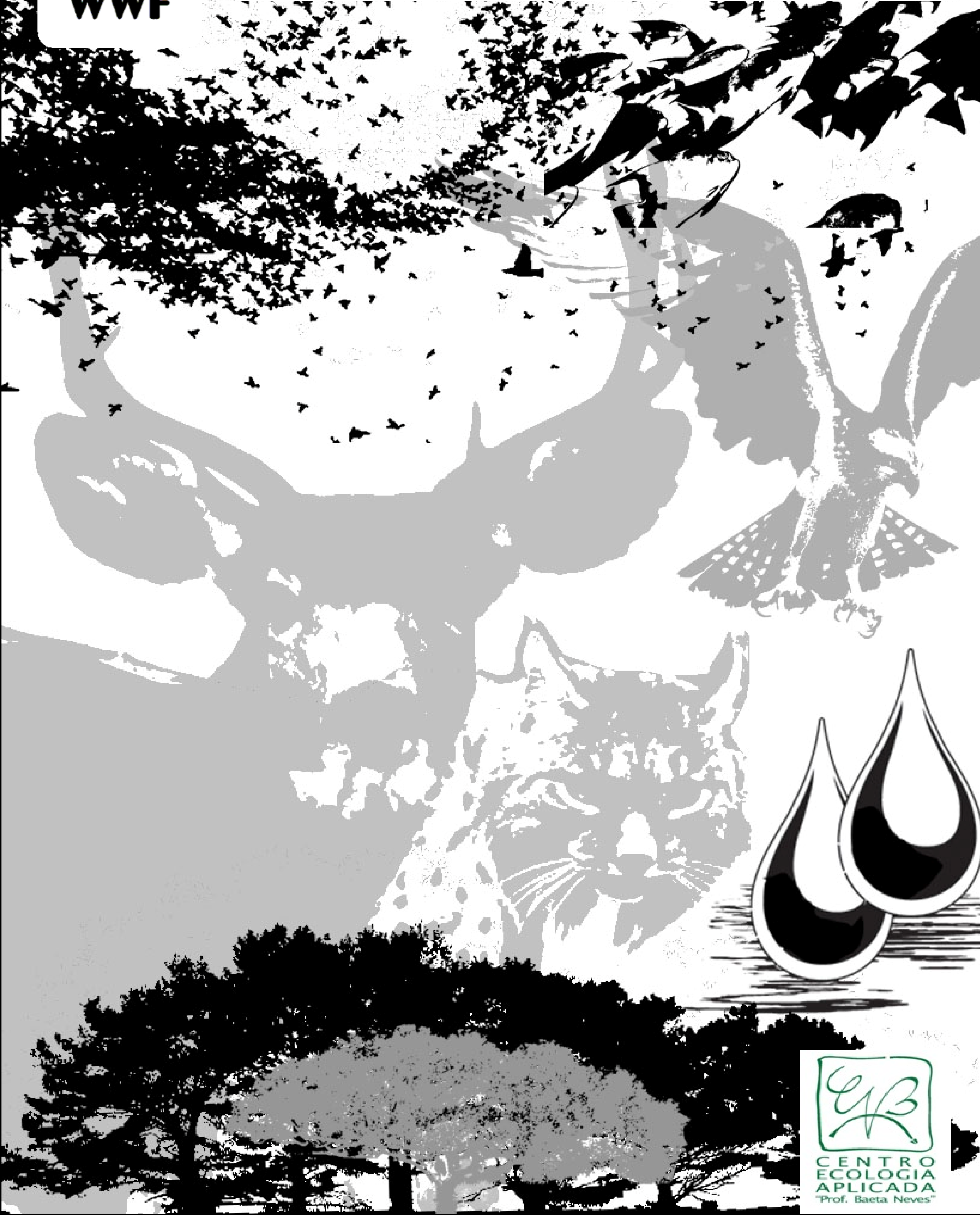
HOTSPOT AREAS FOR BIODIVERSITY AND ECOSYSTEM SERVICES IN *MONTADOS*



CENTRO ECOLOGIA APLICADA "Prof. Baeta Neves"

"Hotspot Areas for Biodiversity and Ecosystem Services in Montados Report - 2010", from WWF Mediterranean Programme in Portugal intents to be a tool alongside with WebGIS - HABEaS (www.habeas.com.pt) for a fully understanding of the ecosystem *montado* in Portugal and its importance for PES (Payment For Ecosystem Services).

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LIST OF ABREVIATIONS AND ACRONYMS

CEABN- *Centro de Ecologia Aplicada Prof. Baeta Neves* - Centre for Applied Ecology Prof. Baeta Neves
EWGS: The English Woodland Grant Scheme
FC: Forestry Commission
FMU: Forest Management Unit
FONAFIFO: *Fondo Nacional de Financiamiento Forestal* – National Fund for Forestry Financing
FSC: Forest stewardship Council
GFTN: Global Forest Trade Network
GIS: Geographic Information Systems
HABEaS: Hotspot Areas for Biodiversity and Ecosystem Services
HCVAs: High Conservation Value Areas
IBAs: Important Bird Areas
ICNB: *Instituto da Conservação da Natureza e da Biodiversidade* – Portuguese Institute for Nature Conservation and Biodiversity
IFN: *Inventário Florestal Nacional* – National Forest Inventory
IGP: *Instituto Geográfico Português* – Portuguese Geographic Institute
INAG: *Instituto da Água* – Portuguese National Water Institute
NGO: Non-Governmental Organisation
PES: Payment for Ecosystem Services
RDPE: Rural Development Programme for England
RNAPs: *Rede Nacional de Áreas Protegidas* – National Network of Protected Areas
SICs: *Sítios de Importância Comunitária* – Sites of Community Interest
SPEA: *Sociedade Portuguesa para o Estudo das Aves* – Portuguese Society for the Study of Birds
SSSIs: Sites for Special Scientific Interest
UKBAP: United Kingdom Biodiversity Action plan
UKWAS: United Kingdom Woodland Assurance Standard
WMG: Woodland Management Grant
WWF- World Wide Fund for Nature
ZPEs: *Zonas de Protecção Especial* – Special Areas for protection of Birds

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PREFACE

Our wellbeing as humans depends on healthy, functional ecosystems, which depend on adequate levels of biological diversity. The essential message associated to the term 'biodiversity and ecosystem services' is, therefore, that ecosystems are crucial for our wellbeing and thus they have economic value.

Economic value is primarily about human welfare and not markets and prices. Markets, as well as related social institutions, such as property rights and public regulations, have been analyzed by most economists, since Adam Smith, as regards their efficiency as tools to improve the wellbeing of people rather than as an end in itself.

One problem with biodiversity and ecosystem services is that, apparently, markets are not working properly here. So, even with an increasing acknowledgement of our dependence on biodiversity and ecosystems, we currently witness an acceleration of the pace of degradation of these valuable assets, which is precisely driven by market incentives (prices) that convey our needs for food, energy, mobility, housing and other goods and services to good producers who manage our ecosystems.

It is also clear that this happens because biodiversity and ecosystems, which are valuable assets, are usually priced at zero by the markets. Zero priced valuable assets mean that economic agents (ecosystem managers) have no interest in investing in these assets and no strong concern about their degradation. Any effort to conserve or improve these assets wouldn't after all be appropriately remunerated by the market.

This failure of the market in reflecting the value of biodiversity and ecosystem services is due to difficulties in creating effective demand for these services, as we all usually benefit from them for free (e.g. water and air purification, pollination, soil conservation and flood alleviation, as well as scenic services). This situation is difficult to revert, as most of these services have public-good characteristics: exclusion of non-payers is impossible or extremely costly to organize. This failure of the market to remunerate private investment in conservation and restoration of biodiversity and ecosystem assets is reflected in the accelerated pace of ecosystem degradation and biodiversity loss we witness in our days.

Market failure called for government intervention to preserve zero priced but valuable assets with public-good characteristics. Nature conservation laws, acting mostly through the creation of protected areas, are the most prominent of these public policies and present a good record of success stories. But they also have limits, as they only establish constraints for the behavior of ecosystem managers which are usually contradictory with market signals, which induce destructive behavior. On the other hand, protected areas and regulations do not easily translate into positive incentive to sustainable ecosystem management.

So these forms of government intervention through restrictive regulation, while still enormously relevant to slow down ecosystem degradation, particularly in crucial biodiversity hotspots, need to be complemented by different approaches, which can also be generalized to the countryside outside protected areas.

One of these approaches is precisely that of creating markets in which those investing in biodiversity and ecosystems may sell the output of their investment effort. This output is the added levels of ecosystem services to be credited to investment in natural capital or simply to sustainable management when compared to business-as-usual management. This approach is particularly appealing as it directly addresses the problem of market failure by giving a price to everything that has value, and thus realigning economic incentives in a way that makes it profitable to invest in conservation and restoration of biodiversity and ecosystems. On the other hand, if a price has to be paid for ecosystem degradation (e.g. by mandatory buying of offsets from those investing in ecosystem restoration), then ecosystem degradation will be integrated as a cost in decision-making processes and solutions to avoid or minimize degradation may become profitable options. So, the market approach creates incentives for both investing in ecosystems and refraining from degrading them.

The so called market approach includes a diversity of strategies to create an effective demand for biodiversity and ecosystem services: (1) some of these strategies (cap and trade mechanisms) act through a regulatory cap on allowed ecosystem degradation, which then can be complied with by regulated agents through buying certified biodiversity offsets from others (including conservation banks); (2) in other cases, demand results from environmental impact assessment processes that require biodiversity compensations; (3) in others, demand results purely from voluntary initiatives of business or individuals to purchase biodiversity offsets to manage their footprint on ecosystems; (4) in others, public agencies act on behalf of the general public by paying for ecosystem services that we all desire but for which a real market is difficult to organize.

Creating market-like solutions for ecosystem services is a good idea, but one with complex implementation requirements. It demands hard and good-quality work in designing appropriate market structures.

This report and the related work of the WWF in this area, in which the report fits well, is an excellent example of what can be done to contribute to turn the market approach into a more generalized, effective solution to market failure problems in forest ecosystem management. In fact, the report develops and proposes a process to organize the supply side of a possible market for the biodiversity and ecosystem services delivered by the management of *montados*.

First, it selects one of the most relevant terrestrial ecosystems in Portugal and the Western Mediterranean, in terms of biodiversity and several ecosystem services: cork and holm oak *montados*. Montados are also ecosystems under economic stress: cork oak *montados*, because of its extreme reliance on a single market output (cork) whose marketing prospects exhibit some level of risk; holm oak *montados*, because here there are generally no market outputs that adequately remunerate sustainable forest management. These difficulties mean that certified markets for traditional outputs (cork), which have mostly been a way for accessing markets rather than creating additional value, became insufficient and need to be complemented by novel approaches able to remunerate sustainable forest management *per se* and not only in an indirect way through markets for traditional forest outputs.

Good quality work in designing market-like solutions requires focusing the best analytical resources on priority problems, and the *montado* surely was a good choice.

Second, the report made choices on the particular components of biodiversity and ecosystem services to focus on, as well as on empirical indicators to measure and map these services. Use was made of an already tested concept, within sustainable forest management certification, High Conservation Value areas (HCVA), which allowed the authors to progress faster on sound ground, as well as make connections with already implemented verification schemes (FSC and GFTN). Interpretation of the HCV attributes followed the already established national interpretation within the FSC framework, and selected indicators for the several dimensions of the water, biodiversity and carbon services for which credible GIS data was already available. In all of these choices, it is possible to underline a level of pragmatism that is required for all solutions to work on the ground.

Third, an approach was designed to select hotspot areas where different ecosystem services overlap. In these hotspot areas, it is possible to organize the selling of overlapping ecosystem services in a bundled way, in a strategy to reduce transaction costs. The approach is then incorporated into a web-GIS tool that allows anyone to calculate and map ecosystem services in any particular area of the studied region.

Fourth, the approach and the proposed GIS tool were tested in a case study, the area of a group certification scheme (APF Certifica, in Coruche, a core area for cork oak), with good results in identifying hotspot areas where different services overlap and in measuring these areas as a way to assess market potential for different bundles of ecosystem services (water + biodiversity; biodiversity + carbon, or biodiversity alone).

Fifth enabling conditions, such as the potential for using verification and certification schemes already on the ground (FSC and GFTN) and to bundle ecosystem services to market them in a combined way were explored in some detail. These are very important points, because institutional capacity is not unlimited and transactions are not for free. The importance given to capacity and transaction cost considerations shows again the pragmatism of the proposed approach.

As the authors recognize, the way ahead to implement the solution they propose is still long and requires improvements, essentially as regards (1) broadening the empirical GIS-based indicators to plant and bird species belonging to the typical species-assemblages of well-functioning *montado* systems; (2) determining which adjustments to already implemented verification schemes (FSC and GFTN) are required to make sure that they are able to verify improvements in biodiversity and ecosystem services required to emit offset credits; and (3) further exploring the enabling conditions, especially those related to demand creation and market organization for bundled ecosystem services.

Given the relevance of their work for the on-the-ground progress of market-like solutions for current market failures in remunerating the ecosystem services delivered by *montados*, I can only wish the project team and the WWF all the best in their work to implement their project.

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Abstract

Cork and holm oak *montados* are silvi-pastoral systems characterised by high levels of biodiversity which generate different ecosystem services such as carbon storage and water regulation when adequately managed. Lack of economic incentives to management is leading to mismanagement or abandonment of the system with concomitantly loss of biodiversity and ecosystem services. The main incentive to management has been cork production. Novel ways to promote conservation and sustainable management of *montados* are needed. Payment for Ecosystem Services (PES) is a relatively novel conservation tool which can generate economic incentives for good management practices reverting to the conservation of biodiversity. The present report aims to identify and quantify the main biodiversity hotspots and ecosystem services, namely carbon storage and water regulation generated by the *montado,* identifying those areas where biodiversity and ecosystem services are spatially coincident (Hotspot Areas for Biodiversity and Ecosystem Services – HABEaS).

To achieve this, High Conservation Value Areas (HCVAs) were identified and mapped through Geographic Information System (GIS) within the cork and holm oak areas of distribution in the south of River Tagus. The estates within *APF Certifica* – a cork producer forest association - were used as a case study to illustrate the identification of the HABEaS through the HCVA concept. Additionally, a WebGIS public tool was developed to enable stakeholders (e.g. landholders, NGOs, forest producer associations, and environmental agencies) to geographically identify HCVAs. The Global Forest Trade Network (GFTN) and Forest Stewardship Council (FSC) are proposed as mechanisms capable of providing independent verification and monitoring of responsible management practices generating biodiversity and ecosystem services. Finally, the present report outlined three types of market-based payment mechanisms for ecosystem services together with the 'bundled' ecosystem service approach illustrated through three case studies.

Sumário

Os montados de sobro e azinho são sistemas agro-silvo-pastoris caracterizados por níveis de biodiversidade elevados que quando adequadamente geridos, geram serviços como o armazenamento de carbono ou a regulação do ciclo da água. Condicionalismos socio-económicos têm, em alguns casos conduzido à gestão inadequada ou até abandono do sistema com consequentes perdas de biodiversidade e serviços do ecossistema. São necessários novos mecanismos capazes de promover a conservação e gestão sustentável dos montados. O Pagamento por Serviços do Ecossistema é uma ferramenta de conservação relativamente nova que pode gerar incentivos a boas práticas de gestão. O presente relatório tem como objectivo identificar e quantificar os principais *hotspots* de biodiversidade e áreas de armazenamento de carbono e de importância para o ciclo da água gerados na área de distribuição do montado. Identificam-se também as áreas onde a biodiversidade e os serviços do ecossistema são espacialmente coincidentes (*Hotspots* de Biodiversidade e Serviços dos Ecossistemas - HABEaS). Neste âmbito foram identificadas e mapeadas em Sistema de Informação Geográfica (SIG) as Áreas de Alto Valor de Conservação (AAVCs) nas áreas de distribuição de sobreiro e azinheira a sul do Rio Tejo. Como estudo de caso utilizaram-se as propriedades do grupo de produtores florestais - APF Certifica - para ilustrar a identificação do HABEaS através do conceito AAVC. Descreve-se ainda uma ferramenta pública *WebGIS* que foi desenvolvida para permitir às partes interessadas (proprietários, ONGs, associações de produtores florestais e órgãos ambientais) identificar geograficamente as AAVCs. A Rede Global de Comércio Florestal (GFTN) e a Certificação da Gestão Florestal (FSC) são propostos como mecanismos adequados à verificação e monitorização independente de práticas de gestão responsável. Finalmente descrevem-se três tipos de pagamento de serviços do ecossistema "agrupados” (*bundled ecosystem services*) ilustrados através de três estudos de caso.

1.Introduction

The Mediterranean Basin is a biodiversity hotspot (Myers *et al.* 2000) hosting more than 25,000 plant species 50% of which are endemic to the region (Medail and Quezel, 1997) and a number of endangered or critically endangered vertebrates. The biodiversity rich cork oak and holm oak woodlands or *montados* occur within this region covering approximately 1.125,000 ha in Portugal (IFN, 2007).

These human-shaped systems have high conservation and cultural value when adequately managed. Lack of economic incentives is leading to mismanagement or abandonment of the ecosystem. It is crucial to find alternative sources of income and incentive to its management. This report focuses on the conservation value of cork and holm oak *montados* occurring in the southern region of Portugal (Fig.1.1.) where this ecosystem is a dominant land use playing an important role on the conservation of biodiversity and ecosystem services such as watershed protection and carbon storage. The report identifies main biodiversity hotspots, water and carbon storage services within the Portuguese area of distribution of cork and holm oak *montados*, by applying the High Conservation Value Areas (HCVA) concept.

1.1.Aims and Objectives

The aim of this report is to spatially identify and quantify, at regional level, the main biodiversity hotspots and ecosystem services (water and carbon storage) generated by *montados* and assess those areas where biodiversity and ecosystem services are spatially coincident (Hotspot Areas for Biodiversity and Ecosystem Services – HABEaS). In such areas, payment for carbon storage and water conservation services may potentially contribute to the adequate management and conservation (Anderson *et al.*, 2009) of the *montado* ecosystem.


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Specifically the objectives of the report are:

- To identify the High Conservation Value Areas (HCVAs) in *montados* and mapping these areas through Geographic Information Systems (GIS);
- To develop a WebGIS public tool enabling stakeholders (e.g. landowners, NGOs, forest managers, forest producer associations, environmental agencies, and forestry professionals) to geographically identify HCVAs in particular;
- To suggest using the Global Forest Trade Network (GFTN) and Forest Stewardship Council (FSC) tools as an independent verification and monitoring mechanism of management practices generating biodiversity and ecosystem services.

1.2.Outline of the Report

This report explores aspects involving the identification and quantification of HCVAs within the *montado* area situated in the south of River Tagus.

Chapter two provides a review of relevant information regarding the *montado* ecosystem including challenges and opportunities for its conservation. Chapter three describes the study area and the methodology employed to achieve the objectives stated in the section 1.1.

Chapter four presents and explains the Portuguese interpretation of the HCVAs attributes; identifies the HCVAs within the study area – regarding Biodiversity Conservation, Watershed Protection and Carbon Storage; demonstrates the recently created and developed HABEaS WebGIS tool; and finalises with the case study of *APF Certifica* (a cork oak forest producer association situated in the study area) by identifying HABEaS through the HCVA concept in the *APF Certifica* estates.

Chapter five explains the mechanism employed to verify and monitor forest management generating biodiversity and ecosystem services firstly by explaining the role of GFTN and FSC as verification and monitoring mechanisms. This chapter also describes a stepwise approach towards independent verification

of biodiversity and 'bundled' ecosystem services Wendland *et al*., 2010) and the opportunity to create ecosystem markets for those services.

Chapter six outlines the market-based payment mechanisms of ecosystem services that may be applied to the cork and holm oak *montados*. The chapter finishes with three relevant case studies related to bundled ecosystem services. Finally, chapter 7 concludes the report by providing a brief assessment of the HABEaS and recommendations for future developments and directions.

'Bundled' services refer to those services that may be simultaneously generated in the same geographical area including watershed protection and biodiversity conservation. Some services, however, may not be positively related and trade-offs between services must be considered. For example, fast growing plantations for carbon sequestration may negatively affect water storage services.

Fig.1.1 – South of Portugal

2.The Montado Ecosystem

Cork Oak (*Quercus suber* L.) and holm oak (*Quercus rotundifolia* L.) woodlands or *montados* are some of the most biodiversity rich ecosystems of the western Mediterranean Basin. The *montado* is a human-shaped, savanna type ecosystem, with a sparse cover of evergreen oaks and a heterogeneous understorey of shrubland, grassland and fallows, forming a diversity of habitats of high conservation value. More than 135 vascular plants per 0.1 ha can be found in the *montados* (Diaz-vila *et al.* 2003). Endangered and critically endangered species such as the imperial eagle (*Aquila adalberti*), the black vulture (*Aegyps monachus*), the Iberian Lynx (*Lynx pardina*), the black stork (*Ciconia nigra*), and 60,000 to 70,000 wintering common cranes may use this ecosystem. In addition, cork and holm oak woodlands shelter and provide refuge for approximately a hundred of other animal species that are listed in the annexes of the EU Habitats and Birds Directives. Such a list includes species that are rarely found elsewhere (Berrahmouni *et al*., 2009). *Montados* are classified habitats under the EU Habitats Directive due to the high biological diversity that this ecosystem support (Pulido *et al*., 2001).

Cork oak woodlands usually dominate coastal areas because of the stronger oceanic influence, whereas holm oak woodlands are more common in drier and more continental areas. As a consequence, the cork oak woodland areas in Portugal are larger than in Spain. On the other hand, the holm oak forests areas are characteristic of the interior of Iberian Peninsula (Castro, 2009).

Biodiversity in the *montado* is often associated with a matrix of different habitats including grasslands and pastures, shrubland areas and cereal crops. The diversity of plant and animal species in areas where the cork and holm oak trees occur is partly due to the maintenance of this heterogeneous matrix. These conditions allow the coexistence in the same area of species, particularly birds, typically from forested areas and others of more open, agricultural or of low shrubland areas.

The isolated trees in cork and holm oak forests intercept rain and influence water retention. The area under the canopy of trees is also richer in nutrients and retains more carbon (around 60%) than in bare soil (Pereira *et al*., 2008) and promotes the existence of different plant communities within and between the tree canopies.

Through the canopy and root system, the various forms of cork and holm oak forests protect against soil erosion, especially in areas of higher slopes. By promoting the infiltration of rain water and preventing soil erosion, the *montado* (cork and holm oak forests) ecosystem also regulates the water cycle, an ecosystem service particularly important in areas of Mediterranean climate where water is a particularly scarce resource.

Cork and holm oak woodlands also play a role in carbon storage as the long-lived oak trees act as long term reserves of carbon (e.g. they can live up to hundreds of years). In addition, their main product - cork - is harvested without killing the trees with negligible effects on the ecosystem carbon balance. Thus, through adequate management the trees can promote carbon storage over very long periods.

The conservation value of this ecosystem depends on the maintenance of the shrub-grassland matrix through human management. Once abandoned, the ecosystem is rapidly invaded by prone fire shrubs as Cistaceae, causing loss of habitat heterogeneity and conservation value, and increased risks of wildfire.

In terms of protected area system, the cork oak woodlands remain inadequate in regards to design, extension, connectivity, management, and integration with regional planning programmes. Additionally, such areas are in general small and isolated (Berrahmouni *et al*., 2009).

The main economic incentive to human management of *montados* has been cork production, 70% of which is used as wine bottle stoppers. A decreasing world market value of cork, due to competition with synthetic stoppers and screwcaps, is weakening the economic incentives for management which puts the *montado* ecosystem at risk. The big challenge for promoting the conservation of *montados* is to find novel ways for maintaining their economic viability and promote their sustainable use.

Nowadays, the Forest Stewardship Council (FSC), a non-governmental organisation created in 1993 to promote the responsible stewardship of the world's forests, has established international standards for responsible forest management and accreditation of independent organisations to certify managers and producers who achieve these standards. This management must be environmentally appropriate in

terms of maintaining biodiversity, productivity, and ecological processes. In addition, this management type must benefit local people and provide people with incentives to sustain forest resources which in turn are economically viable. So far, over 40,000 hectares of private and public properties of cork oak forests in Portugal, Spain, and Italy, together with four cork industry companies' chains have been certified by the FSC (Berrahmouni *et al*., 2009).

Payment for Ecosystem Services (PES) is a relatively novel conservation tool which can generate economic incentives for good management practices reverting to the conservation of biodiversity. The rationale under PES is to reward those landholders who, through good management practices, promote biodiversity and provision of ecosystem services (Wunder, 2005).


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3. Study Area and Methodology Employed

3.1The Study Area, South of Portugal

The study area comprises all areas situated in the south of River Tagus (Figure 3.1) and covers 3.743,382 ha (Table 3.1). The *Santarém*, *Portalegre* and *Lisboa* Districts are partially located within the study area. The *Setúbal*, *Évora*, *Beja*, and *Faro* Districts lie entirely in the study area. Cork oak woodlands cover 708,000 ha in the study area (96 % of the cork oak area regarding the entire country). Holm oak woodlands cover 349,900 ha in the study area (90 % of the total holm oak area relative to the entire country) (see table 3.1 - comparative areas).

Figure 3.1.: Study Area (South of River Tagus)

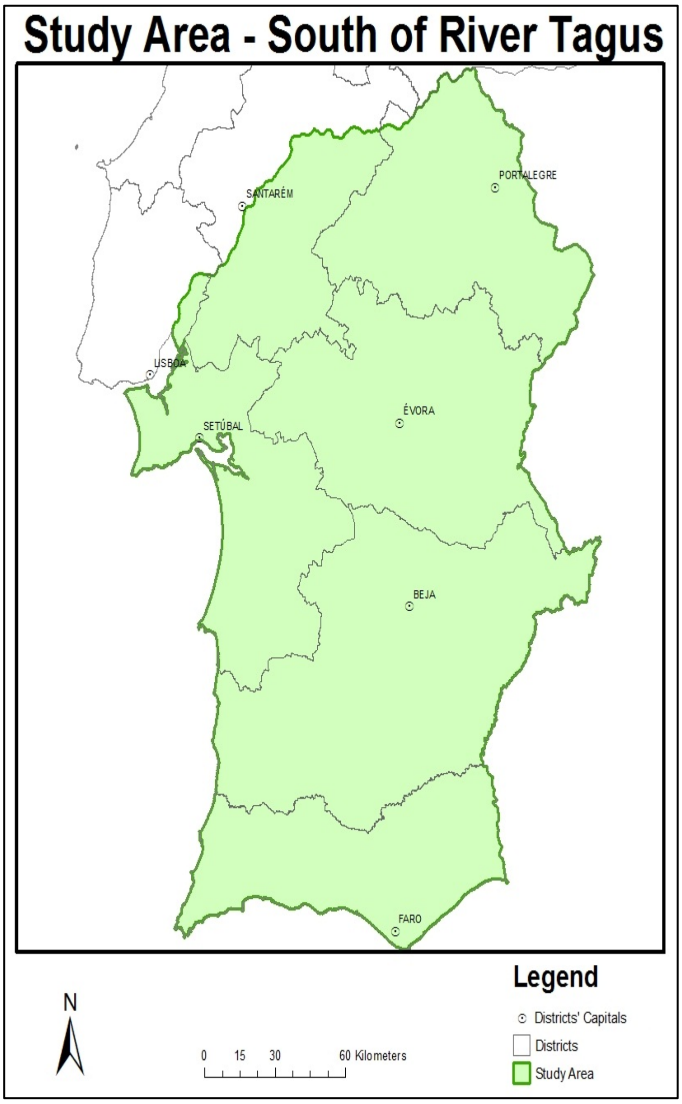

Table 3.1.: Comparative areas between size areas regarding entire Portugal and the Study area including cork and holm oak woodlands extension.

COMPARATIVE AREAS	ENTIRE PORTUGAL	STUDY AREA	
Country Area	(1) 8.896,847 ha	(1) 3.743,382 ha	42 %
Cork Oak Forest Area	(2) 736,700 ha	(2) 708,000 ha	96 %
Holm Oak Forest Area	(2) 388,400 ha	(2) 349,900 ha	90 %

Source: Elaborated from information provided by (1) IGP (2010) and (2) IFN, (2007).

3.2. Methodology

3.2.1 The High Conservation Value Areas (HCVA) Concept

All forests contain environmental and social values, such as wildlife habitat and watershed protection. Where these values are considered to be of outstanding significance or critical importance, the forest can be defined as a High Conservation Value Area (HCVA) (Jennings *et. al*. 2003a).

The key to the concept of HCVA is the methodology employed for identification of environmental and social values of outstanding significance, since it is the presence of these values that determines whether a forest is designated a HCVA. High Conservation Values were first defined by the Forest Stewardship Council (FSC) for use in forest certification. Yet the concept has increasingly been used for other purposes, including conservation and natural resource planning and advocacy, landscape mapping and in the purchasing policies of major companies. For further information on the HCVA concept please visit http://www.hcvnetwork.org

The HCVA concept was applied to the study area and mapped using the GIS tool. In the present report, only 4 out of 6 HCVA existing attributes (Table 3.2) were used since the Cultural and Social benefits (Attributes 5 and 6) were outside the scope of this work.

Table 3.2.: HCVA Attributes codes and Names

HCVA ATRIBUTES	HCVA ATRIBUTES CODE	HCVA ATRIBUTES NAME
Significant Concentrations of Biodiversity Values (HCV 1)	HCV 1.1	Protected and Sensitive Areas
Significant Concentrations of Biodiversity Values (HCV 1)	HCV 1.2	Threatened and Endangered Species
Significant Concentrations of Biodiversity Values (HCV 1)	HCV 1.3	Endemic Species
Significant Concentrations of Biodiversity Values (HCV 1)	HCV 1.4	Seasonal Concentration of Species
Significant large landscape level forests (HCV 2)	HCV 2	Significant large landscape level forests
Rare, threatened or endangered ecosystems (HCV 3)	HCV 3	Rare, threatened or endangered ecosystems
Forest areas that provide basic services of nature in critical situations (HCV 4)	HCV 4.1	Forests critical to water catchments
Forest areas that provide basic services of nature in critical situations (HCV 4)	HCV 4.4 (Provisional Attribute)	Forests critical to Carbon storage (Provisional Attribute)

3.2.2. Geographic Information

The Geographic Information System (GIS) tool was used to identify and quantify HCVAs within the *Montado*. Therefore, the ArcGIS 9.3 software was employed to process and digitise the geographic data. Digital data from the Portuguese Institute for Nature Conservation and Biodiversity (Equipa Atlas, 2008; Loureiro *et al*., 2008; ICNB, 2010a; and ICNB, 2010b), the Portuguese Society for the Study of Birds (SPEA, 2010), and RAMSAR Sites (Wetlands International, 2010) have been utilised in order to meet the requirements of the attributes HCV 1.1 (Protected and Sensitive Areas); HCV 1.2 (Threatened and Endangered species), HCV 1.3 (Endemic Species), HCV 1.4 (Seasonal concentrations of species) and HCV 3 (Rare, threatened or endangered ecosystems). For the attributes HCV 2 (significant large landscape level forests) and HCV 4.4 – provisional attribute (Forests providing critical carbon storage), digital data available from the Portuguese National Forest Inventory - 2005 (Tomé *et al*., 2007) was applied.

Digital data related to the aquifers' recharge rates from the Portuguese National Water Institute (INAG) (Oliveira *et al*., 1999) have been used. In addition, digital data from the Portuguese National Forest Inventory - 2005 (Tomé *et al*., 2007) have also been utilised in order to identify cork oak areas that coincides with areas of medium to high aquifer recharge rates. Both types of data sources have been used to identify the HCV 4.1 (Forests critical to water catchments).The Portuguese geographic divisions have been identified through digital data available from the Portuguese Geographic Institute (IGP, 2010). Thus, only published and systematic data was used in the present report.

Processed and digitised data through GIS, allowed the geographical identification of HCVAs. Based on this information, a WebGIS application was developed (see Chapter 4, section 4.3) enabling stakeholders to identify HCVAs in particular areas within the study region. For instance, a landowner aiming to identify and locate HCVAs within his/her property may use the WebGIS tool to achieve this. Stakeholders will be able to identify particular areas through the WebGIS.

The sequence of the HCVA evaluation of a particular area is based on the following questions:

- Is the property situated within any protected or sensitive area? (HCV 1.1)
- Are there any threatened or endangered species within the property? (HCV 1.2)
- Are there any endemic species within the property? (HCV 1.3)
- Is there any site within the property with important concentrations of species that use the forest only at certain times or at certain phases of their life-history? It includes critical breeding sites, wintering sites, migration sites, migration routes or corridors (HCV 1.4)
- Is the property located within any significant large (cork oak) landscape level forests? (HCV 2)
- Are there any priority habitats situated within the property? (HCV 3)
- Is the property located within any watershed area? (areas that contain aquifers and relevant aquifer recharges which coincides with cork oak forest cover) (HCV 4.1)
- Is there any relevant area that contains carbon stock within the property? (HCV 4.4 – provisional attribute).

3.2.3. Verification and monitoring

In addition to the employment of the HCVA concept, the use of the GIS as a tool, and the creation and development of a WebGIS to identify HCVAs, a verification and monitoring mechanism is necessary to evaluate if biodiversity and ecosystem services are being generated through adequate management (see Chapter 5). Both the Global Forest and Trade Network (GFTN) and Forest Stewardship Council (FSC) can be used as such independent schemes (see Chapter 5, Sections 5.1 and 5.2).

4.The Ecosystem Services in Montado

4.1. The HCVA Portuguese Interpretation

The HCVA concept has an international standard that is regionally adopted through a process of stakeholder consultation and public participation. The HCVA concept was interpreted for Portugal aiming to integrate the concept into the Portuguese reality. The following sections explain each HCVA's attribute based on the Portuguese interpretation. For more information regarding the Portuguese interpretation of HCVA attributes, please visit the following link: http://www.fscportugal.org

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4.1.1. Protected and Sensitive Areas (HCV 1.1)

If a particular forest management unit (FMU) is included within a protected or sensitive area, then it may be regarded as having high conservation value. According to the Portuguese Interpretation of HCVAs (Bugalho and Santos, 2010), the attribute 1.1 corresponds to those FMUs that include or are included within protected and sensitive areas such as National Network of Protected Areas, Natura 2000 Network (special areas for protection of birds – ZPEs and Sites of community interest – SICs), Ramsar sites and Important Bird Areas (IBAs).

4.1.2. Threatened and Endangered Species (HCV 1.2)

Forests that contain concentrations of threatened or endangered species are indeed more relevant for maintaining biodiversity values than those containing minimum or no endangered species. This is because such species are more vulnerable, for example, to continued loss of habitat. It is therefore important to identify within the FMU the presence of threatened or endangered species. Based on the Portuguese Interpretation of HCVAs (Bugalho and Santos, 2010), several sources of information were used including the Portuguese Red Book of Vertebrates (Cabral *et al*., 2005), the Portuguese Atlas of Breeding Birds (Equipa Atlas, 2008), and the information relative to Nature 2000 sites (the *Plano Sectorial Rede Natura 2000*) to identify and map the HCVA 1.2 attribute.

4.1.3. Endemic Species (HCV 1.3)

Endemic species are those confined to a specific geographic area. When this area is delineated, a species within that area has particular importance for conservation. National interpretations would be expected to determine which species are regarded endemic for forests to which the standard applies. Since biological boundaries unusually follow political boundaries, this will sometimes include species whose range only partly overlaps with the area to which the standard applies (Jennings, 2003b). In accordance with the Portuguese Interpretation of HCVAs (Bugalho and Santos, 2010), sources of information such as the Portuguese Red Book of Vertebrates (Cabral *et al*., 2005), and the Portuguese Atlas of Amphibians and Reptiles (Loureiro *et al*., 2008) were used.

4.1.4. Seasonal Concentrations of Species (HCV 1.4)

Important concentrations of species that utilise some areas only at specific times or at specific phases of their life-history include relevant breeding sites, wintering sites, migration sites, migration routes or corridors. Following the recommendation of the Portuguese interpretation of HCVAs (Bugalho and Santos, 2010), information derived from the Portuguese Red Book of Vertebrates (Cabral *et al*., 2005), the Portuguese Atlas of Breeding Birds (Equipa Atlas, 2008), the *Plano Sectorial Rede Natura 2000*, and the handbook of electric power transmission lines (ICNB, 2010 b; ICNB, 2010c) were consulted and used to identify and map sites potentially corresponding to the HCV 1.4 attribute.

4.1.5. Significant Large Landscape Level Forests (HCV 2)

This attribute includes extensive and continuous forests of regional importance over large areas containing a full representativeness of the species that are peculiar to that particular habitat. The area and degree of *"non-fragmentation"* which are required for a forest to be designed a HCV 2 vary according to the country, depending on the forest cover remaining and how the forest was used throughout history.

According to the Portuguese interpretation of HCVAs (Bugalho and Santos, 2010), the type of forest that is regarded as regionally (Mediterranean basin) and globally relevant is cork oak. The cork oak forest has a limited area of distribution, 2.277 million hectares, with 90% located in 4 countries (Portugal, Spain, Morocco and Algeria) (Barreira *et al.*, 2010). Portugal is the country with the largest area of cork oak distribution, with one third of the global area occurring within the country. The *Tejo* and *Sado* river basins include most of the continuous and non-fragmented area of cork oak in Portugal.

In order for a Forest Management Unit (FMU) to be classified as a HCV 2, it is necessary to fulfil the requirements relative to size, fragmentation and condition. Based on the Portuguese Interpretation, for a FMU to be classified as HCV 2, it should have a minimum size of 1000 ha no more than 500 m separating adjacent management units (Bugalho and Santos, 2010). The requirement relative to 'condition' refers to the occurrence of adequate levels of oak regeneration within the area, heterogeneous cohorts of age classes, and woodland areas in healthy conditions with low levels of tree mortality.

4.1.6. Rare, Threatened or Endangered Ecosystems (HCV 3)

Some ecosystems are naturally rare or rapidly diminishing due to human pressures. In order to conserve and protect biodiversity as a whole, it is important that enough areas of these rare habitats or in the reduction process are kept in good situation.

The best effective way to achieve this goal is to provide these ecosystems with adequate coverage within secure protected areas. Thus, the aim of this HCV is to detect sites where this is necessary for each rare, threatened or endangered habitat type. For several habitats, it will be necessary to identify and focus on the higher priority sites from a range of sites of varying relevance. For other habitats, every surviving example of the habitat may be regarded valuable. Information related to areas which have been identified as priority sites may be accessible through government agencies responsible for conservation. For instance, members states of the European Union (under the Habitats Directive) must identify and designate as Special Areas of Conservation sites that include habitats whose natural range has decreased considerably or are outstanding examples of European Community ecosystems. These comprise the Nature 2000 network of protected sites (Jennings, 2003b). Hence, according to the Portuguese interpretation of HCVAs (Bugalho and Santos, 2010), the *Plano Sectorial Rede Natura 2000* (ICNB, 2006) has been used as the main source of information for identifying the occurrence of priority habitats for this HCV within the study area.

4.1.7. Forests Critical to Water Catchments (HCV 4.1)

Forests in general influence the watershed in which they occur. Thus forests can be regarded important to watershed protection in specific situations such as when a particular forest area protects against potentially calamitous drought or floods; extensive loss of irreplaceable drinking water; agriculture; and changes in the hydrological processes of a catchment that would severely and irrevocably deteriorate a protected area. Some types of forest such as riparian forests are specifically relevant in terms of regulating stream flow, thus, such forest types tend to be more important to watershed functioning. Catchments areas that present high risk of flooding or drought, or those catchments that provide important supplies for reservoirs, irrigation, river recharge, hydroelectric schemes and are important to the ecological functioning of protected areas can be regarded as critical catchments for protection. Information regarding these catchment areas should be available from government departments or governmental agencies (Jennings, 2003b). Based on the Portuguese interpretation of HCVAs (Bugalho and Santos, 2010), watershed plans can be relevant sources of information. For this report, the Portuguese National Water Institute (INAG) (Oliveira *et al.*, 1999) has been used as an important source of information especially regarding the aquifer situated in the study area.

4.1.8. Forests Critical to Carbon Storage (HCV 4.4 – provisional attribute)

Storage of carbon in biomass is increasingly being recognised as a critical ecosystem function of forests. Forest areas that provide basic services of nature in critical situations are directly linked to carbon stock in biomass based on the assumption of climate change and mitigation. The Kyoto Protocol requires every industrialized country to have a transparent and verifiable method for estimating the size and evolution of the carbon stored in forest ecosystems. According to Cañellas *et al*. (2008), the intergovernmental panel on climate change predicts the evolution of the stock over the first commitment period (2008–2012) using the “bottom-up approach”. This approach is based on the use of data from national or regional forest inventories.

Initially, National Forest Inventories were established to assess commercial value of existent timber in stands (Ciais *et al*. 2008). Nowadays, they are employed worldwide as others sources of information in order to quantify and analyse the distribution of carbon sinks regionally (Ciais *et al*. 2008; Ravindranath and Ostwald, 2008). The biomass of living trees which includes their dead parts forms the main carbon pool in forest ecosystems together with the biomass of understorey plants, litter, woody debris and soil organic matter (Ravindranath and Ostwald, 2008). Hence, the Portuguese National Forest Inventory has been employed so that data on growing stock of cork oak *Montados* can be analysed. Carbon stocks can be estimated from National Forest Inventory data by applying allometric equations that predict individual tree biomass per tree component (e.g. leaves, branches, stem, cork, wood and roots). Therefore, digital data available from the Portuguese National Forest Inventory - 2005 (Tomé *et al*., 2007) has been used to identify and quantify critical areas of carbon storage in cork oak *montados*.

4.2. The HCVAs in South of Portugal

The main types of ecosystem services that have been addressed by this study are watershed protection, biodiversity conservation and carbon storage. Each of these ecosystem services corresponds to one or more attributes of the High Conservation Value Areas (HCVAs) concept (Table 4.1). The HCVA attributes have been essential for the identification of ecosystem services within the study area.

Table 4.1.: Types of Ecosystem Services and their relation with the HCVA Attributes

ECOSYSTEM SERVICES	HCVA ATTRIBUTES
Watershed Protection	4.1
Biodiversity Conservation	1(1.1; 1.2; 1.3; 1.4); 2; 3
Carbon Storage	4.4 (provisional attribute)

4.2.1. Watershed Protection

Forest ecosystems provide people with different types of water-related benefits. Water quality, water supply, and flow regulation are some examples. Forests can provide people and companies with high quality water supplies that have low nutrient and chemical contaminant levels. This benefits rural and urban domestic water users and industrial water users, including distilleries, water, beer and soft drink bottlers. The HCV 4.1 (Forest Critical to Water Catchments) is therefore related to the ecosystem service regarding Watershed Protection.

4.2.1.1. The Identification of the Attribute HCV 4.1

The *Tejo-Sado* Basin can be divided into two Basins: The Tertiary Low Tejo Basin and Avalade Basin. The Tertiary Low Tejo Basin comprises the major aquifer system of the national territory. The Low Tejo Basin is divided into three aquifer systems, namely, *Aluviões do Tejo*, *Margem Esquerda*, and *Margem Direita*. The groundwater resources of this aquifer system represent an important factor of development as it supplies water for urban, industrial and rural areas.

Incidentally, this aquifer system is within an area of high urban and industrial concentrations (Almeida *et al.*2000). This report focuses on the *Margem Esquerda* aquifer (SNIRH, 2010) since significant areas of cork oak forest are within it (approximately 36% of cork oak forest cover) (WWFMedPO, unpublished data). The geographical distribution of cork oak within this aquifer (Tomé *et al.,* 2007) coincides with areas of medium to high aquifer recharge rates (e.g. from 151-200 mm/year to 351-400 mm/year) (Oliveira *et al*., 1999) (See map in appendix 1). This aquifer is recharged mainly by atmospheric precipitation and water infiltration thus forest cover and forest management practices may affect its recharge rates and water quality.

4.2.2. Biodiversity Conservation

The following attributes are relevant in terms of Biodiversity Conservation ecosystem service for the study area: HCV 1.1 (Protected and Sensitive Areas), HCV 1.2 (Threatened and Endangered Species), HCV 1.3 (Endemic species), HCV 1.4 (Seasonal concentrations of species), HCV 2 (Significant large landscape level forests), and HCV 3 (Rare, threatened or endangered ecosystems).

4.2.2.1 The identification of the Attribute HCV 1.1

Many protected and sensitive areas in the study area cover the cork and holm oak *montado* ecosystem: National Network of Protected Areas (RNAPs) and Natura 2000 Network, namely Sites of Community Interest (SICs) and Special Areas for Protection of Birds (ZPEs) are protected areas whereas RAMSAR Sites and Important Bird Areas (IBAs) are regarded as sensitive areas. Hence, a list of protected and sensitive areas (Table 4.2) has been utilised to apply the HCV 1.1 attribute. In other words, the HCV 1.1 comprises all of those protected and sensitive areas of the list (see map in appendix 2).

WWF Mediterranean Programme in Portugal

Table 4.2: List of Protected and Sensitive Areas within the study area related to the HCV 1.1

PROTECTED AND SENSITIVE AREAS	
1.National Network of Protected Areas (RNAPs)	
Natural Park of Arrábida	
Natural Park of Ria Formosa	
Natural Park of Serra de São Mamede	
Natural Park of Sudoeste Alentejano e Costa Vicentina	
Natural Park of Vale do Guadiana	
Nature Reserve of Estuário do Sado	
Nature Reserve of Estuário do Tejo	
Nature Reserve of Lagoas de Santo André e Sancha	
Nature Reserve of Sapal de Castro Marim e Vila Real de Santo António	
Classified Site of Açude do Monte da Barca	
Classified Site of Fonte Benémola	
Classified Site of Rocha da Pena	
2.Natura 2000 Network	
2.1.Special Areas for Protection of Birds (ZPEs)	**2.2. Sites of Community Interest (SICs)**
Açude da Murta	
Cabo Espichel	Alvito / Cuba
Caldeirão	Arade / Odelouca
Campo Maior	Arrábida / Espichel
Castro Verde	Barrocal
Costa Sudoeste	Cabeção
Cuba	Cabrela
Estuário do Sado	Caia
Estuário do Tejo	Caldeirão
Évora (norte)	Cerro da Cabeça
Évora (sul)	Comporta / Galé
Lagoa da Sancha	Costa Sudoeste
Lagoa de Santo André	Estuário do Sado
Lagoa Pequena	Estuário do Tejo
Leixão da Gaivota	Fernão Ferro / Lagoa de Albufeira
Monchique	Guadiana
Monforte	Guadiana / Juromenha
Mourão / Moura / Barrancos	Monchique
Piçarras	Monfurado
Reguengos	Moura / Barrancos
Ria Formosa	Nisa / Lage da Prata
São Vicente	Ria Formosa / Castro Marim
Sapais de Castro Marim	Ribeira de Quarteira
Torre da Bolsa	São Mamede
Vale do Guadiana	
Veiros	
Vila Fernando	
3.RAMSAR Sites	
Castro Marim	
Estuário do Sado	
Estuário do Tejo	
Lagoa de Albufeira	
Lagoas de Santo André e Sancha	
Ria de Alvor	
Ria Formosa	
4.Important Bird Areas (IBAs)	
Albufeira do Caia	Lagoas de Santo André e Sancha
Alter do Chão	Luzianes
Arraiolos	Mourão, Moura e Barrancos
Cabeção	Planície de Évora
Cabo Espichel	Planície de Monforte
Cabrela	Reguengos de Monsaraz
Campo Maior	Ria Formosa
Castro Marim	Rio Guadiana
Castro Verde	São Pedro Sólis
Costa Sudoeste	São Vicente
Cuba	Serra de Monchique
Estuário do Sado	Serra do Caldeirão
Estuário do Tejo	Torre da bolsa
Lagoa pequena	Vila Fernando/ Veiros

Source: Elaborated from information provided by ICNB (2010a)

4.2.2.2. The Identification of the Attribute HCV 1.2

The canopy of cork and holm oak trees forms a heterogeneous environment which provides horizontal as well as vertical diversity to the system. This favours the occurrence of various species of fauna and flora through the creation of different ecological niches. **Over 130 species of vertebrates live and breed in the *Montado* ecosystem making it one of the richest terrestrial ecosystems of Portugal**. Among these species, between 60 and 75 are birds, around 18 to 28 are mammals, and about 10 to 15 are reptiles and 5 to 7 are amphibians (Belo *et al*, 2009). The list of threatened and endangered species (Table 4.3) is a compilation of species that deserve special attention due to their conservation status. Only species which were considered with 'confirmed' occurrence in the study area were included in this list. The list below was used to apply the HCV 1.2 concept using the GIS tool (see map in appendix 3). Please note that some of the species may not be considered as typically species from the *montado* ecosystem but were listed as they may occur in other habitat types within the *montado*. For instance, birds occurring in water ponds within the system.

Table 4.3: List of Threatened and Endangered Species related to the HCV 1.2 Attribute


WWF/Canon – Sanchez & Lope (Peregrine Falcon)

THREATENED AND ENDANGERED SPECIES		
Species Scientific Name	**Species Popular Name**	**Conservation Status**
Anas clypeata	Northern Shoveler	[1] EN ([4]Res)
Aquila chrysaetus	Golden Eagle	[1]EN ([4]Res)
Ardea purpurea	Purple Heron	[1]EN ([6]MigRep)
Ardeola ralloides	Squacco Heron	[2]CR ([6]MigRep) and [1]EN ([5]Vis)
Chlidonias hybrida	Whiskered Tern	[2]CR ([6]MigRep)
Circus pygargus	Montagu's Harrier	[1]EN ([6]MigRep)
Coracias garrulous	European Roller	[2]CR ([6]MigRep)
Hieraaetus fasciatus	Bonelli's Eagle	[1]EN
Milvus milvus	Red Kite	[2]CR ([4]Res) and [3]VU ([5]Vis)
Neophron percnopterus	Egyptian Vulture	[1]EN ([6]MigRep)
Netta rufina	Red-crested Pochard	[1]EN ([4]Res)
Nycticorax nycticorax	Black-crowned Night-heron	[1]EN ([6]MigRep)
Otis tarda	Great Bustard	[1]EN([4]Res)
Pterocles orientalis	Black-bellied Sandgrouse	[1]EN ([4]Res)
Pyrrhocorax pyrrhocorax	Red-billed Chough	[1]EN ([4]Res)
Tringa tetanus	Common Redshank	[2]CR ([7]Rep)

Source: Elaborated from information provided by Cabral *et al*. (2005) and Equipa Atlas (2008).

Note:
[1]Endangered, [2]Critically Endangered, [3]Vulnerable, [4]Resident, [5]Visitor, [6]Migratory Breeder, [7]Breeder.


WWF/Canon –Martin Harvey (Bonelli Eagle)


WWF Spain – Alfonso Moreno (Iberian Lynx)

4.2.2.3. The Identification of the Attribute HCV 1.3

Endemic species are those species unique to a particular geographic location, such as a nation, habitat type, or other defined zone. To be endemic to a place or area means that it is found only in that part of the world and nowhere else. For this study, the geographical area of endemism considered is the Iberian Peninsula. In other words, all endemic species identified in the study area that are endemic to the Iberian Peninsula have been considered.

The species that have been identified and inserted into GIS so far are mainly amphibians and reptiles (Table 4.4, appendix 4).


WWF/Canon – Jacques Trotignon (Purple Heron)

Table 4.4: List of Endemic Species related to the HCV 1.3 Attribute

ENDEMIC SPECIES		
Species Scientific Name	**Species Popular Name**	**Geographic Endemism**
Alytes cisternasii	Iberian Midwife Toad	Iberian Peninsula
Chalcides bedriagai	Bedriaga's Skink	Iberian Peninsula
Discoglossus galganoi	Iberian Painted Frog	Iberian Peninsula
Lacerta schreiberi	Schreiber's Green Lizard	Iberian Peninsula
Podarcis carbonelli	Carbonell's Wall Lizard	Iberian Peninsula
Rana ibérica	Iberian Frog	Iberian Peninsula
Triturus boscai	Bosca's Newt, Iberian Newt	Iberian Peninsula

Source: Elaborated from information provided by Cabral *et al*. (2005) and Loureiro *et al*. (2008).


Anaecypris hispanica (saramugo)

Other species have already been identified and will be inserted into GIS soon. Such species include fishes as the *Anaecypris hispanica*, *Barbus comizo*, *Barbus bocagei*, *Barbus microcephalus*, *Barbus sclateri*, *Barbus Steindachneri*, *Chondrostoma almacai*, *Chondrostoma polylepis*, *Chondrostoma willkommii*, and *Chondrostoma lusitanicum*; or mammals as Cabrera's Vole (*Microtus cabrerae*) and Iberian Lynx (*Lynx pardinus*).

4.2.2.4. The Identification of the Attribute HCV 1.4

The *Montado* is an area used as escape, nesting and feeding for many species of unique fauna or conservation status. Several species come together as groups in specific resting or feeding areas either on a daily basis or a regular, seasonal or annual basis (e.g. wetlands and other key feeding areas for migrating birds or other species), or at irregular intervals. Migration routes and wetlands are usually well known zones used as resting or feeding areas by many species and can be mapped at large scales.

For this report, the handbook of electric power transmission lines (ICNB, 2010c) has been consulted as an important source of information as well as guidance for digital data information (ICNB, 2010b).

Therefore, critical areas for seasonal concentration of species have been identified (see appendix 5):

- Nesting and priority areas for birds of prey with high conservation status: Egyptian Vulture (*Neophron percnopterus*), Cinereous Vulture (*Aegypius monachus*), Bonelli's Eagle (*Hieraaetus fasciatus*), Montagu's Harrier (*Circus pygargus*), Spanish Imperial Eagle (*Aquila adalberti*), Golden Eagle (*Aquila chrysaetos*), Eurasian Eagle-owl (*Bubo bubo*), Peregrine Falcon (*Falco peregrinus*), Lesser Kestrel (*Falco naumanni*), Griffon Vulture (*Gyps fulvus*), and Eurasian Hobby (*Falco subbuteo*);
- Areas of concentration and passage of steppe birds: Great Bustard (*Otis tarda*) and Little Bustard (*Tetrax tetrax*). These areas correspond mainly to areas designated as Special Areas for Protection of Birds (ZPEs) and Important Bird Areas (IBAs);
- Concentration of wintering birds in areas of wetlands;
- Nesting and feeding areas regarding species such as Black Stork (*Ciconia nigra*) and Common Crane (*Grus grus*);
- Bird migration routes;
- Shelter areas for bats considered important at the national, regional and local levels.

4.2.2.5. The Identification of the Attribute HCV 2

Fifty eight areas of continuous non-fragmented cork oak woodlands were identified as HCV 2. This area amounts to 318,400 ha within the study area. The minimum continuous area identified was around 1,025 ha whereas the maximum continuous area identified was 81,300 ha (see map in appendix 6).

4.2.2.6. The Identification of the Attribute HCV 3

Fifteen priority habitats situated within this ecosystem have been identified as attribute HCV 3 (Table 4.5 and appendix 7).

Table 4.5: List of Priority Habitats related to the HCV 3 Attribute

PRIORITY HABITATS	
Habitat Code	**Priority Habitat Name**
1150	Coastal lagoons
1510	Mediterranean salt steppes (Limonietalia)
2130	Fixed coastal grey dunes with herbaceous vegetation
2150	Atlantic decalcified fixed dunes (Calluno-Ulicetea)
2250	Coastal dunes with Juniperus spp.
2270	Wooded dunes with Pinus pinea and/or Pinus pinaster
3170	Mediterranean temporary ponds
4020	Temperate Atlantic wet heaths with Erica ciliaris e Erica tetralix
5140	Cistus palhinhae formations on maritime wet heaths
5230	Arborescent matorral with Laurus nobilis
6110	Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (important orchid sites)
6220	Pseudosteppe with grasses and annuals Thero-Brachypodite
8240	Limestone pavements
91E0	Alluvial forests with Alnus glutinosa and Fraxinus excelsior

Source: Elaborated from information provided by ICNB (2006)

4.2.3. Carbon Storage

4.2.3.1. The Identification of the Attribute HCV 4.4 (provisional attribute)

The Attribute HCV 4.4 (Forest Critical to Carbon Storage) relates to the Carbon Storage's ecosystem service. Owing to the cork oak forest's carbon storage importance, the total amount of carbon storage regarding the whole country and the study area has been quantified based on the forest biomass data of the Portuguese Forest Inventory - 2005 (Tomé *et al,* 2007) (Table 4.6). The total Carbon stock derived from cork oak forests regarding the entire Portugal is 14.748,500 tons. For the study area (south of River Tagus), the total carbon storage derived from cork oak forests is 14.030,787 tons.

The average values for each cork oak stand have also been quantified. For pure stands, the average value is 22 tons/ha. Regarding mixed dominant stands the average value is 16 tons/ha and for mixed non-dominant stands the average value is 11.5 tons/ha. The map that demonstrates the cork oak forest's capability of carbon storage with the average value in regards to all stands within the study area can be seen in appendix 8.

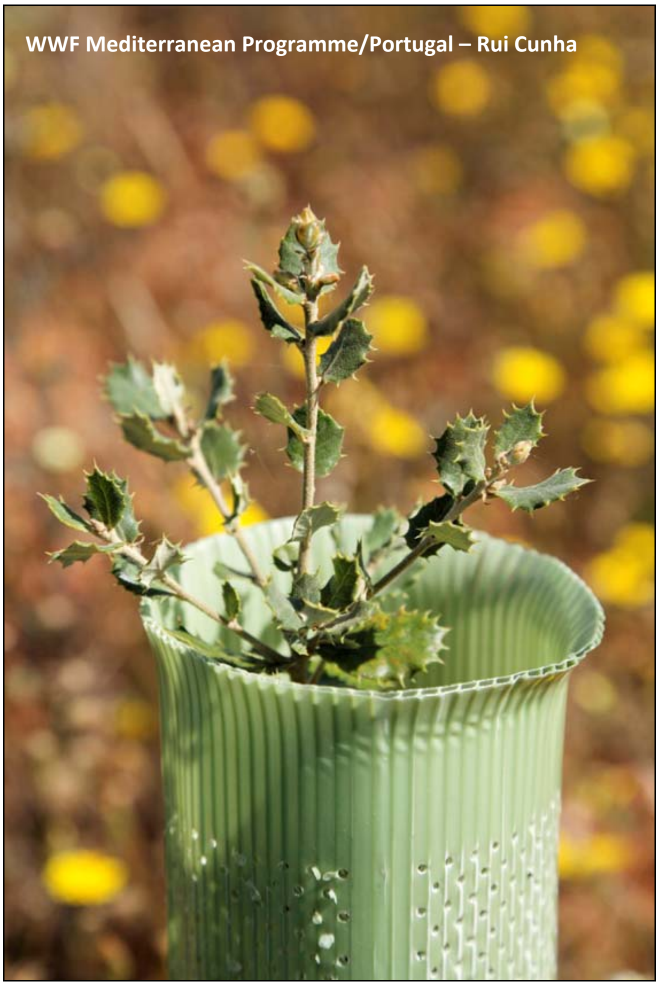


Table 4.6: Carbon Storage: Average values for each cork oak stand and Total values for the entire country and for the study area - considering all types of cork oak stands (Pure, Mixed Dominant or Mixed Non-Dominant).

CORK OAK STANDS - AMOUNTS OF CARBON STORAGE		
Average Values for Each Cork Oak Stand (tons/ha)		**Total Values for All Cork Oak Stands *Entire Portugal* (tons)**
Pure Stands	22 tons/ha	14.748,500 tons
Mixed Dominant Stands	16 tons/ha	**Total Values for All Cork Oak Stands *Study Area – South River Tagus* (tons)**
Mixed Non-dominant Stands	11,5 tons/ha	14.031,200 tons

Source: Elaborated from information provided by Tomé *et al*. (2007)

4.3. HABEaS - Hotspot Areas for Biodiversity and Ecosystem Services

A WebGIS tool (HABEaS) (fig 4.1.) was developed based on the information relative to HCVAs. Biodiversity values and ecosystem services identified in the previous section (4.2) were mapped and can be accessed through the HABEaS WebGIS tool by any user. The user may give the geographical coordinates of a particular area and identify the HCVAs occurring in that area. The HABEaS WebGIS can be accessed at: www.habeas.com.pt

The following outputs can be expected from the HABEaS WebGIS application:

- GIS application for the *web* (WebGIS) that displays geographic information layers (vectors or rasters) that are related to HCVAs and orthophotomaps;
- The functions/tools presented will be visualization/display of the available geographic information, 'scale based rendering', features identify, pan, zoom, select, attribute search, legend, print (PDF or image), and export (tiff format);
- Stakeholders will also be able to enter and upload geographic data regarding the boundaries of a particular property through an online form.

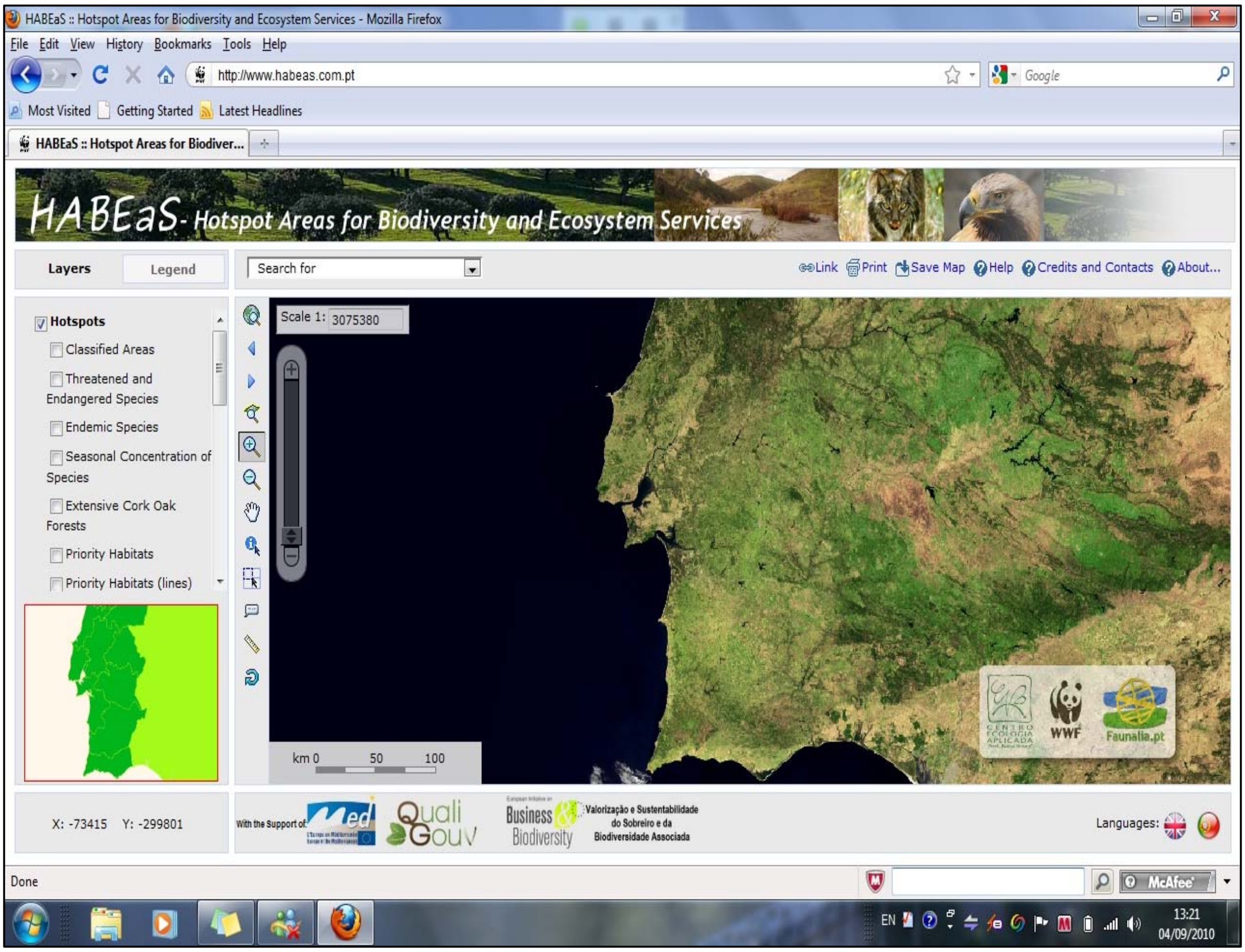


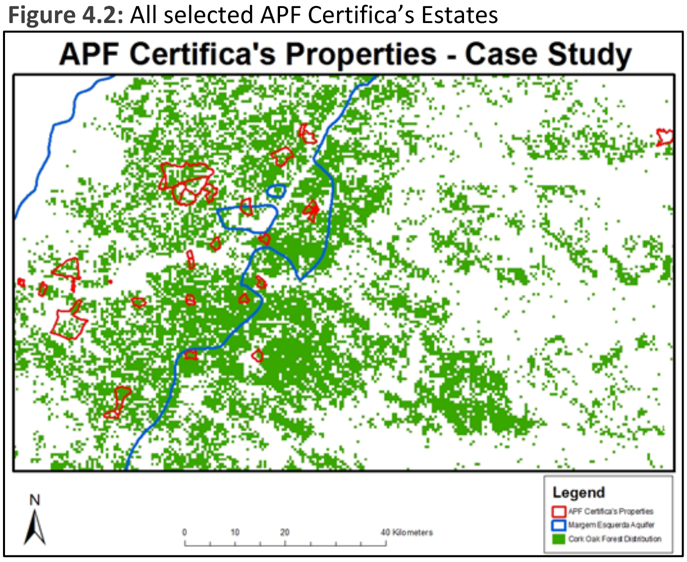
Figure 4.1. – HABEaS homepage

4.4. The identification of HABEaS in APF Certifica's Properties

The *Associação de Produtores Florestais de Coruche – APF Coruche* (Association of Forest Producers of Coruche - Portugal) represents landowners involved in forestry in the wider Coruche region, in a total area of 178.413 ha, dominated by *Quercus suber*, *Pinus Pinea*, *Pinus pinaster*, *Eucaliptus globulus*. The *APF Coruche* was created in 1992 to support forest producers through technical aid in managing forestry in the region. The aim is to protect and promote the interests of producers through enhancing members' knowledge of their products and consequently maximising value for them.

The *APF Coruche* created a group certification scheme named *APF Certifica* to help the producers committed to forest certification achieve their goal, by providing an easier and better access to information and technical advice, preparing management documentation, and reducing costs associated with the certification (external audits, training, monitoring and public and specific consultations). The certified products available by the group members are cork, timber for pulp and paper and cones. Therefore, the *APF Certifica* has been chosen as a case study in order to demonstrate some examples of the application of HCVAs (Figure 4.2, Table 4.7). The total area of *APF Certifica*'s properties selected by this study comprises 17,752.53 ha.

Figure 4.2: All selected APF Certifica's Estates



By using the HABEaS WebGIS, it is possible to identify and quantify HCVAs by applying all the HCV attributes (as a method used by this study) to *APF Certifica*'s properties:

- The attribute HCV 1.1 (Protected and Sensitive Areas) has been detected in a small proportion of APFC area, with less than 10% as HCVA 1.1 (1,297.23 ha) (Appendix 9). Only three out of five types of protected and sensitive areas have been identified;
- The attribute HCV 1.2 (Threatened and Endangered Species) has been equally identified in a very limited area, with only 443.60 ha identified as HCVA 1.2 (Appendix 10). Solely one species has been identified in this HCV;
- The attribute HCV 1.3 (Endemic Species) is the biodiversity largest HCVA identified in 5,977.83 ha (Appendix 11). Six endemic species lie in these properties;
- The attribute HCV 1.4 (Seasonal Concentration of Species) has been recognised in 1,212.11 ha as HCVA 1.4 (Appendix 12). Five seasonal areas have been identified;
- The attribute HCV 2 (Large landscape Forests) is significantly present in APFC estates with 4,981.87 ha identified as large forests (Appendix 13);
- The attribute HCV 3 (Rare, Threatened and Endangered Ecosystems) is the smallest HCVA encountered within the *APF Certifica*'s properties in only 14.66 ha (Appendix 14). Two priority habitats have been discovered;
- The attribute HCV 4.1 (Forest Critical to Water Catchments) is identified in 8,373.68 ha. This HCV is only present in properties situated within the *Margem Esquerda* Aquifer (Appendix 15) and four recharge areas of such an aquifer have been identified;
- The attribute HCV 4.4 (Forest Critical to Carbon Storage) is the largest HCVA identified (9,269.91 ha) which is present in most properties (Appendix 16).

This area corresponds to approximately 52 % of the total *APF Certifica's* area. The amount of carbon stored in the area identified is 185,337 tons (amount relative to pure, dominant, and non-dominant cork oak stands).

The total HCVAs identified in the *APF Certifica*'s properties comprises 31,570.89 ha (Table 4.7). This amount is the sum of all HCV attributes identified in the properties. Indeed, each attribute can be present in the same area of the *APF Certifica*'s properties and this is the reason why the total HCVAs is larger than the *APF Certifica*'s properties area.

Table 4.7.: Results regarding the application of the HCVA method to *APF Certifica's* properties expressed as: HCVAs (ha), amounts of carbon stored (tons), and features within each HCV. ***Note*:** n/a: not applicable

HCVAs within *APF Certifica* Properties			
HCV Attributes	**HCVAs**	**Carbon Stored**	**Features Identified in Each HCV**
HCV 1.1	1,297.23 ha	n/a	Protected and Sensitive Areas: RNAPs, SICs, and IBAs.
HCV 1.2	443.60 ha	n/a	Threatened and Endangered Species: *Hieraaetus fasciatus.*
HCV 1.3	5,977.83 ha	n/a	Endemic Species*: Alytes cisternasii, Chalcides bedriagai, Discoglossus galganoi, Lacerta schreiberi, Rana Iberica and Triturus boscai.*
HCV 1.4	1,212.11 ha	n/a	Seasonal Areas: Nesting and priority areas for birds of prey (sensitive areas), sensitive wetland areas for concentration of wintering birds, sensitive and very sensitive nesting and feeding areas for *Ciconia nigra* and *Grus grus* species, and shelter areas for bats
HCV 2	4,981.87 ha	n/a	Large Forests: Continuous cork oak forest areas that achieve the HCVA Portuguese interpretation and requirements.
HCV 3	14.66 ha	n/a	Priority Habitats: 3170 and 4020.
HCV 4.1	8,373.68 ha	n/a	Aquifer Recharge Rates: 151-200 mm/year, 201-250 mm/year, 251-300 mm/year and 301-350 mm/year.
HCV 4.4 (Provisional)	9,269,91 ha	185,337 tons	Forest Stand Types: Pure, Mixed Dominant and Mixed Non-dominant.
All HCV Attributes	31,570.89 ha	185,337 tons	All features above identified

In order to spatially identify and quantify the main biodiversity hotspots and ecosystem services (water and carbon storage) generated by *montados* and assess those areas where biodiversity and ecosystem services are spatially coincident (HABEaS), all existing HCVs must be overlapped. Each ecosystem service is related to one or more HCV Attributes (see section 4.2, table 4.1). For instance, carbon storage is directly related to the attribute 4.4 and biodiversity conservation is directly related to the following attributes: HCV 1.1, HCV 1.2, HCV 1.3, HCV 1.4, HCV 2, and HCV 3. Hence, to assess those areas where biodiversity and carbon storage is spatially coincident, the attribute regarding carbon storage and those attributes relative to biodiversity must overlap each other. Based on these, after the identification of all the HCV attributes and the HCVAs in hectares within APF *Certifica*'s estates (table 4.7), HABEaS can be identified through the overlap between the correspondent attributes (Table 4.8). The area that biodiversity spatially coincides with water services in the *APF Certifica's* properties corresponds to 5,573 ha (Appendix 17). Only 5 out of 6 biodiversity HCVs overlap with the water service HCV (Table 4.8). The area that biodiversity and carbon storage occurs simultaneously is equivalent to 6,482 ha (Appendix 18).

All biodiversity HCVs overlap with the carbon storage HCV (Table 4.8). The area that biodiversity occurs alone is equal to 9,733 ha (Table, 4.8, Appendix 19).

Identification of HABEaS within *APF Certifica*'s Properties					
Biodiversity Conservation versus Biodiversity Conservation		**Biodiversity Conservation versus Water services**		**Biodiversity Conservation versus Carbon storage**	
HABEaS	***HCV Attributes Overlapped***	***HABEaS***	***HCV Attributes Overlapped***	***HABEaS***	***HCV Attributes Overlapped***
9,733 ha	HCV 1.1 HCV 1.2 HCV 1.3 HCV 1.4 HCV 2 HCV 3	5,573 ha	HCV 1.1 HCV.1.3 HCV 1.4 HCV 2 HCV 3 **HCV 4.1**	6,482 ha	HCV 1.1 HCV 1.2 HCV.1.3 HCV 1.4 HCV 2 HCV 3 **HCV 4.4**

Table 4.8: Identification of HABEaS within *APF Certifica*'s estates through the overlap between the HCV Attributes

5.Verification and Monitoring

Management practices generating biodiversity and ecosystem services must be validated and monitored. Only a proper validation tool will be able to assure the potential funding and market value of such services. Verification and monitoring must be held by independent schemes promoting the existence and conservation of HCVAs. The GFTN – Global Forest and Trade Network and the FSC – Forest Stewardship Council Standard can be used as such validation tools.

The GFTN's "HCV Identification, Management and Monitoring Checklist", included in Application, Participation and Management Process, and the Principle 9 of the FSC Standard, "Maintenance of High Conservation Values" cover HCVAs monitoring aims. The example below (Table 5.1) exemplifies how the GFTN and FSC criteria may be used to verify and monitor the ecosystem services identified in this report.

ECOSYSTEM SERVICE	HCVA	VERIFICATION AND MONITORING	GFTN	FSC
Water	4.1		C5	9.1
Biodiversity	1; 2; 3		C6	9.3
Carbon	4.4 (provisional)		C7	9.4

Table 5.1.: Ecosystem Service types, the related HCVA attributes versus the GFTN and FSC verification and monitoring criteria

5.1.GFTN – Global Forest and Trade Network

GFTN is a WWF's initiative to promote the sustainable forest management by using the global marketplace into a force for saving the world's most valuable forests. Since 2008 WWF has been using this tool in Portugal to work with trade companies to create market for responsibly managed cork oak forests. Given the slow progress in FSC cork oak forest management certification, WWF will use GFTN to promote the cork oak forest FSC certification by adding more value to the process through facilitating the access to the "bundle" ecosystem services markets. For this purpose WWF created the cork producers group within the GFTN Iberia.

By facilitating trade links between forest producers committed to achieving and supporting responsible forestry, the GFTN creates market conditions that help conserve the cork oak forests while providing economic and social benefits for the businesses and people that depend on them. **GFTN uses the Forest Stewardship Council (FSC) as a tool** towards responsible forest management and practices through the cork trade supply chain. With this project WWF aims to extend this market approach to the "bundle" ecosystem services market. Through its work with Participants the GFTN is frequently operating in areas which probably contain HCVs. GFTN Participant forest companies, while progressing towards credible certification will have finalized and 2nd party verified the management prescriptions to ensure the maintenance of HCVs.

This will ensure that the GFTN will have a positive impact on how the HCV concept is adopted and implemented by its participants.

The benefits of GFTN membership for forest owners and managers are:

- Information and assistance to achieve FSC certification through a Stepwise Approach;
- Information and quantification of Ecosystem cork forest Services provided;
- Facilitate market access as an incentive for the pursuit of certification.

The environmental criteria recognized in HCV Identification Checklist of the Baseline Apprai-sal used for verification and monitoring of Eco-system Services is demonstrated in the Table 5.2.. This baseline appraisal and annual monitoring is done by a 2nd party verification process.

HCV identification, management and monitoring Checklist		
Indicator		**Verifying strategy**
C5	Identification, location and status of each HCV	▪ National HCVA national interpretation ▪ Maps and existing species ▪ Existing reports
C6	Management of HCVs	▪ Management Plan and/or associated documents (information about HCVA – ecosystems, landscape, *habitats*, species, protected areas, ecosystem services, social services and cultural values)
C7	Monitoring of HCVs	▪ Management Plan and/or associated documents (Monitoring procedures, monitoring program) ▪ Records (Monitoring records and/or conservation evolution of the HCV attributes) ▪ Field inspections ▪ Stakeholders Consultation

Table 5.2.: Simple and understandable interpretation of the complete checklist that should be entirely used for verification and monitoring of the HCVs

5.2.FSC – Forest Stewardship Council

FSC is an independent, non-governmental, not-for-profit organization established to promote the responsible management of the world's forests. Established in 1993 as a response to concerns over global deforestation, FSC is widely regarded as one of the most important initiatives of the last decade to promote responsible forest management worldwide.

WWF Mediterranean Programme-Portugal

FSC is a certification system that provides internationally recognized standard-setting, trademark assurance and accreditation services to companies, organizations, and communities interested in responsible forestry. The FSC label provides a credible link between responsible production and consumption of forest products, enabling consumers and businesses to make purchasing decisions that benefit people and the environment as well as providing ongoing business value.

WWF Mediterranean Programme-Portugal: Rui Cunha

FSC specified 10 principles that define Responsible Forest Management. These principles are global and can be applied in any forest worldwide:

- Principle #1: Compliance with laws and FSC Principles
- Principle #2: Tenure and use rights and responsibilities
- Principle #3: Indigenous peoples' rights Principle #4: Community relations and worker's rights
- Principle #5: Benefits from the forest
- Principle #6: Environmental impact
- Principle #7: Management plan
- Principle #8: Monitoring and assessment
- **Principle #9: Maintenance of high conservation value forests**
- Principle #10: Plantations

WWF Spain

The Verification Process based on the FSC standard uses the Principle #9: Maintenance of high conservation value forests (Table 5.3). This principle states that *"Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach."* The verification process of the FSC is based on a 3rd party auditing mechanism.

Table 5.3.: The verification process of the FSC Principle #9 (criteria and verifying strategy)

Principle #9 – Maintenance of high conservation value forests		
Criteria		**Verifying strategy**
9.1.	Assessment to determine the presence of the attributes consistent with high conservation value forests will be completed, appropriate to scale and intensity of forest management	▪ Management Plan and/or associated documents (information about HCVA – ecosystems, landscape, *habitats*, species, protected areas, ecosystem services, social services and cultural values) ▪ Records (HCVA identification and characterization and mapping, monitoring records with the % area of HCVA in the FMU)
9.3.	The management plan shall include and implement specific measures that ensure the maintenance and/or enhancement of the applicable conservation attributes consistent with the precautionary approach. these measures shall be specifically included in the publicly available management plan summary	▪ Management Plan and/or associated documents (methodology used assessing the HCVA state of conservation and HCVA management measures description) ▪ Records (Monitoring records of the % HCVF area maintained and/or improved and of the % HCVA area under management) ▪ Field inspections ▪ Public Summary of the Management Plan
9.4.	Annual monitoring shall be conducted to assess the effectiveness of the measures employed to maintain or enhance the applicable conservation attributes	▪ Management Plan and/or associated documents (Monitoring procedures, monitoring program) ▪ Stakeholders Consultation ▪ Records (Monitoring records and/or conservation evolution of the HCV attributes) ▪ Field inspections

5.3. Verification to access the market

The access to the market is a critical aspect of any mechanisms of payment for ecosystem services. The verification process is the key to open the market gate. It makes proof to buyers the service is being well provided. The value of the service (be it water service, carbon storage or biodiversity conservation) that should be paid will be determined and rewarded according to the number of markets available to the service and the service's capability to access each market.

The selection of the verification system should take into account several aspects:
i) Analyse the cost/benefit of the system;
ii) Assess the quality of the system since the more credible it is, the more value is added to the service;
iii) Adjust the product profile to the markets needs.

This report has analysed three interrelated standards (Table 5.4), in a stepwise approach towards independent verification of 1st, 2nd, or 3rd party appraisals, where 3rd party appraisal represents the highest level of independency of the system. These standards can be applied to access "bundle" ecosystem service markets.

Table 5.4.: Interrelated standards towards independent verification of 1st, 2nd, or 3rd party appraisals

	VERIFICATION PROCESS		
	1st party	2nd party	**3rd party**
Biodiversity & Ecosystem Services	**HCVA**	**GFTN**	**FSC**

This verification stepwise approach intends to be a flexible model which can adjust the product to market demand in terms of its sophistication and requirements. Less demanding markets will require 1st party appraisals while most demanding markets will require 3rd party appraisals. The present report suggests using FSC and GFTN as validation mechanisms of bundled biodiversity and ecosystems services. For validation of individual services such as carbon trades other specific tools would be required.

6.Market-based Payment Mechanisms for Ecosystem Services

There are three payment mechanisms that have been identified by Powell and White (2001) and explored by Johnson, White, and Perrot-Maitre (2001):

- Public payment mechanisms;
- Trading Schemes; and
- Self Organised Private Deals.

In addition, Ecosystem services can be sold as a package, in other words, Biodiversity Conservation, Watershed protection and Carbon Storage can be sold together rather than individually. This is the so-called ‘Bundled Ecosystem Service’ and such an approach has been the reality of a number of emerging markets.

Several examples regarding distinct payment mechanisms can be seen at: http://moderncms.ecosystemmarketplace.com/repository/moderncms_documents/PES_MATRIX_06-16-08_oritented.1.pdf

6.1.Public Payment Schemes

Public payment mechanisms involve public agencies purchasing services. These arrangements can be based on market or quasi-market prices, frequently using extra-market payment mechanisms such as bonds, tax revenues, or user fees and may be subsidised (Robbins, 2005). Public payment schemes for private landholders are designed to maintain or enhance ecosystem services. These types of PES agreements are country-specific, where governments have established focused programmes. Exact details vary by programme focus and country but they normally involve direct payments from a government agency (or another public institution) to farmers and/or managers (Forest Trends, The Katoomba Group, and UNEP, 2008).

6.2.*Trading Schemes*

Trading schemes consist of heavily regulated industries that can trade credits below a predetermined cap. In order for this scheme to function, a strong regulatory system with enforcement capacity must exist so that this system can operate. Such a scheme is well-established in the United States (Robbins, 2005). This mechanism functions through formal markets with open trading schemes between purchasers and sellers. This can be done either under a regulatory cap (or floor) on the level of ecosystem services to be provided, or voluntarily as the following subsection (6.2.1.) explains (Forest Trends, The Katoomba Group, and UNEP, 2008).

6.2.1.Regulatory and Voluntary Ecosystem Service Markets

Regulatory ecosystem service markets are set up through legislation that creates demand for a particular ecosystem service. This is done by setting a ‘cap’ on the damage to, or investment focused on an ecosystem service. The users of the service, or at least the people who are responsible for decreasing that service, respond either by complying directly or by trading with others who are able to meet the regulation at lower cost. Purchasers are defined by the legislation and are normally private-sector companies or other organisations. Sellers may also be companies or other organisations that the legislation permits to be sellers and who are going beyond regulatory requirements (Forest Trends, The Katoomba Group, and UNEP, 2008).

Voluntary markets work through companies or organisations that seek to reduce their carbon footprints and therefore are motivated to engage in the voluntary market. Such companies or organisations aim to enhance their brands, to anticipate emerging regulation as a result of stakeholder and/or shareholder pressure, or other reasons.

6.3.Self-organised Private Deals

Self-organized private deals may include deals negotiated business-to-business or business-to-community and government organisations are not normally involved (Robbins, 2005). In this scheme, individual beneficiaries of ecosystem services contract directly with providers of those services. Voluntary markets as described in the trading schemes subsection are also a category of private payments for ecosystem services. In addition, other private PES deals also exist in contexts where there are no formal regulatory markets and where there is a minimum (if

any) government participation. In these examples, purchasers of ecosystem services may be private companies who pay farmers to change management practices so that the quality of the services on which the purchaser wishes to maintain or is dependant can be improved (Forest Trends, The Katoomba Group, and UNEP, 2008).

6.4.Bundled Ecosystem Services

This report has outlined payment mechanisms that can be used for three ecosystem services that this study focuses on, namely, Biodiversity Conservation, Watershed Protection and Carbon Storage. However, according to Landell-Mills and Porras (2002), a number of emerging markets do not fit neatly under any single Ecosystem Service category. Instead, they represent efforts to sell a bundle of services. These efforts reflect the fact that ecosystem services are often in joint production, such that investment in the production of one service results in the simultaneous production of other services.

The 'bundled ecosystem service' approach consists of several ecosystem services sold as a package instead of selling each service individually (see case studies Boxes 1, 2 and 3). For instance, payment for water services that preserves standing forests at the same time also benefits biodiversity conservation (Wertz-Kanounnikoff, 2006). In many cases, forests can provide various services jointly (watershed protection, biodiversity conservation and carbon sequestration).

The process of selling ecosystem services together can minimise transaction costs from the supply and demand perspectives. In addition, bundled ecosystem services markets are growing mainly due to developments in the supply and intermediary mechanisms, not to mention the increasing awareness of the opportunities provided by joint production. In the case of bundle services, certification can decrease transaction costs and facilitate marketing of various services. Thus, linking ecosystem services verification with certification of sustainable forest management is another way to minimise transaction costs (Katila and Puustjärvi, 2004).

There are two main categories of bundled service sales, namely, merged bundles (ecosystem services are sold together and cannot be subdivided for sales to separate purchasers) and shopping basket bundles (purchasers can acquire specific services on their own or as part of a package and land stewards can sell different services to different buyers). The merged bundle approach offers a useful control on transaction costs. On the other hand, the shopping basket bundle approach permits the sale of individual services to distinct buyers resulting in a more efficient allocation of resources and higher returns to sellers. However, the challenge for most forest managers is to organise technical data and institutional requirements for successfully marketing a suite of services to separate buyers (Landell-Mills and Porras, 2002).

CASE STUDIES

BOX1

The English Woodland Grant Scheme (EWGS)

The EWGS consists of grants for the creation and stewardship of woodlands. It is operated by the Forestry Commission (FC) under the Rural Development Programme for England (RDPE). The objectives for EWGS are to sustain and increase the public benefits derived from existing woodlands in England; and to invest in the creation of new woodlands in England of a size, type and location that most effectively delivers public benefits. The key targets of EWGS are areas of woodland under certified sustainable forest management and approved management schemes; expanding the area of woodland with public access; bringing woodlands Sites for Special Scientific Interest (SSSIs) into favourable condition; assisting delivery of priority habitat and species action plans for woodlands; and woodland creation. EWGS offers a range of six grant types which have their own unique criteria and structures.

These six grant types fall into two categories, namely, stewardship of existing woodlands and creation of new woodlands. The grant type regarding the Creation of New woodlands Category is that of Woodland Creation Grant (WCG). The grant types related to the stewardship of existing woodlands category are Woodland Planning Grant (WPG), Woodland Assessment Grant (WAG), Woodland Regeneration Grant (WRG), Woodland Improvements Grant (WIG) and Woodland Management Grant (WMG).

Therefore, the following relevant type of grant has been selected for this case study:
Woodland Management Grant (WMG)

WMG aims to encourage sustainable woodland practice. It is designed to protect the delivery of existing benefits to the public and improve the capacity of the woodland to increase these. The objective of WMG is to contribute to protect, increase and maintain the area of woodland under sustainable management; identify and address threats to woodland, and prevent decline and increase the capacity for sustainable management.

The eligibility requirements must consist of the following:

-Woodland properties over 100 ha must be certified to the UK Woodland Assurance Standard (UKWAS) and the management plan required for that certified status must support the proposed work. The UKWAS is recognised by the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC);

-Woodland properties between 30 and 100 ha must be either certified or have an approved management plan in place;

-Woodland properties smaller than 30 ha must either be certified and have a management plan or the application must be supported by Conditions, Opportunity and Threat (COT) Assessment.

WMG can be paid in situations such as the property is within a woodland type that is important to the UK Biodiversity Action Plan (UKBAP), the property is located within a Red Squirrel reserve, the property is within the East Midland woodland bird priority area, and the property offers public access on demand. The payment rate is £30/ha for 5 years on the eligible criteria.

Source**:** Forest Commission, England (2009)

BOX2

Costa Rica's National Forestry Financing Fund (FONAFIFO) – Biodiversity Conservation and other jointly provided services

The government-financed programme FONAFIFO was created in 1997 on the basis of Forestry Law of 1996. The forestry law explicitly recognises four environmental services provided by natural forests and forest plantations such as biodiversity conservation, carbon sequestration, watershed protection, and the provision of scenic beauty. Under this framework, private land and forest owners can be compensated for providing these services.

Thus, the role of FONAFIFO is to compensate forest owners and managers for reforestation and for activities that help protect native forests. Financing for FONAFIFO comes from a variety of sources such as a tax on gasoline, a tax on wood products, the emission of "forestry bonds", pollution and other environmental fines, and other revenues coming into the Ministry of Energy and the Environment. The target environmental services are biodiversity conservation, water, carbon and scenic beauty. The autonomous state agency (FONAFIFO) buys the service whereas private landholders and indigenous communities are the sellers.

The main environmental services paid for are forest conservation, timber plantations and agroforestry. The programme also relies on many other actors such as other government agencies, local NGOs, and private actors (Certified Forest Engineers) in order to fulfil a range of roles.

Sources: Bayon *et. al.* (2000) and Wunder *et. al.* (2008).

BOX3

France: Perrier Vittel's Payments for Water Quality and Reforestation

In 1990, the Perrier Vittel (now owned by Nestlé Waters) detected water quality issues in its 5100 ha catchment at the foot of the Vosges Mountains. Consequently, in order to tackle the issues found and maintain the aquifer water quality to its highest standard Perrier Vittel came to the conclusion that it would be cheaper to invest in conserving the farmland surrounding the aquifer instead of building a filtration plant.

The programme is implemented through a created agricultural extension agency which is trusted by the farmers. The extension agency then persuaded farmers to adopt less intensive pasture-based dairy farming, abandon agrochemicals, improve animal waste management, reduce animal stock, and reforest sensitive filtration zones. Therefore, long-term conservation contracts were signed with local farmers (18-30 years). In return, farmers receive compensation due to the reconversion to low-impact dairy farming and improved agricultural practices.

The type of service provided is quality drinking water. The buyer is Perrier Vittel (bottler of natural mineral water) whilst the sellers are the upstream dairy farmers and forest landholders. In terms of payment, Vittel pays each farm about $230 per hectare per year. The company spent an average of $155,000 per farm or a total of $3.8 million.

Sources: Forest Trends, The Katoomba Group, and UNEP (2008) and Wunder *et al*. (2008)

7.Conclusion

The application of the HCVA concept through the GIS and WebGIS tools has been essential to identify and quantify the main biodiversity hotspots and ecosystem services. Yet, new systematic data, especially those of flora will need to be collected and inserted into the WebGIS in the future. In addition, such information will need to be refined in order to achieve the best results. **This will be a powerful tool for stakeholders such as forest managers, forest producer associations, landowners, environmental agencies, NGOs, and forestry professionals in general to identify ecosystem services in the largest cork woodland area in the world.** The *APF Certifica* case study (demonstrated in this report) is a clear example of how HABEaS can be identified and quantified through the HCVA, GIS and WebGIS methods.

This report has recognised GFTN and FSC as the most suitable way of independent verification and monitoring mechanism of management practices to access bundle ecosystem services based on interrelated standards. Again, this is another potential way available to verify and monitor HABEaS, not to mention that this verification and monitoring process can decrease transaction costs and facilitate marketing of various services, both key factors to open new market opportunities.

Opportunities for future developments and directions regarding the WebGIS development are to enhance the user tool interaction and the replication of the HABEaS to other countries where Mediterranean oak forests represent great potentialities in terms of ecosystem services. **On the market side there are opportunities on the *REDDINESS* and marketing of the ecosystem services of the largest cork woodland area in the world**.

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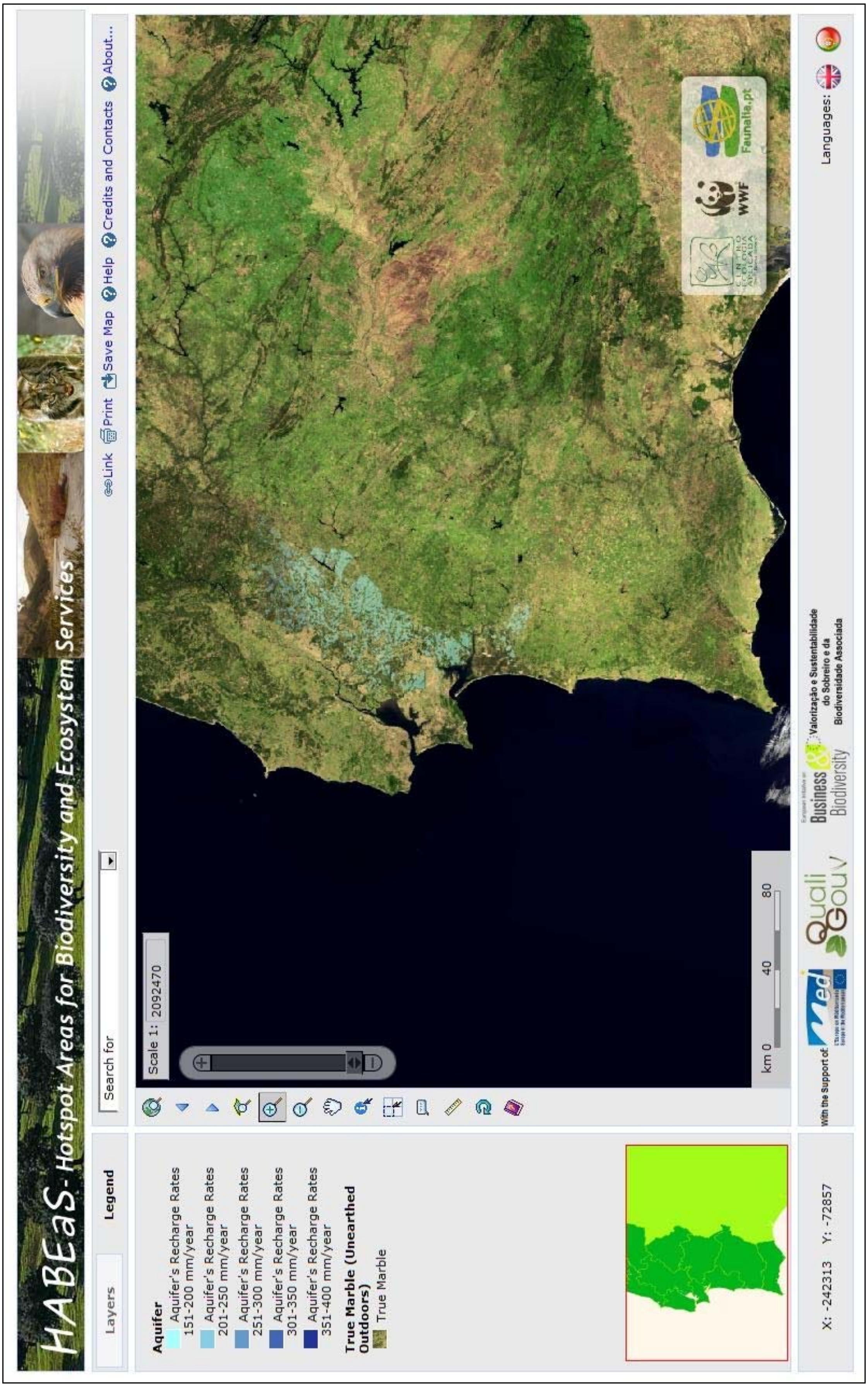
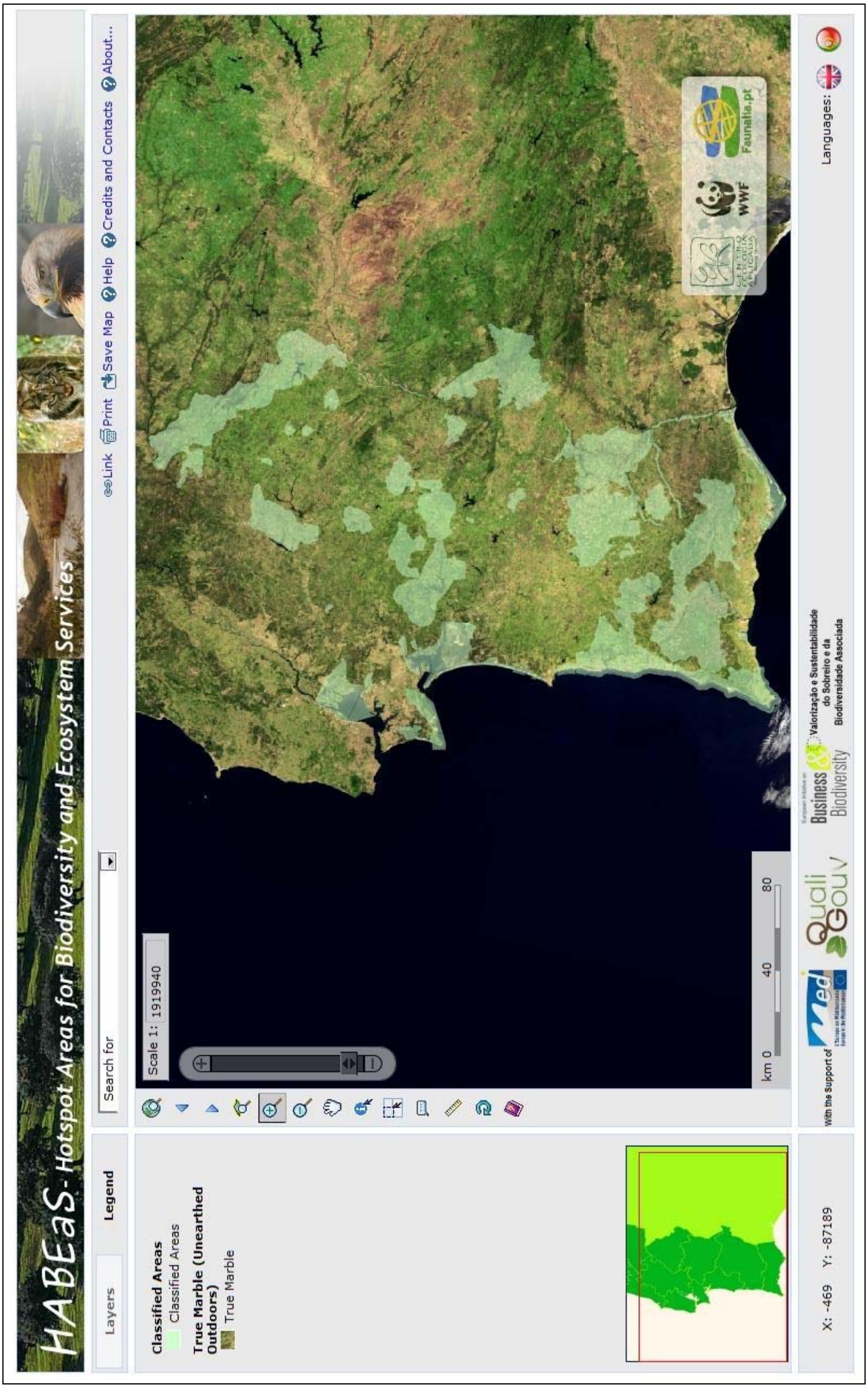
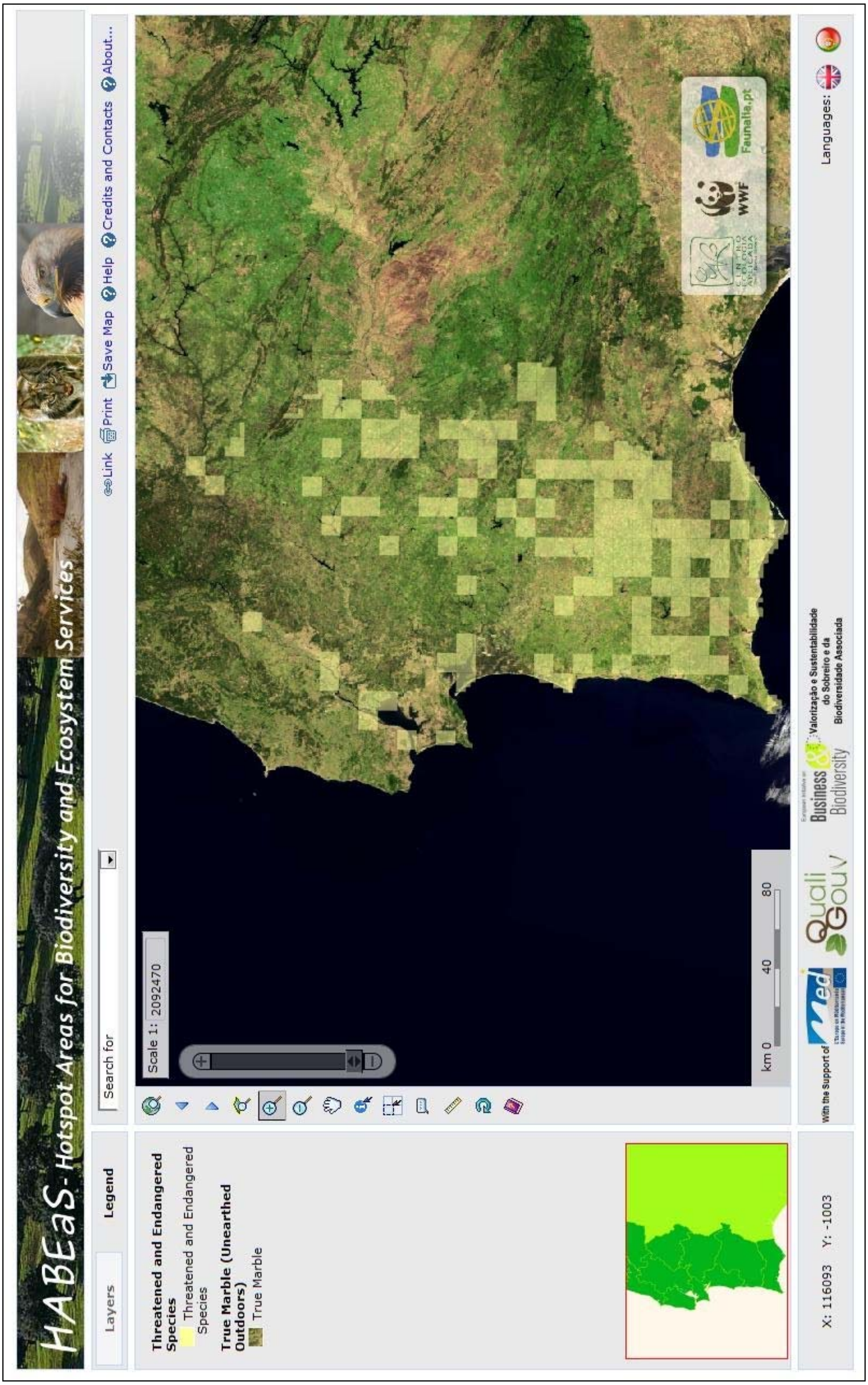
Appendix 1. Forests Critical to Water Catchments (HCV 4.1)



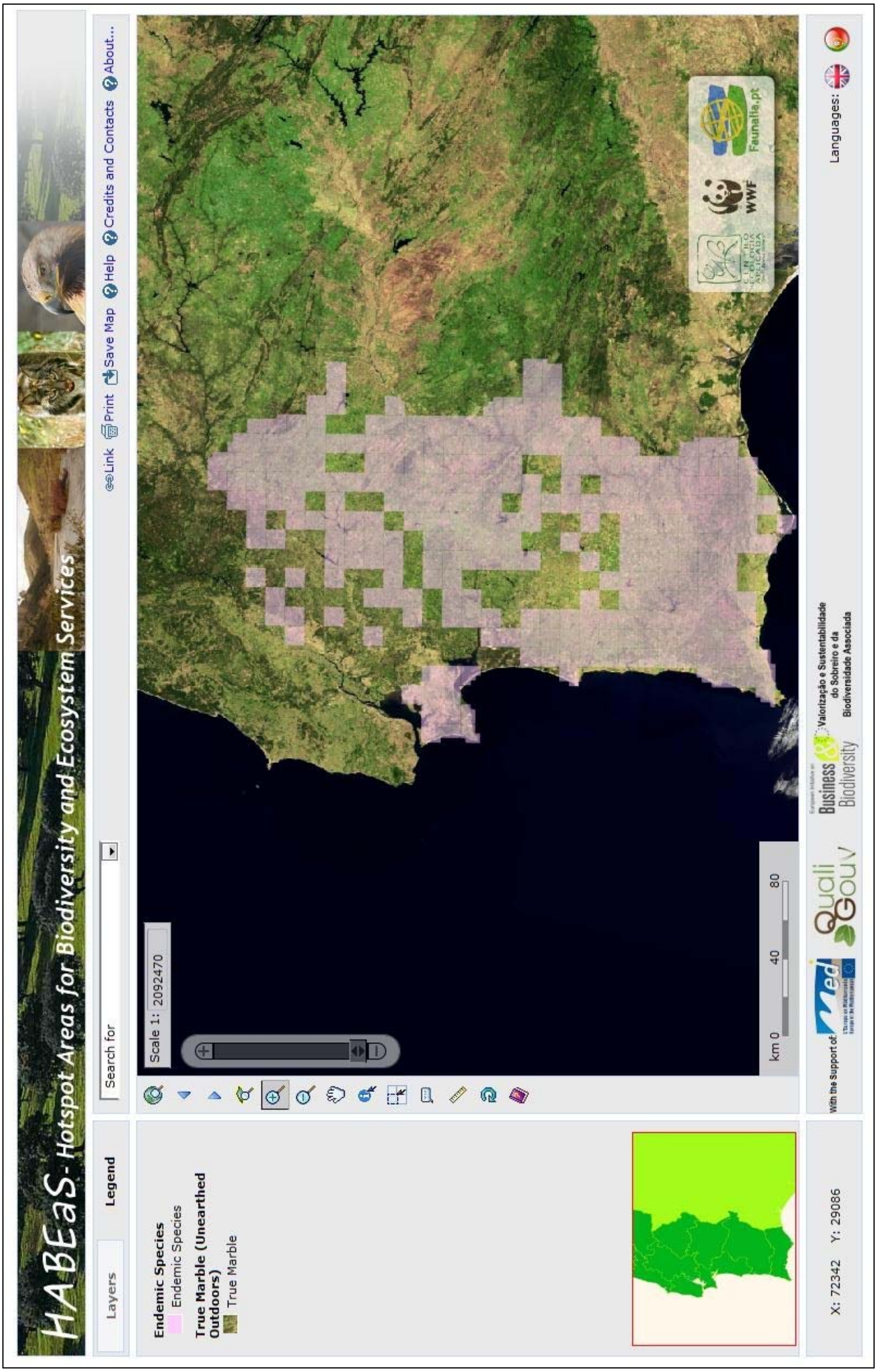
Appendix 2. Protected and Sensitive Areas (HCV 1.1)



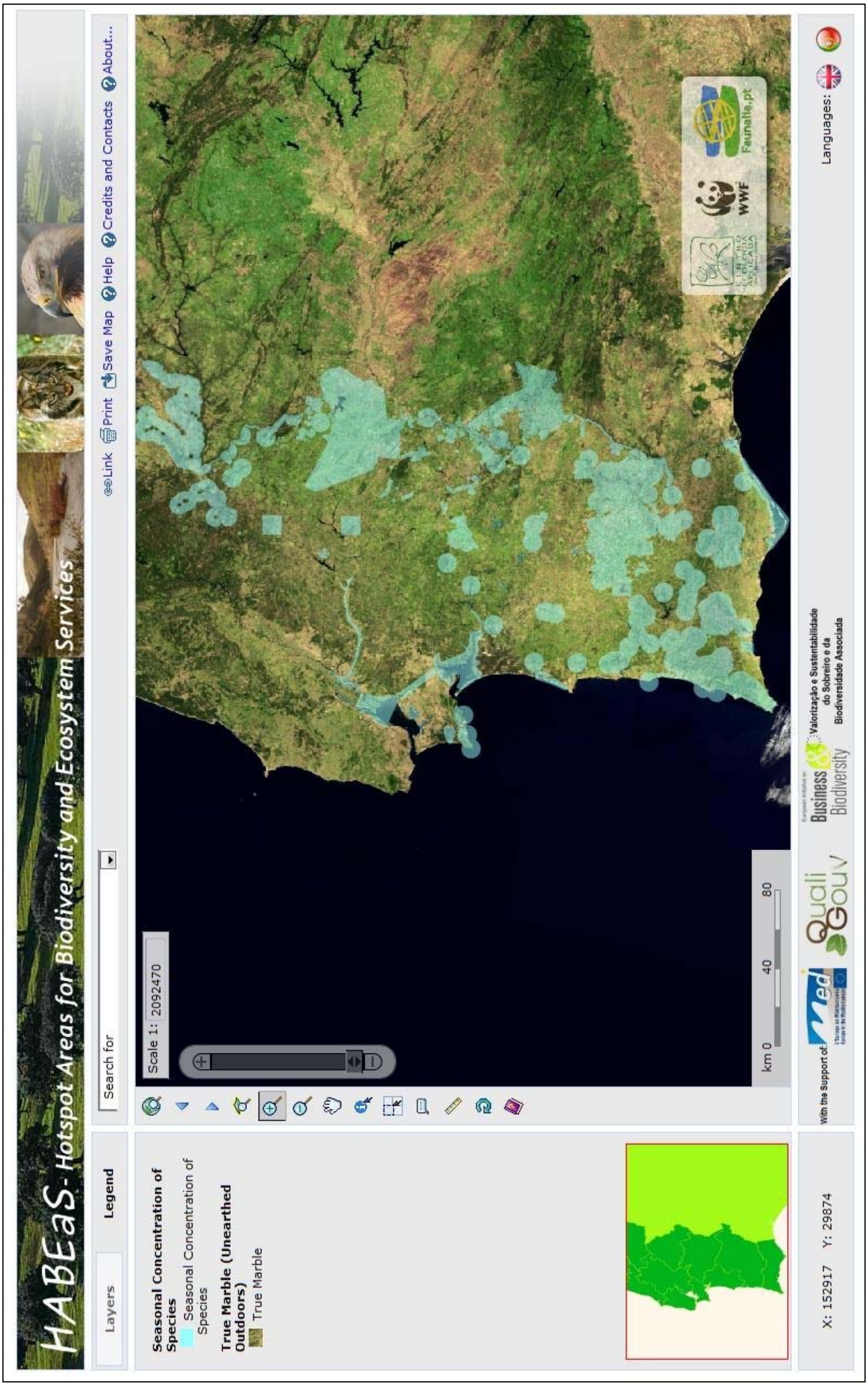
Appendix 3. Threatened and Endangered Species (HCV 1.2)



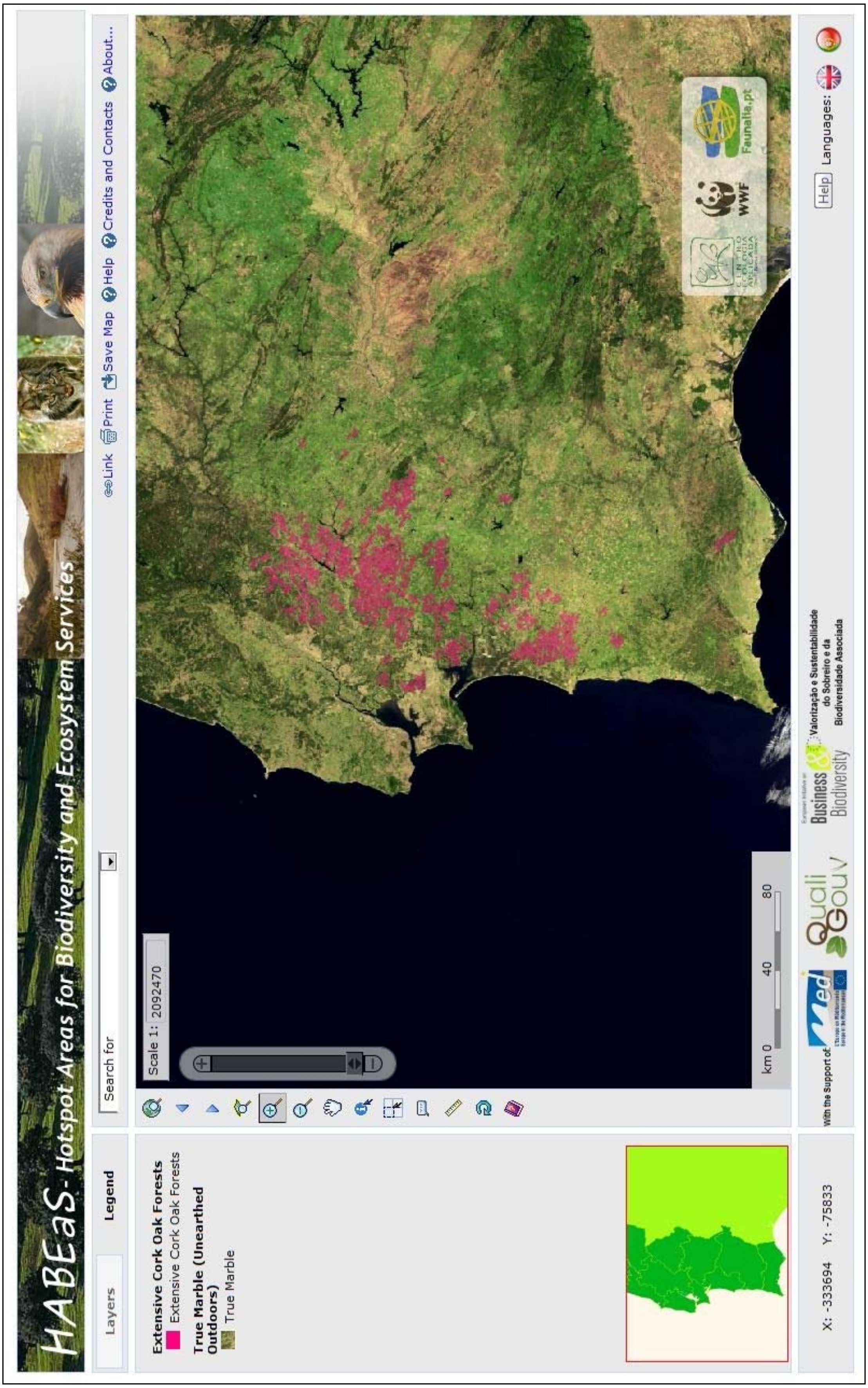
Appendix 4. Endemic Species (HCV 1.3)



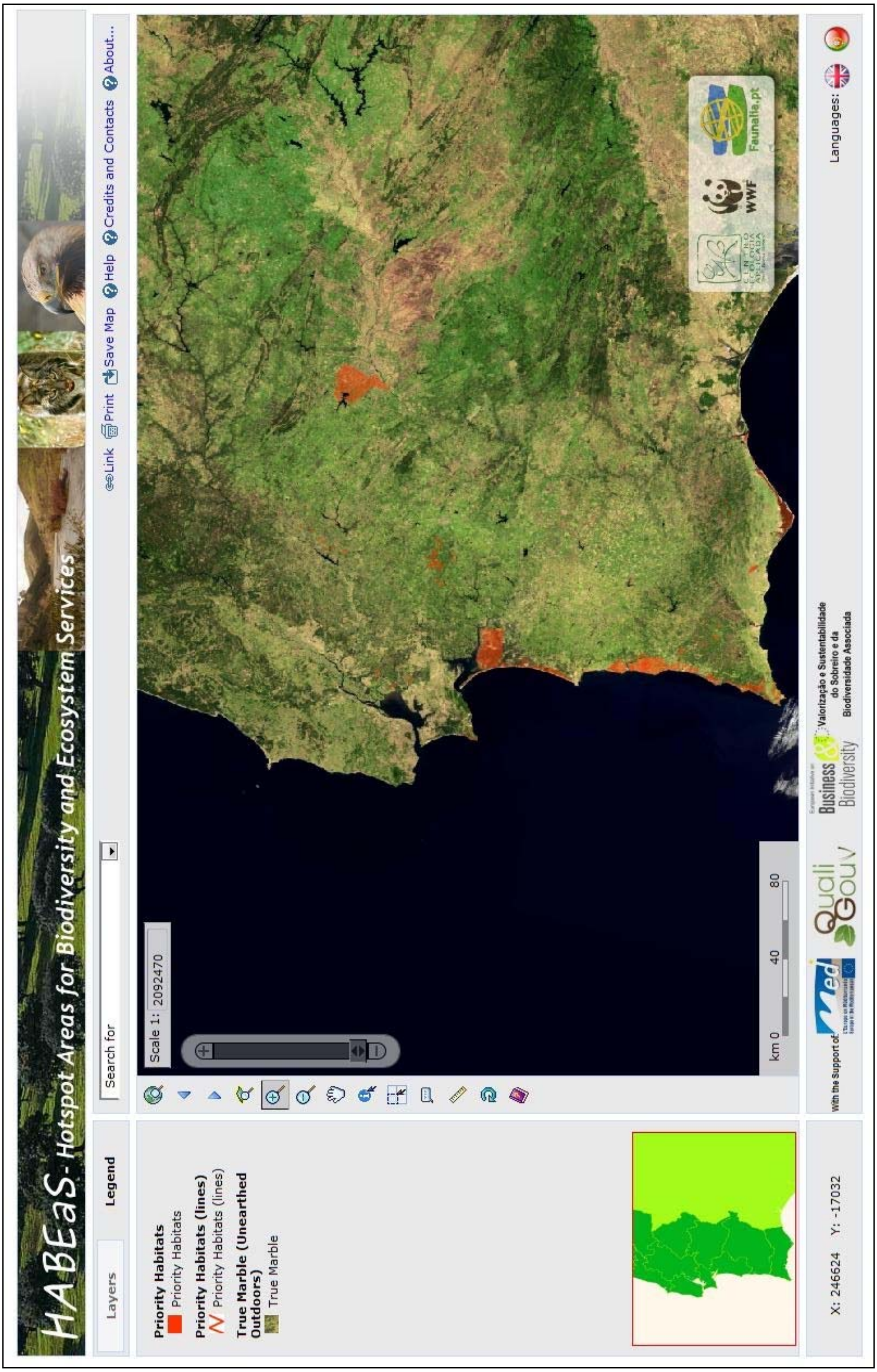
Appendix 5. Seasonal concentrations of Species (HCV 1.4)



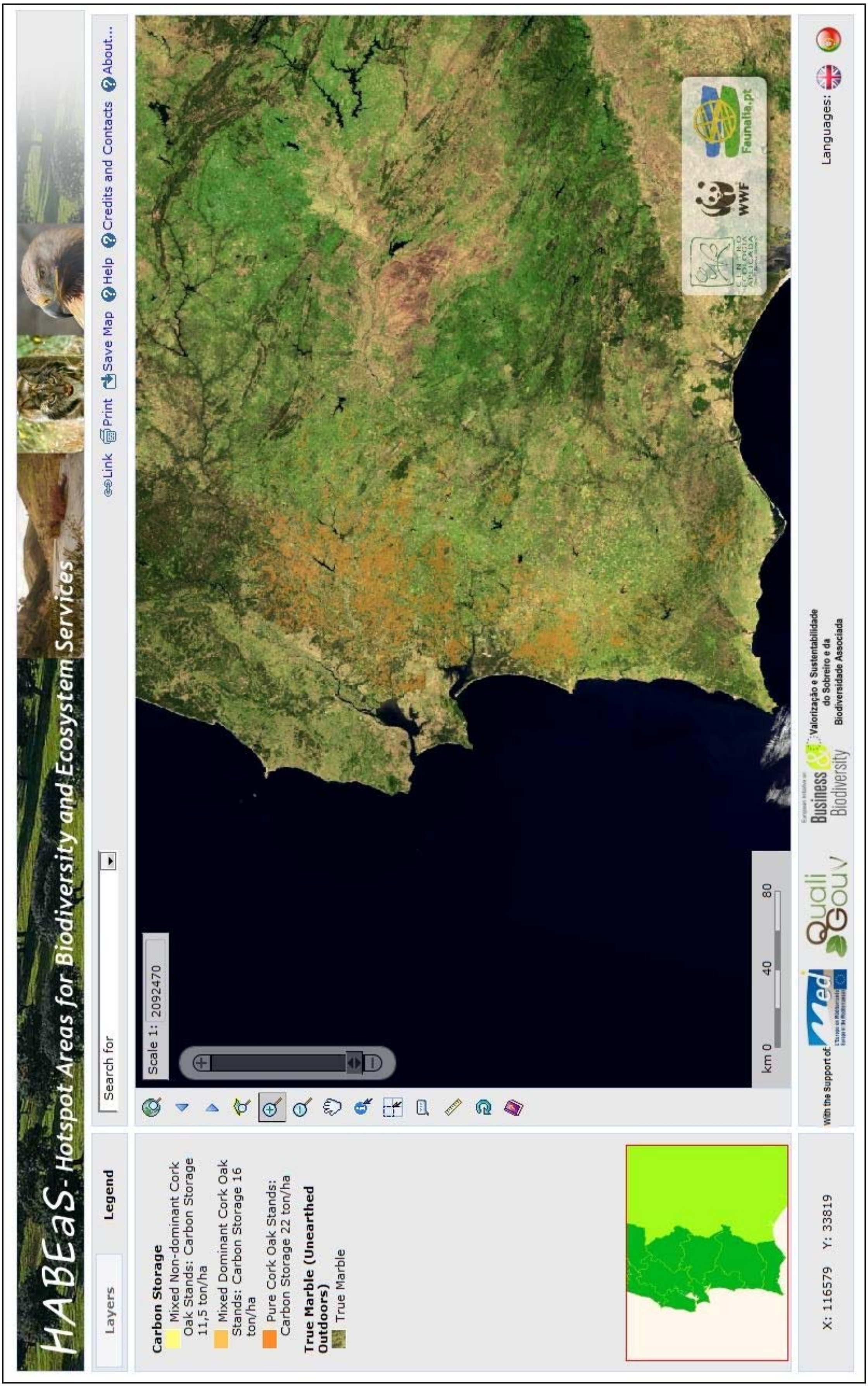
Appendix 6. Significant Large Landscape Level Forests (HCV 2)



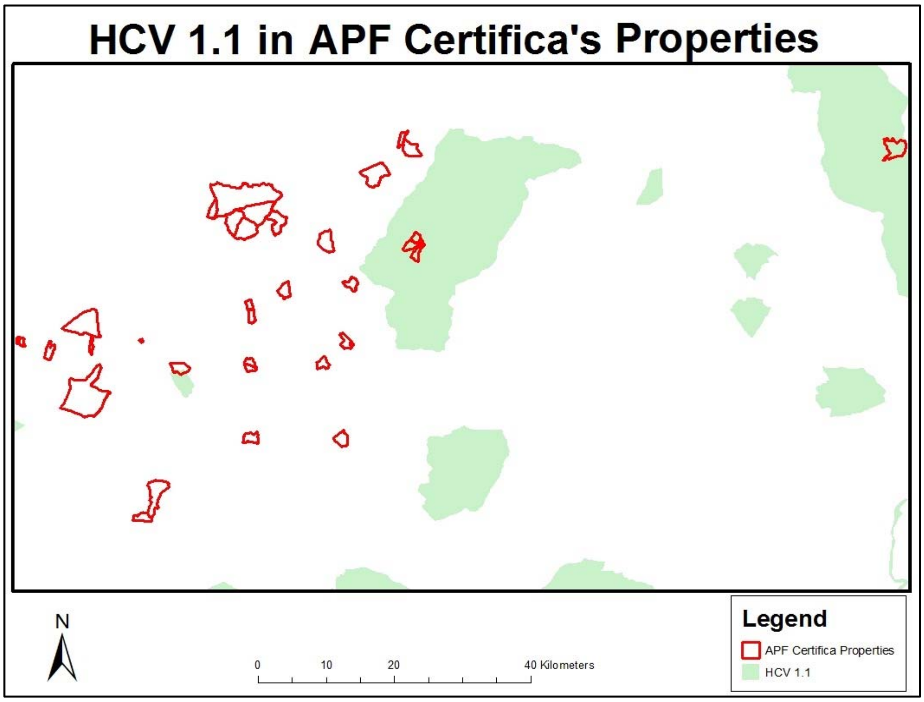
Appendix 7. Rare, Threatened or Endangered Ecosystems (HCV 3)



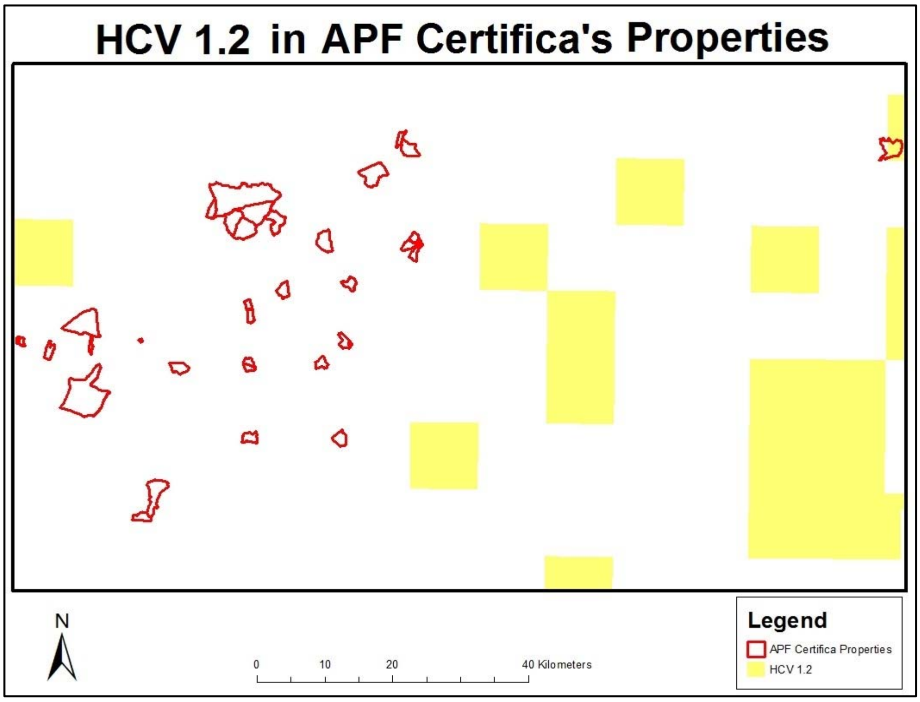
Appendix 8. Forests Critical to Carbon Storage (HCV4.4)



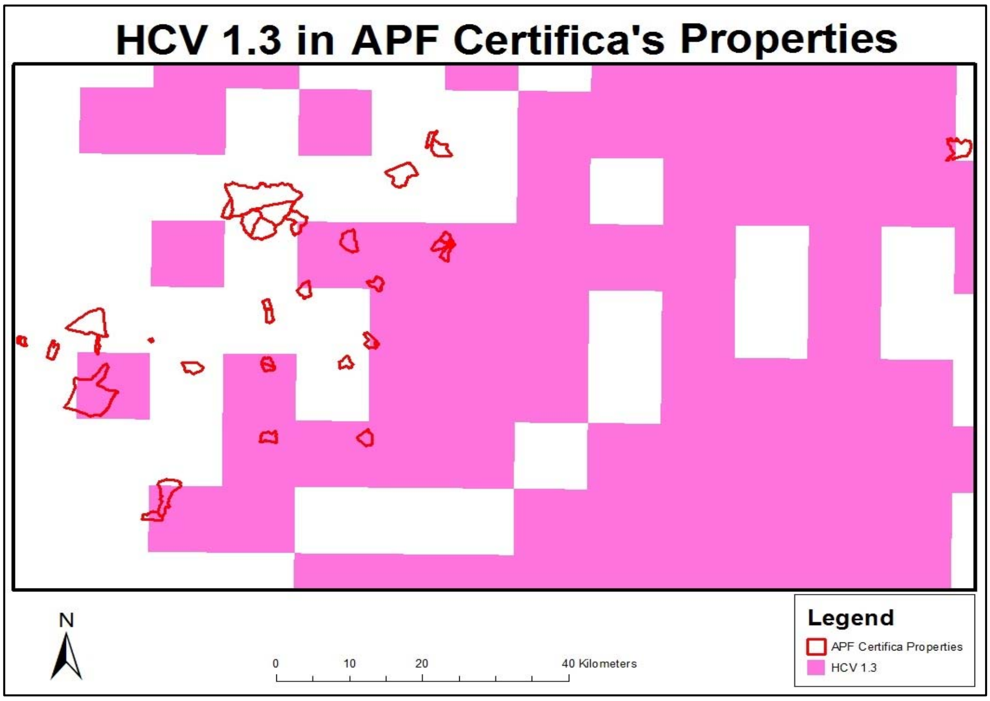
Appendix 9. Identification of HCV 1.1 in APF Certifica's Estates



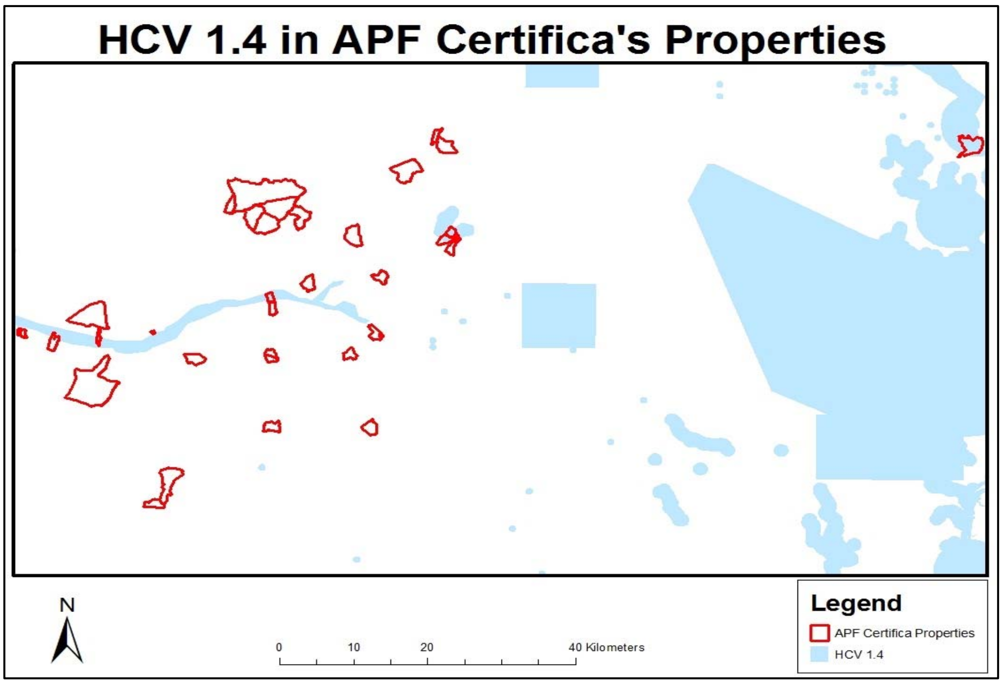
Appendix 10. Identification of HCV 1.2 in APF Certifica's Estates



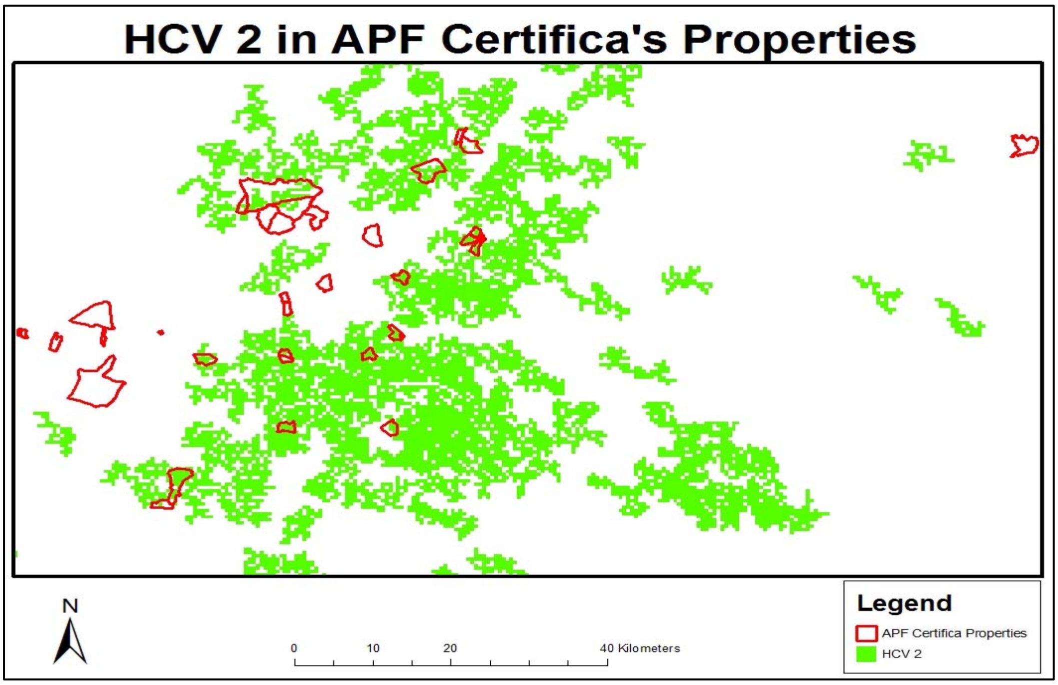
Appendix 11. Identification of HCV 1.3 in APF Certifica's Estates



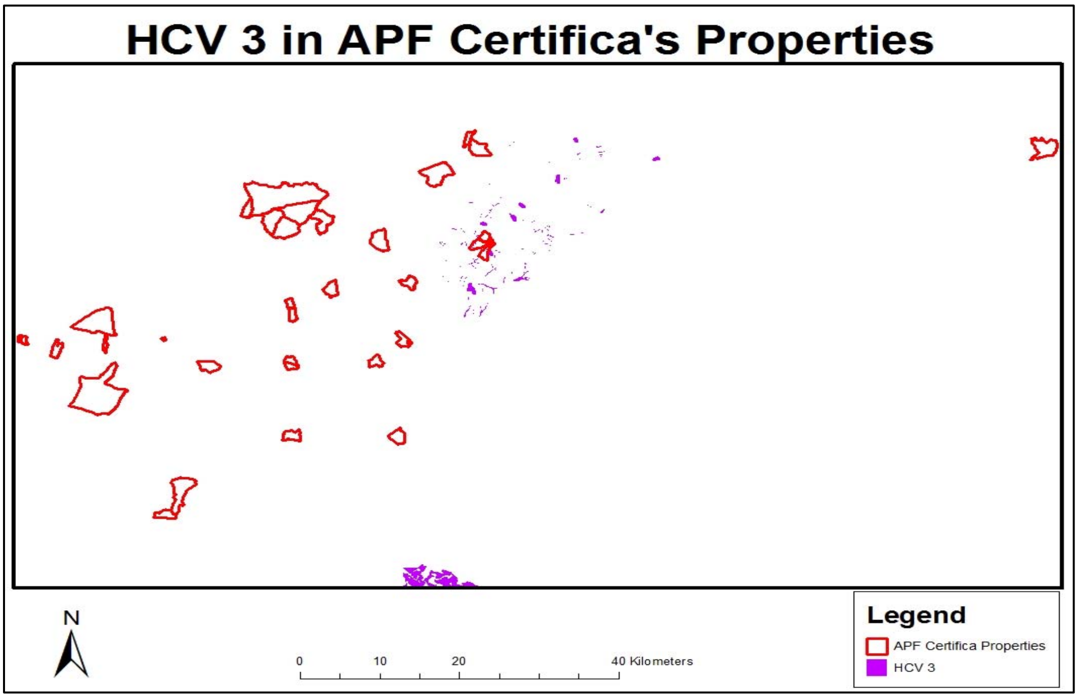
Appendix 12. Identification of HCV 1.4 in APF Certifica's Estates



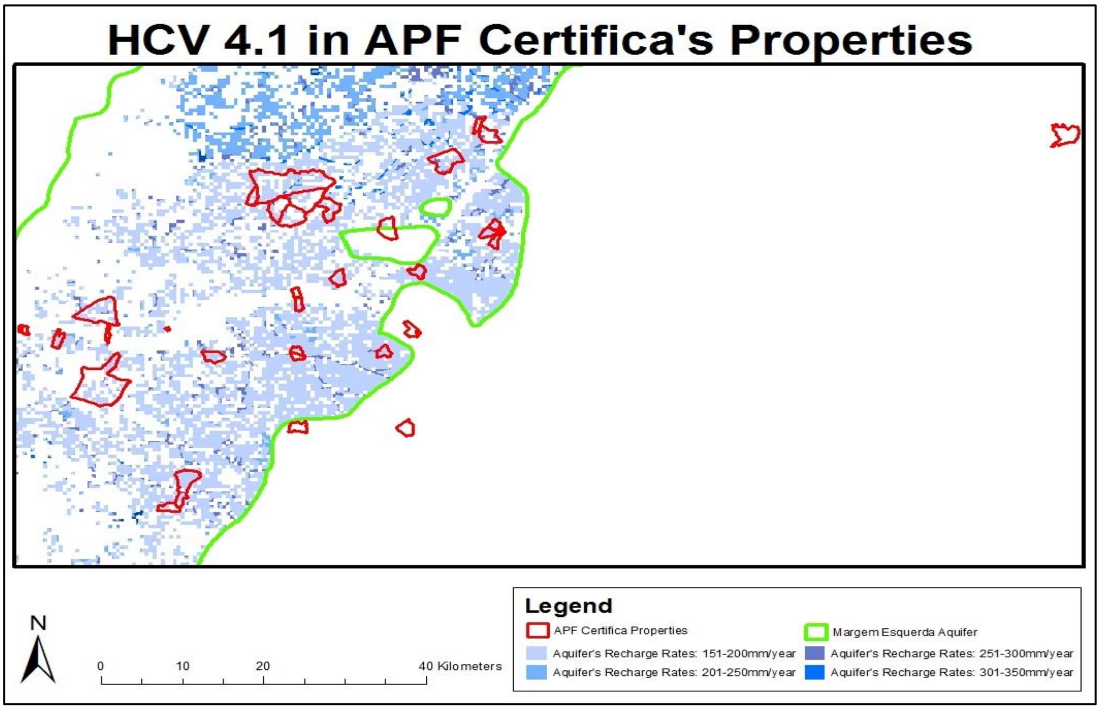
Appendix 13. Identification of HCV 2 in APF Certifica's Estates



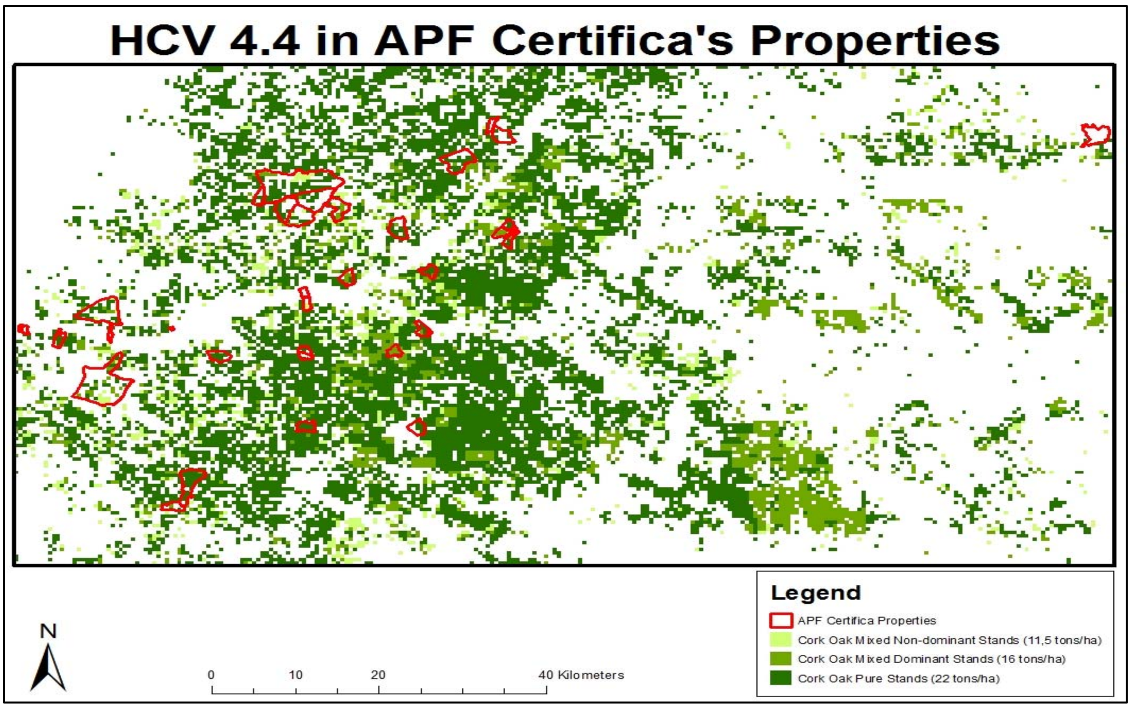
Appendix 14. Identification of HCV 3 in APF Certifica's Estates



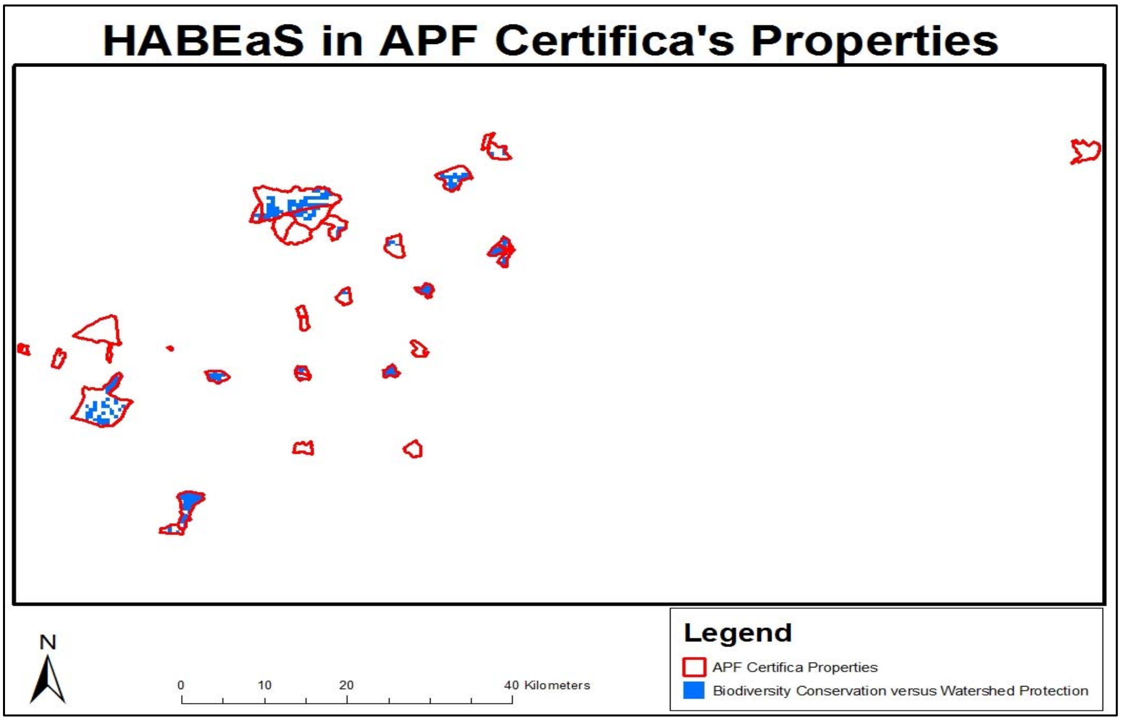
Appendix 15. Identification of HCV 4.1 in APF Certifica's Estates



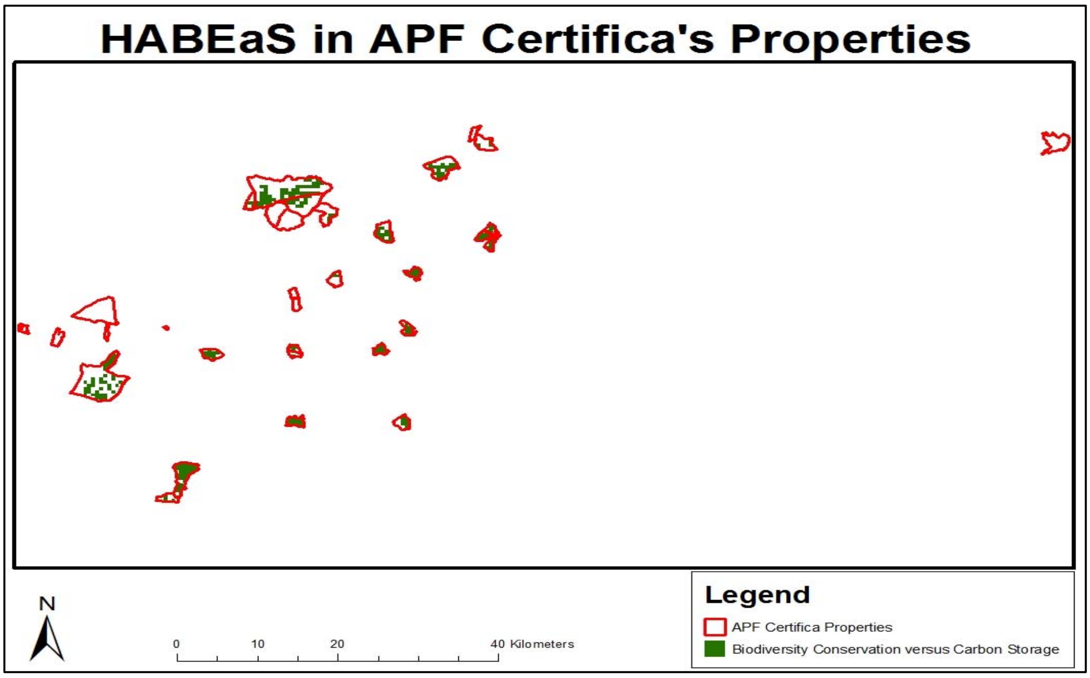
Appendix 16. Identification of HCV 4.4 in APF Certifica's Estates



Appendix 17. Identification of HABEaS (Biodiversity Conservation overlapped with Watershed Protection) in APF Certifica's Estates



Appendix 18. Identification of HABEaS (Biodiversity Conservation overlapped with Carbon Storage) in APF Certifica's Estates



Appendix 19. Identification of only Biodiversity Conservation Areas in APF Certifica's Estates