

The scores given in each of the plots, previously physiognomically delineated by GIS, allowed developing a map showing the abundance of species in the study area (**Map Number of fungi specimens found in the period 2009-2012 within the different bounded tesserae in the Biological Reserve "Campanarios de Azaba"**) and valuing that almost a third (32.5%) of the plots showed a medium amount of specimens, a quarter (25.8%) a low number, and only 7.5% with abundant fruiting bodies. These results appear to reflect, in a general way, a greater amount of fungi specimens in Holm oak woods, mainly in the eastern half of the study area.

The combination of the above-defined parameters and their scores, allowed setting numerical criteria reflected in the chart below to assess the conservation status of the various plots that are part of the biological reserve. In this case, it was considered

appropriate that the scores follow a series of intervals that would help catalog the condition resulting from the combination of several factors (health status, number of species and number of specimens), always from the mycological point of view, and taking this group of organisms as bioindicators of the conservation status of the area as a whole, and each of their plots, particularly.

Score	Conservation status
8-7	Optimal
6-5	Favorable
4-3	Adequate
2-1	Inappropriate
0	Not favorable

These data combined with the possibilities afforded by the GIS, resulted in obtaining a map (**Map Condition of different tesserae defined in the Biological Reserve "Campanarios de Azaba" as mycological indicators (proportion of livelihoods, number of species and number of specimens)**) which graphically and intuitively shows the conservation status of the tesserae considered, except, as already discussed, of all those subject to a high degree of human intervention. by Thanks to mycological indicators, these results show that almost a third of the plots studied presented a suitable condition, with only a small fraction (2.6%) having a favorable conservation status, mainly Holm oak woods located on the eastern sector of the reserve. The remaining analyzed plots, over 30% of the total, showed inappropriate (13.3%) or not favorable (17.5%) conservation status.

The assessment of the conservation status of different vegetation units occurring in the study area, is summarized in a Summary-Chart of the conservation status of different vegetation units defined in the Biological Reserve "Campanarios de Azaba" outlining the data obtained after the mycological bioindicator analysis.

The best preserved vegetation unit along the Reserve was the Holm oak, since only 3% of the areas with this type of plant formation showed an unfavorable state, located in the vicinity of a building -located in a central area. The different parameters considered when making this assessment, had different impact on this final assessment, although it should be noted that almost in all the holm oak woods, the level of health was adequate or

favorable and the number of species and specimens stood primarily on an average amount. This could be because these formations dominated by Holm oak are more adapted to a use of its resources by the different activities related to human use, and therefore, were better able to withstand the intense stocking that occurred in the area in the years prior to the beginning of the current project.

Pyrenean-Holm Oak woods were established as the second most valued vegetation unit, since almost 70% of the few areas with this type of mixed forest had a proper evaluation, largely due to a high number of taxa and an average amount of specimens. However, it should be noted that the level of health was estimated as "inappropriate" given its high percentage of saprophytic species (always above 80%), possibly motivated by the presence of grasslands favored by human intervention with a higher moisture content soil, except during summer months, conducive to livestock use and located between Pyrenean and Holm oaks.

In the case of Holm-Pyrenean Oak woods, more than a third of the areas that develops in this vegetation unit (71%) showed an unfavorable degree of preservation; due to a medium-low number of species and individuals, as their health degree was appropriate or favorable, in many cases (71%). This low number of species and specimens could be due to a more dispersed woodland conformation of these mixed formations with respect to the above mentioned, which prevented the tree layer from acting, to a greater or lesser extent, as a protection against the weather peculiarities of the area (frost, high temperature, ...) and favoring the development of fruiting bodies of different species whose mycelium could be found in the underground.

Lastly, the tesserae jointly considered as grasslands, were rated as inappropriate or not favorable, due to a low number of species and specimens also, being preferable saprophytes. As in the case of grassland present in the mixed type consisting of Pyrenean and Holm oaks, this type of grassland, whether moisture, nitrified or hydrophilic formations without a significant tree component, high livestock pressure prevented from the development of fruiting bodies of symbiotic species and favored the appearance of those belonging to saprophytic taxa.

Holm oak woods

Livelihood	Optimal	Adequate	Favorable	Inappropriate
		27%	73%	
Nº Taxa	Very high	High	Medium	Low

	3%	5%	92%
Nº Specimens	High	Medium	Low
	24%	76%	

Assessment	Optimal	Favorable	Adequate	Inappropriate	Not favorable
	3%	5%	89%	3%	

Holm-Pyrenean Oak Woods

Livelihood	Optimal	Adequate	Favorable	Inappropriate
		35%	36%	29%
Nº Taxa	Very high	High	Medium	Low
			57%	43%
Nº Specimens	High	Medium	Low	
		57%	43%	

Assessment	Optimal	Favorable	Adequate	Inappropriate	Not favorable
			29%	71%	

Pyrenean- Holm Oak Woods

Livelihood	Optimal	Adequate	Favorable	Inappropriate
				100%
Nº Taxa	Very high	High	Medium	Low
		67%	33%	
Nº Specimens	High	Medium	Low	
		100%		

Assessment	Optimal	Favorable	Adequate	Inappropriate	Not favorable
			67%	33%	
Grasslands					
Livelihood	Optimal	Adequate	Favorable	Inappropriate	
		16%		84%	
Nº Taxa	Very high	High	Medium	Low	
				100%	
Nº Specimens	High	Medium	Low		
			100%		
Assessment	Optimal	Favorable	Adequate	Inappropriate	Not favorable
				16%	84%

Chart Summary of the conservation status of different vegetation units defined in the Biological Reserve "Campanarios de Azaba" with the different parameters used for this purpose and the final assessment.

4.2.4.4. Elaboration of proposals for the proper management and sustainable use of mycological resources and habitats.

Through the lens that gives us the mycological and, to a lesser extent, ecological study, a number of proposals to implement sustainable use of mycological resources and habitats, are established.

First, in general, not only for a more appropriate use of the area, but also to support future scientific studies, we suggest establishing a climate station that allows hourly and daily data collection of the most relevant and influential meteorological parameters in the life cycle of different organisms, such as temperature, precipitation, solar radiation, relative humidity, atmospheric pressure, dew point, wind speed and direction. This arises because of the relative remoteness of the nearest climate station (located in the town of

Fuenteguinaldo), and the use that such stations would have when assessing the impact of these parameters in the production cycle of various habitats and organisms in the territory under study.

The assessment of the conservation status of the area as a whole indicated, as already mentioned, a large proportion of saprophytic species which establish symbiotic relationships with trees and shrubs, possibly due to excessive stocking throughout the territory and the major contribution of organic matter that favor the occurrence of this type of fungi, essential elements in ecological cycles for its role as "recyclers". Thus, the de-intensification of livestock use that has been developed in the Reserve has helped reducing the supply of nitrogenous substances to soil and has also reduced the amplitude, sometimes excessive, of treeless pastures, within which, without the proximity of trees or shrubs, it was found to be more complicated the development of fruiting bodies from symbiotic species. In turn, the use of animal species native to the region or nearby regions from a biogeographic or a genetic perspective has been recommended; as it is estimated that organisms are better adapted to habitats located in the territory and therefore perform a more adequate and sustainable use of resources.

Proposals to improve mycological management and use of each vegetation unit defined for the territory under study, also have to be framed within a global context for the entire reserve; except for possible peculiarities that will be discussed consistently. The most abundant unit, and perhaps the more representative of the Reserve, is the Mediterranean open forest in general, holm oak woods, obviating the dichotomy that might occur between its forest features or its agro-forestry model use of natural resources, presenting high conservation parameters compared with other units. However, we suggest a suitable cattle use to avoid excessive coverage of shrub canopy without this leading to increased treeless pastures, and attached to the latter, it is also proposed to contribute to increase tree canopy, either by facilitating the development of new individuals of Holm oak with peripheral protection against potential damages from livestock in the area or by forest farming of new specimens, recommending, whenever possible, the first one. This increase of woodland is further extensible to eroded areas of the central part of the territory, as in this case, jointly promoting the tree layer, a reduction in erosion processes that characterize these sites is expected.

The two mixed formations dominated in different ratios, by Holm and Pyrenean oak, have a lower conservation condition regarding holm oak woods. In the case Holm-Pyrenean oak woods, it is considered advisable to perform a reforestation with specimens of both species, also facilitating the development of the young of Pyrenean oaks, estimating in the medium term a greater variety of fungi in these formations. In the case

of Pyrenean-Holm oak woods, while taking into account the previous proposal, a rationalization in the use of livestock hence avoiding a high organic matter load in the wet grasslands is suggested, which develop in the field of this vegetation unit.

Grasslands presented, together, low values in relation to the parameters evaluated for mycological indicators, and thus a degree of preservation inappropriate or not favorable. With all this, a lower livestock density is also required in these formations, very favorable for pastoral use of different animal species used for this purpose, in order to reduce levels of organic matter in soil. This proposal seems relevant since in some wet grassland plots, fungi symbiotic species were detected, probably indicating a good potential for this type of herbaceous formations to accommodate a greater variety of fungi and, thereby, promote their health status. It may not be forgotten that, in this vegetation units, degraded hygrophilous formations were also ascribed; therefore suggesting reforestation with native species such as ash, willows, poplars, alders, elders and white hawthorn, which contribute to regulating the water regime of the different streams that run through the territory and increase mycological richness in the area.

4.3. Restoration of Habitat 6310 (evergreen pastures of *Quercus spp*) and Habitat 92A0 (Gallery forests of *Salix alba* and *Populus alba*).

4.3.1. DESCRIPTION OF THE ACTION

It is well known the general state of longevity of the dehesa, exposed to low mortality and lack of major regeneration, which in turn, has its causes in a livestock management that prevents this regeneration by exposure to excessive stocking .

Erosion is one of the main risks that Mediterranean open woodlands are facing, due to deforestation and heavy but short rain. Therefore, the restoration of habitats within the Reserve of Campanarios de Azaba is done in areas with lower tree density and increased risk of erosion. This action seeks to restore two of the most significant habitats in the study area, but in particular to halt erosion in high risk areas -sparse forest or high slope areas- and contribute to age diversification of trees.

4.3.2. EXPECTED OUTCOMES

Risk of erosion and desertification on the reserve, missing; and increased surface of the two habitats of community interest mentioned, in at least 40 hectares (estimated area based on identified needs), most of them Holm oak woods.

4.3.3. WORK CONDUCTED AND METHODOLOGY

The work done in terms of restoration of Habitats 6310 (evergreen pastures of *Quercus spp*) and 92A0 (gallery forests of *Salix alba* and *Populus alba*) included planting specimens of the species that give name to these habitats, promoting reforestation of these trees in areas of the reserve where it became more necessary: those treeless areas with high risk of erosion and habitat loss, introducing an improved age structure, currently aged.

- Restoration of Habitat 6310: Frameless reforestation, to a final density of 200 plants/hectare, with forest tree of 1-2 sap in 40 x 40 x 30 cm boxes. The structure of the species has been influenced by soil depth, placing more demanding species in deeper soils. The proportion is as follows: as main species holm oak (*Quercus ilex* subsp. *ballota*) and cork oak (*Quercus suber*), both adding up to 80% of the species, although somewhat higher for the Holm oak. As associated species: *Quercus pyrenaica* (10%), *Crataegus monogyna* (5%) and wild pear (*Pyrus bourgaeana*, 5%).
- Restoration of Habitat 92A0: Frameless reforestation, staggered every 4 meters, with a ratio of 100% of forest tree of 1-2 sap in 40 x 40 x 30 cm boxes. The development of the species is influenced by soil depth. The proportion is as follows: the species closest to the river was *Alnus glutinosa* (40%), *Fraxinus angustifolia* (40%) and other species such as white willow (*Salix alba*, 10%) and black poplar (*Populus nigra*, 10%).

The most appropriate seasons to perform reforestations in this area were chosen as autumn and winter, as it is the best timing for the plant in the one hand, and for climate conditions in the other. Thus, first Cork and Holm oak reforestations were performed during winter of 2009 as they are two of the slowest-growing species. Later, in the autumn - winter of the years 2010 to 2012, reforestation with other species were conducted.

Reforestation work was performed manually with a crew of skilled forest workers. A basin (*alcorque*) was performed in every hole.

Reforestations were implemented without planting frame and with an estimated density of 200 trees per hectare in the case of trees of the genus *Quercus*. In the rest of the reforestation of Habitat 9340, planting structure was consistent with physical suitable placement for these species linked to more humid soil, with the general pattern of leaving about 4-5 meters between trees .



In every plantation, specimens were protected individually. Thus, the 1 to 2 sap trees were protected by aerated plastic to ensure early plant establishment, while at trees from 1 to 1.5 meters high were protected through a metal mesh of 2 meters high surrounding the tree to avoid the effect wild or domestic herbivores.

To achieve the highest possible survival rate, during the summer of 2011 and 2012 irrigations were conducted due to hot and dry summers, experienced in the area.

On the most exposed and affected by erosion slopes, *Quercus faginea* was used preferably; sometimes together with the waterboxx system, that collects water from night dew and makes it available to the seedling during the driest times of summer.

4.3.4. ACHIEVED OUTCOMES

Missing the medium term risk of erosion and desertification in the reserve Campanarios de Azaba and increased surface in two of the habitats mentioned in 86.2 hectares, identified for their high need for restoration, contrasting with the rest of the reserve that store acceptable levels in terms of quality and quantity of trees.

Below in **Charts Trees planted. Species, number of individuals, plant size (chart 1)** and **planting season** and **Chart 2 Surface planted with target species**, species planted and selected plant size and number of trees planted in different reforestation dates ,can be observed.

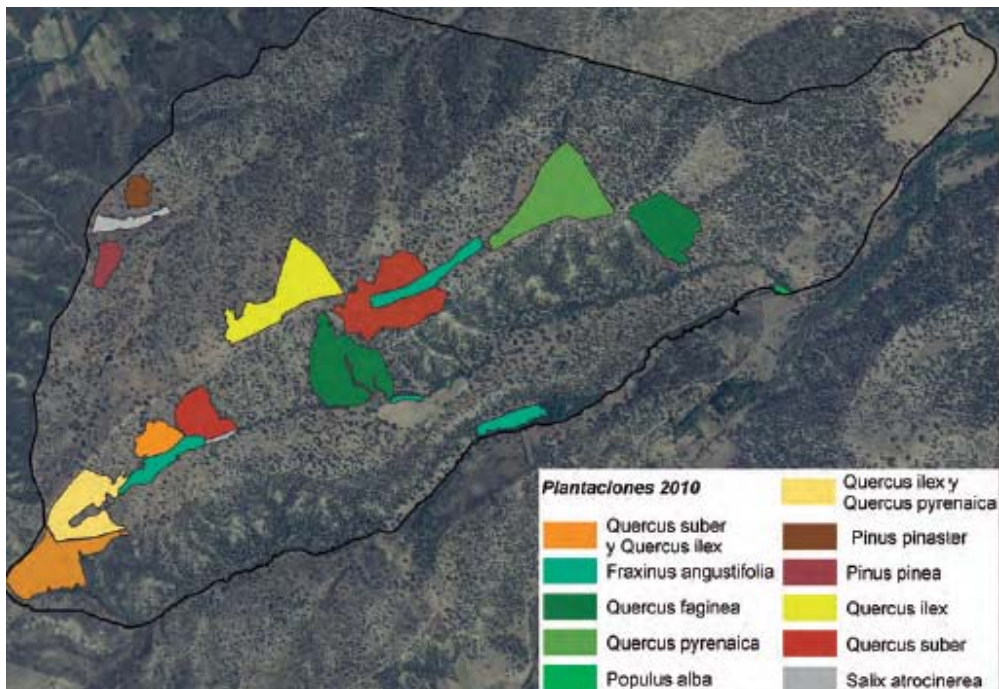
Small: 1-2 saps / Large 1-1,5 meters	2009-2010		2010-2011		2011-2012	
	Large	Small	Large	Small	Large	Small
<i>Quercus ilex</i>		600	135	1.500		650
<i>Quercus suber</i>		550	140		100	500
<i>Quercus faginea</i>				500		400
<i>Quercus pyrenaica</i>						200
<i>Fraxinus angustifolia</i>				750		500
<i>Salix atrocinerea</i>			250		300	
<i>Populus alba</i>			135			
<i>Pinus pinaster</i>				150		
<i>Pinus pinea</i>				150		
Total	0	1,150	660	3,050	400	2,250
	1,150		3,710		2,650	
Total	7,510					

CHART 1. Trees planted. Species, number of individuals, plant size and planting season.

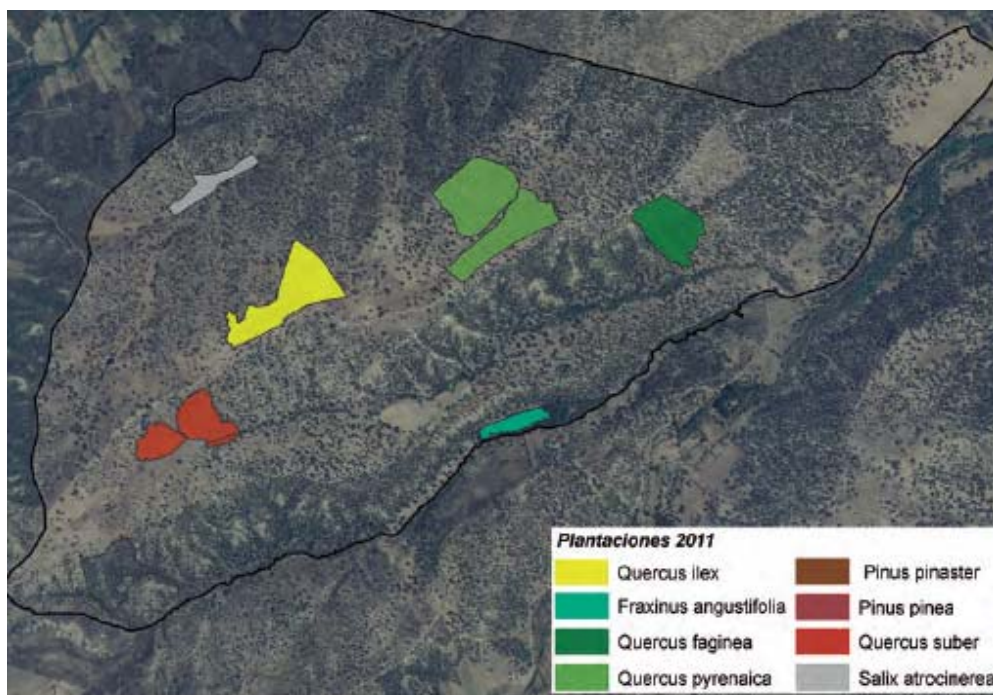
2009 to 2012	
Quercus ilex	20.2
Quercus suber	15.9
Quercus faginea	16.7
Quercus pyrenaica	19.8
Fraxinus angustifolia	7.3
Salix atrocinerea	3.7

Populus alba	0.2
Pinus pinaster	1.0
Pinus pinea	1.4
Total	86.2

CHART 2. Surface planted in target species.



Map of reforested surface in 2010. FNYH



Map of reforested surface in 2011. FNYH

The final survival percentage of reforestations was approximately 40%. This reflects the great difficulty in having success of plantations in sandy soils such as those that we find inside the reserve Campanarios de Azaba. The arid summer climate of the area also affects the progress of the restoration, water availability being the main limiting factor for seedlings.

At the beginning of the project, a reforestation took place at the end of winter -being important that plantations occur at the end of autumn/beginning of winter-, which largely failed. At first it was understood as being due to this reason, however, later experiences showed that the main limiting factor for the survival of the plants was sandy substrate, together with long and dry summer period. This theory was reinforced by the success of *Quercus faginea* plantations, located on the slopes suffering more erosion, where survival was higher because the soils contains a higher proportion of clay and therefore retains higher amounts of water, thus minimizing water stress. According to several authors, those Mediterranean forest plantations who do not have coat of the bushy substrate has less success, so this factor may also be applicable to the results obtained with this experience.

4.4. Forestry work aimed at regenerating habitat 6310 (evergreen pastures of *Quercus spp.*)

4.4.1. DESCRIPTION OF THE ACTION

Increasingly poor management of farms has degenerated into multiple conservation problems. Although, there are many factors affecting this magnificent environment, decimating its biodiversity and incorporating doubts for its future.

Overexploitation also occurs by increased pruning to produce firewood, cutting the stem branches to facilitate mechanized work, intensification of agricultural production even around each tree trunks, fungi and flora simplification due to periodic plowing of all the surface and the appearance of *Quercus* decline phenomena, known as *La Seca*, problem caused by the action of various fungi, especially *phythophthora*, though possibly its devastating effects are increase by multifactorial causes, some of them described in this guidelines.

The action aims at improving existing Holm oak woods and pastures within the reserve, promoting plant health of the trees and forest structure, to facilitate their development and fire protection, extending its longevity or *Quercus* decline in general. In particular, very specific trimmings performed in those Holm oaks that were coming from the regrowth and pruning and by *olivados* in adult trees, individual protections for seedlings where there is livestock management, etc.

Production pruning to increase the supply of fruit for primary consumers and punctual coppice trimming, which would ensure adequate stands of trees for possible nesting targets and that would maintain mass availability. Although in practice, production pruning were progressively abandoned.

Management of dead wood in both tree and in soil, is taken into account as a special performance which favors both vertebrates (insectivorous birds, dormice, owls, bats and small mammals) and invertebrates, especially saproxylic. In any case, this wood is removed, and it is under consideration whether to provide an extra supply of dead wood from other nearby intensified pastures where it is always removed, even undertaking a radical removal of trees completely perforated by insects, because of their age and be replaced by plantations of 1-2 saps which are recipients of EU funds for agro forestation.

4.4.2. EXPECTED OUTCOMES

Improved plant health and structure of habitat 6310 (evergreen pastures of *Quercus spp*) in Campanarios de Azaba as a whole.

4.4.3. WORK CONDUCTED AND METHODOLOGY

Before conducting forestry work or actions within the Reserve Campanarios de Azaba, we examined plant health of the forest as a whole, selecting specific areas. This allowed cartographical location and organization of the actions throughout the year.

The season when these forestry works were conducted, coincide with the coolest and wettest times of the year, autumn and winter, performed manually with chainsaw, ax and brushcutter by a qualified forestry crew.

Forestry

Pruning

Desmoche (Pollarding): Formation tree pruning which aims to achieve greater treetop surface (usually, only 3-5 main branches are left), in species of the genus *Quercus*. They are usually aggressive for the tree as to prepare it for acorn production, especially in those areas whose economy is focused on the Iberian pig breed.

The topping is made only in the months of October, February and the first half of March. However, it is a technique that is meaningless in those lands whose aim is not going to be raising pigs, but that will be dedicated to hunting, conservation, etc.

Ash *Fraxinus angustifolia*, has also been historically pollarded for the use of the branches by livestock. Virgin riverbank pollarding is becoming a conservation problem regulated by law in some regions as they are included in the Habitats Directive.

Olivados: Those cleaning pruning of dense, declining or dead branches. It's a soft pruning, for maintenance and sanitation, that can get to be crucial in masses treated with these methods, this is, most dehesas in this area.

During the LIFE project, all pruning made into Campanarios de Azaba reserve has been carried out by *olivados*. This is much less aggressive than pollarding and helps conserve the typical wooded pasture that, if not handled in this way, would in many cases tend to disappear due to a slowly collapse of the tree.

The main reason that these *olivados* have continued to take place is the need of management, because once the trees, in the early stages of growth, have been formed with these pollarding pruning formations, the natural way of tree growth changes and so requires a continuous management as both the center of gravity of the tree and the way branches grow, has changed. This variation in the physical shape and the tree growth creates problems due to broken branches because of an excessive biomass load and fungi infection, diseases and insects; so tree management is recommended.

Abandonment of tree management, occurring in many of the fields, in many cases resulting in a proliferation of suckers or branches on which sometimes moss grows disproportionately, choking and defoliating the tree progressively to the extent of weakening it or even causing a decline that finally ends its life. This phenomenon depends greatly on the quality of the treatments provided previously.

In the case of *Quercus pyrenaica* oaks, pollards with undergoing sudden and repeated treatments over decades, biomass reduction pruning have been done to alleviate the weight of the main branches and mitigate the "candle" effect caused by the wind.

In this case we selected the most exposed areas to the wind and prioritized actions in them, in order to avoid centenary branches from falling and prevent collapse of old trees and monuments that characterize the landscape of this land.

The Biological Reserve is not a production area, but of conservation and de-intensification, so stopping firewood extraction and treatment of trees is an objective of the reserve, being reduced to the choice of these forest stands that need support to not disappear, as they are being greatly affected by the processes described above.

Resalveos (Tree Trimming): Within these forest activities we can distinguish between those works done on isolated trees or bushes and groups of mainly young trees. This is referred to tree trimming work, in dense clumps of young trees where the aim is to open a gap and encourage the growth of stronger individuals.



- **Woodland Protection:** Protection of young trees in a combined system with livestock and wildlife use, is one of the ways to safeguard the natural and artificial (plantations) regeneration of the Dehesa.

In Campanarios de Azaba, 3 types of woodland protection have been carried out:

- Plastic protective tubes with aeration of 40 cm height: used for plantations with plants 1-2 saps.
 - Plastic protective tubes with aeration of 160 cm: used for tree plantations of 1 to 1.5 meters high.
 - Protective mesh 2 meters tall and mesh openings of 5x10 cm²: used to protect floor from 1 to 1.5 meters high with iron pickets of 1.70 meters for strengthening stability and resistance of the mesh.
- **Clearings and Firewalls:** Work in clearings and fire preventing bands have been primarily focused on fire prevention at the perimeter of the reserve.

Moreover, in coordination with the University of Alicante, there have been selective clearings also in some areas inside the reserve to foster *Lonicera sp.*, since it is the nurturing plant of the caterpillar of the butterfly *Euphydryas aurinia*, one of the species protected by the habitats Directive, which has performed a particular conservation action analyzed later in this guidelines. These clearings have included the removal of scrub competing with this plant, mostly blackberry (*Rubus ulmifolius*), in those areas with proofed presence of this butterfly's caterpillars, in those seasons not affecting the insects activity.

- **Dead wood:** As indicated in the above action for quality bioindicators of habitat 6310 from insect functional groups, this is a very important action to improve the habitat of saproxylic insects. In this way and in addition to pruning performed by forestry workers, material from pruning and branches has been deposited and left throughout the whole reserve to facilitate the habitat of these groups of insects.



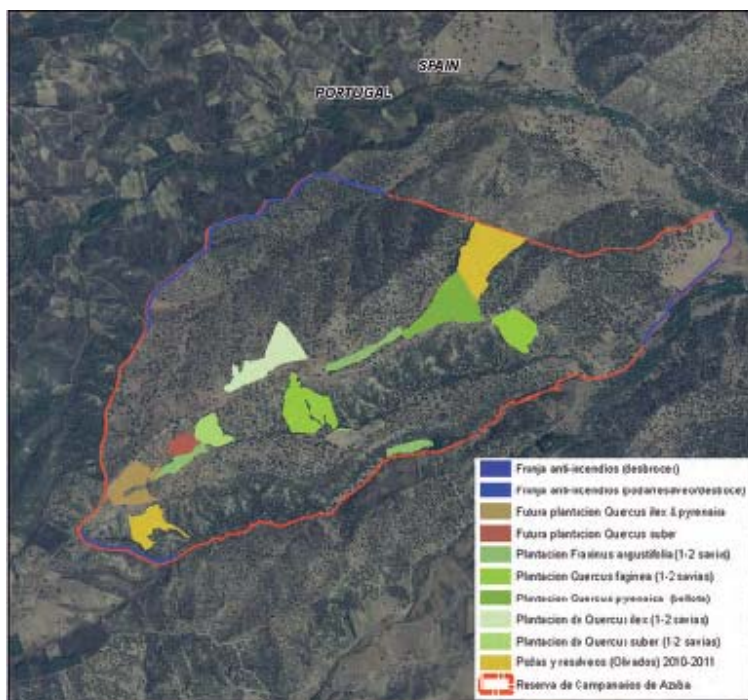
4.4.4. EXPECTED OUTCOMES

Plant health and structure of habitat 6310 (evergreen pastures of *Quercus spp*) has been improved in a total of 52 hectares inside Campanarios de Azaba, where the immediate need to implement these forest tasks was studied, because the growth of coppice was increasing mortality due to asphyxia and intraspecific competition and also increasing forest fires risk by leaving a continuous vegetation that could allow fire into the forest. These areas with more or less immediate need for action were also chosen taking into account the different agro-forestry uses that remained on the farm prior to its purchase by FNYH as well as the needs facing maintenance and existing habitat conservation, without aiming to achieve profitability for the forestry use in any case.

As shown below in the **Chart** Surface subject to forestry works inside the reserve and total area of each of the forestry actions performed within the reserve.

	2010 a 2012
Firewall	4.00
Firewall	1.29
Pruning and trimming I	4.02
Pruning and trimming II	9.40
Pyreanean oak pruning zone A	21.70
Pyreanean oak pruning zone B	5.82
Olivado 2012	5.65
Total	51.88

Chart Surface of forestry work performed within the reserve- Campanarios de Azaba [hectares].



Map. Surface affected by forestry works_FNYH

The surface of each of the forestry work or actions performed, has relied mostly in the study of forests inside the reserve of Campanarios de Azaba, which has reflected the physical demarcation of the different actions taken.

4.5. Creation and restoration of Habitat 3170 (Mediterranean temporary ponds).

4.5.1. DESCRIPTION OF THE ACTION

Priority Habitat designated by UE Directive which includes small size water bodies (ponds) of the Mediterranean, suffering partial or complete drying out during the summer. In the reserve, it is represented by a dozen ponds for livestock that are distributed along the small streams that exist on both sides of the central elevation, plus natural ponds in the channels which remain untouched.

This habitat usually presents the following problematic, which also occurred in the reserve at the beginning of the project. Namely:

- Many Mediterranean temporary ponds have been transformed into mere wells or drinking troughs for livestock, by excavation that have made deep holes in them, losing all functionality for biodiversity.

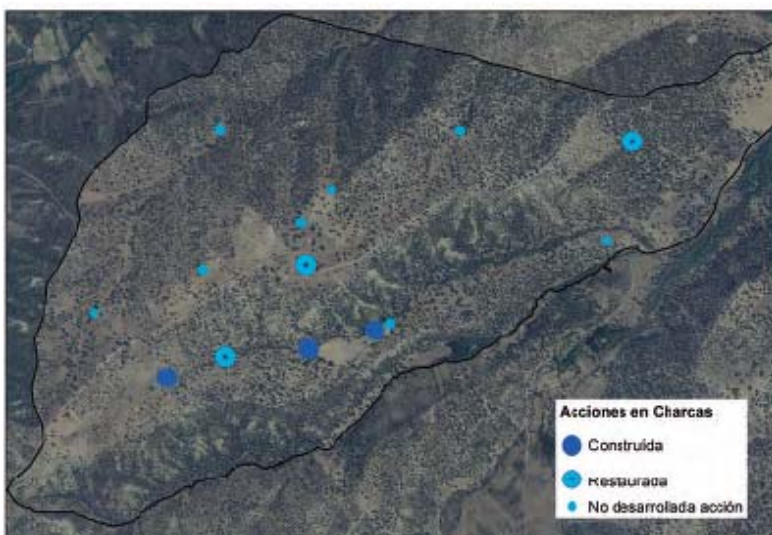
- Existing ponds presented different preservation status, but in general it can be said that, until the time in which FNYH took over the pastures management, most of them had a high degree of damage caused by high stocking that, together with constant trampling and eutrophication caused by their droppings, and their morphology, had led to drastic species impoverishment.

- Colonization by invasive species, especially *Azolla caroliniana*, water fern detected in the reserve, in one of the ponds, but also in other areas of the SPA.

This action is a measure aimed primarily at improving the populations of black stork *Ciconia nigra* in the area of the project and also common cranes *Grus grus* wintering in the vicinity that use this as resting and wintering area. But the restoration of these habitats also aims to restore plant communities, amphibians and reptiles (tortoise) present in this habitat.

This action is complemented by monitoring the breed of Black Stork in the three target areas Natura 2000, control of their use of ponds and tracking migratory concentrations in the areas included in the project to see its impact.

The whole of the works required for the creation of ponds took place between July and September of the first year, and after a period of rest of a month a half, transfer of amphibians took place.



Map. Location of ponds in the reserve_FNYH

4.5.2. EXPECTED OUTCOMES

Restored and/or recreated priority habitat 3170 in at least 4 sites of the land subject of action.

4.5.3. WORK CONDUCTED AND METHODOLOGY

The first step taken for the creation and restoration of Mediterranean temporary ponds inside the reserve was studying each and every one of the temporary ponds inside it in order to know their condition and establish in each case the priority restoration actions for each.

The performance was made correcting these factors:

1. Improved morphology and structure of the ponds, for the development of biodiversity and for use by the black stork and other birds that use these water points as feeding and resting areas, since perimeter had too steep slopes (not fordable nor usable by these birds to hunt frogs and other amphibians). This problem, typical to the Spanish dehesa, lies in the use of temporary ponds for watering livestock that are able to wade across these slopes, so landowners needn't to do a great work conditioning ponds in this sense.



2. Removal of invasive aquatic plants. In this sense we could control the presence of *Azolla caroliniana*, water fern that because of its American origin, its growth rate and its great capacity for colonization of other ponds, is considered an invasive species.
3. Management of ponds with livestock: Protection of Mediterranean temporary ponds in part of its surface has also been one of the techniques used to protect and conserve the biodiversity of these water points. These hedges have included the closure of a percentage close to 75-80% of the surface of the temporary pond, so that livestock can be watered in the 20 to 25% remaining. This fence protects vegetation and wildlife habitat linked to it for those times when feeding livestock remains in the area near the pond or in *montanera* time when the maximum pig load takes place. In times when there is no danger of stocking density being too high, fences were removed to not interfere with other wildlife, such as the spring-summer season when the Black Stork feeds in these points of water.

The works of creation and restoration of this habitat are located on surfaces with appropriate morphology to collect water runoff and store it for as long as possible throughout the year, especially during summer. Thus these works were placed on natural depressions, borders of small seasonal streams, flooded meadows with summer moist or by upwelling or proximity to the surface of the water table, etc., avoiding acting in existing natural and untouched Mediterranean temporary ponds.



In each selected area approximately 2,000 m² were excavated, with a maximum depth of 2.5 meters in its central area. The bottom was compacted. Leftover soil from excavations was accumulated at the edges of the pond where a small spillway was opened to drain the excess volumes in case of heavy rains.

The action was completed by planting macrophytes native to this habitat and moving amphibians egg lays from other ponds with good populations to new ponds, to accelerate the process of recolonization and habitat restoration. The capture and transfer was

performed with nets and capture meshes at night, being used for transportation small water tanks installed in vehicles. Furthermore, existing artificial ponds within the reserve where naturalized.

These three problems have been managed differently. Thus, the morphology of the ponds was solved using the heavy machinery needed to attenuate the slopes for birds and other vertebrates.

Furthermore, in those ponds in which the presence of *Azolla caroliniana* was confirmed, a disposal protocol was established.

The extraction was performed manually (landing nets, rakes, shovels, etc. ..) to get to completely eliminate the presence of that species of aquatic fern. Later, the remains of *Azolla* extracted from the pond, dried in a separated area from the pond, on plastics, for disposal burning and/or burying the remains. Tools used to extract this water fern were sanitized and disinfected to prevent the spread to other ponds by translocation of spores or plants.

A parallel activity to these three actions mentioned has been conducting ecological restoration in ponds inside the reserve with greater need because of its higher degree of degradation, in terms of biodiversity, due to the effect of previous livestock use. These ecological restoration consisted, first, in the removal and planting of native vegetation in those ponds with higher degree of conservation and abundant vegetation which had a lower degree of conservation and / or fewer native species. Plant species used in ecological restorations were reeds (*Juncus sp.*), pondweed (*Potamogeton sp.*) or duckweed (*Lemna minor*). This work must be done very carefully to avoid transference of invasive aquatic plants and prevent the spread between affected and unaffected habitats. The best option, or the only possible, is to not use those ponds contaminated by invasive plants as donors.

Furthermore, the ecological restoration of ponds has also considered the removal or translocation of amphibians egg lays among ponds. Amphibian species that have been translocated are: common or green frog (*Rana perezi*), Toad (*Bufo calamita*), Western Spadefoot (*Pelobates cultripes*) or European tree frog (*Hyla arborea*) among the most common frogs in ponds reserves, and Sharp-ribbed Salamander (*Pleurodeles waltl*) or marbled newts (*Triturus marmoratus*) among the species of urodeles. This action took place when the egg lays of amphibians were at their best, before the hatching of the eggs and the birth of new tadpoles or larvae. This particular period goes from January and July as different amphibian species have different breeding periods, concentrated among those months.

The construction of new Mediterranean temporary ponds in the reserve, and after the experience gained in the implementation of the project, will focus towards the harmonization of livestock use and biodiversity conservation so that new build Mediterranean temporary ponds must, firstly, have an optimal morphology for combination of these uses. Thus we have designed a pilot pond to serve as reference for the others.

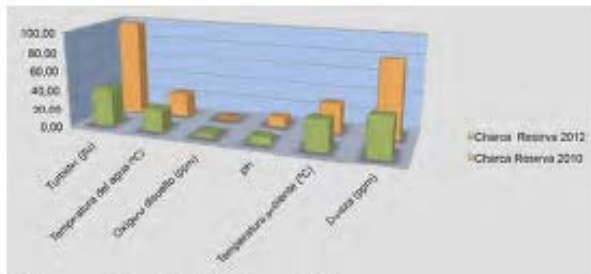
4.5.4. EXPECTED OUTCOMES

The priority habitat 3170 (Mediterranean temporary ponds) has been restored and/or recreated in 6 sites inside Campanarios de Azaba, 2 more than expected. Four of these points have been achieved through excavation. On the other hand, the other two Mediterranean temporary ponds were restored by removing invasive plants; though effect of de-intensification can be seen in all of them.

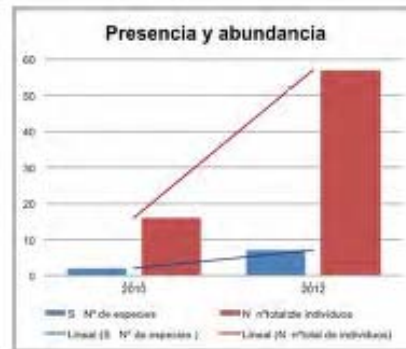
Ecological restoration placed by translocation of amphibians egg lays and native aquatic plants between ponds was carried out in all the reserve as to accelerate the natural processes of colonization and recolonization by these species, that naturally would entail a long wait .

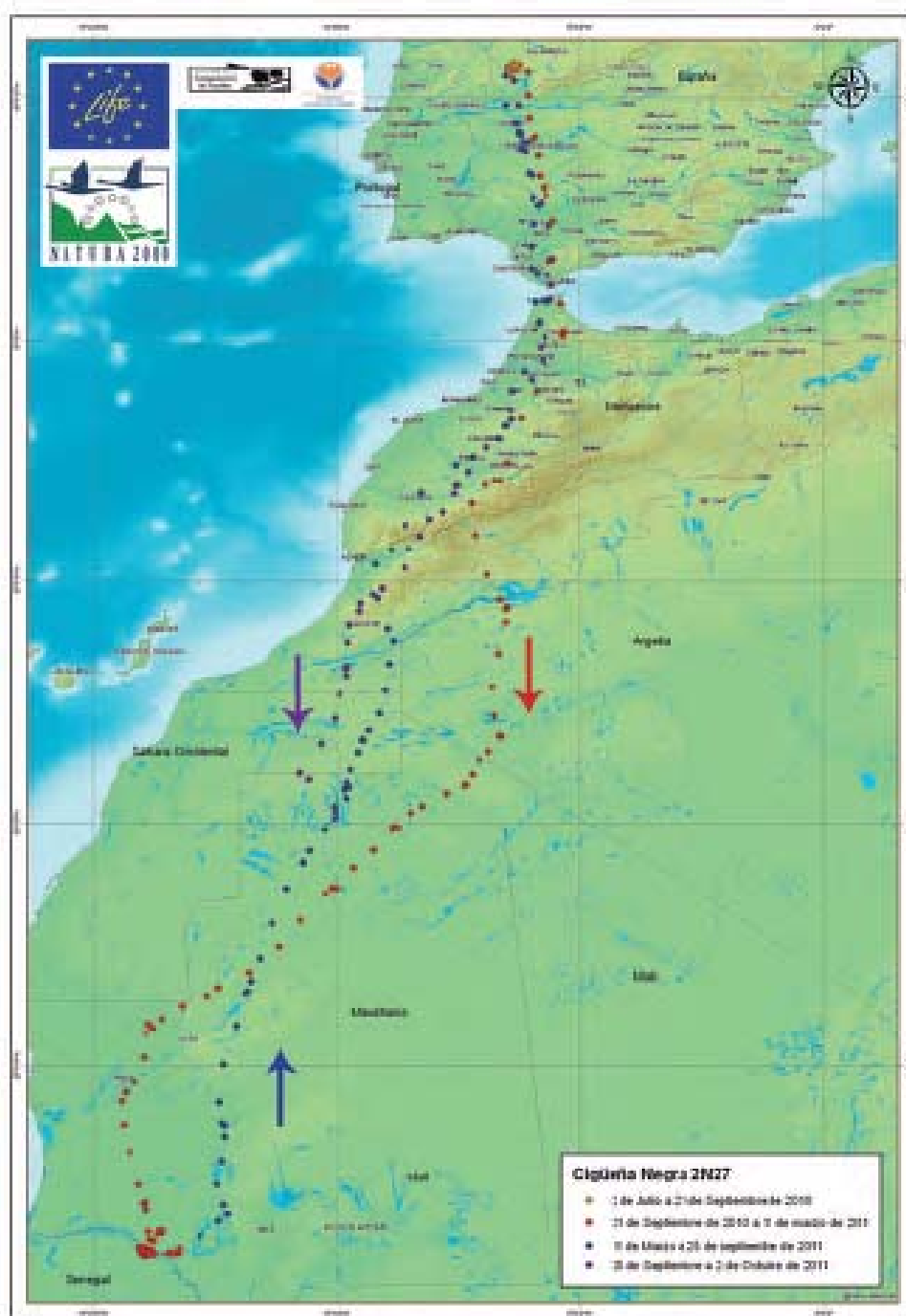
It has been achieved:

- An increase in the usable area for the Black Stork in all ponds in which work has been carried out, being fordable in almost 100% of its banks.
- Increase of the area occupied by macrophytes in all the banks of ponds, in a width not less than 3-6 m.
- Exponential increase in amphibian populations as a result of conditioning done and the increased availability of habitat, an evident feature in the dozens of ponds of the reserve, in addition to natural ponds, regardless they were subject to the LIFE project actions. Thanks to general de-intensification, they have experienced a dramatic recovery.
- Increased surface and sandy breeding habitat for the European pond turtle *Emys orbicularis*, which has a large population in the reserve.
- Increased presence and abundance of invertebrate species
- Increased carnivorous mammal observations, benefiting from this abundance of biomass, which they use as a food resource.
- Improved water quality, with a recovery and stabilization of all measured parameters that facilitate the development of life and encourage greater biodiversity (oxygen, pH...).

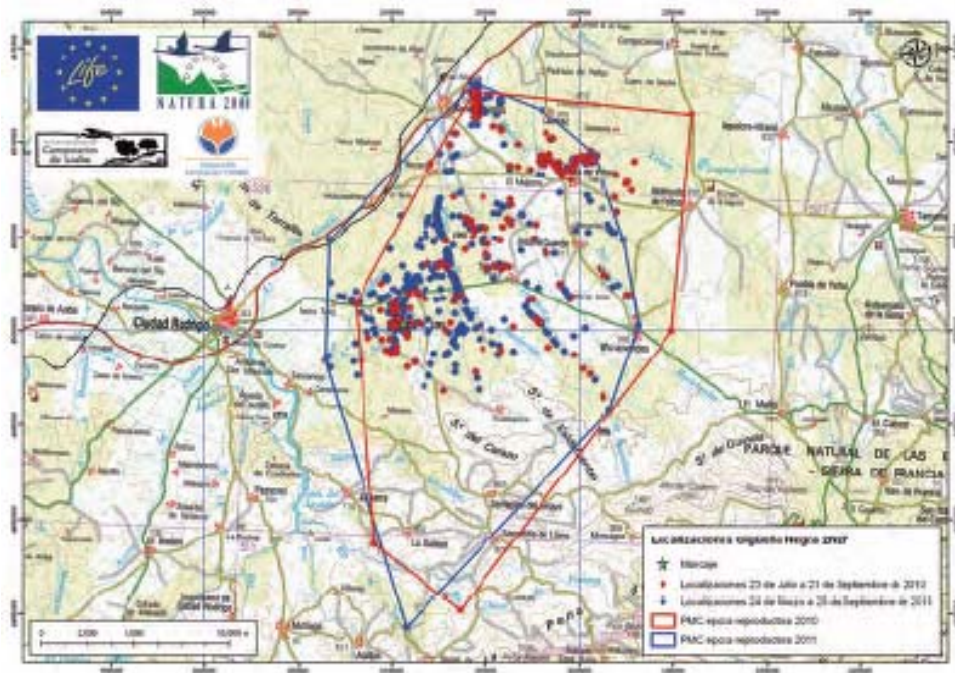


Gráfica comparativa calidad de las charcas, FNYH.





Map of the migratory route if the marked black stork. 2010,2011_FNYH



Location map within the province of Salamanca of the black stork marked with GPS. 2010, 2011_FNYH



- As a result of the above, Campanarios de Azaba is the best feeding area for the black stork in all the SPA Campo de Azaba, with permanent presence of

black stork feeding on the reserve. Several individuals feed daily in ponds, and the observations are constant. Based on observations in the field, the most frequently used ponds are those in the central area of the Reserve, ponds 8 and 10, where they feed on fish, amphibians and juvenile tortoises. Ponds 2 and 4 were also frequently used.

- The use of the reserve by black stork has also greatly increased as resting zone, given the absence of disturbances and improved habitat status.
- A couple of black storks has been seen breeding on the adjacent land to the Reserve, in a large cork oak. The nest was installed in a side branch, as of late April. Since that time continuous observations were made of both individuals entering or leaving the nest after or before going to feeding areas. This couple had a total of three chickens in the middle of May (05/15/11), although by the end of June (06/26/11), only two chickens were observed. In late July (07/27/11) these juveniles were already fully developed and presented definitive plumage. On this date the juvenile observed began exercising the flight muscles, for the flight to begin within weeks. However, it should be noted that the improvement in the habitat and populations of prey species (turtles, amphibians, arthropods) is much more significant than the improvement in the predator of these wetlands, the black stork, but this is due only to a matter of time, still taking two or three years to see the real effects of improvements on the population of this species.
- In addition, a specimen of black stork was marked in Campo de Azaba SPA on July the 23rd, 2011. It stayed until September the 21st, feeding in the ponds and streams. That is, in total, 61 days remaining in the area before the autumn migration. Migration began with the end of summer (September the 21st), crossing Extremadura, Sevilla and Cádiz, reaching the Strait of Gibraltar after three days of travel. On the 24th of September, it crossed the Strait and continued the migration in African territory, crossing Morocco including the Atlas Mountains, to penetrate in Algeria and consequently in the Sahara desert. It crossed the Mauritania desert to reach the country's border with Senegal. In total, autumn migration in 2010 lasted for 14 days reaching the wintering area on the border between Senegal and Mauritania on October the 5th, 2010. During this trip, it made 13 stops in total: night periods (between 7 pm and 9 am) during which it remains stable in one place. These stops are usually carried out on African territory especially near wetlands, rivers, lakes and oasis. It stopped in the wintering area for nearly seven months (157 days in total). In the area, it sits on the banks of the Senegal

River for most of the time, particularly in a section of 38 kilometers between the towns of Kaedi and Bababé. At the start of the winter, it stayed for 13 days north of this area near in a tributary of the Senegal River. Spring migration lasted only 12 days, with a similar migration route which crosses Mauritania, Western Sahara and Morocco and reached the Strait of Gibraltar on the 21st of March. It crossed the strait that night and after crossing Cadiz, Seville, Badajoz and Cáceres, it reached the breeding area on March the 24th. During this migration, the stork stops every night in different resting points than those used during the autumn migration, but also in wet areas. During the mating season, it inhabits near the place of capture, breeding again the following year. It remains in the vicinity of the nesting area in an area of 10-15 km around the nest, at all times. That year, they achieved raising a brood of three chicks. A map with their migration route and a use map of Campo de field, according to the locations received, is included.

It is now evident that environmental quality and conservation status of Mediterranean temporary ponds of Campanarios de Azaba is far superior to that found at the beginning of the project, so it has made possible the minimization of use and the mitigation or even elimination of high levels of eutrophication present in ponds in the reserve, due to high livestock and agricultural discharges which provided fertilizer, organic wastes and other wastes rich in phosphates and nitrates, altering the habitat. In some cases, it has taken years to produce a wash of substrates enough to eliminate or mitigate the problem. In more severe cases, summer drought maintained pH above 9, although in most ponds and pools the parametric values reached are balanced and optimal for life.

4.6. Installing nesting platforms for large birds.

4.6.1. DESCRIPTION OF THE ACTION

The nearest black vulture colony to the Biological Reserve is located in the Sierra de Gata, a place where more than 100 couples of black vultures nest and from where they move into the pastures of both sides, Salamanca and Cáceres, searching for food.

The problem of black vulture (*Aegypius monachus*) is due to the lack of food resources, but also to intense forest management developed in Sierra de Gata, noting that the largest colony is in Cáceres, in the Biological Reserve of the Sierra de Gata, with about 40 nests, and barely 4-5 nests survive in the side of Salamanca, where the disturbances are much higher. There is great difficulty in increasing the colony in this northern area and trying to find solutions to the problem has fostered the settlement of black vulture by

developing two actions. First, creating nesting platforms with social attraction decoys and secondly, by supplementary feeding, developed in the next action of this guidelines.

The black stork (*Ciconia nigra*) has in Argañán and Azaba and one of its main Castilian-Leonese strongholds, with about 11-12 nests located in pine and holm oaks of the area. The loss of nests due to tree death or disturbances has made us think about this action which tries to focus nesting platforms in quiet places, preventing from spoiling egg production or death, caused by human disturbance.

The imperial eagle *Aquila adalberti* has its nearest breeding location found in the International Tagus Valley, having been observed in dispersions by the Sierra de Gata and *el Rebollar*, though, it has not been observed in the area throughout the development of the project.

The action involves installing nesting platforms in appropriate breeding areas for black stork, black vulture and the imperial eagle with the aim at directing nesting activity to safer and more quiet areas, increasing the chances of reproductive success of these species in the area. This technique has already yielded positive results in various projects in the Iberian breeding cores of the three species, being generally occupied by newly formed couples or couples who have lost their homes by the action of wind, fire or other causes. This type of artificial platforms are very attractive to birds by the assumed significant energy savings, as they avoid having to provide building materials, only needing to refurbish its inside or just upholster it with branches and fresh herbs.

4.6.2. EXPECTED OUTCOMES

Nesting platforms at least in 8 points in the project area installed. Black vulture and black stork nestlings inside the reserve, proven.

4.6.3. WORK CONDUCTED AND METHODOLOGY

Early work regarding the creation and installation of nesting platforms for large birds inside the reserve has studied possible locations to install platforms on the field. This was the cornerstone of this action as being two completely different species of birds, concrete trees should be studied in which structures where such nesting place.

Large trees over 10 meters tall were found for the black stork *Ciconia nigra*, preferably *Quercus suber*, located in very quiet undisturbed sites, such as valleys. These desired features for the trees in which platforms for black stork would be set, are subject to the peculiar activity of Black Stork which, besides needing a quiet place for breeding, it has a nesting style which is distinguished by building nests inside the treetop hence it usually uses large branches or areas near the main stem. The preference for locating platforms in cork oaks is explained by their larger size and the observed nesting in other areas. The

cork oaks have been molded by man for the use of cork for centuries, shaping the morphology of the tree so that the provision of the first branch is located at an average height of about 4-6 meters high due to the use cork from the trunk in this area.



De arriba a abajo y de izda. a dcha.:
 » Alcornoque (*Quercus suber*) escogido para la instalación de la plataforma, FWH.
 » Un alcornoque de gran porte superior a 10 metros, FWH.
 » Instalación del redamo de cigüeña negra, FWH.
 » Aspecto final de la plataforma instalada en el árbol, FWH.



The black vulture *Aegypius monachus*, prefers to locate its nests in the treetops. Thus, we studied the location of those trees that, as well as large sized, are located in quiet areas without human disturbance. For the location of the black vulture's platforms it is important that there are no physical barriers that prevent the entry and exit. As they are large birds with big wingspans, they need enough space to start the flight; hence a sloping terrain and the lack of obstacles in front of the platform greatly benefit the chances of success.

After locating suitable trees for building platforms for black vulture and black stork, the following works consisted in:

1. **Conditioning** of the area where the platform is to be installed. In some cases it requires a preconditioning, taking into account the entry and exit of the birds to it. In the case of the black vulture, this conditioning has become necessary in all cases because in Campanarios de Azaba, Holm Oaks had to be used for installing platforms therefore conditioning the treetops was needed. The black vulture nests preferably in pines that have lost his treetops caused by wind or some other environmental factor and the absence of this tree species within the reserve is what has led to installing the platforms in *Quercus ilex*.
2. **Installation of the platform**; in this case, we have used metal rings of about one meter in diameter and 3 mm thick, reinforced with metal rods of 0.8 cm diameter forming the base to place decorative foliage. These metal structures should be sized prior to the placement in the tree because each tree has its particular size and shape, so that these structures must be tailored to each individual case. For the black stork, this is more evident given the need to adapt the nest to the conditions of the internal branches of the tree. In the case of the black vulture, it may not seem so obvious, but this exercise should be done prior to installation.
3. **Decoration** inside the platform, with branches and vegetation from the area that can come from the preconditioning or any other pruning that has been performed. The branches should be placed at the base of the platform and then criss-crossed with vegetation of the surroundings, such as lavender or brooms. Subsequently this mattress is covered with moss giving a sense of antiquity and platform stability. In some cases you can also decorate the nest built with some gypsum or lime, as bird droppings, scattered around the outside of the nest to give the impression that this platform has been used previously.

All works carried out on the installation of nesting platforms have been high-risk jobs as they were conducted at heights and on live material (wood) which can cause unexpected accidents, so it is necessary to follow all safety rules, working with the appropriate personal protective equipment.

4.6.4. EXPECTED OUTCOMES

After studying potential trees that could host these infrastructures throughout the whole reserve, finally, six platforms have been installed in different parts of the Reserve to promote black stork nesting and five other nesting platforms for the black vulture. In total,

eleven new platforms were built for large birds nests¹: Black Stork *Ciconia nigra* and black vulture *Aegypius monachus*. In addition to this action, four more platforms for white stork were installed in the surroundings of the housing area.

All of these platforms have been used in addition to placing life-size decoys in order to socially attract species object to the biodiversity conservation actions of this project. We also think that the placement of life-size decoys in some of the platforms built, along with making some management improvements, has helped to establish a quiet core for this sensitive species, permanently present in the reserve.

In two and a half years, since the installation of all nesting platforms until the end of the project, there is no evidence that any of the platforms have been used, although it is noticeable the increased presence of these birds in the reserve, so it is expected that they may be used in future for other breeding couples.

As important finding that has resulted from the action of the project, the nest of a couple of black stork was found in 2010 in an area near several platforms installed for the black stork. This black stork has continued breeding in the following years, but she created another nest near the reserve on a neighboring land, although this should be interpreted as a result of the project actions.

Performing various nesting platforms comes along with its maintenance throughout the year, due to the growth and falling of branches. An annual review and maintenance of each of them is performed.



Ejemplar escogido para la instalación de la plataforma (nido artificial) de buitre negro, FMYH.



Los nidos de buitre negro se localizan en la copa de los árboles.



Al ser un ave de gran envergadura necesita un espacio despejado para aterrizar.



Detalle del nido con el fondo de la finca.



Carlos Sánchez, participando en la colocación.



El técnico Ángel Fernández, probando el nido.

4.7. Improved food resources for carrion birds

4.7.1. DESCRIPTION OF THE ACTION

The application of sanitary control of animal subproducts not intended for human consumption, mainly the EC Regulation 1774/2002, has had a positive impact on preventing transmission of Spongiform Transmissible Diseases (STDs) among livestock species and human beings.

However, at the same time, it has led to a significant reduction in the availability of food for threatened scavengers, of which Spain is home to its main European populations. To date there have been some palliative measures, both regulatory and practical actions. However, the problem gets worse over time, and the effects on the populations of some of these raptors begin to be worrying.

It is very necessary to implement alternative solutions. This is a growing threat factor and can be tackled before they increase the risk of extinction of Egyptian vultures, black vultures or Spanish imperial eagles; maximum representatives of the Iberian biodiversity and whose role is fundamental in many food chains of ecosystems

In order to help mitigate this rising problem, this action is posed in one of the most important areas for the black vulture *Aegypius monachus* in Iberia:

Shaping a supplementary feeding point for the black and Egyptian vultures, with expected presence of both kites, black (*Milvus migrans*) and red (*Milvus milvus*), griffon vulture and several species of corvids, in order to provide a feeding point free from disturbance in the area covered by the project, given the problem of food shortage for scavengers due to the absence of dead livestock in the pastures because of restrictive European laws on this particular issue. However, because of its population levels and the proximity to one of its major colonies (Sierra de Gata), the black vulture would certainly be the species of greatest conservation concern that would benefit from the installation of the feeding point.

4.7.2. EXPECTED OUTCOME

The feeding point would be built by 2009, its use beginning as soon as the permission of the competent authority was given. Used preferably by specimens of black vulture *Aegypius monachus* and Egyptian vulture *Neophron pernocterus*. In addition, and to a lesser extent, griffon vulture, red kite and black kite also benefit from the feeding point.

4.7.3. WORK CONDUCTED AND METHODOLOGY

The first step to building the feeding point was to study its possible physical locations. Thus, we took into account all the constraints imposed by the different administrations (legislation that applies can be found in the annexes) and chose the ideal location for an infrastructure of this kind within Campanarios de Azaba, establishing physical limits.

In general, the feeding point must be in an open area (with herbaceous or shrubby short vegetation), in a sloppy hillside, so as to facilitate the take off of carrion birds once fed, sometimes a difficult maneuver due to its large wingspan.

By the very nature of the activities involved, it must be sufficiently far from any human activity to be developed within the reserve, including any other action of the Project. It also took into account the separation to electrical installations that could be dangerous for the vultures in their landing and takeoff maneuvers to the feeding point.

It has a minimum area of 1 hectare, so allowing the stay of a large number of vultures inside (vultures are gregarious animals and gather in large numbers to eat), and in a relatively quiet and isolated environment. The perimeter is fenced, so that other carnivores do not have access to food (opportunistic wildlife such as foxes or domestic dogs and cats). The enclosure consisted of a simple torsion mesh 2 meters high, buried 50 cm below ground level with concrete strip footing. This fence was placed so as not to interfere with the takeoff of the vultures.

There's a single entry, with a locked door, provided with a Canadian barrier modified in the sense to present a bigger separation than usual, in order to prevent entry of cattle and carnivores to the area. Reptiles and amphibians were prevented from the Canadian barrier by creating a side exit to it. Before the barrier there is a pit with disinfectants for vehicle wheels.

There is an access road that allows the transportation of food throughout the year, without the vehicle having to step over animal remains. Property information signs from the feeding point, exclusivity of products that can be disposed, the points to leave the carrion and any other relevant information was placed beside the door. In a corner, a ditch was built to bury the bones, skins, hooves and other remains not eaten by scavengers.

Once finished the fencing the feeding point and its entrance, it only remains to signal it properly as a feeding point, registered in the feeding point network if the regional administration by a indicative poster.

4.7.4. EXPECTED OUTOCOMES

This action has managed to reduce the problem of food shortage in the black vulture's colony of Sierra de Gata and its vicinity.

After the long paperwork to get proper authorization to allow providing carrion with a vehicle for the collection and transportation of corpses, finally a private feeding point was operative in which besides being able to provide carrion, you can authorize other farmers in the region to contribute to our feeding point with a request to the regional administration. This activity makes FNYH have a more direct relation with farmers in the region, which require our services for the collection of dead animals on their farms.

The feeding point's supplementations depend on the time of year, being higher in the season corresponding to the reproduction of the target species; but allowing regular supplementation throughout the year.

Availability of carrion was not constant; though it was solved increasing the network of partner farms.



The feeding point has been put into operation during the final year of the project because of long administrative process. This has prevented from creating essential synergy between the action of installing platform for black vulture's nest and this, as it one can not work well without the other. The greatest potential for success of a hypothetical black vulture nesting in Campanarios, will only occur in case they have trophic resources available; believing that in next years, the opening of this feeding point will contribute to achieving the expected results. The expansion of the species into the northern areas will be marked by consistency in food resources provided over time.

4.8. Management plan for the rabbit (*Oryctolagus cuniculus*)

4.8.1. DESCRIPTION OF THE ACTION

The rabbit is the keystone species of Iberian ecosystems, as it's a prey for all predators. However, habitat loss, disease and hunting ally against the wild rabbit populations, decreasing for decades, being a vital species to the Mediterranean

ecosystem.



Buitre negro (*Aegypius monachus*), FMYH.



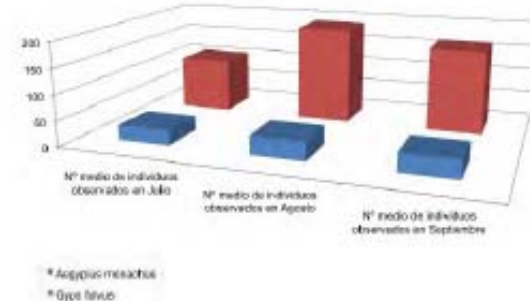
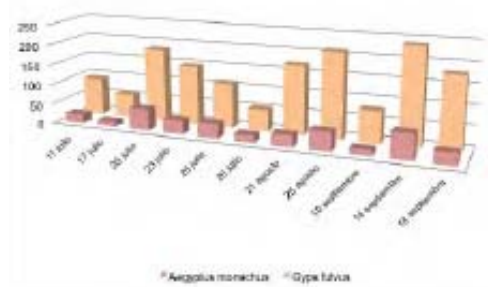
Buitre leonado (*Gyps fulvus*), FMYH.



Milano negro (*Milvus migrans*), FMYH.



Alimoche (*Neophron percnopterus*), Staffan Widstrand.



The population decline caused by myxomatosis and viral hemorrhagic pneumonia, subsequently modified proper functioning of Mediterranean ecosystems, leading to certain predators population to dramatically reduce its levels and even disappear from large areas. The rabbit, generally in Iberia, has about 60% less individuals compared to their original populations, but also local extinctions of large areas are common.

The area of performance of the project has not been immune to this problem, localizing few nuclei where the rabbit remains to minimal levels in Campanarios de Azaba and Malcata nuclei, scanty remnants that prevent from maintain populations of predators which are unable to expand, surviving stable for many years.

To help address this problem a Rabbit Management Program has been developed; the design aiming to achieve the following objectives:

- Create sustainable wild rabbit populations over time which evolves in harmony with natural processes and factors such as disease and predation, without periodic contributions due to declining rabbit populations.
- Achieve high population density cores from which the rabbit could recolonize peripheral areas, which would improve the habitat to support this expansion.

The ultimate goal is to recover the wild rabbit in areas that have had historically good populations of the species in which currently population density levels are low or very low, thereby increasing the availability of food for endangered species such as the Iberian lynx, the imperial eagle, black vulture...

At the beginning of the project, a quantitative survey was conducted to determine the starting point of the rabbit population, prior to the commencement of actions aimed at improving the habitat of these lagomorphs. To this end, we conducted a systematic sampling grid of 500x500 m² and in randomly selected natural warrens.

The program raises a habitat enhancement designed to obtain the following types:

- Areas with abundant refugee points, with fruiting shrubby vegetation with canopy coverage of 35% to 65%.
- Areas with abundant feeding points and water supply, both natural and artificial.
- Areas sufficiently far from roads or trails.
- Areas with soft soil, slopes or mounds easy to excavate by animals to make their burrows.
- Areas far from wild boar's settlements (closed forest formations).

And conducting periodic monitoring with a valid methodology to determine the response of rabbit populations to the actions taken and determine how best to promote their populations.

4.8.2. EXPECTED OUTCOMES

In January 2012 in the land there existed a large and stable population of rabbit without necessary restock with new specimens. This population would favor the presence of Mediterranean forest predators.

It was achieved an increase of over 50% in the presence (either for breeding or merely as a feeding area) of the bird species that depend on it: golden eagle, imperial eagle, owl and black vulture, on Campo de Argañán and Campanarios de Azaba as a whole.

4.8.3. WORK CONDUCTED AND METHODOLOGY

The work performed within the management program of wild rabbit populations of of project in Campanarios de Azaba focused primarily on the observation of existing populations within the reserve and surrounding areas, their foraging sites by activity traces and shelter areas containing food and water. The study of data collected by these observations provided us valuable information regarding potential areas for establishing new populations of wild rabbits as well as expansion and reinforcement of existing populations.

Once we knew the best areas of the reserve to locate the most suitable working points for the management and improvement of wild rabbit populations, we designed a network across the whole area to create artificial burrows, providing food and water, in order to establish small settlements which in the future could be connected and this way create a good and stable population in the overall of the reserve. These zones should possess several characteristics that are essential for the stability of a rabbit population along its annual cycle:

- **Presence of natural shelter:** Where possible, areas with natural bushes (brooms or brambles) or with pruning remains must be sought to confer extra protection against predators in the artificial shelters built.
- **Nearby water points:** There must be a Mediterranean temporary pond to a maximum of 200 meters away because although artificial watering was provided, to create a natural fondness to the zone, it must have a continuous water supply.
- **Mosaic of habitats:** Preferably with open areas of grassland in combination with woodland and scrub, where this species of lagomorph could find food while protecting from predators.

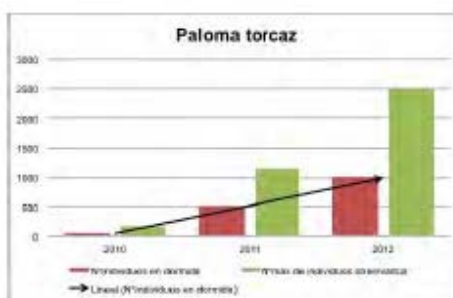
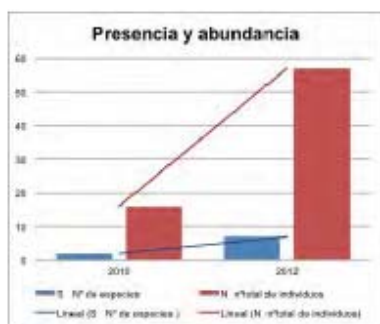
In each of the selected areas to establish a management and improving point for rabbit populations, works to build warrens or artificial shelters were conducted taking into account the peculiarity of each zone; one of the warrens was fenced with the intention to serve as an acclimatization warren, fenced, in which release the rabbits, providing extra protection for reintroductions of new specimens of wild rabbits. These acclimatization and fenced warrens have 4-8 ways out that allow rabbits to go out after 2-3 days of

acclimation to the area. This acclimatization to the release area is a very important factor to consider in reintroductions since the stress from the release of specimens generates nervousness as well as large movements of individuals so, with fenced warrens the calm needed was provided to allow optimal establishment of the rabbits in the area previously prepared for it.

Besides fencing warrens for acclimatization, in each of the selected areas there was created a range of artificial shelters composed of other satellite warrens, which were intended to create a safe area for rabbits after the release of the acclimatization warrens, as to reduce post-release predation pressure.

To promote the establishment of the rabbits released in each of the areas selected for the management of wild rabbit populations in Campanarios de Azaba, cereal legume crops were grown in close areas, to increase the availability of trophic resource. The basis for good population cores is to have enough shelter; food and water to create the necessary conditions needed by a stable population to generate excess population levels to colonize other territories. The species used in the planting where wheat, rye and vetch.





The materials with which warrens have been built were varied, having used from wooden pallets to building materials (bricks), stones and even used car tires, all combined with local materials like branches and soil. The particularity of the sandy composition of the area of the reserve Campanarios de Azaba is in principle the ideal substrate for the rabbit, which has led to this variety of materials, to compare between the fondness of wild rabbits to each material. Thus, we proved that the warrens that have been most successful have been those that combined brick (as a maze) under a covering of wood, soil and branches. In addition, also wooden pallets made with low branches and soils, were proved to be good shelters.

An important feature to consider when building an artificial shelter for the rabbit is that the land on which its to placed should not puddle, so it is recommended that these shelters are located in areas with soft slopes to solve the problem in case of heavy or constant rain.

4.8.4. EXPECTED OUTCOMES

Six fences have been built for acclimatization warrens, with food and water bowls installed in the vicinity. Besides these, four small warrens were built in the surroundings of each of the fences. Also, around each of the areas where these fences are located, more shelter was provided with plant remains placed on wooden pallets and covered with soil from the area, forming a type of warren widely used by rabbits; that will serve to promote the installation of a stable population in this territory.

To complement this action, there have been several performances as the collection of plant remains from pruning, located clearings to promote the availability of food, food and water, sowing cereals and legumes, all aimed at the management, recovery and establishment of a large population of these herbivores.

There has been the establishment of a stable population inside the reserve Campanarios de Azaba, existing a population center in an area near the main water course apparently expanding and several areas of sporadic presence in those places where recolonization has been fostered by artificial warrens. But new reinforcements are needed for the population, since its distribution is limited to a small area of the reserve.

It has increased the presence of raptors such as golden eagle or black kite, using it as a feeding area. The nesting of booted eagle, short-toed eagle or red kite was proved in the reserve, fulfilling the project's objective.

As well as raptors, the observation of predator mammals has also increased.

However, the main difficulty found was the predation occurred. Virtually all rabbit predators are present in high density, being the Lynx and Wolf absent.

Fox (*Vulpes vulpes*), mongoose (*Herpestes ichneumon*), marten (*Martes foina*) or weasel (*Mustela nivalis*) have been the most incisive predators; followed by aerial predation led by Booted eagle, red and black kites; looking for young rabbits.

The population has shown no symptoms of disease, being absent of myxomatosis and viral haemorrhagic fever; however predation was very high, causing post-release declines up to 80% of the animals released in the following weeks.

4.9. Improving *Cerambyx cerdo* populations

4.9.1. DESCRIPTION OF THE ACTION

It was proposed to carry out a development of study protocols populations of this insect species saproxílico, included in Annex II of the Habitats Directive, considered vulnerable by IUCN and included in the Bern Convention (Annex II) as strictly protected. This raised further establish monitoring plans for their populations in order to analyze their evolution over time and their relationship to changes in habitat management. It also established the select certain areas where improvement programs establish their habitats in order to establish recovery programs for their populations. The monitoring of this species should be carried out with specific trapping.

4.9.2. EXPECTED OUTCOMES

Increase of 30% pork *Cerambyx* observations between the start and end of the project in all three Natura 2000

4.9.3. WORK CONDUCTED

Cerambyx cerdo is a characteristic species of Holm oaks, which has been quoted numerous times in pastures localities of the province of Salamanca and other areas of Castilla y León. Official data showed earlier that we had the presence of *Cerambyx cerdo* in Ciudad Rodrigo, the location of the Reserve Campanarios de Azaba.

To locate *Cerambyx cerdo* inside the reserve Campanarios de Azaba, a total of 64 traps was used, distributed in the land, of which 32 were window traps (action 3.2.1) and 32 emergency traps (action 3.2.1) that have been active for two years. Despite this high sampling effort, the presence of *Cerambyx cerdo* was not detected in 2010, the first year of sampling. As an incidence to point out, the first year, sampling had to be suppressed for traps in point 7, since it was coincident with the nesting season of black stork, so it was preferred to avoid any interference with their biological activity as this species is very sensitive to disturbances and easily forsakes the nest.

During the second year of study, in 2011, sampling in point 7 was possible since a path was found that did not interfere with the zone of possible black stork nesting. It was at this point that the first recorded observation of *Cerambyx cerdo* occurred in the month of February 2011.

Subsequently, as a result of increased sampling, we recorded three specimens in the month of August 2011.

4.9.4. EXPECTED OUTCOMES

At present not well known distribution in the Iberian Peninsula as *Cerambyx cerdo* is often confused with *Cerambyx welensii* (*Cerambyx velutinus*). This error has led to the rejection of the conservation of *Cerambyx cerdo* by large sections of farmers and land owners who attribute damage in *Quercus* species in dehesas of this species, when they are actually produced by *C. welensii*.

In total 116 specimens of *Cerambyx welensii* were registered, compared to 4 of *Cerambyx cerdo*. The ratio of these two species is common and is within the ratio found by other researchers in other parts of Europe.

The results achieved in Campanarios de Azaba throughout this study, have revealed the abundant presence of *Cerambyx welensii* along all the Reserve of Campanarios de Azaba while populations of *Cerambyx cerdo* are much smaller and generally intermingled with the first.

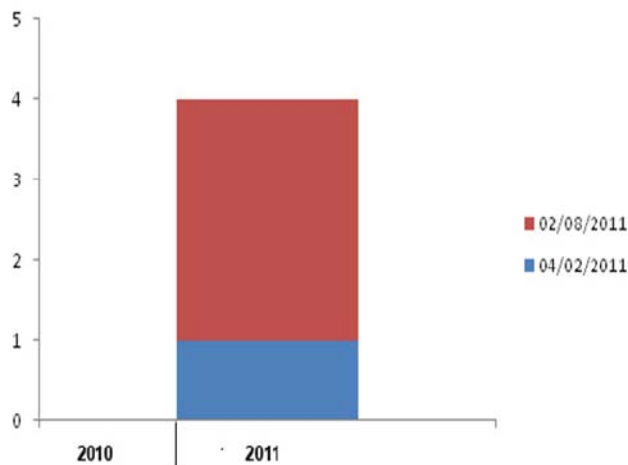
While the detected abundance of *Cerambyx cerdo* might seem low, the data indicate that there is a well-established population in the reserve of Campanarios de Azaba which can be easily maintained and improved through an open forest management plan that has

been established within the management plan that has been established in this LIFE project, which includes the *olivado* of holm, gall and Pyrenean oaks, along with the retention of dead wood on the ground from fallen or pruned branches.

The planned study protocol and setting of intensified sampling, allowed meeting the target of locating the species within Campanarios de Azaba, while increasing the number of observations by 75% over the year 2011, since the location of the first specimen at the beginning of the year.

	04/02/2011	02/08/2011
<i>Cerambyx cerdo</i>	1	3

The presence of *Cerambyx cerdo*, according to the data obtained indicates that the species should be present throughout the land, although in discontinuous populations' far one from each other. Most individuals were located in cavities of *Quercus pyrenaica*, facing south or southwest. The trunks of the trees used where those with a perimeter between 150-190 cm and at a height of 2 to 2.4 meters.



Increase in the quoting of *Cerambyx cerdo* in Campanarios de Azaba

4.10 Improving *Euphydryas aurinia*'s populations

4.10.1 DESCRIPTION OF THE ACTION

We planned tuning the protocols of populations studies of this species of Lepidoptera included in Annex II of the Habitats Directive and as strictly protected in the Berne Convention (Annex II). This butterfly feeds mainly on honeysuckle (*Lonicera spp.*), occurring in well preserved copse. The Maid of red waves, as it is commonly known, is a univoltine species that overwinters in larval stage, caterpillars living gregariously in silk nests until spring. The flight period of the adults of this species extends from May to July.

The project had raised establishing monitoring plans for existing populations in order to analyze their evolution over time and their relationship to changes in habitat management. It also sought to identify certain areas where habitat improvement programs could be established. Monitoring would be done with specific trapping.

4.10.2. EXPECTED OUTCOMES

Increase of 30% of observations of *Euphydryas aurinia* between the start and end of the project in all three Natura 2000 object areas.

4.10.3. WORK CONDUCTED

The caterpillar of this nymphalid, as already indicated, feeds mainly on honeysuckle (*Lonicera sp.*), a plant that has been often affected by changes in land use, agricultural intensification or incorrect forestry work. One of the factors that affect the conservation of this plant species are the clearing works of the spiny bushes where it lives. At the beginning of the LIFE project, it was noted that the lack of proper land management had led to the loss of *Euphydryas aurinia* habitat, therefore during 2010 we proceeded to identify and delineate potential breeding areas to enhance the nourishing plant of the caterpillars and promote the establishment and development of populations.

Euphydryas aurinia habitat was improved over 2011, favoring the growth of honeysuckle by removing brambles invading these areas and establishing climbing supports for plant growth. Given the dispersal ability of the species, it was expected that once the habitat was recovered by the improvement plan, an increase in population and natural colonization from nearby lands will happen.



Mapa Presencia de *Euphydryas aurinia* en la Reserva Biológica de Campanarios de Azaba, FNYH.



4.10.4. EXPECTED OUTCOMES

The result of these actions was the location in April 2011 of caterpillars of this butterfly in *Lonicera* bushes, in two areas of the farm (Map. Presence of *Euphydryas aurinia* in the Reserve of Campanarios de Azaba). The points were geolocated and bounded, and the established protocol for habitat improvement was implemented.

In 2012 new evidence of biological activity of tracks on the nourishing plant were observed, such as the existence of baggins and remnants of pupae, having found three clutches of eggs in late July.

One factor to consider in the management of this species is its great dispersal capacity and metapopulation formations that has as a consequence that their presence in different parts of the region may have discontinuous presences, appearing intermittently in new areas nearby .

An important factor is that you can always register empty habitats and absence of the species in places where specimens may have been registered in previous years. For this

reason, in 2011 and 2012 new habitats with the nourishing plant were found where that were improved in order to facilitate future colonization of the species, thus ensuring its natural process of survival of populations in the Biological Reserve of Campanarios de Azaba.

5. Best practices

Improving the resilience of the dehesa

While much of the actions defined in the previous section can be considered themselves good practices, this chapter details a series of matching or complementary criteria to the actions carried out, which guide the management of the pasture to sustainability. As a result of the experiences carried out during the LIFE project and after collecting ideas and experiences from other owners, managers and other projects, we can synthesize a series of measures to put in use, that will help ensure the sustainable management of pastures or open Mediterranean forests.

All these good practices have the overall goal of increasing the resilience of the dehesa - defined as the ability of the ecosystem to adapt to change and to maintain its structure and functionality when facing external changes and disturbances.

In a changing and increasingly exposed to global change area, the question is whether ecosystems as the dehesa will have the capacity to address and overcome the global changes that are taking place in this century.

The problems of their habitats has a multifactorial cause and is not attributable to a few specific reasons, but all together they are creating a less resilient environment to global challenges that truly affect vast areas of pastures and open forest in the Iberian Peninsula.

The *dehesa* fulfills its function as a carbon sink especially when managed sustainably. Deposits of carbon in the soil favor soil productivity and water retention, though this capacity is decreased when soil use is intensified.

Climate change is causing rainfall reduction, which limits primary production and increases imbalances in forests, varying the carbon catch.

Prolonged droughts deplete water reservoirs contained in trees.

When water reservoirs accumulated in the soil and in plants deplete the decay phenomenon of *la seca* occurs, especially if rainfall in recent years has been very low. The monitoring of the level of starch present in the trees is a good indicator to anticipate the sudden death of *Quercus* in the dehesa. Very wet years also favor the development of fungi responsible of *la Seca*.

It is therefore necessary to adjust the grasslands before a more pronounced water stress and increased potential evapo-transpiration by rising temperatures.

The increase of CO₂ in the atmosphere is causing lower quality food for defoliating insects, some of which suffer higher mortality, but others increase their damage increased tree defoliation.

Good soil management practices help improve these situations, using appropriate stocking, maintenance of natural grass, minimizing logging, maintaining good water quality in ponds, etc.

Promote pasture maturity coupled with its renewal with trees of different ages and enhance their biodiversity, avoiding being a garden of trees, to maintain species richness that characterizes the area, will help build resilience.

Thus, the set of Best Practices that follow are intended to increase the resilience of the pastures, and with it, his chance of survival to future changes.

These good practices have been mostly applied to Campanarios of Azaba and recommended based on their cost / benefit and temporary performance.

5.1. Forestry work: pruning and brush clearing.

Goals

The cultural form of treatment has been carried out for centuries in the Mediterranean pasture, has been trimming trees for increased production of fruits (acorns) and wood.

Pruning promotes well-managed pasture ecosystem dynamics in a triple sense: promotes regeneration of trees (in a context where there are serious problems of regeneration, due, in part, to the intensification of the density), the persistence of existing trees (that if they have pruned shoots a huge load of threatening its stability) and increasing fruits, to the benefit of wildlife. That is why controlled pruning practice should be followed in lands both dedicated to conservation or hunting, to avoid sudden death of trees, and to those dedicated to production (production pruning). Each dehesa defines the level of intervention needed or if it is even needed; which makes it very difficult, maybe impossible, to talk in general terms.

Likewise, clearings in areas where scrub closes are key as a means of protection against fires, to promote the development of the remaining trees and foster a Mediterranean forest mosaic.

Technical Recommendations

For hunting or conservation uses, *olivados* are recommended as main pruning activities, even in cases in which in the goal is to have a Mediterranean forest without management. This process of change may be gradual.

However, for acorn production purposes (pig livestock), it is compulsory to start with the topplings to later continue with the *olivado*.

So, to eliminate the problems described regenerated, is recommended eliminating vertical branches arising from the development of epicormic buds, with a periodicity of about 10 years

(varying according to local locations). In many cases, these branches threaten the viability of the treefoot and lower productivity. These outbreaks are dormant buds in woody areas. They are characterized by strong growth reaching large in a relatively short time. They are also colloquially known as "thieves" or "suckers" as they consume much energy from the plant and are hardly productive at all.

In turn, these pruning eliminates the presence of fungi and lichens on the surface of the tree that could pose choking the excess foliage growth of these parasitoid organisms. This type of pruning is best suited for woodland conservation while input luminosity produced inside the tree with the consequent production of fruit. It is known by the name of *Olivado*.

It should be performed from December to March, provided at least 200 meters away from any nest from species that are conservation targets. It is recommended not to remove more of one third of the biomass of the treetop, making flat, vertical or oblique cuts as close to the trunk as possible without being attached to it, if tears occur, should be treated with antifungal agents. In order to ensure healing, cut branches are not excessively large, exceeding 15 cm diameter (taking into account that the branches oriented to the north take more time to heal).



Perimeter firebreak maintenance of the reserve



Work carried out in an oak



The use of machinery in prunings of treetops entails risks, so protection



Perimeter firebreak maintenance of the

measures are established.

reserve.

As regards *resalveos*, held in areas where the forest of *Quercus* has closed, densely feet competing with each other, without achieving any of them great development. It thus reaches a situation of stagnant growth and poor viability of the feet and strains, it being necessary to resort then *resalveos*: relatively severe removal of part of the foot of the kills. Thus, the conversion is achieved at high mount by increasing the fructification occurs to reduce competition between feet of a same strain. They should preferably be from November to February, more than 200 meters from any species nest to be protected.

In shrub areas than just oaks, should favor the mosaic landscape, creating shelter for small animals such as rabbit, hare or partridge. There will thus in open areas with presence of nuclei scrub so that the smaller species find refuge near open areas where they find food. There are different ways to perform these clearings selective so that these areas can be created:

Flower shape: with petals shaped clearings leaving areas of scrub in the gaps between the "petals".

Irregular: shapeless clearings and sharp-edged. These areas may have a small or large surface depending on the surface to be treated. What they do have in common, both large and small surfaces is the existence of scrubland within the clearings as an islet in the open area of grass.

Stripes: This form maintains regular strokes as herringbone with a main strip leaving other secondary. This method can also be used as a firewall.

Using either method depends on the availability of specialized machinery (tractor with mower or hand trimmer), as existing vegetation, being recommended to use the methods in "flower-shaped" or "irregular" in those shrubby areas with small size, like thyme and heath, and the methodology of slots in areas with large-sized shrubs as brooms or thickets that are more difficult to work.

For livestock production farms, however, topping trees is due. This is a pruning in which the vast majority is pruned tree branches from young, leaving only 3-5 main arms or guides. It should be held in October, February or March. These arms grow so much that underpins the rest of the branches of the tree in the future. These pruning should be done with extreme care, since they can cause serious damage to the tree in their adult stages since it changes the natural way to grow the tree, which can cause a shift in the center of gravity of the same and can lead breaks branches large enough to kill the tree. Another problem that can cause these pruning is the possible entry of pathogens by those cuts and wounds made by pruning the branches of larger diameter, difficult to heal. This practice is also done in riparian forests in ash and willow, which are called "coronation",

every 5-15 years. With the development in wetlands of trough gives them a place to heal the wounds in a short time, while many individuals can not stand the stress of this pruning. This technique is banned in some regions, given their enormous aggression and we do not recommend it.

Likewise, we also not recommend the clearings in fact, removing all stains scrub. Discard also clearings with unseeded after plowing.



Clearings are likewise recommended to effectively eliminating all scrub stains.

It should be noted, finally, that all forestry work must maintain all necessary security measures for its realization. Thus all the work of pruning height should be made to:

- Safety Harness
- Lifeline (rope by which to move about the tree)
- Protective headgear and earmuffs screen.
- Goggles.
- Resistant gloves.
- Anticutting Pants.
- Anticutting Boots.

5.2. Reforestation.

Goals

One of the best ways to promote and maintain biodiversity and conserve soil and protect from erosion in areas where there is no vegetation, is reforestation. Thanks to the existence of vegetation, these soils are fixed, preventing atmospheric factors such as rain or wind to erode and degrade. To increase the chances of fixing and building soils and increase biomass and biodiversity of pastures, plantations are made in order to speed up the natural process of regeneration.

Technical Recommendations

- Riparian forests: In order to establish ecological corridors between different ecosystems or areas thereof, enabling diverse wildlife dispersal and increase structural diversity and global biodiversity of the environment in which they are made. Treatment in these areas should be a high density (1300-1500 feet hectare, including shrubs) strictly forest areas and in descending half dehesa riparian forests with livestock use. Always plant saps 1-2, on a stretch of 5-10 meters wide and parallel to the course of the stream. Single whole digging can do the previous work. Each seedling protector must have a single, preferably grid-like (at least in the flooring and mesomediterranean thermos). In the event that the number of ungulate is considerable, repopulation is protected by enclosure. We recommend planting trees with fleshy fruits, birds and mammals: rosehip and hawthorn, etc and plant at least 25% of blackberry (*Rubus* sp.). Not be made in areas where riparian vegetation exists already (in those areas the promotion and enhancement of riparian vegetation will be made by closing the area, with electric fence for ungulates and rodents mesh-to herbivores potential consumers for a period of at least 10 years).



Placement of metallic protector for trees of great size.



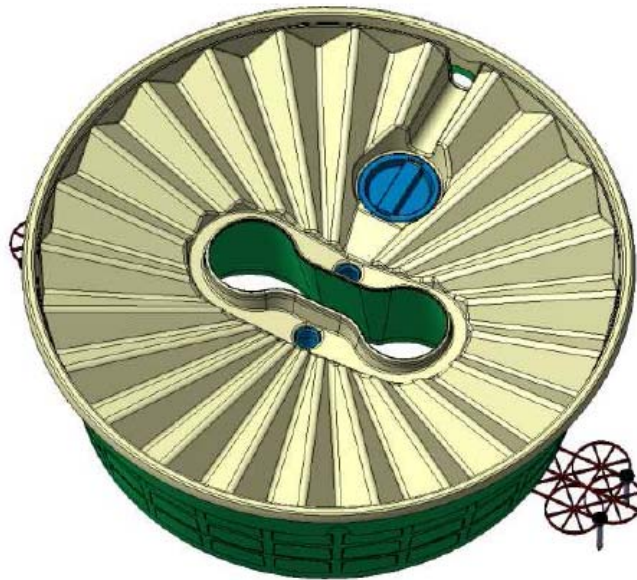
The plantation has been hand made.



Tubex protector Aban Sistem, which facilitates the protection of the young woodland.

- Implementation of hedges: In order to increase the structural diversity and biodiversity and provide suitable places for breeding and shelter the rabbit, quail and other wildlife species, reforestation recommended at high density and linear. Should be performed along the boundaries between different agricultural parcels. The estimated minimum width of 5 meters, ensuring at least 10 years of grazing exclusion. Never will be in line of maximum slope or where and where there are hedges. If it is intended to enhance and promote existing ones is recommended only protect the area against herbivores and make timely replanting in areas where there are no plants that imbue forest continuity to the fabric. No place in areas where there are rabbit warrens.
- R Reforestation Mediterranean open forest (pasture): Recommended planting unframed, with a final density 400 plants / ha, including trees and shrubs, with 1-2 forest tree sap, by boxes, with dimensions of 40 x 40 x 30 cm. The formation of the species will influenced by soil depth, placing more demanding species in the deeper soils, geographic and geographic location. The proportion of trees is as follows: as a targeted Holm oak (*Quercus ilex spp. Ballota*) (80%), as target species, Pyrenean oak (*Quercus pyrenaica* (10%)), hawthorn (*Crataegus monogyna* (5%)), wild pear (*Pyrus bourgaeana* (5%)). With use mastic bushes, kermes oak, lavender and heather.
- Using protective. In areas of intense livestock use, reforestation, in addition to closures, can be protected with guards or individual fences. In the livestock section gives some indications about it. Also can use plastic protective type "Tubex" of different sizes depending on the type of plant, about 60 cm for 1 to 2 saps and others about 1.5 meters for the largest trees of 1.5 to 2 meters. For other higher plants, up to 2 meters, should be used individual mesh fences to hold pickets.
- Using Waterboxx: In sandy soils with little clay layer using Waterboxx can be a survival advantage copies reforested. This is a plastic bucket with a studied way to condense water from the atmosphere and allow the trees to grow in the desert. In

this case the use is not due to lack of water, but the loss can suffer the ground to be found in these soils with greater drainage.



5.3. Dryland pastures and fields

Goals

In this section are listed all actions aimed at vegetation management associated with open areas of Mediterranean forest where there are plants of Dryland grasslands. These areas hold great importance from the point of botanical and also from the farmer, because these are areas where wildlife and domestic livestock are the largest part of their diet. These plants in turn are adapted to grazing livestock given the centuries of coexistence with man.

One of the factors that populations of prey species such as rabbits, hares, partridges and quail have declined or become scarce in our Mediterranean forests, is being the abandonment of traditional farming and ranching that has been going on for centuries in the meadows and replaced by an absence of mechanization Dryland crops. By creating planting areas intended for food only these minor species is greatly favors the Mediterranean forest biodiversity.



Crop fields for the partridge and the rabbit.



Cultivated zone for minor species.



The meadow has been the most habitual sowing area.



Manual sowings -no machinery- were performed near the forest.

Technical Recommendations

Best practices for maintaining a good level of biodiversity in these open areas of grass are:

- Maintenance areas without agricultural management to promote the establishment and maintenance of native species of Mediterranean pasture to maintain the ecological balance suitable for biodiversity in the pasture.
- Scattered plantings Areas: As favoring trophic resource for minor species such as rabbits, hares and partridges. This way we ensure food for these species in times of increased food shortages naturally.
- Areas dispersed harrowing: In areas previously planted as ground aeration for the implementation of local native plant species

Plantations suitable for prey species should be carried out taking into account factors such as location, if they are close or not to water points or areas of rabbit warrens, etc ... as well as the supply of seed or plant to plant. This also sets the plantar surface as it depends entirely on the terrain and the amount of food you want to contribute.

Thus, we recommend the creation of zones with small crop sowing areas in mosaic with abandoned pickup, seeded guaranteed. Ideally, recommended four 500 m² plots in 10 acres on a rotational basis, ie a 4-microseeding you every 20 active plots each year, including 50% of cereal crops (rye, wheat) and 50% of legumes (chickpeas, lentils, clover, beans). If these surfaces are excessive for cattle farms, should be approached as possible, so as to enhance the presence of prey. In areas with heavy frost, sowing must be done with 50 kg / ha of cereal protector (rye). This culture should be removed by light grazing winter is considered, if necessary, their protection with fencing during germination. Preferably be located at points close to the water.

The technique used, and it is recommended to carry out seeding, is using a mechanical planter tractor machined or ground without prior plowing or shallow tillage. It takes tractor, equipped with plow, cultivator, spreader and roller. Be avoided under trees styling. The elevation (October-November) will be made by the plow, while the binary (December-January) and harrowing (September to November) can be made by grower. Planting (September to November) and the subscriber (September to November) are performed simultaneously with the fertilizer, while the loop is used to keep immediately after planting.

Avoid the use of biocides, but if you can apply phosphorus fertilization, which greatly increases the yield of grassland with 300 kg / ha of 18% (number next to the 50 units of P per ha). It has been found that productivity is increased remarkably in rabbit meadows fertilized with phosphorus.

In these works, it should always be left without tillage area shelters of any kind. Removing this flip land is a haven for insects and fungi that favor the above mosaic landscape.

All of them are therefore not recommended due to the consequent erosion and soil loss in the event of heavy rains associated with the problem of rooting plants and desertification.

Also noteworthy is a significant need for perimeter fencing to be unable to access the livestock. You can use mesh called "collie" a meter tall and hollow mesh accessible enough for a rabbit or hare into the fence.

5.4. Creation and management of ponds and water points

Goals

Wetlands are one of the most important habitats to consider in the Mediterranean, since the availability of water, which is linked to this habitat, a limiting factor and definitive for the existence of life, especially in the long time summer.

To preserve environmental quality and biodiversity in this priority habitat, it is necessary to reconcile the traditional livestock uses the existence of flora and fauna associated with it, making good use of these water points is vital for life the wild meadow.

The harmonization of agricultural and livestock ponds and wetlands protection of wild plant and animal species or endangered, is one of the main challenges to achieve in Mediterranean forest management.

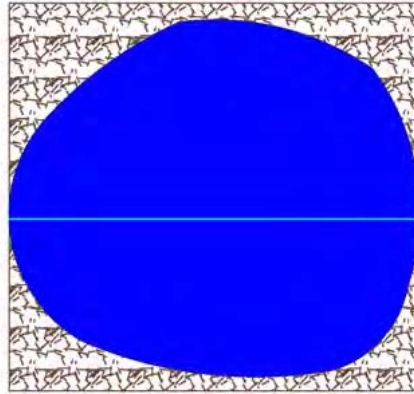
This is vital to protect them from their main threats: overexploitation of water, overgrazing (by trampling and habitat destruction), intensive aquaculture (tench is traditional in southern Extremadura and Salamanca), existence of non-native wildlife (which are transmitted through streams and are favored by the presence of continuous physicochemical conditions, regardless of where the wetland is), deterioration of water quality (for nitrification of the water, stagnant areas, dumping of solid waste or artificial substances) and inadequate structure to be used by wildlife, mostly because, in the meadows wetlands were created by man to increase available water points for domestic livestock, thereby increasing productivity livestock.

Technical Tips

- Over-exploitation of water resources for irrigation: It is recommended the establishment of a minimum ecological water level of the wetland, allowing the conservation of habitats and species, both from within and existing wetland downstream. From this level, water may be used. It is also recommended control water flow that contributes to the wetland as long as it is a continuous supply as spring or stream permanent this control is usually done using traditional wisdom and experience of each manager, who knows even the order in which they dry their wetlands. However, currently available on the market flow meters can be helpful, to provide short-term variation in water level.

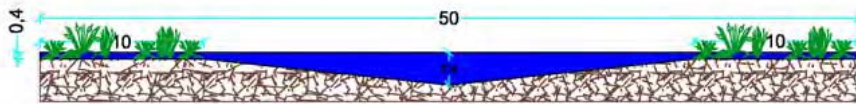
- Intensification of livestock: We recommend the simple method of making a pond perimeter fence to keep out livestock in an amount of 75 to 80% of it, so that cattle access, use and only 20 steps remaining 25%. With this method we keep intact the values of Mediterranean temporary pond in two thirds of it. This fence protects vegetation and wildlife habitat linked to this for those times when feeding cattle remains in the area near the pond or montanera time when the maximum load is pigs. In times when there is no danger that the maximum stocking density is recommended removal of these fences ponds that do not interfere with other wildlife, and in the spring-summer season when the Black Stork goes to feed these water points.
- Existence of non-native flora and fauna or invasive: Methods and protocols elimination of these species should always be done by manual or mechanical removal of invasive species given the nature of the aquatic habitat and the use of substances for disposal carries deleterious effects on water and then the rest of vegetation and associated fauna habitat. Each species of animal or plant requires a different extraction methodology, so we can not recommend one or the other, in any case, should be fully informed of the species to be removed and the methodology to be used, since driving the species you run the risk of spreading it.
- Semi-intensive and intensive aquaculture: This is an extensive cultivation, with minimal control of environmental factors in ponds or reservoirs where it is grown and where handling is performed normally limited to the Periodic stocking fry and extracting net fishing. In these farms not done any outside supply of food (only occasionally brings some wheat moistened). A performance that is usually done in this type of operations is to increase the populations of plankton (water flea or daphnia) that can grow in the pond, especially ponds may be interesting in new construction. These traditional farms usually devoted only fattening fry from other farms.

PERFIL TRANSVERSAL



Diámetro charca 50 m

CORTE TRANSVERSAL



- **Morphology:** The morphology suitable for these ecosystems to reconcile agricultural and livestock uses the presence therein of a greater number of species of flora and fauna, responds to a model with a water surface area of about 2000 square meters (close to 50 meters in diameter) and with a slope of less than 8% slope to get to be about 2 feet deep in the center of the pond. In addition to them, one of the banks, different from cattle access should have shallow depth, less than 35 cm, up to about 4 meters from the edge, so that it is an area with high light intensity, with a bottom colonized by large number of plants, fish, amphibians, reptiles, and arthropods, used by species such as the black stork trophic resource. These measures succeeds in obtaining the ideal habitat for plant and animal species diversity areas are shallow and deep waters in which to settle, while creating habitat for amphibians, fish and reptiles can benefit from shelter and food created by these aquatic plants. Above them on the food chain will benefit birds such as the black stork, herons and ducks among others, as well as opportunistic mammals, incorporating each wetland wading enough surfaces.
- **Water quality:** A good water quality is represented by a haze degree not very high, slightly transparent water with concentrations between 5 and 6 p.p.m. of oxygen, a pH between 6 and 8 and nitrate levels between 4 and 20 p.p.m. The causes turbidity, high oxygen concentrations, abrupt changes in pH and elevated nitrate levels are external contaminants (manure, waste ...), drainage, acid rain and standing water. Therefore it is recommended to keep the water points, wetlands and clean Mediterranean temporary ponds without tipping, while a load is set properly cattle allowing water without difficulty and maintain the existence of a water quality optimal.

We recommend building new ponds in autumn and winter, while matching two factors: the time when wild species are less sensitive, far from the breeding periods, and there are more chances that the earth is soaked in water, so that the blade performance is increased and reduces the risk of fire. However, one should be careful with the transition of the machinery through moisture-soaked land.

To evaluate the success of the ponds is recommended to establish quality factors to evaluate the surface water depth and the volume of water stored per hectare of dehesa (*mature Mediterranean woodland forest*) and periodic censuses of wildlife (including arthropods, amphibians and waders) to assess the impact the outcome.



5.5. Creation and management of natural firebreaks

Goals

Fire is one of the biggest problems and most difficult to tackle in the management of Mediterranean ecosystems. The fire suppression is a very complex task since vegetation is adapted to fire and they need the same in their life cycle to survive, causing very abundant biomass

Firebreaks are the most important preventive work in fire management. They work to break the continuity of the fire at ground level and also facilitate the entry of firefighting effective to zones. Thus, proper planning of these facilities will provide greater protection forest to Mediterranean forest area we manage.

Technical Tips

Prior to the commencement of the proceedings should be analyzed in the field and orographic available, since the infrastructure should stand in fire dynamics. This preliminary study should include high performances in those areas where the fire loses strength and brush clearing and flatten soil after plowing to interrupt the continuity of the fire.

Whenever possible we recommend the use of biological firebreaks, adopting the following criteria::

- Riverbanks and reforestation. Keep riparian woodland in good condition, making selective clearings without coronation of ash, which, although permitted in some regions, is very aggressive for vegetation, is a firefighting practice that reconciles the conservation of ecosystems protection.
- Firefighting Areas: In addition to its own firewall to be discussed later, a less aggressive performance that combines perfectly with sustainable environmental management is the maintenance of fire areas, defined as areas where the

vegetation is not removed completely through a more intensive grazing. In Campanarios de Azaba it is performed using local varieties of endangered cattle, keeping open the medium containing the advance of the scrub, grassland surface being variable, depending on the terrain and vegetation conditions of each location. This activity is simply to introduce the variable fire in the Mediterranean mosaic favoritism, so as to delay its speed and decrease their ability to spread. They also have the added advantage of maintaining these fire areas require not only additional cost, but it is productive. In general, keep a shrub cover less than 10% and is dispersed in groups of less than 50 m². Fertilization can be adopted depending on soil characteristics, climate and existing plant taxa. It must obtain indices fire surface areas relative to the surface of pastures, to establish future indicators of effectiveness.

In cases where it is not possible to make these measures work opt for conventional firebreaks construction with heavy equipment (bulldozer) or forestry tractor tiered to facilitate work and earthmoving required. The width of this infrastructure should also depend on the area where it is built but a distance of about 12 to 15 meters long is enough to stop a small fire on flat, although you should always take into account the amount of vegetation or combustible material present to assess the minimum distance.

This infrastructure must take annual maintenance since vegetation growth inside the work by harms that have been built so that this work is recommended they be held annually with manual mowers, if the firewall does not have great distances, or brushcutter tractor mechanics. After 3 to 4 years is again performing work harrowing the soil because soil can regain underground roots that in case of fire, a fire can maintain active under the soil surface.

The work done in creating fire strips must be done with tractor through flatten terrain after plowing, combined with hand trimmer for forest laborers crew safety equipment mentioned above.

5.6. Livestock management

Goals

Cattle is the primary tool for managing the Mediterranean environment for creating and maintaining open areas of grass, causing the landscape of *dehesa* (*mature Mediterranean woodland forest*). However, the cattle managed unsustainably also creates serious problems in terms of their own health by Mediterranean forest exploitation and intensification of livestock.

It is important to maintain good management of domestic livestock in our *dehesa* since it is the basis to preserve their natural values. The objectives of the pasture livestock management should be:

- Keep the *dehesas* (*mature Mediterranean woodland forest*) as sustainable production systems.
- Ensure woodland regeneration.
- Promote biodiversity associated with *dehesa*.
- Improve productivity and environmental parameters of the pastures.

Technical Tips

Adjust stocking density biomass production of the *dehesa* and the conservation of biodiversity, particularly the landscape mosaic, is undoubtedly the most important measure to consider. This stocking density is based on the type of livestock and pasture characteristics. This should take into account that a pasture Iberian produced between 1000 and 2500 kg of dry matter per hectare, depending on the geographic location of the *dehesa*, orientation, soil and climate. The limiting factors are recurrent droughts (times when one must resort to supplements) and poor soil.

Put another way, the intensification of livestock use with above-stocking sustainable is the main threat to the *dehesa*, threat also is favored by EU policies: census of all species breeding livestock, except dairy cattle, had a big boost since 1986.

It should be noted further that the *dehesa* pastures consist mainly of annuals species and unproductive, seasonal harvesting in autumn and spring, which implies a supplementary feeding for livestock during the summer and sometimes in winter. The latter can be supplied in large part to the use of the acorn and *acebuchina* (the fruit of the olive tree or wild olive, if any) and the *ramon* (*brushwood cutting shepherds to graze cattle*) (although the oak is not much performance and is very laborious handling, make it available for livestock). The taxa of most interest are more frequently grass pastures belonging to the families of the *Compositae*, *Gramineae* and *Fabaceae*, also having a broad representation of *Caryophyllaceae*, *Cruciferae* and *Umbelliferae*, as *Trifolium glomeratum*, *Trifolium arvense*, *Medicago sp.*, *Poa bulbosa*, *Agrostis castellana*, etc. Shares of increased production and quality of pasture management techniques (*majadeo* or *redileo*), subscriber or seeding are recommended.

It is important, first, to evaluate the possibility of using local varieties of cattle. It is very common in different Iberian regions still persist landraces adapted to the climatic conditions and soil, than cow, goat, sheep, poultry, pork, or horse, often at risk of extinction; cattle breeds *avileña* black-Iberian, *retinta*, *morucha*, *cacereña* white or *Torbiscal* pig, hairless Spotted *Jabugo*, all Iberian, are examples of them. The use of these animals ensures perfect adaptation to the environment (climate, topography, distances, etc.), provides added value for biodiversity conservation, a great potential for ecotourism and a commercial value. As an example, Campanarios de Azaba uses *Retuerta* horses, *Sayaguesas* cows and *Castellana Negra* (Black Castilian) sheep. When using this type of livestock, particular attention is taken to the maintenance of indigenous genotypes, avoiding indiscriminate crosses racial and takeovers.

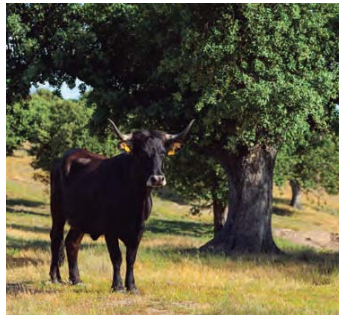
It is desirable to combine different species of domestic animals in the pasture, since each animal feeds on plant species and at different levels and different times of the year, so a good range of varieties of cattle decreases pressure on the environment.

Also, in general, and for obvious reasons, it is recommended to organic production, resulting in higher quality products with lower input use in the territory and with a very low environmental impact. It also has a great compatibility with the conservation management of biodiversity and the state of the pastures.

The stocking rates used in each farm can not be standardized, and it is advisable to do a case study analyzing the sustainable stocking for each space, considering that many farms do a mixed use with several cattle, which should be studied each case.

The following briefly describes the major characteristics of each of the cattle from the point of view of the management of the pasture:

- Cows: Of the variety of species you eat and the daily amount you need is the most important herbivore in the management of the Mediterranean environment. It, in turn, earned one of the most productive in terms of the wide variety of its derivatives or foodstuffs (meat, milk, leather, bones, dung for paid, etc ...) so that their use is a priority when manage the pasture. Their main food source is grass, herbs, stems, leaves, seeds and roots of many plants. They can not digest certain substances such as lignins and tannins so you do not appreciate the woody species. Prefer grasses but also appreciate the Fabaceae that are an important source of nitrogen in the diet. Given its characteristics is key to maintain optimal stocking density of cattle because that same capacity can go up against if not properly estimated. Loads exceeding 0.2 hectares / head are not recommended, although the CAP (Common Agricultural Policy) subsidies encourage much higher loads, since the medium and long term is the meadow ecosystem will degrade due to lack of regeneration of wetland eutrophication, trampling pasture, etc.. Precisely these CAP subsidies are those that have led to the passage of the 0.2 ha / head half had in Spain in the 60s to almost 0.4 that currently exist. And even at fixed 1.4 LU that the European Commission to encourage extensification more intensive European systems, but in the pasture had a devastating effect, since many farms providing supplementary feeding reached the limit for collecting stocking CAP premiums.



- The horse is the other large herbivore existing in *dehesas* for centuries. Tolerates more than cattle browsing scrub, which gives more value in managing the territory in combination with other livestock species.
- Sheep: The shape of these cattle grazing maintains ideal characteristics for conservation of pasture and woodland pasture since they have an action as "aggressive" with the environment and have horses or cows, as long as the load livestock is met in optimal levels. Its management organized the subscriber benefits controlled soil where other herbivores graze. The *Merina* sheep is the most used in *dehesa* systems, with great adaptation to the environment and productive response. Traditional sheep density ranges between 0.7 to 1 head / hectare, although values have soared up to 3.5 or more, helped by the CAP.
- Goat: With greater digestive capacity of plants to other pets, capable of digesting plants and tissues which other animals can not swallow. Its use is closed by suitable means thicket and shrub species areas which are intended to open, as it is able to extract energy efficiency in this type of plant less palatable. Also, this type of livestock is also very suitable for areas of Mediterranean forest soils with greater abundance of rocky since adapts much better than other herbivores mentioned above these stony or is steep. Livestock overgrazing or overuse of such livestock also creates problems of natural regeneration of trees due to their intense ramoneadora. It is traditionally linked to a subsistence economy, where land is communal property and farm uses or leases, which conditions the lack of adequate

management and farm size is low.





- Iberian pig: Pig variety linked to the pasture for centuries and whose task was to produce meat and meat byproducts. It is, in fact, the main species configuring the *dehesa* ecosystem Iberian given the high productivity that is obtained from its use, as a great product internationally renowned, the Iberian pork sausage, and of great importance in all socioeconomic pasture areas. The pig very efficiently leverages *montanera*, i.e., the fruit of *Quercus*, the acorn fall in autumn. The bloom of the oak begins in April or May for two months and acorns ripen from October / November. The average production of acorns is between 400-700 kg / year / hectare. The production per tree is 10-15 kg / year. Pigs are handled by the technique of the open range, in extensive, grazing in the pastures, mainly acorns, but being omnivorous, from grass to roots, insects, small vertebrates and even can take some kind of carrion, etc. This varied diet and greed causes must be carefully managed its presence in these agroecosystems. Overloading or excess burden of this type of livestock kills all plants and animals of the area in which they are, if the load is high livestock, which is usual. It is, therefore, cattle more "aggressive" with the *dehesa* if not handled optimally. Besides this voracious appetite increases when the problem by having a highly acidic droppings, you just have natural decomposers, plant removes any vestige of those born in the intensive farms. We recommend a maximum load of 1 head every 3 acres, to allow use compatible with the conservation of ecosystems.

To prevent damage from the pigs, we recommend using a banding system for piggy snouts, using 3 to 5 rings, ensuring greater impact on acorn and food surface rather than the removal of soils .



Livestock waste management:

As in other industry or company, the livestock sector generates a number of waste management is necessary properly to minimize the impact these may pose to the environment.

Livestock waste can be defined as those that are generated as a result of intensive farming and extensive livestock farming in all its varieties and also within this definition we can classify the following subgroups with corresponding recommendations (in addition to those specified in the legislation):

- Assimilable MSW (Municipal Solid Waste): As in other activities generated packaging waste, paper and glass. It is generally recommended to reduce this waste by encouraging purchases of bulk products, whenever possible, rather than solid packs.
- Manure: droppings are solid or fluid of animals. It is recommended for recovery thereof as agricultural fertilizer, as it provides organic matter to soils and their management solves the farmer. However it is not always possible due to the pressure index of soil nitrogen in the area, which should not exceed 170 kg N / ha per year. In this case, the excess waste can have multiple outputs:
 - External: Towards composting and biogas plants located in the region, close to the farm to amortize the movement of manure. Biogas is a gas composed primarily of methane (CH₄), carbon dioxide (CO₂) and small amounts of other gases. It is produced by the fermentation of organic matter without oxygen (anaerobic) and their characteristics are similar to natural gas. In a biogas plant accelerates this process that occurs naturally. Mix organic matter (animal and industrial waste) and lead to digesters (large closed containers without outside air). Act is where

bacteria, anaerobic digestion occurs or controlled decomposition of organic matter. This yields biogas and fertilizer for the fields.

- Internal: Construction of a small biogas plant for cogeneration. This is a facility that primarily slurry mixed with organic matter and the process is performed is known as anaerobic co-digestion. Blend is based on different substrates to compensate each other and to obtain an optimum biogas and digested biomass which is a fertilizer or sprayable biofertilizer fields. The biogas produced is valued in cogeneration equipment in the end we get electricity and heat from renewable sources. The investment required for this installation makes it profitable only in the case of very large farms or joint achievements of different owners.
- Waste animal health: They are the remains of the products used for sanitation animal drug residues, containers, syringes ... It is recommended to keep these products away from the area where animals are kept until the time of transport to the appropriate manager.
- Carcasses: The management of this waste is governed by the health rules for the collection, transportation, storage, processing and disposal or other permitted uses of animal by-products and by-products not intended for human consumption. In any case it is recommended as a measure to enhance biodiversity collaboration with middens or supplementary feeding points authorized by the competent authority in each region.

One of the action under the project “Reserve Campanarios of Azaba” for favoring the availability of food for large birds of prey, was the construction of a vulture feeding place . This will place a fence along the existing legislation concerning the administration vulture feeding places (Applicable Legislation of this subject in Appendices to this manual), to prevent the entry of opportunistic mammals such as foxes, of a nearby surface one hectare, which are deposited the bodies which are then eaten by birds.

The experience made specifically for this action is that of irregular bodies make contributions in those times of scarcity of food for carrion birds. These times of increased scarcity coincide with summer and winter or all abnormal situations as they could be cold waves, breeding seasons, etc ...

One of the actions that have benefited the tranquility necessary for feeding the birds in a kind of infrastructure like this has been the placement of heather and broom (*Cytisus multiflorus*) area, interlaced between the mesh holes hunting. This set has been able to get a visual separation between the interior and exterior of dung that has kept the peace necessary to inside carrion birds to feed undisturbed.

5.7. Hunting management

Goals

While the origin of the *dehesa* must be placed on the use livestock, hunting also has a use that has been increasing in recent years.

Thus, until recently more intensive hunting used to take place in steep terrain, with poorer soils and access, on slopes, hills and mountain peaks. There the big hunting, primarily deer and boar was most practiced in areas with little grazing. But in recent decades has been found to increase the activity and hunting pressure in lower areas of meadow and valley bottom.

Currently, hunting is one of the most important economic resources that are also associated with *dehesa* land. Given the large amount of available food and habitat for hunting species, the pastures maintain large populations of wild species so managers territories economically benefit from this practice. In certain cases, the pastures managed a top quality hunting resources.

Good management of hunting and hunting species is also a very important factor in managing a territory in which human activities combined with the conservation of natural values and biodiversity.

Technical Tips

All measurements described in this manual, aimed at having some ecosystems in good condition in the pasture, are the best guarantee to have healthy populations of hunting species. Generally, you must first promote such measures, and only if not prove sufficient, to address other semi-extensive production hunting. The structural and crop diversification and the Mediterranean mosaic habitat for hunting species of interest.

Hunting in the *dehesas*, as in any place, must be orderly and planned by Hunting Technical Plans, based on census data of hunting species collected in place own or *dehesa* and tools using population model, evaluate the impact of hunting on natural resources.

- As habitat restoration activities of interest may be mentioned the restoration of hedgerows and boundaries, already detailed in section reforestation. This is typical refuges for species such as rabbit or partridge. The restoration includes hedges reforestation and restoration of stone walls. You must use traditional masonry walls made from local materials; in addition to preserving the crafts and the landscape reduce contamination of other materials on the soil, water and vegetation.

- Creating ridges as a means of improving populations of hunting species successfully in several European countries. Thus, homogenization is interrupted half, providing the means for greater agricultural and livestock diversity, assuming suitable places for breeding, shelter and feeding of all kinds of wildlife, from invertebrates, small mammals, reptiles and predators. The diversity of orientations, spatial heterogeneity favors these species. Recommended dimensions of approximately 120 cm by 50 in the high basis, preferably made in the direction of the contour. Once created not due till, so that natural vegetation can be established and become permanent shelter. It must ensure that the ground is loose and compacted at least avoiding possible landslides and silting and, especially, the appearance of gullies.



- Installing water points, feed and water: As already mentioned in the section on rabbits and partridges, these facilities easier and cheaper maintenance, greatly favor the hunting populations. We recommend a minimum density of one every five acres.

- Creating hunting lodges within the drawings, which allows continuous regeneration of towns and continuity thereof, is a key measure that tends to forget to increase productivity hunting.
- Fences hunting: In the case of a closure be necessary hunting, livestock mesh or the like, will be provided with the necessary ecological permeability through a fence light that regulates the passage of the target species. In addition, provide wildlife crossings at least every 200 meters, allowing mobility of animals in both directions, mainly of large herbivores. They try as much as possible to adapt these openings artificial natural steps used by existing and faunal populations in the area, this detection is possible by direct observation of the terrain. To increase this permeability can be made as follows.
 - Enlargement of the mesh in the lower.
 - Open "cat flaps" every certain length in the bottom of the fence.



- Placing artificial wildlife crossings if the fence is too tight.

Water passages are covered by a waterproof hunting fence in order to prevent the departure large herbivores (deer, roe deer) hunting trophies for farms, production or other uses, be provided with hanging woods or veneers that allow the movement of the fish fauna.

Damage to trees: The presence of large deer (roe deer) in high density sometimes causes damage to trees. So if you detect such impact plastic shields should be placed at the level of damages. Also, trees can be harmed by excessive grazing. The protection of individual trees by placing a protective fencing installation consisting mesh 2 meters high with a gap of about $4 \times 10 \text{ cm}^2$ mesh, must be one of the techniques used for the preservation of trees. Also, this technique can also be used

for the protection of reforestation. The color of the mesh would be preferably used as the green visual effect also has a great importance.

- It should be noted that each animal tends to eat every day about 2.5% of their body weight in dry matter grass and pasture. Hunting can not degrade the pasture grasses. In the same way that the stocking density is estimated to not degrade ecosystems, must take into account the presence of large wild herbivores present.

In recent years we have witnessed the decline of populations of several species of small hunting (rabbit, hare, quail, doves ...) for various reasons such as diseases intensification of hunting, agricultural intensification, etc.. Many have attempted to solve drawings this decrease loose individuals (for the immediate arrest) and repopulation (to increase the number of individuals in long-term). However, this release has a number of risks and also no guarantee of success. The risk of using non-native species populations, making releases in areas where habitat is not ready, etc, advised not to use this type of action hunting purposes only, but frame them in a set of actions to improve habitats and species space to restore the overall biodiversity of the area.

In addition to the requirements as stated for the three main species of small hunting, rabbit, partridge and pigeon Here follow a series of recommendations for other hunting species, quail, deer and predator control in case that necessary.

Predator Control: The usual lack of superpredators in the Iberian *dehesas*, specifically Iberian wolf and Iberian lynx, sometimes causes the excessive presence of opportunistic predators such as foxes, wild boar, etc.. In very specific cases, this excess can prevent opportunistic and development presence in sufficient population levels of prey species of great ecological and hunting such as rabbit, partridge, due to strong ecological imbalance. In specific cases where this imbalance threatens the survival of the natural resources of the pasture may be necessary to control predators such as foxes and wild boar.

- Fox: This is a predatory animal "generalist" eating from small mammals, fruits, carrion to rabbits and partridges. The control must always using selective methods, with raids, and could use the midseason, discarding procedures as traps. We strongly recommend the abolition of opportunistic power. It is a very effective measure which consists of waste material inaccessible by their proper maintenance, fencing landfills or saving large organic debris in closed containers.



- Wild boar: One of the most pressing predators to smaller hunting species, such as rabbit or partridge, being able to feed on small kits that are in burrows to rooting in rabbit warrens or partridge sunsets. Control measures for this species are also similar to those applied hunts the fox described in the previous section. To do this, follow the population dynamics of this species, leave the females age, abate more young and less to the more elderly. Obviously, you should not be hunted females also never followed scratches. For planning is very important to collect all catch data (sex and age) to plan further in advance.

However, much contribute resorting to measures that reduce food resources easy for these predators. Constitute measures having effect throughout the year to help reduce reproductive success.

Similarly, the recovery of predators such as Iberian lynx (*Lynx pardinus*) has an immediate effect on the population of other carnivores.

5.8. Mycological resources management

Goals

Mycological resources represent an important aspect of Mediterranean forest farms, both in terms of biodiversity conservation and in the sense of a possible source of income and a culinary use.

The silicolous oak mushrooms are large producers, providing high mycological diversity than other ecosystems not contain. However, they are very dependent on spring and autumn rains, which have no place annually. On the other hand, are little known habitats by collectors, who prefer to approach the pine forests or grasslands wetter where production is safer. The densification of the mountain very detrimental affects to the production of higher quality edible mushrooms and fungal diversity in general.

The oaks are very generous in edible mushrooms when rains are abundant, which usually does not happen every year, with species prized by the market, as *Boletus edulis*, *B. aureus*, *B. reticulatus*, *Amanita Caesarea*, *Cantharellus cibarius*, several species of *Russula* (*R. cyanoxantha*, *R. virescens*) and even *Craterellus cornuco*.

In years of good yields and with abundant summer storms, *Boletus reticulatus* fructifications and *B. aureus* can become explosive. These blooms are very local and often very difficult to locate, even if it occurs at these productions have been dated to over 400 kg / ha. Of course, this is not uncommon and can be given a means of production data for siliceous oaks between 5 and 10 kg / ha for *Boletus* gr. *edulis*, generally composed of *B. reticulatus* and *B. aureus*. This production is cut dramatically with the first frosts of late October or early November.

Technical Tips

- The West Iberian pastures have a high potential as mycological activity areas, given its easy accessibility and rich mushrooms. To do this, after production mycological characterization of forests in the region, should be determined collector pressure and mycological resource sustainability in each property.
- Knowing the number of collectors who visit the area, its spatial and temporal distribution in the mountains, their origin and harvest yields will complete the analysis for land use suitability mycological. These results will be used to meet collector pressure and take steps to correct resource management (establishment of limitations for collecting, monitoring plans, improving access, etc). It should be noted that about 50% of the rural population usually taken mushrooms and fungi.



Coprinus comatus (O.F. Müll.) Pers. Comestible cuando son pequeñas



Amanita pantherina (DC.) Krombh. Tóxica.



Boletus pinophilus Pilát & Dermek. Comestible.



Boletus sp. Comestible.



Polyporus arcularius (Batsch) Fr. Tóxica.

- If you plan to take advantage of the truffles, use of mycorrhizal plants in reforestation.
- Nitrogen is recommended to avoid subscribers severely restrain the development of fungi.
- It should promote stability and variety of habitats and soil microhabitats
- The self-preservation of natural habitats, as set forth herein along with species diversity, with a variety of ages, looking to form mosaic habitats, alternating with other areas of scrub forest and grassland, is a guarantee fungal community conservation.
- Is estimated at least 15% of the fungal biomass and the proportion mushrooms must not be collected, targeting the regeneration of the resource.
- You can classify mycorrhizal fungi based on the age of the forest in which fruit:
 - *Pioneers (0 to 20 years): Suillus spp., Rhizopogon spp., Pisolithus spp., Scleroderma spp., Laccaria spp., Lactarius spp or Tuber spp.*
 - *Secondary (15 to 40 years): Tricholoma spp., Cantharellus spp., Russula spp., Hygrophorus spp.*

- *Late (30 and over): Boletus spp. Amanita Caesarea, Hygrophorus latitabundus, Hygrophorus marzuolus*

Given this information you can plan to apply treatments on a mountain in order to favor one or more of these species. You could assign the mountain stands for high yield and preferred species.

- It should explore the possibility of mycotourism, booming sector in recent years.

In regard to mushrooms and fungi species rare or included in the Red List of Threatened Fungi, conservation should be managed like any other element of biodiversity, recommending the absolute preservation of the specimens

This applies, for example, the longest-living fungi rebollo for goat's beard (*Hericium erinaceus* (Bull.) Pers), avoiding intensive pruning their glasses to the timber, except those branches that do not lead to viable leaves from a photosynthetic point of view and management of the species groups with juveniles, encouraging growth, even at the expense of eliminating some of the other copies.

For *Torrendia pulchella* Bres., whose preservation is linked to the proper conservation of dehesa systems dominated by Holm oak, but could potentially fructify in any other mixed formations of the pasture.

In both cases, as well as in other species of the Red List, is considered appropriate monitoring of these species, as well as completing the catalog mycological continue in the area, to help assess the abundance of these and other possible species of interest in the area and serve as a basis for completing the studies in which taxa mycological act as bioindicators.

5.9. Management of public use and ecotourism

Goals

This section is intended to provide basic guidelines for managers in the management of public use and sustainable tourism or ecotourism. To do this, we must first differences of these two activities.

For public use means all programs, services and facilities to be provided by natural area managers with the aim of bringing visitors to the natural and cultural values of the latter, in an orderly, safe and to ensure conservation, understanding and appreciation of these values through information, education and heritage interpretation.

We consider ecotourism as a tourist and commercial activity, consisting of environmentally responsible travel or visit natural areas to enjoy, appreciate and observe the natural attractions (landscape, flora, fauna or other) of these areas, and any manifestation cultural, present and past, that can be found there, through a process that promotes conservation, has low environmental and cultural impact, and promotes the active participation of local people by promoting a model of sustainable development of the environment.

Both activities are key in our opinion to favor the social recognition of the role of the pastures in economic, defense of the natural and social, as well as to identify the profile of workers in the pasture.

Technical Tips

- **Planning:** Each space should define its own model of public use, preferably by a document, the Public Use Plan, to develop the model that is intended for public use for the space. This plan should analyze the situation and make a diagnosis on the key points that determine the model and the actions proposed. The plan must define public use model to be developed, ie formulas of managing activities and equipment, and guidelines that govern the actions to be taken. All with the goal of showing visitors the conservation objectives of the protected space, sustainable management practices of the territory, habits and behaviors that respect the environment and channel the flow of visitors to improve space utilization and reduce impacts on the territory.
- **Regulations:** In the event that the manager intends to develop a pasture tour program, planning applications and in fact may involve usually does, access regulation. They can be of any nature, that determine a special use for a while and in specific areas, a common case of this is the restriction of activity in areas near nests of birds breeding seasons or traffic regulation by area restoration to recover its natural vegetation or soil. In any case, it is advisable in certain areas within the meadows, which by its nature or ecological fragility accessibility indicates, restricting the passage of visitors and especially motor vehicle or, at least, establishes maximum numbers of admission daily.
- **Determination of carrying capacity:** Visitors provoke an undeniable impact in both its natural and cultural heritage, to the facilities and infrastructure, the quality of services or the level of satisfaction of other visitors. Is controversial and difficult to determine, but the truth is that no pasture can support a large daily visit of tourists, students or researchers and retain both their natural values. In this sense, one can estimate a load according to the physical reception capacity (depending on its size, accessibility, pending), ecological (Vulnerability depending on the medium, admitting certain impacts can be absorbed or corrected by him, and rejecting that number of visits that cause impacts over the limit of acceptable change), services (depending on the conditions of quality, comfort and safety equipment) and social (to allow each visitor a truly satisfactory). We recommend zoning, establishing at least circulation areas and vehicle parking, visitor areas and reserve areas without public use. To give some idea of the estimated charges in the Biological Reserve of Campanarios de Azaba, with 522 acres of pasture, following this methodology, we have determined a load capacity of 50 people per day.
- **Facilities:** There are many types of public facilities, from simple self-guided trails to interpretive centers, campgrounds, recreational areas, nature classrooms, etc.. As equipment of interest in the pastures and good cost / benefit adequacy recommend traditional paths ecotourism routes with minimal intervention in the middle and the

installation of ornithological observatories on points of special interest (wetlands, platforms, etc..).

It should encourage as far as possible the integration of pastures in public use itineraries, cultural itineraries, walking routes, etc., with relevant management restrictions.

It is recommended that each owner or manager has cataloged, inventoried and, if necessary, public use elements that are inside of the range, as streams, public water, twine, public roads, trails, public forests , etc.

Sustainable tourism in private properties:

This is a way to convert the richness and beauty of the natural environment in a local economic development opportunity. Provide the biodiversity and natural heritage of the ability to produce economic income for local people is also the best way to ensure preservation medium and long term.

Thematic resources and exploitation of this resource would always link to the natural values and activities that already take place within the estate and faunal and floristic elements it contains. Among them, the natural elements in ecotourism activities potentially useful elements such as:

- Extensive livestock in the pasture with local varieties of endangered livestock. .
- Agriculture and organic products or local varieties.
- Forestry.
- Traditional buildings
- Observation of wildlife. In particular, the presence of large number of bird species in the Iberian pastures of global interest, and relatively simple observation, as imperial eagle (*Aquila adalberti*), black vulture (*Aegypius monachus*), black stork (*Ciconia nigra*), lesser kestrel (*Falco naumani*), black-winged kite (*Elanus caeruleus*), owl (*Bubo bubo*), golden eagle (*Aquila chrysaetos*), etc is a resource that has been shown capable of attracting ornithologists worldwide to Iberian pasture areas. This is why we recommend this as a resource to promote.

Activities to develop and offer resources on these points we can highlight the following:

- Views interpretive tours.
- Watching wildlife
- Bird walks
- Horse Riding / donkey or suitable terrain.
- Rural accommodation.
- Gastronomy.

5.10. Management of La Seca

Goals

Goals

The name of "la seca" does not refer to a disease but rather to a series of symptoms in which several factors are involved, from living pathogens to climate itself, causing a forest decline mainly on *Quercus* spp. It is characterized as a nonspecific phenomenon (acting on any species), spaceless (present in any area) and timeless (constantly present).

The final outcome is a very noticeable decline in general and has identified three types of behavior:

- Sudden death. A specimen with no apparent symptoms dies within a short period of time. Fifteen days may be all it takes.
- Progressive decay. The tree shows signs of weakness (dead branches) and after a few years just dying.
- Devitalization. Same as above but the tree can survive several years.

Factors involved:

Factors predisposing or predisposition: Determine which eventually die.

- Senescence or excessive age, immaturity, behavior: Those older individuals are more likely to die before however in this case age does not mark the number of years if it suffered over the years and the behavior they have suffered.
- Excessive or thick density: The density of feet high makes individuals present has a soft spot for the limited resources available.
- Genetic (inherited or supervening): Lack of genetic adaptation or by inadequate reforestation varieties recently naturalized or not.
- Natural interspecific competition (evolution): Many other species compete for resources: water, nutrients etc. The most resistant species displace in an environment which are not.
- Previous damage (pollution, errors forestry, logging...): This harm reduction health conditions of trees and makes them more receptive to pathogens and abrupt climate changes. Such damage can be pruned abusive, abrupt topplings, defoliation by plagues, etc.

Detonating Factors: Those which provoke a process that leads to death. It is mainly random environmental factors.

- Incidents Weather: Extreme temperature fluctuations, climate change, high and low rainfall very extreme. The extension of the usual intensity and duration of summer seems to be a crucial factor in la seca detonator.

- Other external events: mutations, competition with exotic species.

Catalysts Factors: Those who do not kill the tree, but the process accelerate or multiply it's effects.

- Space: Depending on the orientation and location of the forest. In Spain a large percentage sudden deaths are concentrated in valley bottoms and deaths slower decay in soil or unhelpful or shallow.
- Temporary: Depending on the timing of the life cycle of the tree. Often occur in the most critical times of change, most in need of nutrition for the plant: flowering etc.

Executors Factors: The kill finally, the gunmen.

- Biotic agents: bacteria, insects, fungi, usually not kill except in very favorable conditions for them, but if we accumulate other factors described above can act freely. Sometimes these agents are imported or mutations as elm DED.
- Other agents: Prolonged drought.

Technical Tips

The complexity of the phenomenon makes of La Seca can not be a simple remedy, so it should be clear that there is no single, efficient solution that fits all and cork oaks. Avoid simplistic proposals purporting to act exclusively on one of the triggers.

Preventive forestry (when La Seca has not reached our pasture)

Recommendations to alleviate this decay focus on a preventive forestry, to try to stop or minimize this process at an early stage:

- Choosing origin of acorns for restocking: Recommended chosen carefully Quercus acorns or seedlings for reforestation based on their origin, especially phytoclimatic factors where the species has been developed previously, as a sudden change of these appears to trigger the phenomenon.
- Prioritize reforestation plantings front: As far as possible be made staggered planting acorns in different periods, with different dates acorns maturing since been shown that plantations and nurseries from protective weaken the root system of the plant and predisposing factors favor the la seca.
- Increased stocking density: When plan is recommended stocking densely planted or planted later to choose between the best specimens and eliminate those with clear symptoms of decay. These high densities can be cheaper if we start from a seed rather than plantations.
- Decreased forest early intervention: early pruning are discouraged because they can accumulate damage, a predisposing factor for the la seca.

Management of La Seca (when already in our pasture)

The starting point of any proceeding before holding damages attributable to la seca should be the determination of the causes of such damage. This requires having sufficient information on existing vegetation: species present, their distribution, density, etc.

From this diagnosis be established, ie, identify and establish the existing biotic (pests, diseases or a compendium of factors) in the process of woodland condition. This data collection is done through the establishment of diagnostic plots distributed throughout the operation.

From this information, for each farm must implement a set of actions depending on the state of the trees, the species present and harmful agents involved: these acts are phosphorus fertilization / potassium if defoliation, population monitoring and traps multiple funnels (attractants-trap beer) if detected the presence of pest species, health and sanitary pruning pruning low intensity (use of healing), if it detects the presence of stem canker and canker carbonaceous, sowing and planting new specimens of bushes, selective pruning and training execution if caught plenty of damage *Botryosphaeria* spp. It is recommended to apply sealants, since this can end saproxylic insect populations.

5.11. Establishment and management of tracks and trails

Goals

Given the large area farms usual Mediterranean forest, road traffic through them is essential through tracks and trails. Proper management of these elements is key to effective conservation of farms.

Technical Tips

Tracks and roads inside the farm must be kept in good condition, no bumps, and have good drainage ditches rains since these potholes and small ponds that can form after rains in poorly maintained tracks serve as points playback and amphibian step, so that the effect of the vehicle passing through these points is the death thereof.



Fosos del paso canadiense en donde se aprecian pasos para la salida de los anfibios y evitar la mortalidad asociada a esta infraestructura.



Detalle del paso canadiense.

Speed is also an important factor to consider since collisions with wildlife for speeding are the main factor in death of wildlife and domestic. Thus, it should maintain a suitable speed reducing gear allowed in case of encountering an animal. We suggest a speed not exceeding 40 kilometers per hour in cases of speed although the indication should be adapted to the circumstances of each route and each moment is lower in all cases was needed.

- In areas of the road where there are "Canadian walks" used to divide one area from another by building a moat and metal pipes on it for the passage of vehicles and prevent animals, we recommend performing small ramps inside the pit to facilitate the exit of those amphibians that have been dropped into the pit when it is filled with water at the bottom.



- It is recommended in all cases of non-circulation on farms converted to pasture outside the marked trails as it can cause habitat degradation and death by crushing of many species of arthropods, reptiles and amphibians.
- Sustainable Mobility: Using hybrid or electric cars with a combustion engine combined with other electric propulsion. The major advantage of these vehicles that use a 30% energy compared with conventional generating makes only 19%. This efficiency is achieved by batteries that store the energy. It is possible to decrease the impact of noise pollution and CO2 emissions considerably.

5.12. Building management.

Goals

Buildings on properties within mediterranean mountain were built centuries, agricultural and livestock with a sense that has been configured so that human use combined with the presence of animals, food, and shelter for them. Thus, these buildings have always maintained a close relationship with the fauna present in the pasture.

Technical Tips

It is recommended that new buildings adapt to uneven terrain, avoiding steep slopes or embankments reducing soil loss and the use of indigenous materials or types and local, with no flashy colors, while maintaining a balance with the environment and using materials typical area for construction decreasing the maximum visual impact and landscape

To promote the presence of the associated fauna is recommended:

- Performing actions such as placing nest boxes for nesting raptors and other birds.



Artificial nests of Northern House-martin placed in an eave



Nest for raptors



Central de energía solar, muy recomendable para fincas aisladas.

- Building on the roof eaves for nesting swallows, etc ... to increase populations of these species and thus increase the biodiversity of the areas where they perform such actions.

Electricity Supply

Infrastructure should be reduced as cables, power lines, large wind turbines etc. that degrade habitats and landscape. Where necessary thermal and electrical service for new construction, they will opt for renewable energies less impressive:

- Photovoltaic solar energy is a type of renewable energy that is obtained directly from the sun's rays through the quantum photodetection device, called photovoltaic cell. There are many advantages of solar autonomous electrical independence, reduced CO2 footprint and reduced landscape impact point only. In this case the survival of 100% faunística to eliminate collision risks for electrical wiring.
- Solar or heat power: As in the previous case involves harnessing the sun's energy to produce heat, which can be used to cook food or to produce hot water for consumption or energy. This energy can serve as support for conventional heating system providing between 60 and 80% of hot water consumption. The long life of the panels ensures many years of economic benefit, once amortized investment.
- Biomass: The set of organic matter of vegetable or animal materials that come from natural or artificial processing including forestry residues and by-products industries of wood processing. Is purely renewable energy as its energy content must ultimately solar energy fixed by plants during photosynthesis conducting life cycle. This energy is released in the combustion process resulting end products carbon dioxide and water, so that these are considered CO2 neutral and the impact is

smaller than the other fossil fuels. Another advantage of this energy, like the above is the autonomy and reduced pollutants and noise impact.

The fuel of these boilers can be wood biomass products pasture management or processed products such as pellets (cylinders produced wood sawdust by pressing after grinding and drying) or chips (from wood chips residues which are conventionally used) and depending on the type of facility or building we can find both types of fuel, automatic, domestic and industrial.

- For use in industrial installations chips are recommended, because the volume of the stored fuel is higher and the amount of fumes that may be generated during combustion.
- In household automatic pellet boilers can work better when the volume of fuel stored.
- Insulated Mini wind-power sufficiency: Renewable energy wind. Are those that are used to generate power with small windmills below 100 kW. They have a structure similar to the large but simple design can be maintained by the owners. Often accompanied hybrid photovoltaic systems to increase electric power. It is a clean energy, with minimal visual impact and a very low collision mortality by size, with protection grid avoidable and installable on the roofs of buildings

For installations where it is not possible to remove the wiring or electric poles, the best techniques to avoid problems associated with wildlife and home are:

- Burying power lines, where this possibility exists.
- Flag visibly all those spots, that is, those poles and power lines that can cause death by electrocution or collision.
- For points of deaths by electrocution, the solution is to isolate the point of contact with the wire or iron, usually made with plastic insulation.
- For those spots by collision deaths power lines technique used is to place anti-collision devices in the wiring.



Spiral collision avoidance gadget

5.13. Management of endangered species

Goals

Mediterranean open forest host a large number of threatened and endangered species, in a global, European and national levels, as indicated above. This applies, for example, of the Iberian lynx (*Lynx pardina*), imperial eagle (*Aquila adalberti*), black vulture (*Aegypius monachus*), black stork (*Ciconia nigra*) or eagle owl (*Bubo bubo*) and invertebrate species (*Limonasclus violaceus*, *Euphydryas aurinia*, *Cerambyx cerdo*). That is why Mediterranean open forest owner or manager must consider the possible presence of these species if ensure the sustainable management of the habitat is wanted.

Technical Tips

Throughout the whole manual it has been described recommendations or best practices that promote the conservation of listed species habitat, and that also ensure the perfect conditions for their development. However fundamental measures must be taken during the most sensitive period for threatened species. This period extends from February-March (heat season) and August-September (end of breeding season) for described species.

- Sensitive breeding areas: It is recommended that after detecting the presence of any of these endangered species, it must be established a sensitive area of reproduction, feeding and shelter that can be in a 500-800 m radius around the nest and avoid forestry and cattle related work that could disrupt the quiet of the area during the breeding season, they should be programmed out of breeding season.
- Foraging: Sometimes certain endangered species set their farming area in a particular place but travel to nearby territories to feed. That is why, even when a particular species is not present in a territory as breeder, it is possible that this territory is used as a feeding area. In this case, the main recommendation focuses on following the recommendations outlined above: proper conservation of Mediterranean temporary ponds, which can be used as a watering place for species such as the black stork, a well established rabbit population turn out to be to be the main feeding reference to specialized prey birds such as imperial eagle and collaboration with additional feeding places for black vulture, to strength their populations and decrease the effect of attacks to sick livestock.



Cigüeñas negras alimentándose, Jorge Sierra.

- Nesting structures: It is recommended not to change substantially the structure of those trees which have served for nesting to these species in previous years by making toppings.

However, apart from these sensitive species, within the open Mediterranean forest we find other diurnal raptors important for conservation. It is important to know the critical period and try to minimize the inconvenience that the maintenance of Mediterranean open forest could cause them.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
Black vulture (<i>Aegypius monachus</i>)										
Golden eagle (<i>Aquila chrysaetos</i>)										
Imperial eagle (<i>Aquila adalberti</i>)										
Bonelli's eagle (<i>Aquila fasciata</i>)										
Booted eagle (<i>Hieraetus pennatus</i>)										
Short-toed eagle (<i>Circaetus gallicus</i>)										
Buzzard (<i>Buteo buteo</i>)										

5.14 Rabbit Management:

Goals

Lagomorph specie at the base of the food chain of the Mediterranean forest, a large numbers of predators (lynx, imperial eagle, black vulture, golden eagle, eagle owl) depend to survive of its population. It is also one of the most important hunting species for small hunting sport.

The population rabbit has largely declined in recent decades due to two infectious diseases, myxomatosis and viral hemorrhagic disease, VHD, which have decimated their populations. Similarly, habitat degradation has adversely affected, in particular, because of its strict social structure. The two dominant females in a den usually expel other females to lower quality land, where they breed in less suitable habitats or without proper shelter. Normally, they dig tunnels called "gazaperas", which are easy to occupy by opportunistic species, such as foxes, wild boars, etc..

Maintaining good rabbit population in the territory is sign of habitat good health. So, we can say that the rabbit is a biomarker of the state of biodiversity in the Mediterranean open forest.

Technical Tips

There are various techniques to promote the existence of wild rabbits on Mediterranean open forest farms, but the reality is that it is a very difficult specie to work successfully with. There are three essential criteria to manage this species in an open forest area:

- Water availability: Water supply must be ensure in areas where rabbit trails have been described, since it is a species that does not make large movements in their territory, so the farthest water points in rabbit areas should not be over 200 meters. In the absence of a fixed water point, such as a temporary Mediterranean pond, stream or wetland, it is possible to ensure water supply with the installation of mobile isolated waterpoints, situated with a spacing of no more than 100 to 150 meters between them.
- Food availability: Also, to benefit or increase the rabbit population in the territory, it is necessary to ensure the food supply during scarcity times, such as summer season. The most common ways of offering food to these lagomorphs are two:
 - Drops: Planting scattered seeds in areas close to water points and shelter with different herbal species including wheat and rye, as grass species, and alfalfa and vetch, as forage legume species.
 - Feeders: Installing artificial feeders with seeds of herbal species just listed in areas where traces of lagomorph have been found.
- Availability of shelter: The best technique is to protect natural dens, both active or inactive that may be recolonized, usually with forestry pruning residues. Another

technique to ensure the availability of shelter is to build artificial warrens, called "majanos", in which the rabbit can find shelter from predators. They should be located about 150 meters distance from active dens, in high places to avoid flooding problems in case of the biggest rainfall and place them in mosaic areas (grassland / shrub / crop / forest). It is convenient the location of "majanos" networks in maximum density of 10 units / hectare to increase the possibility of shelter. If the construction is circular, it must have a minimum radius of 2.5 meters, with entries each 1.5 meters (slabs protected to avoid predators excavation) and an outer wall of a minimum of 50 cm. tall. These dens can be constructed in different ways and with different materials, depending on the area and the availability of these materials, although the most common are described below:

- Timber, rocks and soil: clumps of wood of large diameter (greater than 20 cm) covered with dirt in the area. Once settled these headlands are used by rabbits to build natural dens.
 - Rocks and soil: There are maybe the most natural, along with the above, as the rabbit has to find local materials to build their own shelters.
 - Wooden pallets, branches and soil: A base of wooden pallets will provide this den a basis used for the rabbit as an entry, this "majano" is covered by a second level branches and above ground.
 - Bricks, wood, branches and soil: A labyrinth of bricks, in the base, show the rabbit the spaces under the timber they need, which are also covered with a skeleton of branches and soil covering the whole structure.
 - Besides these kinds of "majanos", some variants could be constructed by combining materials, as the shelter system remains the same.
- Habitat improvement: In addition to the above, it is recommended conducting the seeding of crops and cereals, that will not be harvested (see section on rainfed pastures), and to encourage, by forestry work, mosaic areas of brambles and shrub communities (*Rhamno-Prunetea* class), mastic, kermes oak and shrub oaks and river bank communities in rivers and streams.

The effectiveness of restocking for this species appears to be low because mortality increase significantly during the first days after the release. Mortality rates between 85% and 90% of specimen released are very common. Therefore, extreme caution should be considered.

If this method is chosen, it is recommended the use of wild specimens. The capture method chosen should be little aggressive to prevent specimens from suffering and increase their chances of survival. A good managing measure will be making a sanitary control of the specimens, during this capture, to ensure that they will not be spreaders of disease agents in the environment.

Rabbits restocking can be done with different methodologies.

- Release of individuals in restored or artificial dens: Preferably in areas with a previously prepared habitat (water points, non harvested crops, habitat mosaic, with many kermes oak, mastic, etc.) and “majano” closed at least for 24 hours. This method is cheaper but its success is less than the pre-release enclosure.
- Pre-release enclosures: although they require much investment is a successful option. It is about areas of at least 3-4 hectares, which are closed by a perimeter fence impenetrable whether for rabbit and terrestrial predators. This site makes possible raising a lot of wild rabbits destined for its expansion after opening the enclosure. With 60% of scrub and 40% of grassland, artificial shelter may be created inside, pastures, feeders, etc.. When reproduction and saturation of rabbits have been tested, small exits will be opened, about 10 cm in diameter in the bottom of the fence, especially oriented to the areas of interest for expansion (choosing for example a suitable microhabitat, as a scrubland or a stone quarry). The great advantage of the locked rabbits restocking, is that these, after the release, they can't escape and scatter, so the objective of fixing the restocked population is achieved. To this must be added the impediment to the entry of terrestrial predators and competitors for food, primarily ungulates.

5.15. Red-legged partridge management

Goals

This species, as rabbits, is a pillar of the Mediterranean forest trophic pyramid. Also, as the rabbit, it is also object of intense small hunting.

Technical Tips

As concerns the partridge, habitat management actions very similar to those proposed for the rabbit should be done, favoring the mosaic, with non harvesting crop areas, feeders and water points.

In the event that the owner harvests the crop, this action must be very careful, since harvesting time usually coincides with the critical period of this species. To avoid the loss of many specimens, these recommendations should be followed:

- Respect a non-harvested band 1-2 meters wide margins of cropland, as there is found a high percentage of partridge nests.
- Failure to perform the above should start harvesting slowly (to allow time for the flight of the possible occupants) starting from the center to the margins.
- Besides the perimeter band is also interesting unharvested, a narrow strip (0,5-1 m), it is interesting to leave small areas unharvested (2-3 meters in diameter) distributed irregularly.
- Use a cutting height higher in the machine than usually to provide more coverage to the species.
- It is advised not to harvest or collect straw overnight, since it is easier to disturb this species.

Also, other actions referred in this chapter are beneficial to the partridge, as reforestation, clearing, etc.

According reproductive phenology, pairing occurs in mosaics of crops, fallow and scrub; breeding time occurs in scrub and grasslands bordering streams and crops, and outside of the breeding season, partridge selects sites with greater shrub coverage.

It is proposed by a combination of measures consisting of a habitat management that promotes spatial heterogeneity, favoring the boundaries and cropping systems with rotating crops that allows having fallow, crops, wasteland and shrubland at the same time.

It is recommended the treatment for trees and shrubs mass, thinning, maintenance and improvement of water points and feeders (only used in specific times of the year, depending on the evolution of populations), hedges creation, mosaic of micro-croplands with abandoned harvest, cleaning and adjustment of fountains and springs, and placement of decoys in a maximum

density of 3 per 10 hectares (in areas where there are good populations not recommended to place anything). For all recommendations have been indicated in the relevant sections.



5.16. Common wood-pigeon management

Goals:

The pigeon has suffered a sharp decline of its population throughout the West Iberian, especially in regard to major wintering areas. Therefore arises as to the recovery of this species.

Technical tips

The wood pigeon is favored by the low intensive or non use of the Iberian pigs feeding in oak areas, leaving lots of trophic resource available; the installation of feedlots to use in very specific times of the year depending on the evolution of populations and placing decoys, in the same density Red partridge. Also, there are general recommendations of habitat structure diversification and sustainable management of the pastures are sufficient to improve the species, whose regression is largely due to excessive hunting pressure. It is therefore recommended the application of the following hunting management measures:

- Establish a hunting quota: As in other species catch quotas are set for small hunting, this is not the case of the wood pigeon. It is therefore recommended or prohibit hunting, at least in certain areas until you get good population numbers and subsequently establish annually a maximum number of fish hunter and catch per day depending on the annual population number but in general will be about 15 - 20 birds per hunter per day.
- Limit hunting in the wintering areas: Between 1 November and 28 February, wintering season for the pigeon in the Iberian Peninsula, this species has a strong gregarious behavior and focuses on roosts. The hunting schedule is not regulated in the same way between regions so it is recommended to do from sunrise until 17:00 in Spain and in Portugal by 16:00 to ensure the rest of the pigeons in their roosts.
- Protect roosts: During wintering time, it is proposed to protect roost areas of the species as hunting refuge areas and even a security perimeter to secure this rest and encouraging the development and reinforcement of populations year after year.
- Set refuge areas in ancient roosts: It is recommended establish free hunting zones in places that were traditionally pigeon roosts to encourage population recovery.

5.17. Common quail management

Goals:

It is a very small gallinaceous that migrates and it is very demanded as a small hunting species. It is also one of the main food supply of many predators in the Mediterranean forest.

It is another species that has suffered a sharp decline in recent years, both in the West and in the whole Iberian Peninsula. Therefore, its recovery is a goal itself.

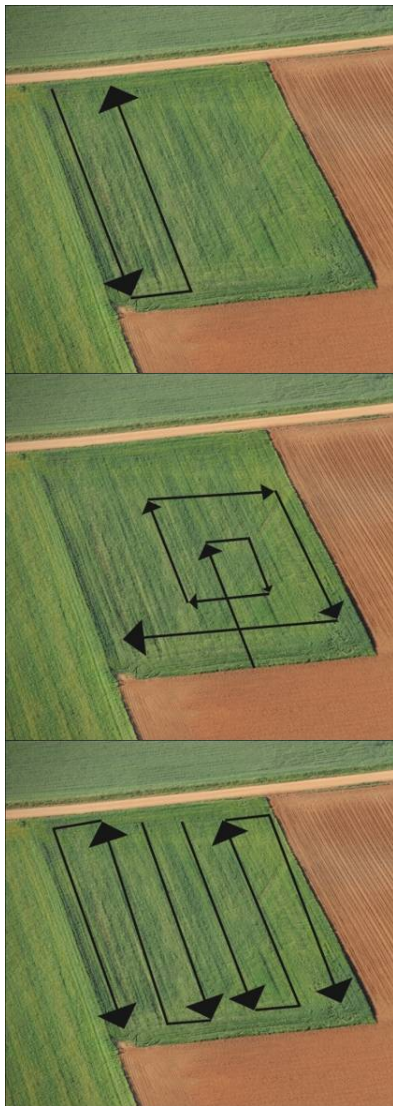
technical tips

The techniques recommended for the promotion of this species are similar to those adopted in the case of the partridge, adjusting the timing of migration of this species. It spends the winter in Africa and comes into our land around April and May (but its arrival can be extended to June depending on weather conditions). Their life cycle lasts two to three months from the start of laying until juveniles are independent. It takes about 10 days for a female to complete a full egg lay (one egg per day), with an incubation period of 16-18 days and the chicks are independent after one or two months. So in areas that receive the quails on late May, as it is the case of West Salamanca sites, if as arriving they choose a couple, the chickens will be independent in late July or August.

In October, with the arrival of the first cold they begin the migration, many of these birds stay in Spain using crop and irrigated farmland existing in the south and southwest of the Peninsula.

As good practice for the management of populations of this species, the following are suggested:

- Plant varieties of longer and stronger life cycle: The use of seed varieties of longer biological cycle and resistant to extreme weather conditions favor quail populations in the West Iberian area as harvest takes place around the month of July and early August, depending on the year, coinciding with the critical time for the young of this species. These varieties allow quail to complete its cycle by increasing the number of individuals available for the following year.
- Delay collecting straw: a very favorable conservation measure for this species is to postpone as much as possible the straw packing (about two weeks), so the chicks of less than three weeks have a greater chance of survival to fully develop and have greater mobility to escape the harvester.
- Respect crop margins: Respect a band of 1 to 2 meters wide in unharvested limits and free of herbicides. It is a very popular measure in other European countries with good results for nest survival.
- Adapt mowing routines: This measure permits to increase quail populations.



Use the longer side to make the mow, delaying the passage of the mowing machine around the same place and giving enough time for the chicks to run to the margins.

Starting from the middle of the field and moving outwards the crop allowing chickens run to the margins.

Starting harvest midfield by two points and heading toward the ends. As in the previous case chickens can escape to the edges.

5.18. Red deer management

Goals

It is one of the most important large herbivores species in the Mediterranean area since, along with cows and horses, is one of the best management tools of habitats. Therefore, its management should be incorporated into the planning of the pasture.

Technical Tips

Depending on the treatment given to this species: domestic, animal husbandry, hunting farm or wild herbivore, release or pseudo-release, management will be different. Thus, in this section the best management practices will be regarding it as wild animal. The following is recommended:

- Population control: it is recommended to maintain a sex ratio about 1:1 within the population. So extraction quotas should be planned carefully seeing population census data.
- Selective hunting: It is recommended selective hunting of specimens of different ages, or those who have a problem and must be separated from the rest. So, the tendency must not be of hunting male trophies that could lead to an uncontrolled population of females which dangerous increase the population size.
- Scattered clearings or plantings: This measure is to increase the deer diet quality with high quality grasses when pastures are poor or do not form a mosaic of pastures, scrubs and trees. Furthermore this measure will reduce the consumption of woody species, which prevents shrubs and trees regeneration and in many cases degrade existing trees. The surface will be less than 1 hectare of sinuous perimeter and located in shrub borders or woodland to achieve the mosaic effect with different vegetation types.



5.19. Hare management

Goals

It is a small hunting animal of family Leporidae, it is similar to rabbit in the order of lagomorphs, but its fur has different shade and it is larger than the rabbit.

Like rabbit and partridge, it has suffered a population decline, but much more recent affected of diseases like tularemia and European brown hare syndrome.

Technical Tips

The following guidelines are proposed, which are mostly valid for other species such as rabbit, partridge and quail:

- At harvest time: It is recommended to start at the center of the planting to allow time for the hare to escape to new shelters. Placing chains and repelling wildlife systems may be favorable to avoid death by crushing specimens.
- Crops: The growth and diversification of crops can be highly recommended to have an additional supply contribution during unfavorable times. A mixture of cereals (wheat, rye and vetch) and maintenance of vacant lots increased food availability for this species.
- Shelter construction: As for other species, it may be favorable to build woody materials shelters that may favor their escape and refuge in case of need, hunting etc.
- Adapt mowing routines: A good routine mowing may favor the strengthening of populations and prevent the loss of individuals for the following season.
- It is recommended to suspend hare restocking because of the high risk of spreading diseases, as tularemia and European brown hare syndrome.

Bibliografía

- Alaejos Gutiérrez, Joaquín; Alejano Monge, Reyes; Calzado Carretero, Anabel; Carevic Vergara, Felipe; Del Campo, Antonio; Domingo Santos, Juan M; Domínguez Nevado, Luis; Fernández Villarán San Juan, Ruben; Fernández Martínez, Manuel; Flores Hurtado, Enrique; García Vázquez, Francisco Jesús; López Pantoja, Gloria; Marín Pageo, Francisco; Navarro Cerrillo, Rafael M^a; Pérez-Carral Lorenzo, Cristina; Sánchez Osorio, Israel; Tapias Martín, Raúl; Torres Álvarez, Enrique; Vázquez Piqué, Javier. 2011. Manual para la gestión sostenible de las dehesas andaluzas.
- Blondel J & J. Aronson, 1999. Biology and Wildlife of the Mediterranean Region. Oxford University Press, New York
- CABI Index Fungorum (2008). www.indexfungorum.org.
- Cabo, A. 1998. Formación Histórica de las dehesas. In: La Dehesa. Aprovechamiento sostenible de los recursos naturales. p.15- 44. Ed. Agrícola Española. Caja Madrid. Fundación Premio Arce. Madrid.
- Columbares Asociación. Manual de buenas prácticas ambientales para la zona de especial protección para las aves de monte el valle y sierras de Altaona y Escalona (Murcia).
- Consejería de Medio Ambiente de la Junta de Andalucía. La Dehesa. (<http://www.juntadeandalucia.es/medioambiente/site/portalweb/>)
- Dahlberg, A. & Croneborg, H. 2003. 33 threatened fungi in Europe. Complementary and revised information on candidates for listing in Appendix I of the Bern Convention. Uppsala, Sweden.
- Díaz, M., Pulido, F.J. y Marañón, T. 2003. Diversidad biológica y sostenibilidad ecológica y económica de los sistemas adehesados. Ecosistemas 2003/3 (URL: <http://www.aeet.org/ecosistemas/033/investigacion4.htm>)
- FUNGESMA. Fundación para la Gestión y Protección del Medio Ambiente. 2001. Buenas prácticas cinegéticas.
- Galante, E., M. García-Roman, I. Barrera & P. Galindo, 1991. Comparison of spatial distribution patterns of dung-feeding scarabs (Coleoptera: Scarabaeidae, Geotrupidae) in wooded and open pastureland in the Mediterranean 'dehesa' area of the Iberian Peninsula. Environmental Entomology, 20, 90–97.

- Galante, E., J. Mena & C.J. Lumbreras, 1993. Study of the spatiotemporal distribution in a coprophagous community in a Mediterranean holm-oak ecosystem (Coleoptera: Scarabaeoidea: Scarabaeidae: Geotrupidae). *Elytron*, 7, 87–97.
- Grove, S. J. 2002. Saproxylic insect ecology and the sustainable management of forests. *Annual Review of Ecology, Evolution, and Systematics*, 33:1–23.
- Guil F., Moreno-Opo R., Berenice Acuña E., Martínez-Jaúregui M., San Miguel A. Catálogo de buenas prácticas para la gestión del hábitat en Red Natura 2000: bosque y matorral mediterráneos Una propuesta de actuaciones financiadas en Red Natura 2000.
- Hernández de la Obra, J. y Gómez, J.-García, L. EUROPARC-España. 2005. Manual sobre conceptos de uso público en los espacios naturales protegidos. Editado por Fundación Fernando González Bernáldez. Madrid 94 págs.
- Juan Carlos Blanco y José Luis González Libro rojo de los vertebrados de España. Editores Ministerio de Agricultura, Pesca y Alimentación.
- Juan José Tuset, Gerardo Sánchez. Organismo Autónomo de Parques Nacionales. 2004. La seca: El decaimiento de encinas, alcornoques y otros *Quercus* en España.
- Lieutier F. & D Ghaioule, 2005. Entomological research in Mediterranean forest ecosystems. Inra Editions, Paris.
- Madroño, A., González, C. y Atienza, J. C. (Eds) 2004. Libro Rojo de las Aves de España. Dirección General para la Biodiversidad-SEO/BirdLife. Madrid.
- Marcos-García MA., E. Micó, J. Quinto, R. Briones & E. Galante, 2010. Lo que las oquedades esconden. *Cuadernos de Biodiversidad* 34: 3–7.
- Mariano González L., San Miguel A., Oria J., Moreno-Opo R., Sánchez R., Silvestre F., Gea Guillermo., Muñoz J., Cacho C. 2005. Manual de buenas prácticas de gestión en fincas de monte mediterráneo de la Red Natura 2000.
- Mico E., MA. Marcos-García, J. Quinto, A. Ramírez-Hernández, S. Ríos, A. Padilla & E. Galante, 2011. Los árboles añosos de las dehesas ibéricas, un importante reservorio de insectos saproxílicos amenazados. *Elytron*. 24: 89-97.
- Micó, E., R. Briones, J. Quinto & E. Galante, 2010. Presencia de *Eupotosia mirifica* (Mulsant, 1842) en la Reserva Campanarios de Azaba, Salamanca (LIFE Nature) (Coleoptera: Scarabaeoidea: Cetoniidae, Cetoniini), *Boletín Asociación Española de Entomología*, 34 (3-4): 437-440.

- Ministerio de Medio Ambiente y Medio Rural y Marino. Catálogo Nacional de Especies Amenazadas.
- Moreno, G. 1996. Setas micorrizógenas, parásitas y saprófitas; una forma de valorar el impacto ambiental en nuestros bosques. Comunicación en Congreso Micológico. Laredo (España).
- Moreno-Opo R., Guil F., Agudín S., Arredondo A., Manuel Blanco J., Alfredo Bravo J., Caldera J., Camiña A., Corbacho C., Coronilla R., Costillo E., Crespo E., De la puente J., Donés J., El Khadir N., Galán R., García V., Hernandez M., Higuero R., Hoflé U., Inogés J., Lecocq A., Martínez M.A., Morán R., Mosqueda I., Oria J., Bettina Perales A., Redondo S., San Miguel A., Sánchez J.M., Segovia C., Silvestre F., Vielva J., Villegas A. 2007. Manual de gestión del hábitat y de las poblaciones de Buitre Negro en España.
- Muñoz-Igualada J., Roig Gómez S., San Miguel Ayanz A, González García L. y Oria J.2007. Gestión del monte mediterráneo para la caza menor: características e importancia para la conservación de predadores amenazados.
- Nieto, A. & K. N. A. Alexander, 2010. European Red List of Saproxyllic Beetles. Luxembourg: Publications Office of the European Union.
- Numa C., J.R. Verdú, A. Sánchez & E. Galante, 2012. Effect of landscape structure on the spatial distribution of Mediterranean dung beetle diversity. *Diversity and Distribution* 15: 489-501
- Numa, C., C. Rueda, J. R. Verdú & E. Galante, 2010. Influence of grazing activities on species diversity of dung beetles in Mediterranean pastures. *Options Méditerranéennes* 92: 277-280
- Oficina de publicaciones oficiales de las comunidades europeas. Comisión Europea dg xi - Medio Ambiente, Seguridad nuclear y Protección civil. Natura 2000, Gestión de nuestro patrimonio.
- Palomo, L J y. Gisbert, J, 2005. Atlas de los mamíferos terrestres de España. Dirección General para la Biodiversidad-SECEM-SECEMU, Madrid, 564pp.
- Pérez P-Carrera C. Fernandez P., Lopez V. , Rosa E. ESTUDIOS Y PROYECTOS LÍNEA, S.L. Fundación Patrimonio Natural de Castilla y León. Valladolid.2010. Manual de Buenas Prácticas Cinegéticas en Castilla y León.
- Pleguezuelos J. M., R. Márquez y M. Lizana, (eds.) 2002. Atlas y Libro Rojo de los Anfibios y Reptiles de España. Dirección General de Conservación de la Naturaleza-Asociación Herpetologica Española (2ª impresión), Madrid, 587 pp.

- Proyecto europeo “CypFire”- “Barrières vertes de cyprès contre l’incendie: une solution faisable, écologique et économique pour sauvegarder les régions méditerranées. Diputación Provincial de Valencia.
- Quinto J., M. A. Marcos-García, C., Díaz-Castelazo, V. Rico-Gray, H. Brustel, E. Galante, E. Micó, 2012. Breaking down Complex Saproxylic Communities: Understanding Sub-Networks Structure and Implications to Network Robustness.: PLoS ONE 7(9): e45062. doi:10.1371/journal.pone.0045062
- Ricarte, A., Marcos-García & M. A., Moreno, C.E., 2011. Assessing the effects of vegetation type on hoverflies (Diptera:Syrphidae) diversity in a mediterranean landscape: implications for conservation. Journal Insect Conservation, 15: 865-877
- Ricarte, A., T. Jover, M. A. Marcos-García, E. Micó, & H. Brustel, 2009. Saproxylic beetles (Coleoptera) and hoverflies (Diptera: Syrphidae) from a Mediterranean forest: towards a better understanding of their biology for species conservation. Journal of Natural History, 43(9): 583- 607.
- Salvador Rivas-Martínez Catedrático de Botánica de la Universidad Complutense MADRID Memoria del Mapa de Series de Vegetación de España 1:400.000.
- San Miguel, A. 1995. La Dehesa española. Ed. ETSI de Montes. Madrid. 315 p.
- San Miguel Ayanz A., Sandra Agudín Menéndez; Paloma Garzón Heydt, Francisco Guil Celada, Javier Inogés García; Fernando Silvestre Barrio; Luis Mariano González García; Francisco M^a García Domínguez; Mariana Fernández Olalla; María Martínez Jaúregui;Jaime Muñoz Igualada; Carlos Rodríguez Vigal; Fernando Alda Pons; Ignacio Doadrio Villarejo; Mauro Hernández Segovia. 2006. Manual para la gestión del hábitat del linco ibérico (*Lynx pardinus*) y de su presa principal, el conejo de monte (*Oryctolagus cuniculus*).
- Speight M. C. D. 1989. Saproxylic invertebrates and their conservation. Nature and environment series 42. Council of Europe, Strasbourg, Francia.
- Stokland J.N., J.Siitonen & B. G. Jonsson, 2012. Biodiversity in dead wood. Cambridge University Press, Reino Unido.
- Tarazona Lafarga T. Sección de Espacios Naturales y Especies Protegidas, Servicio Territorial de Medio Ambiente de Salamanca. Las Dehesas de Salamanca y la Red Natura 2000.
- Valladares F. 2008. Ecología del bosque mediterráneo en un mundo cambiante. Organismo Autónomo Parques Nacionales.

- Verdu JR & E Galante (ed.). Libro Rojo de los Invertebrados de España. Madrid (Spain). Dirección General de Conservación de la Naturaleza, Madrid
- Zamora, J., Jr. Verdú & E. Galante, 2007. Species richness in Mediterranean agroecosystems: Spatial and temporal analysis for biodiversity conservation. *Biological Conservation* 134 (1): 113-121
- Zavala M. A., Zamora R., Pulido F., Blanco J. A., Bosco Imbert J., Marañón T, Castillo F. J. y Valladares F. Nuevas perspectivas en la conservación, restauración y gestión sostenible del bosque mediterráneo.

