Cultural Oak Landscapes as Green Infrastructure for Human Well-Being

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Licentiate Thesis
Swedish University of Agricultural Sciences
Skinnskatteberg 2014

Cover: A solitary veteran Oak tree
(photo: M. Angelstam)

ISBN (print version) 978-91-576-9246-7
ISBN (electronic version) 978-91-576-9247-4

Print: SLU Service/Repro, Uppsala 2014

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Abstract

Human and nature interactions have been the ancestral normative model to provide and secure livelihoods worldwide. Hence, humans have been coevolving in an intrinsic relation with the natural system until medieval times. The mentioned interactions formed the so-called cultural landscapes as a result of human gradual re-organization and adaptation of the biophysical system to adapt better to changing societal demands. Concerned to balance sustainable development of landscapes among its social, economic and environmental dimensions, as well as aware of the important role of landscapes for individual and social well-being through their protection, management and planning, the European Landscape Convention emerged. The cultural dimension of landscapes has proven difficult to measure and thus commonly neglected in ecosystem services (ES) research. To tackle this knowledge gap, I first reviewed methods and tools to fully capture cultural ecosystem services in landscapes, to focus thereafter on the diagnosis of the cultural oak landscape in Östergötland (Sweden). I identified and analyzed the diversity of ES important for stakeholders at local and regional levels that represent different societal sectors. The private sector locally emphasized provisioning ES, whereas the civil and public sectors highlighted the importance of cultural services in terms of recreational values and landscape beauty. Supporting services were considered only in relation to biodiversity, especially species and habitats linked to old oaks. Hotspot of ES were identified and discussed in terms of green infrastructures for human well-being. Traditional farming practices are in a steady regression which entails greater uncertainty for the long term survival of such systems and associated diversity of delivered services and values. Solutions, including adaptations of modern farming techniques to better mimic the traditional ones are urgently needed, as well as the generation of additional income through alternative rural development initiatives such as tourism and recreation. Complex realities demand multi-disciplinary methods and approaches to find viable ground-based solutions. We suggest holistic research methods, hands on with stakeholders, i.e. transdisciplinary research, to satisfy the increasingly complex needs, improved understanding of conservation objectives and demands of a changing society.

Keywords: agroforestry, biodiversity, cultural services, ecosystem services, socio-ecological system, stakeholder perspective, traditional knowledge

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Dedication

To an angel from another world who once grandmother of mine she was

Grandiosa presencia en su calma apariencia,
Alma robusta mas de candor agraciada,
Madre de la mía, de amor la engendrada,
Tamaña querencia e intangible vacío, su ausencia.

Contents

List of Publications

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

I Garrido, P. What are cultural ecosystem services? A review of definitions, classifications and methods to capture cultural services (manuscript).

II Garrido, P., Elbakidze, M., Angelstam, P., and Axelsson, R. Stakeholder's perspectives on ecosystem services of Sweden's last cultural oak landscapes (manuscript).

The contribution of Pablo Garrido to the papers included in this thesis was as follows:

I 100%

II 60%

Abbreviations

CAB	County Administrative Board
CAP	Common Agricultural Policy
CE	Council of Europe
EC	European Commission
ENRD	European Network for Rural Development
GHGWI	Gallup-Healthways Global Well-Being Index
GI	Green Infrastructure
ES	Ecosystem Services
MA	Millennium Ecosystem Assessment
MCPFE	Ministerial Conference on Protected Forests of Europe (now Forest of Europe)
OECD	Organization for Economic Cooperation and Development
SBA	Swedish Board of Agriculture
SEPA	Swedish Environmental Protection Agency
TEEB	The Economics of Ecosystems and Biodiversity
UNEP	United Nations Environment Assembly of the United Nations Environment Programme

1 Introduction

Human and nature interactions have been the ancestral normative model to provide and secure livelihoods worldwide (Farina 2000, Ellis and Ramankutty 2007). Hence, humans have been coevolving in an intrinsic relation with the natural system until medieval times. The mentioned interactions has formed the so-called cultural landscapes as a result of human gradual re-organization and adaptation of the biophysical system towards a composition and spatial structure that delivers desired products, services and values (sensu Antrop 2005). Thus, cultural landscapes are considered integrated socio-ecological systems (Antrop 1997, Baker 2003, Elbakidze and Angelstam 2007, Hartel and Plieninger 2014), evocating the co-evolution between humans and nature (Marañón 1988, Díaz et al. 1997, Rackham 2003, Eichhorn et al. 2006, Manning et al. 2006, Bergmeier et al. 2010, Bugalho et al. 2011).

Many landscapes worldwide has been shaped by traditional agroforestry practices (Calvo-Iglesias et al. 2006) including food production, habitat regulation and cultural functions that deliver environmental, social, cultural and economic goods, services and values that are important for human well-being, and can thus foster sustainable rural development (McAdam et al. 2009). However, as pointed out by McAdam et al. (2009), when local knowledge is disappearing due to modernization, this results in a significant loss of knowledge about how to maintain multifunctional cultural landscapes. The European continent contains a diverse gradient of landscapes that have been shaped by different cultures throughout historical times (Eichhorn et al. 2006, Bergmeier et al. 2010), conforming the cultural landscapes of today (Angelstam et al. 2011). Hence, the importance of cultural landscapes is acknowledged at international level, and its protection and management promoted (Von Droste et al. 1995, Pressouyre 1996, CE 2000, Rössler and Cleere 2001, Luengo and Rössler 2012).

Concerned to balance sustainable development of landscapes among its social, economic and environmental dimensions, as well as aware of the important role of landscapes as key elements for individual and social well-being through their protection, management and planning, the Council of Europe agreed to develop the European Landscape Convention to aid addressing landscape issues and harmonize them in Europe (CE 2000). The aim of the convention was to foster landscape protection, management, planning and cooperation on landscape issues at European level (CE 2000). A working definition was created accordingly, as "an area as perceived by people whose character is the result of the action and interaction of natural and/or human factors". General principles to guide the parties were created and specific measures defined, including awareness raising, training and education of landscape specialists, identification and assessment of landscapes within the different countries, as well as the specification and development of certain landscape quality objectives and their implementation through landscape policy instruments. Here, human dimension of landscape is important to study in order to understand the dual role of humans on landscapes as source of ecological impacts and, as legitimate landscape users (Hunziker et al. 2007). Furthermore, knowledge on people's needs and preferences is necessary for designing publicly acceptable nature conservation and landscape planning strategies (Hunziker et al. 2007).

Pan-European cultural landscapes include the full range of states in the transition from authentic to degraded landscapes (Bergmeier et al. 2010) and therefore can provide opportunity for knowledge production and learning among countries, regions and places (Angelstam 2006, Angelstam et al. 2013b). They occur in all European biomes from Boreal to Mediterranean, although nowadays mainly residually (Bergmeier et al. 2010, Hartel and Plieninger 2014). Spain and Sweden are two European countries with marked social and cultural differences, in which remnants of valuable cultural oak landscapes based on traditional agroforestry systems still persist. These landscapes can be seen as reference systems of cultural landscapes in the Mediterranean and north European regions respectively. At present both in Spain and Sweden, the distribution of cultural oak landscapes is decreasing (Bugalho et al. 2011, Paltto et al. 2011). ES provided by cultural oak landscapes depend on the intensity of human use (Bugalho et al. 2011). In both countries these landscapes are threatened by insufficient or inexistent land management on the one hand, or land use change and over exploitation on the other hand (Bugalho et al. 2011, Paltto et al. 2011), leading to biodiversity losses and subsequent ES reduction needed for human well-being (Raymond et al. 2009, de Groot et al. 2010, Bullock et al. 2011, Fisher et al. 2011, Farley

2012). Thus, opportunities for knowledge production based on comparisons of multiple landscapes as case study areas in different regions of the European continent with contrasting landscape use history can greatly contribute to innovative solutions for the long term maintenance and sustainable management of such valuable landscapes (Angelstam et al. 2011).

As an example, in southern Scandinavia cultural oak woodland landscapes are severely fragmented, and thus currently subjected to conservation management efforts (CAB 2005). Sweden is one of the countries in which remnants of former cultural oak landscapes still persist in the hemiboreal zone (Bergmeier et al. 2010). These landscapes were traditionally used for husbandry including grazing and hay-making (Bergmeier et al. 2010). Furthermore, they were historically a strategic resource for the navy's warship building, and thus oak trees belonged to the Crown for centuries (Eliasson and Nilsson 2002). Since XIX century, after the abolition of oaks' protection status, they were massively cut by peasantry, whereas some were kept in nobility estates refugia (Eliasson and Nilsson 2002). Cultural oak woodland are agroforestry systems of great importance for the maintenance of living multifunctional rural landscapes as well as conservation of biodiversity associated with traditional land use (Rackham 2003). However, such landscapes are often threatened by insufficient or non-existent traditional land management (Bugalho et al. 2011, Paltto et al. 2011). This leads to biodiversity loss and subsequent reduction of ES needed for human well-being (Raymond et al. 2009, de Groot et al. 2010, Bullock et al. 2011, Fisher et al. 2011, Farley 2012). Swedish policy states that "The value of cultivated landscapes shall be protected, while the biodiversity and the cultural heritage values are preserved and strengthened" (SEPA 2006).

Östergötland County has the largest remnants of cultural oak landscapes with high natural values in Sweden. In this thesis the cultural oak landscape is understood as a coupled social-ecological system that has been a result of traditional agroforestry occupying a vast area in the past and nowadays displays a diversity of different land covers that in many cases have replaced traditional land use. The importance of this landscape in relation to biological diversity has been documented for saproxylic beetles (Ranius et al. 2005), butterflies (Bergman et al. 2004, Bergman et al. 2007) and lichen species (Paltto et al. 2010), as well as the negative impact of land-use change related to biodiversity levels (Paltto et al. 2011) and urbanization sprawl effects (Lättman et al. 2014). However, the importance for humans and their well-being it has not been yet investigated to date. To enhance the delivery of ES by spatial planning of natural and semi-natural areas the concept green infrastructure has emerged (EC. 2013).

The aim of the thesis is to analyze the role of cultural oak landscapes as provider of multiple ES for human well-being through the diagnosis of the largest area containing fragments of cultural oak landscapes in Sweden (Östergötland County). We learn about past and present landscape use, ES delivered and perceived by different stakeholder categories at different levels of governance, as well as identify current challenges for the long term perpetuation of such valuable landscape. Since forest habitat and green space fragmentation is notably increasing, there is a need to protect, manage and restore habitats and green space that deliver important ES for wildlife, and human well-being. Simultaneously production on forest and agricultural land is intensified, and more space is used for housing and transport infrastructures. In urban landscapes green spaces shrink as roads and buildings expand (Tzoulas et al. 2007), which forms a threat to human health and well-being (Björk et al. 2008). These trends imply increased conflicts between intensified economic use of forest and urban landscapes, and maintenance of functional green infrastructures for ecological sustainability. Thus, a diagnosis of landscapes as integrated socio-ecological systems is urgently needed for the production of socially robust knowledge in order to understand how green infrastructures for species and humans should be maintained.

2 Research context

2.1 Cultural Landscapes as Socio-Ecological Systems

Many international agreements, processes, and programs point out the importance of traditional knowledge in supporting sustainable rural development that maintains multiple ES delivered by cultural landscapes (e.g., CE 2000, MCPFE 2003). At the global level the World Heritage Site Convention describe the significance of cultural landscapes that are "an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change". Political commitments have highlighted the importance of increasing the awareness about the role of traditional knowledge that contributes to the protection of landscapes and biological diversity (CE 2000, MCPFE 2003, Rametsteiner and Mayer 2004). Similarly, the EU Forest Action Plan (EC 2013) and Leader program acknowledged cultural landscapes, traditional practices and other cultural values of forests, as some of the ways of achieving local and regional sustainable development (ENRD 2014). Such landscape values are also included in the new Common Agricultural Policy (CAP), and the European Landscape Convention (CE 2000). Cultural landscapes have thus been recognized as important and are promoted at multiple levels from local to global (e.g., CE 2000, MCPFE 2003, CAB 2005, 2006, SEPA 2006).

However, European directives and policies have also directly or indirectly affected cultural landscapes negatively (Prieto Guijarro and Martin Montero 1994, Bergmeier et al. 2010). The implementation of the Common Agricultural Policy (CAP) aimed to enhance agricultural productivity, efficiency and competitiveness, has in many cases resulted in abandonment or transformation of cultural landscapes towards intensive and simplified production systems

(Plieninger 2006a, McAdam et al. 2009, Bugalho et al. 2011). Negative effects on biodiversity and ES have been documented (Plieninger and Wilbrand 2001, De Aranzabal et al. 2008, Bugalho et al. 2011, Costa et al. 2011). Similarly, negative consequences on human well-being can also be directly assumed to changes in ecosystems (MA 2005, Haines-Young and Potschin 2010). Conventional approaches to land management including agriculture and forest management are often characterized by a predominant bias towards the provision of ES with market values (MA 2005, McAdam et al. 2009, Hasund et al. 2011), whereas other benefits delivered by cultural landscapes but with no market prices, i.e. public goods, are usually not considered (Hasund et al. 2011). By contrast, numerous research and policy documents have pointed out the need for a balanced development approach including all sustainability dimensions, landscapes' material and immaterial values, and the full range of ES to accommodate economic development and human well-being (de Groot et al. 2010, de Jonge et al. 2012, OECD 2012, UNEP 2014). Thus, it is important to understand diverse ES provided by cultural landscapes in order to maintain economic, ecological, social and cultural functions of these integrated socio-ecological systems, similar to landscapes as space and place (Hunziker et al. 2007).

Conceptually a landscape can be seen as a geographical unit that offers a sense of place to actors and represents a wide range of dimensions including biophysical, socio-cultural and perceived dimensions (Antrop 2006). Natural components of the landscape include habitats, species, and ES, while social components include cultural legacies, heritage, and people who interact in space and time with natural components. The landscape as a social-ecological system reflects the need to expand the spatial scale of management, moving from smaller units or objects to the magnitude of landscapes and regions. Additionally, all social organisational scales must be considered, from local to regional and national levels (Elbakidze and Angelstam 2007). In this thesis landscapes are understood as socio-ecological systems (Folke et al. 2005) or coupled human and natural systems (Chan et al. 2006). Humans have intensively interacted with natural systems, and thus to understand the complex human-nature interaction in space and time, interdisciplinary research is needed (Liu et al. 2007, Chan et al. 2012b, Daniel et al. 2012, Klain and Chan 2012, Hernández-Morcillo et al. 2013, Satterfield et al. 2013). Folke et al. (2005) stressed that addressing only the social dimension of resource management without an understanding of resource and ecosystem dynamics will not be sufficient to guide society toward sustainability. Thus, both the social and ecological systems, as well as their interactions, must be included in research. As a consequence social-ecological systems (e.g., Folke et al. 2005)

or landscapes need to be studied using multiple approaches, including both quantitave and qualitative methods (Daniel et al. 2012, Chan et al. 2012a,b). However, it is challenging to understand this complexity for several reasons that include but are not limited to different traditions among academic disciplines (Tress et al. 2006, Angelstam et al. 2013a), difficulties to fund research that bridges disciplines (Angelstam et al. 2013a) as well as limited mutual understanding of researchers' and practitioners' conditions (Wickson et al. 2006).

2.2 Green Infrastructure: a new policy term not concept

The Green Infrastructure concept (GI) emerged in the XIX century both in UK, and North America (Benedict and McMahon 2002). More recently, during the 70s, in both countries two major literature contributions where published in the context of landscape planning (Kambites and Owen 2006), linking green space benefits to people, as well as preserving natural areas for biodiversity conservation by reducing habitat fragmentation (Benedict and McMahon 2002). The terms green space, green ways, and green networks are commonly used as synonyms of GI (Moseley et al. 2013).

In Europe, GI development has been applied in the context of urban planning to effectively integrate green spaces among high populated areas (Beatley 2009). GI definitions are diverse (Cameron et al. 2012, Roe and Mell 2012) and have emerged in parallel with the context they were developed (Wright 2011). Thus, conceptually GI is not novel, but newly captured in the European Union political agenda. To tackle the increasing loss and fragmentation of forest habitats and urban green space, it is necessary to protect, manage and restore habitats and green space for wildlife and ES important for human health and well-being (Rockstrom et al. 2009, Nilsson et al. 2011). Thus, to communicate this need for improved biodiversity conservation and provisioning of ES toward ecological sustainability, the concept green infrastructure has emerged at EU and Swedish policy levels (Anon. 2009, EC. 2013). It is defined in this context as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services". GIs are considered especially important in urban environments where 60% of the European population lives (EC. 2013). The many benefits that GI and natural environments deliver are commonly referred to as ES. The importance of promoting GI in areas such as agriculture, forestry, nature, water, marine and fisheries, transport, energy, and disaster prevention has recently been emphasized in the political agenda (EC. 2013). Additionally, it also plays a

significant role as tool for implementation of environmental EU directives, such as the water framework and the habitats and birds directives (Lucius et al. 2011).

According to Kambites and Owen (2006) the process of GI planning should be: holistic, strategic, inclusive, and qualitative to include biodiversity values, water quality and human satisfaction. Moreover it has the potential to foster (1) biodiversity loss by increasing connectivity between existing natural areas and increasing their ecological coherence, (2) to strength ecosystems functionality for delivering goods and services, (3) to increase the resilience of ecosystems by improving their functional and spatial connectivity, (4) to promote integrated spatial planning by identifying multi-functional zones or by incorporating habitat restoration measures and other connectivity elements into various land-use plans and policies, (5) to contribute to developing a greener and more sustainable economy by investing in ES services instead of purely technical solutions, and mitigating adverse effects of transport and energy infrastructure, and (6) to reconstruct or adjust existing or planned infrastructures to mitigate barrier effects and create ecological corridors (Lucius et al. 2011).

In this thesis we understand GI as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services", for which their many benefits to humans are commonly referred to as ES.

2.3 Ecosystem Services and Human Well-Being

The term "ecosystem services" was first coined by Ehrlich and Ehrlich (1981), to merge the value of nature and ecosystems for humans, and its importance for well-being. Several disciplines greatly contributed to stress societal dependence on ecosystems, traditionally enrooted to economic (recognizing only the value in use; see for review, Gómez-Baggethun et al. 2010), ecological (Braat and de Groot 2012), and social sciences (Albrecht et al. 1982, Fransson and Gärling 1999, Mascia et al. 2003). Although, the term "ecosystem services" was original, the concept has existed since the origins of human civilization, citing the classic Easter Island society for instance (Fisher et al. 2009). The significance of the concept was also recently acknowledged at international level through the publication of the Millennium Ecosystem Assessment (MA 2005), followed by the Economics of Ecosystems and Biodiversity (TEEB 2010). The mentioned events have fostered the inclusion of ES assessment into the political agenda, and helped to understand the importance of ecosystems and biodiversity for human well-being. This also

fostered the rapid and exponential development of ecological economics, including marketed valuation methodologies (Costanza et al. 1997, TEEB 2010). Such valuations are still controversial, yet the uncertainties significant and assumptions numerous, provide a minimum value necessary nowadays in decision contexts (Costanza et al. 1997). The most widely used classification is provided by MA (2005), attending at supporting, regulating, provisioning, and cultural services. This classification has also been used in the present study, as it will standardize our results and make them comparable with other studies.

To date, full characterization of cultural services and values of the non-tangible aspects has been neglected both in ES research and valuation techniques due to certain intrinsic properties of such services as intangibility and incommensurability. These properties of cultural services together with the difficulty to measure them have led to their exclusion from economic valuation. This calls for the use of multiple methods and approaches, in combination with different disciplines to facilitate and capture the expression of the cultural services at stake (Chan et al. 2012b, Satterfield et al. 2013).

2.4 Cultural Ecosystem Services: Paper I

Cultural ES were firstly defined by Costanza et al. (1997) as "aesthetic, artistic, educational, spiritual and/or scientific values of ecosystems". Later, the Millennium Ecosystem Assessment (MA) expanded the definition including "the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values" (MA 2005). While originally defined by Costanza et al. (1997) as values, the MA enunciate them as benefits people obtain from ecosystems. Therefore, to clarify the concept, Chan et al. (2012b) suggested the distinction between services as producers of benefits, which are of value to people, strengthening the differences among services, benefits and values . Consequently, they re-defined cultural ES as "ecosystems' contribution to the nonmaterial benefits (e.g., experiences, capabilities) that people derive from human–ecological relations" (Chan et al. 2012b). Cultural ES categories have experienced a significant evolution from recreation and culture (Costanza et al. 1997), to the classification proposed by the Millennium Ecosystem Assessment (MA 2005). The latter includes Spiritual and religious, recreation and ecotourism, aesthetic, inspirational, sense of place, cultural heritage and, educational services. However similar classifications also occurred such as the one proposed by Chan et al. (2012a) who define the following types of nonuse and/or cultural services-cum-values as: spiritual, educational, place, identity,

artistic, intergenerational and recreational value. According to several scholars a distinction has to be made among benefits, services and values, in order to facilitate ES assessments, in particular to address cultural aspects in ES contexts (Haines-Young and Potschin 2010, Chan et al. 2012b). These could potentially also alter future classification frameworks from which services are considered as benefit suppliers which are of value to people. As will be presented in the following sections, cultural ES are context dependent and thus to identify the set of important services and values requires preliminary surveys involving relevant stakeholders and appropriate methodologies.

The adopted focus on economic valuation of ES, has render efforts to characterize the cultural aspects due to the especial difficulty represented by intangible aspects (Chan et al. 2012a,b, Daniel et al. 2012, Satterfield et al. 2013). Spiritual, inspirational and place values are not related nor produce by a single kind of experience, therefore valuation methodologies should adapt to account for multiple benefits and their interdependencies (Raudsepp-Hearne et al. 2010, Chan et al. 2012a, Chan et al. 2012b, Daniel et al. 2012, Satterfield et al. 2013). To successfully address all important values for people, ES research must use other social-science methods and tools than mere economic approaches (Chan et al. 2012a, Chan et al. 2012b, Daniel et al. 2012). In valuation contexts, principles and virtues should also be taken into account to avoid valuation based on a distorted conceptual reality ignoring what people care about. To address the inclusion of cultural services in ES research, inter/transdisciplinary approaches should be adopted to create common grounds for understanding (Chan et al. 2012b, Daniel et al. 2012, Klain and Chan 2012, Hernández-Morcillo et al. 2013, Satterfield et al. 2013). Cultural services are directly experienced and intuitively appreciated by people (Daniel et al. 2012), and therefore they are motivations for owning, managing and conserving the land (Chan et al. 2012a). They are also perceived in bundles and could thus foster the orientation of ES management towards multi-functionality or multi-purpose management (Plieninger et al. 2012).

The number of published peer-reviewed journal articles on cultural ES has grown exponentially since the publication of the Millennium Ecosystem Assessment (MA 2005), therefore that date was considered as starting point for retrieving cultural ES research articles. To demonstrate the global increasing research interest in cultural ES, the cumulative number of peer-reviewed articles from 2005 to 2013 (103 peer-reviewed articles) has been graphically represented by using the leading author's affiliation as proxy of country (Figure 1). After reviewing definitions, classifications, identification and mapping, as well as the different methods and tools to quantify cultural ES, I focused on the diagnosis of the case study (the cultural oak landscape), its uses

and the perception by different stakeholder categories of the delivered ES (Paper II).

In this study cultural ES are defined as "the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values" (MA 2005). Based on the analysis of peer-reviewed journal articles, I used the following approaches:

1. To combine the use of quantitative and qualitative research methods for deepen understanding of the case study, the cultural oak landscape; best represented geographically within the limits of Östergötland's County (Flyvbjerg 2011, Chan et al. 2012a,b, Daniel et al. 2012, Satterfield et al. 2013).
2. To identify which services matter to people, stakeholder involvement have been suggested (Chan et al. 2012a,b, Klain and Chan 2012, Daniel et al. 2012, Plieninger et al. 2013, Satterfield et al. 2013).
3. To capture in full ES, and specially to characterize the poorly represented cultural aspects, open-ended or semi-structured interviews with stakeholders have been suggested (Chan et al 2012a, Klain and Chan 2012, Satterfield et al. 2013).
4. Participatory mapping tools are essential to capture the intangible aspects of ES, to allow for a better understanding of spatio-temporal dynamics, as well as enable their comparison in relative importance scale (Brown 2005, Fagerholm et al. 2012, van Berkel and Verburg 2012, Plieninger et al. 2013). Several techniques have been proposed to represent landscape values spatially using interviews with stakeholders to delineate sites on the map using pencils or markers (Fagerholm et al. 2012, Klain and Chan 2012), the use of color sticker dots to locate sites (Brown 2005, Raymond et al. 2009), or to pre-identify and number special sites on the map and to include them into a questionnaire (Tyrväinen et al. 2007). Here we used the method proposed by Fagerholm et al. (2012) and Klain and Chan (2012) (see participatory mapping of ES section).

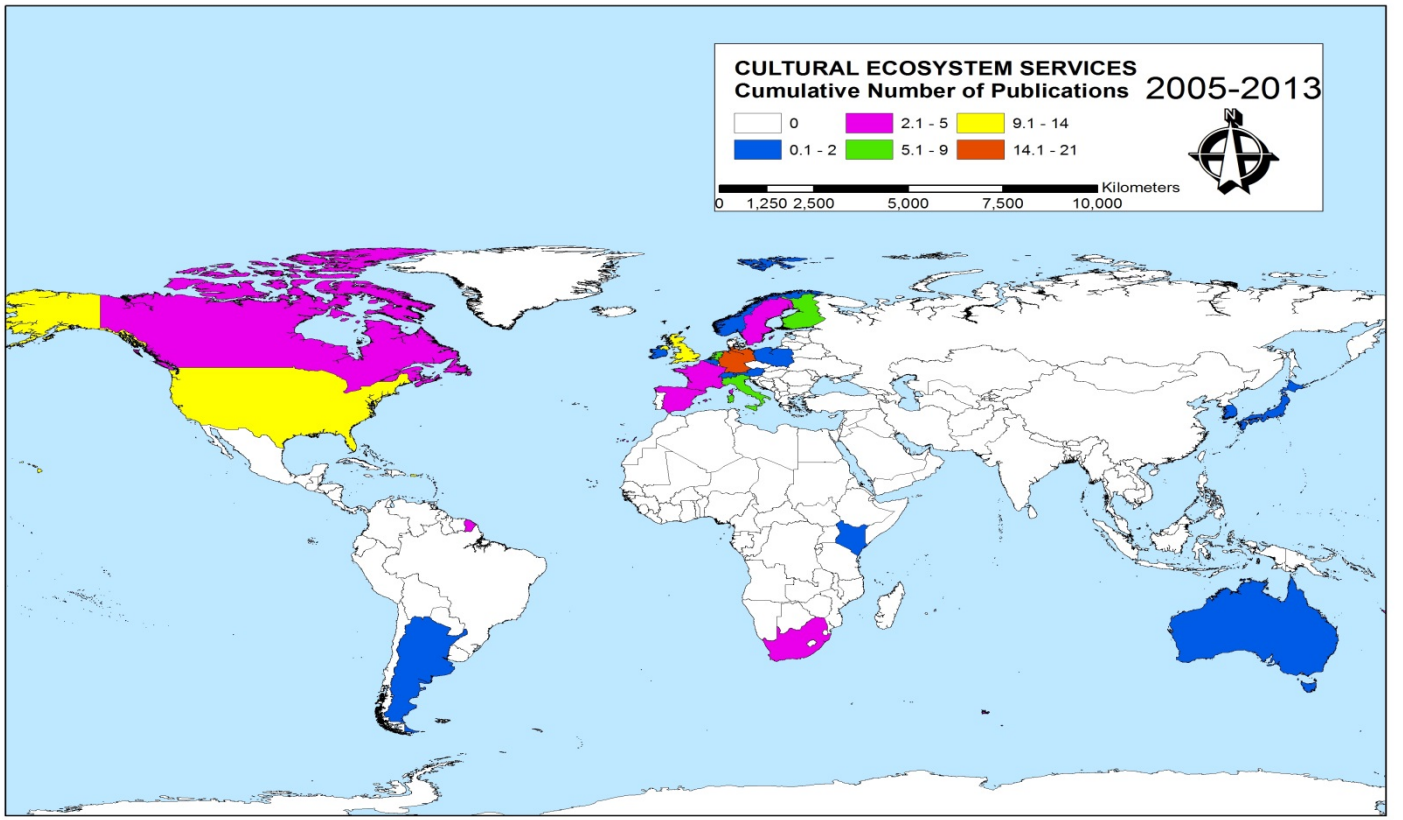

Figure 1. Cumulative number of publications retrieved from the studied period using the term "cultural ecosystem services"; leading author institution extracted in an ad hoc process, as proxy of the country. Note that 2013 is also utilized for computation although data correspond with the first two months of the year.

3 Methodological Framework

3.1 Case Study Approach

According to Merriam-Webster's dictionary (2009) a case study is defined as "an intensive analysis of an individual unit (as a person or community) stressing developmental factors in relation to environment". In this line, Bryman (2008) pointed out that it is a research design, whereas other definitions from the plethora of instances are misleading and has been applied for decades (see also Gerring 2004, Flyvbjerg 2011). Case study research has been utilized as long as recorded history and today accounts for a great number of scholarly works in human and natural sciences. Paradoxically, while case study research is largely used, it is still considered in low regard as a research method in academia (Flyvbjerg 2011).

The critical factor is to define the individual unit of study and its boundaries (Bryman 2008, Flyvbjerg 2011). In this study, I focused on an intensive analysis of an individual unit, the best representation of cultural oak landscapes occurred in Sweden was considered as the case, including both social and ecological aspects. Thus, boundaries of the case were defined by its geographical extension, which coincided with the administrative division of the County of Östergötland. So what is important is not the selection of the method to use, but rather to define what is to be studied. Then the case or individual unit could be analyzed either by quantitative or qualitative methods, both in parallel or any other appropriate to best fit the question at hand. The definition of the boundaries is intrinsically related to what will count as case or count as context otherwise (Table 1). Thus, when the goal is to obtain the maximum amount of information from a problem, a representative case or a random sample might not be the best strategy. This is due to average cases are usually not the richest in information (Flyvbjerg 2011). An extreme case instead, might reveal more information and thus be best suited (Table 1).

Table 1. *Strategies for the selection of samples and cases. From Flyvbjerg (2011).*

Type of selection	***Purpose***
A. Random selection	To avoid systematic biases in the sample. The sample's size is decisive for generalization.
1. Random sample	To achieve a representative sample that allows for generalization for the entire population.
2. Stratified sample	To generalize for especially selected subgroups within the population.
B. Information-oriented selection	To maximize the utility of information from small samples and single cases. Cases are selected on the basis of expectations about their information content.
1. Extreme/deviant cases	To obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense. To understand the limits of existing theories and to develop new concepts, variables, and theories that are able to account for deviant cases.
2. Maximum variation cases	To obtain information about the significance of various circumstances for case process and outcome; e.g., three to four cases that are very different on one dimension: size, form of organization, location, etc…
3. Critical cases	To achieve information that permits logical deductions of the type, "If this is (not) valid for this case, then it applies to all (no) cases."
4. Paradigmatic cases	To develop a metaphor or establish a school for the domain that the case concerns.

Depending on how the case study is chosen, results can also be generalized. This applies both to natural and social sciences (Platt 1992, Ragin and Becker 1992). In any case, the selected research method should be based on the problem under study and its context. Further, case study is very suitable for generalization when using Popper's falsification test, since the observation of a single exception is enough to reject or revise the proposition. Case study approach fits very well in finding "black swans", or deviant cases because of its in depth analysis and thus, stimulate further investigation and theory building (Flyvbjerg 2011). Generalizability can also be enhanced by the strategic choice of cases (see Ragin 1992). Additionally, it is more relevant to figure out the causes behind a given problem and its consequences, than to

describe the symptoms and the frequency of the occurrence. Thus, the use of random samples as representation of a certain reality will rarely elucidate this kind of information and consequently, in some cases will be more appropriate to select few valuable cases for investigation.

The selection of the "case" object of study deserves much more attention, i.e., the research design, and the boundaries and research unit should be much clearly stated. This selection, even in cases when a single unit is analyzed "critical case", is crucial. These type of cases are especially well suited to either falsification of propositions, or verification, from which new paradigms (*sensu* Kuhn) or research eras can start to build upon.

3.2 Qualitative Methods: Snowballing and Semi-structured Interviews

To get a representative sample on the diversity of stakeholders in the study area for the in depth understanding of the studied phenomena (the cultural oak landscape use, perception, and challenges) snowballing and semi-structured interviews were applied (Atkinson and Flint 2004, Bryman 2008, Kvale and Brinkmann 2009). These methods were considered appropriate as highlighted by the literature review on cultural ES (Paper I). The study began through consultations with key experts in the study area and official authorities such as the County Administrative Board, from which key stakeholders and potential initial respondents were identified. Then, snowball sampling was considered appropriate for the respondents' selection process since the majority of the land was privately owned and thus, difficult to obtain respondents' contacts. By applying this method I asked each interviewee to provide an advice on who could be the best to talk to, based on which kind of information was considered relevant to learn more about. In such a way I collected the names and contact information of potential respondents. In other words, the studied object provides the necessary further contacts according to researchers' specifications or requirements (Bryman 2008). Additionally it is also an adequate method when higher levels of trust might be required to initiate the first contact, as it was presumably the case (Atkinson and Flint 2004).

For data collection I utilized face to face semi-structured interviews in order to identify the full range of ES important for different groups of stakeholders (see Paper II). Face-to-face interviewing is considered appropriate where depth of meaning is important and the research is primarily focused in gaining insight and understanding (Gillman 2000, Ritchie and Lewis 2003). By combining closed questionnaire questions and open ended, respondents were free to answer, while certain level of trust was being constructed. The approach gives

to the respondents full freedom for answering the questions, to follow up specific topics when considered and presented by the interviewees, as well as to understand in depth the reality of the cultural oak landscape from the respondents' perspective (Kvale and Brinkmann 2009). Moreover, it was desirable to have face to face meetings to develop the collaborative mapping procedures to delineate their land holdings, to elucidate how they use them and where they obtained certain services, benefits or values on a topographic map.

4 Methods: Paper II

4.1 Study Area

Östergötland County has the largest remnants cultural oak landscapes in Sweden, and was thus selected as case study area (Figure 2). Biological values associated with ancient oaks are high (Ranius et al. 2005, SEPA and NBF 2005, Bergman et al. 2007, Paltto et al. 2010, Paltto et al. 2011), as well as aesthetic and recreational values (Barthel et al. 2005, Schaich et al. 2010, Edwards et al. 2012a, Edwards et al. 2012b). The main land covers of the study area are forest (59%); arable (19%), grazing (4%) and urban lands (4%), as well as exposed bedrock (8%) (Loman 2008). Within the forested land conifers Norway spruce (Picea abies) and Scots pine (Pinus sylvestris) represent 81%, broadleaved 15%, from which oak trees (Quercus robur and Q. petraea) are about 2% at the County level (Loman 2008). Additionally, oaks usually occur in cultural woodlands outside the forest stands (Mikusiński et al. 2003).

Currently remnants of valuable oak habitats cover around 18,000 hectares (CAB 2005, 2006), and are scattered in small patches. These oak patches are open wooded grasslands with pedunculate oak trees (Quercus robur) that occur in different densities (Paltto et al. 2011). Species richness and habitat conservation values reach significant higher levels in these cultural oak landscapes than in neighbouring areas (Manning et al. 2006, Bergman et al. 2007, Paltto et al. 2010, Paltto et al. 2011). For example, a high proportion of red-listed Coleoptera and Lepidoptera, as well as lichen species, are hosted by old oak trees (Bergman et al. 2004, Ranius et al. 2005, Manning et al. 2006, Bergman et al. 2007, Jansson et al. 2008, Paltto et al. 2010, Paltto et al. 2011). In addition, traditional mowed meadows and semi-natural pastures in cultural oak landscapes are the most species-rich habitats in Scandinavia (Svensson 1988), and are very valuable in terms of cultural heritage and recreational

potential (Hasund et al. 2011). However, these habitats and their quality have declined dramatically over time (SBA 2005a, 2005d).

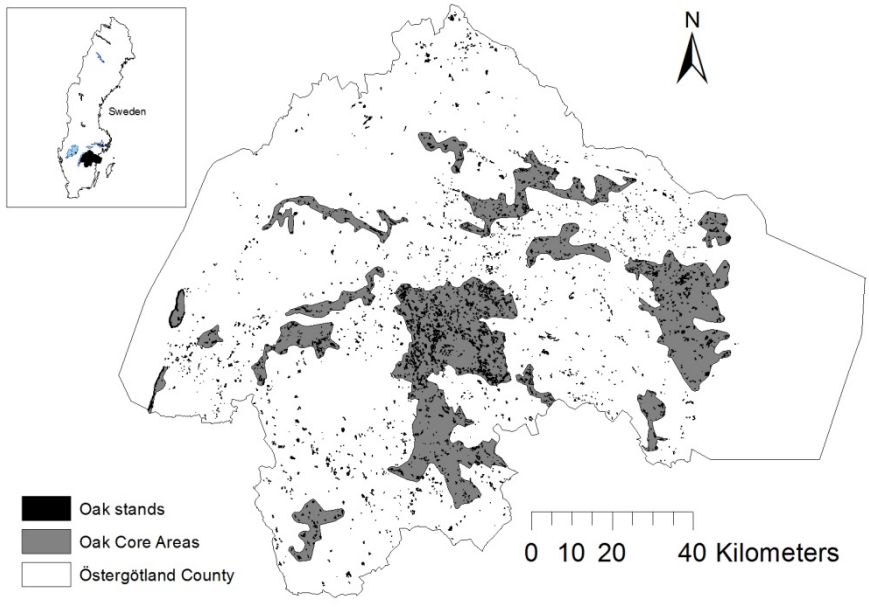

Figure 2. Östergötland County study area and its location in Sweden. High nature value oak stands (black areas) are shown as well as oak core areas for conservation priority (grey areas). Some of these areas still contain patches of former valuable cultural oak landscapes. The represented oak stands are a small proportion of the total oak stands with high natural values (värdekärna), and oak core areas are also denominated high-value tracts (värdetrakt) or oak districts.

In pre-historic times non-anthropogenic factors such as post-glacial climate change exerted a significant reduction of the broad-leaved forest distribution (Lindbladh and Foster 2010). Further, to understand the present occurrence of oak stands with high natural values in Östergötland, it is also important to understand the historical development from the XVIth century (Eliasson and Nilsson 2002). During XVI to XIX centuries, acorns from oak were an important source of fodder for domestic animals, and timber was valuable in the agrarian economy. Simultaneously, oak trees were a strategic resource for warship construction by the Swedish state. Hence, to ensure the provision of oak trees, in 1558 the oak was declared property of the Swedish state by King Gustav Vasa. This decision had adverse consequences for peasants since the use of oaks was no longer allowed. Therefore, oak started to be perceived as an

impediment for agricultural development. As a consequence of this a large proportion of oaks were deliberately damaged. During the XVIIIth and XIXth centuries, this conflict of interests between the state and local farmers created a widespread hatred toward oaks from farmers' side. The described situation lasted until 1830 when royal ownership of oak ceased. A consequence of this was a significant reduction of oak trees due to harvesting by local farmers (see Eliasson and Nilsson 2002). Some of these trees were kept in the landscape, and now are considered as key elements for biodiversity conservation in Europe (Eliasson and Nilsson 2002, Aaron et al. 2005, Bergman et al. 2007, Lindbladh and Foster 2010, Paltto et al. 2010, Paltto et al. 2011). In contrast, nobility could afford to preserve the oaks within their estates. By the XIXth century the oak occurrence had been reduced dramatically to current levels (Eliasson and Nilsson 2002, Lindbladh and Foster 2010).

At present, small oak patches (<100 ha) of high natural values are widespread in Östergötland (Figure 2). Restoration of traditional cultural oak landscape management (i.e. overgrown areas cleared and livestock introduced to keep the areas open through grazing) has been implemented in few areas in order to restore the biodiversity and cultural values associated with former cultural oak landscapes. The County Administrative Board has defined six different valuable oak habitats, including oak wood-pastures and grazed mosaic landscapes (Östergötland CAB 2005) that have to be considered in land management by different stakeholders. Additionally, core areas for oak conservation priority have been defined by the County Administrative Board (CAB 2005) based on the Hermit beetle requirements (Osmoderma eremita) as focal species (Figure 2).

4.2 Stakeholder Mapping

Non-industrial private landowners were the most common stakeholder group with holding sizes from 0.6 to 234.5 ha (Table 2).

Table 2. *Non-industrial private land owners' holding size. Areal units are expressed in hectares. Data sources obtained from National Land Survey 2013 (Lantmäteriverket 2013), and from the Environmental Protection Agency 2005 referred to last category.*

Holding size	0-10 ha	10-100 ha	100-1000 ha	>1000 ha
Number of Landowners	13378	10008	2498	101
Average size (ha)	0.6	34.3	234.5	1966
Total area (ha)	79694	37861	585883	198532

There were also stakeholders responsible for management of municipal and state owned land (SEPA 2005). Other stakeholders involved in governance and management of the studied cultural oak landscape were identified through discussions with experts and official authorities such as the County Administrative Board. The selection of interviewees was done through snowball sampling method (Atkinson and Flint 2004, Bryman 2008). The selection comprised interviewees that covered a wide range of stakeholders, including forest companies, forest owners, nobility estates, environmental NGOs, farmers, hunters and hunting associations, as well as municipal, and regional officials (Table 3).

Table 3. *Number of interviews conducted among the selected stakeholder categories at different levels of governance.*

	Local	**Regional**	**Total**
Civil	Environmental NGOs (1) Swe. Nature conservation association (1)	Swe. Hunting association (1) Swe. Ornithological association (1)	4
Private	Farmers and landowners (8) Others: including oak management expert, and CAP consultant (2) Hunters (1) Ecotourism company (1)	Forest companies (2) Farmers association (1) Tourist guides (1)	16
Public	Municipal officials (5)	Regional officials (3) Regional Swe. Forest agency (1)	9
Total	19	10	**29**

In total, twenty-nine semi-structured interviews (Holme et al. 1997, Kvale and Brinkmann 2009) were conducted with the selected stakeholders during June-September 2013. An interview manual was developed for the purpose, and was first tested during a ten days field-work in a different area. The sample size is in accordance with similar studies (Graves et al. 2009). We began the interviews with a brief introduction about the purpose of the study. Interviewees were then asked about present land use in terms of products, services, and values derived from oak landscapes and their landholdings

accounted for as ES. Each interviewee had a full freedom to think and answer the questions. The interviews lasted from approximately 37 to 125 minutes, and were taken in both Swedish and English, to maximize information inputs according to the interviewee preferences and/or language level. All interviews were digitally recorded and fully transcribed. The interviews were analyzed using qualitative content analysis (Bryman 2008). The themes that emerged during the analysis were coded and grouped into main categories (e.g., particular landscape goods, services and values, expressed as ES, as perceived by the different groups of stakeholders etc.). To identify how ES had been addressed in the interviews we applied the Ecosystem Service Coding Protocol (CP) proposed by Wilkinson et al. (2013) which allowed for consistence of coding among all analyzed interviews. The CP included four categories of ES: supporting (coded A), provisioning (B), regulating (C) and cultural services (D) (MA 2005). Additionally, each category contained a number of ES (Table 6). In addition to the ES that were included in the CP, we incorporated a number of additional ES' categories (e.g., biodiversity including species, habitats and ecosystem processes; Noss 1990) to increase the resolution on specific services of interest from the oak landscape (see Table 6). Identified ES as perceived by the informants were then compared among different groups of stakeholders.

All selected interviewees involved with the use, management, or governance of the studied oak landscape were grouped according to two variables (Elbakidze et al. 2010). First, we defined three groups of stakeholders according to the sector that they represented, i.e., (i) the civil sector, including non-governmental organizations and civil associations, (ii) the private sector, comprising businesses controlled or owned by private individuals, and (iii) the public sector, which was represented by officials handling public interests through governmental agencies and local government units. Second, all interviewees were classified into two groups according to their level of activity: stakeholders from local and operational (e.g., local land owners or farmers), and regional (e.g., counties or governmental organizations on the level of counties) levels (Table 3).

4.3 Participatory Mapping of Ecosystem Services

Several approaches have been discussed to map and delineate the specific areas used by stakeholder categories associated to a certain landscape good, service, or value (Brown 2005, Tyrväinen et al. 2007, Raymond et al. 2009, Plieninger et al. 2013) (see Paper I). Being inspired by Fagerholm et al. (2012) and (Klain and Chan 2012), each interviewee was asked to delineate on a topographic map

the places where he/she had got a certain landscape benefit, service or value, as well as landholding areal extension for farmers and forest owners (see Figure 3).

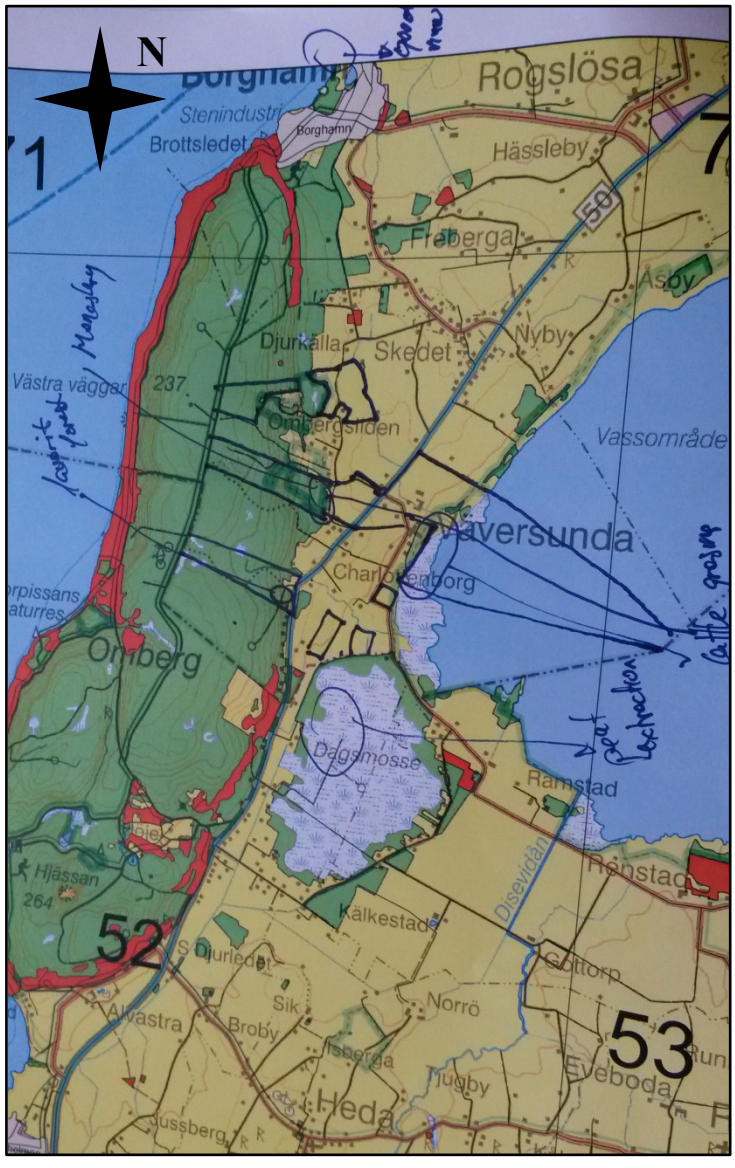

Figure 3. Example of participatory mapping procedure. Green areas represent forest cover, yellow areas agricultural land and, red areas denoted oak habitat occurrence. Interviewees delineated with black polygons their own land, as well as land use, services and values.

The collected data was manually digitalized using GIS techniques and comments and additional information was enclosed as metadata related to each stakeholder.

5 Results

5.1 Perspectives on Ecosystem Services by Local Stakeholders

Provisioning ES were the most important for the private sector, i.e. land owners practicing farming and forestry, whose income depended on the use of the land (Table 3, 4).

Table 4. *Ecosystem services perceived from cultural oak landscapes by the different stakeholders belonging to civil, private and public sector at local level. To enhance clarity the conceptual content of the interviews was approximate to specific key-words.*

Sectors	Ecosystem services			
	Provisioning	Regulating	Supporting	Cultural
Civil	Guiding tours, landscape beauty, Grazed landscape		Biodiversity, species richness	Recreational values, naturalness, silent, historical remains, cultural remains, landscape beauty, education
Private	Crops, grass, milk, meet, timber, firewood, human food (corn), peat, reed for roofs, eggs, renting houses (economy), game (red deer, roe deer, fallow deer, moose and, wild boar), cattle, sheep, mushrooms, strawberries,		Plant diversity, species richness, endangered species, structure, connectivity	Traditional farming, recreation, knowledge of nature, aesthetic values, identity, accessibility, historical remains, inspiration, noiseless, cultural traditional management, landscape beauty, believes, oak

	raspberries and cherries, blueberries, pike, perch and crayfish			silviculture tradition, traditional management of cultural oak landscape (cattle grazing), memories, historical buildings, culture, swimming, fishing, traditional knowledge, cultural management of trees and pastures, traditional tools
Public	Multipurpose management, cattle meat and grazing, timber and wood products,	Phosphorous and nitrogen alleviation by restoring wetlands, nutrient cycling, water cycling	Biodiversity, species and habitats, biodiversity restoration, management for biodiversity, species richness (animals and plants), endangered species, structure, connectivity	Recreation, traditional management, human original landscape (identity), landscape beauty, therapeutic, social purposes, education, accessibility, cultural remains, historical remains, life quality

These services were associated to multi-purpose land management performed by combining in different proportions agriculture, including crop and livestock production, and silviculture. The diversity of products derived from agriculture varied among stakeholders. For example, the variety of cultivated species included wheat (Triticum spp.), oat (Avena sativa), barley (Hordeum vulgare), rye (Secale cereale), flax (Linum usitatissimum), rapeseed (Brassica napus), broad bean (Vicia faba), maize (Zea mays), and peas (Pisum sativum). Crop production was characterized by a four to five year rotation period, and was oriented both to animal and human consumption. As a local farmer explained: "During two years we grow grass for animals and winter wheat, the third year we grow maize, and the fourth either oat or barley. We also have 30 hectares of natural grazing land in the oak pastures for the cows". The application of traditional knowledge was also evident concerning plant suitability based on

soil characteristics, as well as among the beneficial effect of specific plant species rotation. For example one responded commented: “Over time you learn what grows best where. Winter wheat is cultivated when clay in the soil is over 60%, while maize needs lighter soils, with equal proportions of sand and clay”. Crops, meat and pastures were also important for the private sector at local level (Table 4, 6).

Table 6. *Ecosystem services mentioned by interviewees at local and regional level. Integers represent number of interviewees who mentioned such service or value. Adapted from Wilkinson et al. (2013).*

A. Supporting Services	Local	Regional	B. Provisioning Services	Local	Regional
A1. Water cycling	0	0	B1. Food Agriculture		
A2. Soil formation	0	0	B1a. Crops	8	0
A3. Nutrient cycling	1	0	B1b. Pastures	10	3
A4. Primary production	0	0	B1c. Fodder	6	0
A5.Photosynthesis	0	0	B1d. Meat	10	3
A6. Biodiversity			B1e. Milk	3	2
A6a. Species	10	9	B2. Food wild		
A6b. Structure	2	4	B2a. Wild game	4	1
A6c. Function	5	4	B2b. Berries and mushrooms	1	0
			B2c. Fish and crayfish	4	0
			B2d. Other	4	0
			B3. Fresh water	0	0
			B4. Water-energy	0	0
			B5. Water-transportation	0	0
			B6. Biochemicals/genetic resource	0	0
			B7. Fiber		
			B7a. Timber	8	3
			B7b. Wood	3	0
			B7c. Other	1	0
			B8. Fuel		
			B8a. Firewood	2	0
			B8b. Charcoal	0	0
			B8c. Peat/soil energy	1	0
			B8d. Other	2	0
Total-Supporting	18	17	*Total-Provisioning*	67	12

C. Regulating Services	D. Cultural Services

C1. Climate regulation	0	0	D1. Social relations	3	1
C2. Air quality regulation	0	0	D2. Cultural landscape	11	3
C3. Water regulation and purification	1	0	D3. Heritage	6	0
C4. Disease and pest regulation	0	0	D4. Historical remains	4	3
C5. Natural hazard regulation	0	0	D5. Sense of place	4	0
C6. Erosion regulation	0	0	D6. Aesthetic	5	3
C7. Pollination	0	0	D7. Landscape beauty	13	7
C8. Seed dispersal	0	0	D8. Inspirational	2	0
C9. Noise regulation	2	0	D9. Recreation and eco-tourism	13	8
			D10. Education and Knowledge	7	5
			D11. Well-being and health	7	2
			D12. Human original landscape	1	1
			D13. Spiritual and Religious values	1	0
Total-Regulating	3	0	*Total-Cultural*	77	33

Predominantly, farmers raised cattle for beef production. Breeding dairy cattle was in clear regression in comparison with the past. Other products such as eggs and lamb were also produced. The interviewees highlighted the value of the oak woodlands' meadows for all farmers and cattle holders as spring-summer grazing grounds. All landowners and a hunter emphasized the importance of game (wild animal species for hunting), fish (pike and perch) and crayfish for own consumption and as an additional income. However, none of the latter activities were significant for their livelihoods any longer. Coniferous forests and plantations on former agricultural land were a source of timber through commercial forestry, but not represented a significant income. Local stakeholders obtained firewood from oak for own consumption and some of them also produced oak timber within the cultural oak landscape (Table 4, 6). Commercial oak forestry was possible only for stakeholders who owned large mature oak stands (over 120 years). One interviewee, an 88-year old farmer, explained the local use of oak wood: "We get oak wood from the forest to make fences. We don't like using the chemically treated fence posts from spruce wood. The birds won't sit on it, it's some poison in it". Another respondent explained why he performed oak forestry as follows: "I have a lot of oak in my property. It is because my grandfather's grandmother took the decision in 1870 to save all old oak trees here. And my grandfather also started with oak silviculture". For an Ecotourism company, however, the provision of

mushrooms and wild berries was important in developing traditional cooking workshops, and timber for traditional house building.

Cultural ES were the most important for stakeholders from the civil and public sectors at the local level (Figure 4).

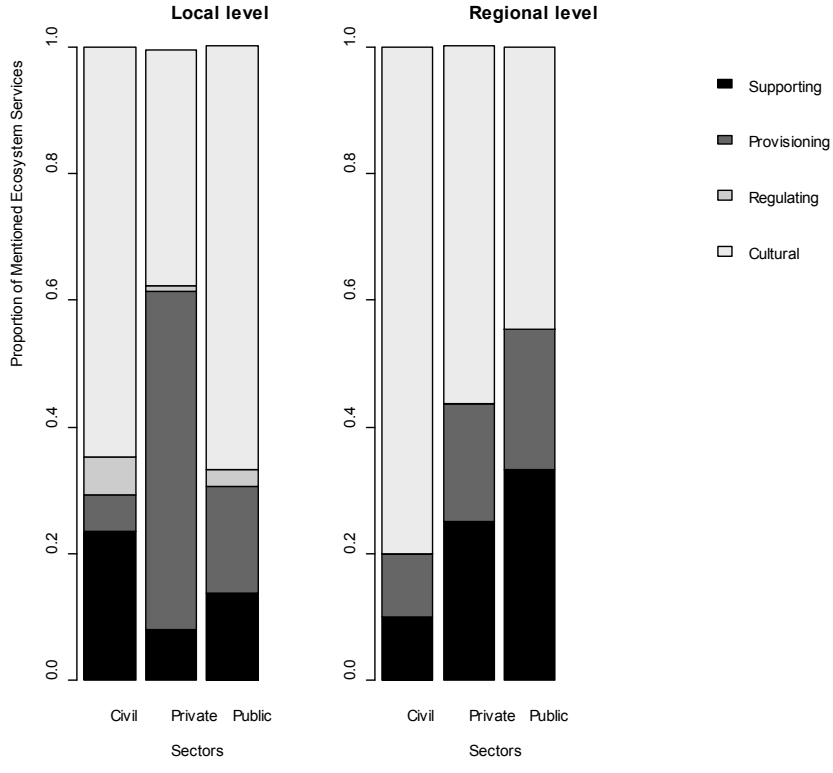

Figure 4. Proportion of mentioned Ecosystem Services by stakeholders at local and regional levels.

These stakeholders (see Table 3) highlighted the importance of landscape beauty; recreational, aesthetic, educational and therapeutic values of oak landscapes (Table 4). Identity related to the landscape where human originated was also mentioned. One respondent, a municipal official, commented: "I think this is the landscape where we as humans are closely connected to. Africans visiting the oak landscape said that it was the first time in Sweden they felt like being at home". In relation to therapeutic services as well as aesthetic values the same respondent mentioned, "A lot of people are stressed by their work. They need this kind of landscapes to restore their batteries and calm down from the stress. I enjoy it very much by this grazed land with old trees and a lot of

cattle, and I think a lot of people do the same". A respondent from a local NGO highlighted: "The recreational value of the area is the most important for people. The area is nice, undisturbed by infrastructure, beautiful, silent; only sounds of nature". A local Ecotourism company also acknowledged the importance of recreational values, and traditional knowledge in handcrafting, pruning techniques, and pastoralism. Interviewees representing the public and civil sectors also commented on the importance of accessibility of green space for public use (Table 4). One official from Kinda municipality expressed it by saying: "The oak landscape is very important. Especially it is the outdoor recreational values for citizens, to have this kind of nature where you live, that it is easily accessible". A municipal planner also highlighted the connection between green space quality and accessibility as follows: "It is very important for people that there are attractive green areas close to where they live. We make them accessible in different ways, by building walking and cycle tracks so you can reach them easily and safely as well. All these aspects are always taken into account when planning". The interviewees representing the private sectors associated cultural ES with traditional farming, nature management and bequest values (see Table 4). Farmers and landowners mentioned further the importance of traditional farming, knowledge and legacy for the maintenance of cultural values of the oak landscape. These aspects are well captured in the following claim: "I am the 8th generation in our family who manage this farm. I use the land in the same way it was used fifty years ago. I manage this farm not for getting an income; I do it for the next generation". Local private stakeholders valued also sense of place, inspiration, spiritual and cultural heritage values, while landscape beauty and aesthetical values were neither diminished (Table 4, 6). For instance, one farmer claimed: "In the oak landscape you see that previous generations have worked here and then you get special thoughts that you do not have in the town. Sometimes I take time to walk around and think about such things".

Supporting ES (see Table 4, 6) were considered in terms of biodiversity, and mentioned as an important intrinsic quality of the oak landscape, although the perceived relative importance among sectors and levels of governance varied, as well as the understanding of what biodiversity was. The interviewees that represented civil and public sectors (Table 3) strongly emphasized species richness connected to the cultural oak landscape (mainly to old oaks), and stressed the importance of cattle grazing and multi-purpose land management as processes to maintain an open landscape structure, and thus enhance multiple services and values such as beauty, recreation and identity (Table 6). Nevertheless, local officials claimed that there were not enough farmers to maintain the whole oak landscape with high natural values open by grazing,

and the financial support from the government for landscape restoration in order to restore ES important for multiple stakeholders was not enough to perform this task. Several interviewees mentioned that the EU provided subsidies for organic farming and landscape restoration, although they were not always perceived as subsidies. As one landowner expressed it “I do not say subsidies. I do a lot of work and get money for that, from the rural development program”. Another interviewee, a cattle holder, expressed a different opinion; “The cattle production that we have is directly supported by EU subsidies on natural grazing lands. We make more money from European subsidies than from the organic meat production itself. It is in the EU subsidies where the real money is”. The interviewees from private sector were concerned about biodiversity (species richness) and proud of having endangered species. As one landowner expressed it “If you have oak trees older than 300 years then you have a lot of different species. As you know we have Osmoderma eremita. It is a very endangered species”. Other farmers valued the knowledge that nature provided. One respondent mentioned: “It is knowledge about different plants that has been most important. Yesterday I found 43 different plant species in one m2”. Some stakeholders commented the importance of protecting oak seedlings for the future, whereas others stressed the importance of the creation of different biotopes, pollarding trees, maintenance of varied habitats, and to have a landscape management perspective. Similarly, public officials also focused on increasing biodiversity levels and they considered multi-purpose land management as an approach that maintained simultaneously a wide range of ES, compatible with recreational activities and the preservation of cultural and historical remains. As expressed by one respondent: “The most important is to maintain the biodiversity, it will benefit the recreation potential and highlight the cultural and historical remains”.

Regulating ES were mentioned the least by all respondents, examples being restoration of wetlands for phosphorous and nitrogen alleviation, and noise regulation (Table 4, 6). As an example, a respondent claimed: “We have restored a lot of wetlands in this area, both for biodiversity connected to wetlands, and to help the phosphorous and nitrogen situation”.

5.2 Perspectives on Ecosystem Services by Regional Stakeholders

Provisioning ES were considered important, by the interviewees from private and public sectors (Table 5).

Table 5. *Ecosystem services perceived from cultural oak landscapes by the different stakeholders belonging to civil, private and public sector at regional level. To enhance clarity the conceptual content of the interviews was approximate to specific key-words.*

Sectors	Ecosystem services			
	Provisioning	Regulating	Supporting	Cultural
Civil	Game: red deer, fallow deer, moose, roe deer, wild boar, mallards, Canadian goose, grey goose		Biological diversity, endangered species, mosaic landscape, habitat diversity	Traditional hunting methods, recreation, source of knowledge, experience nature, landscape beauty, accessibility, well-being
Private	Cattle meat and pasture			Landscape beauty, accessibility, recreation, human original landscape, identity
Public	Timber, wood, meat, milk		Biodiversity, species richness, endangered species, habitat structure and connectivity	Recreational values, landscape beauty, diversity, knowledge, cultural-historical remains, knowledge, tourism, identity

The private sector respondents' highlighted the importance of cattle production in connection to grazing regimes and the EU subsidies, whereas the public sector stressed further timber production. One interviewee representing the civil sector mentioned game meat as an important landscape product. The respondent expressed this by saying: "Wild boar is probably the most common game today. Then I think it is fallow deer, then moose, red deer, roe deer…". Accordingly, the interviewees that represented the private sector on regional level emphasized provisioning ES as relevant for landscape management in relation to landscape use and traditional practices, supported by EU financial aids. One respondent claimed: "A lot of grazing animals are populating the landscape. The main benefits for farmers are the high environmental subsidies that one can get for grazing. If you have grazing animals you get high subsidies for the pastures". Further, officials from the public sector explained that currently two thirds of the former cultural landscapes with high natural qualities were overgrown by secondary woodlands and needed restoration. Additionally, some respondents also informed that oak landscapes delivered

forest products, including timber, meat and milk important for local livelihoods (Table 5, 6).

Cultural ES were acknowledged by stakeholders from all sectors at the regional level. They priced the recreational and aesthetic values of the oak landscape. The respondents from the civil sector also pointed out the importance of nature itself as a source of knowledge and the oak landscape's importance for human well-being, as place for recreation and as catalyst for relaxation from urban life (Table 5, 6). One respondent explained: "The allurement is to be outside, getting to know the species that you hunt. The outcome of the hunt is not important, just to go outside, experience nature and to make some efforts. It is just a hobby for most hunters". Accessibility of the oak landscape was also commonly mentioned as an important precondition to enjoy nature. "It is rather easy bird watching in the oak landscape. There are prepared tourists areas, bird watching towers etc.", as one respondent explained. Regarding the recreational values of cultural oak landscapes one respondent from the private sector also stated: "It is extremely important for me to be outdoors, to be in nature. It is almost like the savannah in Africa. That is humanity's cradle. Most people like such landscape and that's why people like this oak landscape". Regional officials highlighted the significance of the cultural-historical remains, as well as educational values and knowledge systems (Table 5, 6). The latter can be exemplified in the following claim: "In this landscape you could arrange guiding for specialists where you show certain species, ecological problems such as extinction debts and so on". Tourism was also considered by regional officials as a potential viable solution to help farmers financially, and therefore maintain the cultural oak landscape in the future, taking into account the current constrains, i.e. lack of farmers and farmland (livestock to graze oak woodlands), and financial limitations. "From a nature management point of view we see this guiding business as a possible source of income from the landscape, but then it's essential that the landowners get a certain percentage of this income", one respondent explained.

Supporting ES were highlighted primarily by the civil and public sectors (Table 5). These services included the mosaic habitat (habitat diversity) of the landscape and red-listed species (Table 5). The respondents from the civil sector stressed the important of the oak landscape for species that were exclusively associated or dependent of this kind of landscapes. For instance, one respondent stated: "For instance, the corncrake (Crex crex) was common in Sweden 100-200 years ago when the farming was different. But now it has decreased dramatically, however, in Östergötland we do have them in the highest densities in the oak landscape". A respondents from the private sector explained that they set-aside forest patches for biodiversity conservation

purposes (at least 5% normally broadleaved species) in the commercially used forests related to forest certification schemes. The state owned forest company Sveaskog did the same, but the percentage of set aside productive land was much higher (aiming at 20%). Regional officials were concerned about the urgent need for restoration of two thirds of the former cultural landscapes with high natural values that currently had been abandoned and overgrown.

Regulating ES were not mentioned by respondents at regional level.

5.3 Hotspot of Ecosystem Services

Our results revealed certain areas in which the interests of different stakeholders in relation to uses, perceived services and values overlapped. As an example I present the Tinnerö natural reserve and Ekopark which is important for many stakeholders and had the highest score of overlapping ES (Figure 5).

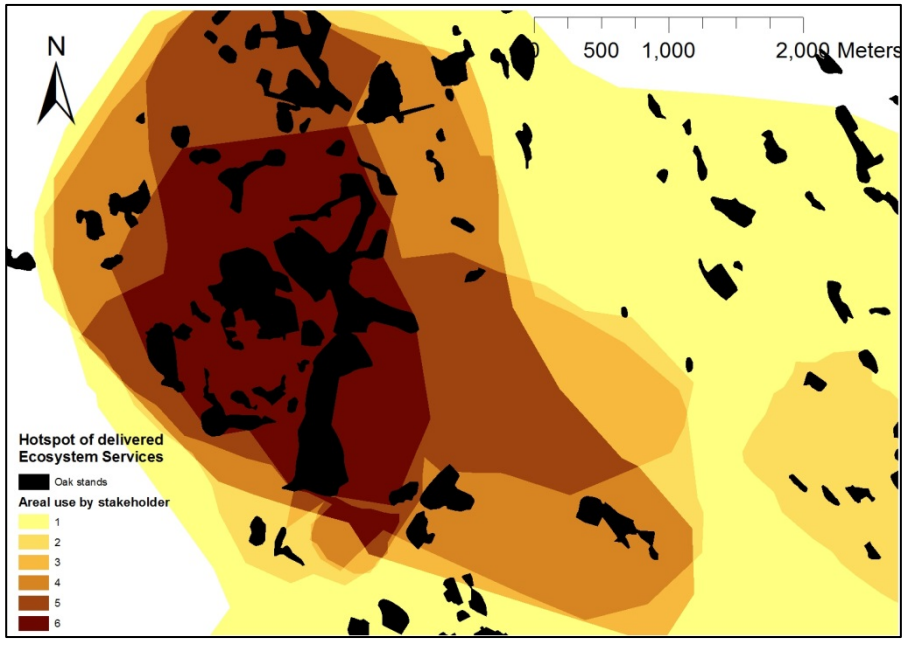

Figure 5. Map of a natural reserve where the different interests from varied stakeholder categories in relation to perceived services, uses and values converged. Yellow symbolizes a single stakeholder use, whereas brown represents the core area utilized by all seven stakeholder categories. Black areas denote the location of oak stands with high nature values. Note: Two areal uses overlapped completely, thus the total number of stakeholders presented equaled six.

Seven different stakeholder categories used this area in order to obtain ES important for their well-being. These included: regional and municipal officials, a tourist company and an environmental NGO, civil associations such as the Swedish Nature Conservation Organization and the Swedish Ornithological Association, and a farmer and cattle holder that graze the oak landscape and produce organic crops and meat (Table 7).

The management and protection of nationally valuable areas is delegated on the regional level to the correspondent County Administrative Board (CAB). In this case the Östergötland CAB has defined sixteen core areas of conservation priority (CAB 2005) based on the Hermit beetle requirements (Osmoderma eremita) as focal species. Tinnerö natural reserve is included in one of these sixteen core areas. Linköping municipality is responsible for the management of the natural reserve, and has actively working to enhance the recreational potential and biodiversity values. The municipal officials have achieved the mentioned goals through the creation of detailed multi-purpose and multi-objective management plans, including oak landscape restoration and traditional management, creation of infrastructures for public use, and wildlife enrichment (e.g., ponds and lakes), as well as restoration and maintenance of cultural-historical remains. The environmental NGO used the area only for bird watching and nature guided walks; and the tourism company organized guided tours about nature, culture, history and military history. Both mentioned the high number of visitors throughout the year ranging from single persons to groups or even school classes. The Swedish Nature Conservation Organization valued the area due to its high biodiversity values and used it for specific seminars and workshop to learn about particular fauna and flora species. The respondent stated: "There are so many endanger species that need oak in the landscape in different types of habitats. We have maybe 50-60% of the endanger species that needs oaks in the landscape. And oak is also very valuable for common species. There are maybe 1500 different species lichens, mosses, fungi, birds, bats who prefer oak. So it places very important role in the southern Swedish ecosystem, both in forest and in more open areas like meadows and pastures". On the other hand, the Swedish Ornithological Association used the oak landscape for bird watching and highlighted the easy accessibility of it and the occurrence of certain species such the corncrake (Crex crex) formerly abundant in agricultural landscapes. Additionally, a farmer and cattle holder was leasing the oak pastures and meadows for their cattle to produce organic meat and crops, and they were also sporadically hired to perform restoration activities, such as selective cuttings and the creation of small lakes for wildlife and recreational activities.

6 Discussion

6.1 The Cultural Oak Landscape in Eyes of Stakeholders

Our results show that the ES provided to stakeholders of the cultural oak landscape varied among all sectors and levels of governance. All groups of stakeholders commonly mentioned biodiversity (i.e. a supporting ES), landscape beauty, recreation and eco-tourism (i.e. cultural ES) as important for human well-being (Table 5, Figure 2). Overall, cultural ES scored the highest both at local and regional levels, as well as among sectors, except for the private sector locally (Table 5, Figure 2). At the local level the importance of provisioning ES (pastures, meat and crops) were the most important for the private sector's stakeholders such as farmers. Regionally, the same pattern has been found in the Mediterranean dehesas of Spain and montados in Portugal, where landowners and farmers prioritized the provisioning functions of the landscape (Plieninger et al. 2004a).

Our results also show that farmers and landowners were proud of having red-listed species and valuable habitats on their land, and thus acknowledged conservation efforts as crucial for the maintenance of biodiversity, facilitated by traditional management regimes, including habitat restoration. The civil sector stakeholders valued more supporting services and social benefits (cultural ES). Moreover, the public sector emphasized equally supporting and provisioning ES, while the cultural were perceived notably more relevant. Regulating services were not highlighted by almost any respondent at any sector or level of governance.

At the regional level cultural ES were more important for civil than for public sectors, while the reverse was true for supporting and provisioning ES (Figure 2). This fact resulted from understanding the need to generate additional income from other activities (such recreation and eco-tourism), because traditional practices alone cannot sustain economically farmers and

landowners and thus functional working cultural landscapes. At the local level, however, this tendency was not observed, and less homogeneity among sectors was detected (Figure 2).

In other European countries, the importance of cultural landscapes has also been recognized and the relevance of traditional practices and delivered services highlighted (Marañón 1988, Kirby et al. 1995, Rackham 2003, Eichhorn et al. 2006, Bergmeier et al. 2010). However, cultural landscapes generally remain only as remnant small patches as for instance in Sweden and in England (Rackham 1998, 2008). This seems to be a general patter for cultural landscapes, and applied also to potential reference systems with a higher level of authenticity, such as dehesa and montado landscapes (Moreno and Pulido 2009). As in Sweden, biodiversity values of cultural landscapes are high and thus foster landscape conservation initiatives in all countries where they occur (Kirby et al. 1995, Moreno and Pulido 2009). However, current threats entail greater uncertainty for the long term survival of such valuable cultural landscapes (Plieninger et al. 2004b, Rackham 2008, Moreno and Pulido 2009, Bergmeier et al. 2010, Bugalho et al. 2011). However, despite uncertainties and limitations faced by different countries (Rackham 2008), with appropriate promotion, support, and extension services, agroforestry systems could be seen as favourable alternative practices as demonstrated by research on farmers perceptions of silvoarable systems in seven European countries (Graves et al. 2009). In Sweden the simultaneous delivery of multiple ES to diverse stakeholders that represent all societal sectors at different levels of governance have been demonstrated. Cultural oak landscapes exert intrinsic features that bind also multiple services, goods and values. Thus, assuming that the composition, structure and functions of cultural oak landscapes as integrated socio-ecological system are the result of traditional land use practices, we consider that desired ES can be only maintained through traditional management regimes (Bugalho et al. 2011).

6.2 How to Maintain the Provision of Ecosystem Services in Cultural Oak Landscapes?

Well-being has many definitions and interpretations. According to the World Health Organization, health and wellness is “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. More recently an index from individual to global well-being has been developed (GHGWI 2014), which includes 5 elements of well-being such as purpose, social, financial, community, and physical aspects. Nevertheless, the influence of natural environments on human well-being is widely

recognized (Kaplan and Kaplan 1989, Ryan and Deci 2001, Logan and Selhub 2012). ES are commonly defined as benefits people obtain from ecosystems (MA 2005), and these benefits contribute to human well-being. Numerous examples on how ecosystems provide essential benefits for human societies and their well-being have been investigated (Butler and Oluoch-Kosura 2006). In cultural landscapes, biological values and the delivery of important ES for humans (e.g., biodiversity, landscape beauty and recreation) are directly related to the occurrence of sustainable traditional management practices (Bugalho et al. 2011). Additionally, an economic valuation study on agricultural landscapes in Sweden performed by Hasund et al. (2011) showed that cultural oak landscapes scored the highest among other agriculture land cover categories, and highlighted further the public's positive attitude and valuation towards their existence. This is also in accordance with our results, in which respondents valued landscape beauty, opportunities for recreation and eco-tourism, and different dimensions of biodiversity the highest among other cultural oak landscape's good, services and values. Furthermore, the majority of respondents had very positive attitude toward the activities closely or directly related to traditional land use practises, or traditional agroforestry, i.e. pastoralism (pastures and cows) and agriculture (cropping).

Our results revealed that well-being is not only related to the biological or aesthetic values of the landscape, nor to its recreational potential alone. Additionally, accessibility of cultural landscapes in order to get desired benefits was highlighted as crucial to foster and guide outdoor recreational activities. We identified three variables affecting provisioning of ES for human well-being: landscape beauty, an infrastructure to facilitate access and use of oak landscapes, and proximity to urban settlements where the main 'consumers' of ES live. Therefore, both the connectivity of areas that deliver important ES is highly important, but also the juxtaposition of oak landscapes as a green infrastructure and human settlements.

Many studies have demonstrated the positive relationship between traditional management and biodiversity in cultural oak landscapes (Plieninger and Wilbrand 2001, De Aranzabal et al. 2008, Bugalho et al. 2011, Costa et al. 2011). Paltto et al. (2011) pointed out negative effects for biodiversity related to the development of secondary woodlands in oak wood pastures due to abandonment of traditional management practices. Lack of management has led to biodiversity losses and subsequent ES reduction needed for human well-being (Raymond et al. 2009, de Groot et al. 2010, Bullock et al. 2011, Fisher et al. 2011, Farley 2012). Hence, in order to maintain a given level of biodiversity and ES important for human well-being, certain level of traditional land management is required (Bugalho et al. 2011).

However, at present deteriorating cultural oak landscapes are common in Östergötland. This is due both to abandonment caused by the absence of domestic grazers (CAB 2005), and to active transformation by Norway spruce plantations (Paltto et al. 2011), as well as changes in landscape matrices (Öckinger et al. 2012). Both processes have negative effects on the richness of specialised species on oak wood pasture habitats (Paltto et al. 2011, Öckinger et al. 2012). According to the respondents, two thirds of the former oak landscapes with high nature values in Östergötland County need to be restored to sustain ES important for humans and biodiversity. This calls for applying landscape restoration initiatives to maintain biodiversity levels in the long term. Wooded grasslands containing old oaks have a higher diversity of saproxylic beetles (Ranius et al. 2005), butterflies (Bergman et al. 2004, Bergman et al. 2007) and lichen species (Paltto et al. 2010). Additionally, the beauty of the cultural oak landscape also attract people to live closer to valuable areas, which promote fragmentation due to urbanization and grey infrastructure development with negative effects for biodiversity (Lättman et al. 2014).

According to regional officials, restoration of oak landscape fragments with high natural values is of limited effect if such values i.e., landscape beauty and open habitat structure promoting higher biodiversity levels, are not maintained in the long term by traditional farming activities especially related to grazing regimes. This highlights the paramount role of farmers and traditional practices to maintain the oak landscape. Our results pointed out that grazing regimes is important to maintain ES of oak pastures, but the generation of substantial income from integrating tourism activities in land management and financial structures to support these activities are becoming increasingly important for stakeholders involved in traditional farming. Tourism and recreation have already been emphasised as an alternative for rural development (van Berkel and Verburg 2011), and enables the generation of an external income and thus promotes the maintenance and preservation of cultural landscapes (Buijs et al. 2006). Hence, holistic landscape planning and management is crucial for integrating both traditional (forestry and agriculture) and emerging sectors' (tourism and outdoor recreation) in cultural oak landscapes (Plieninger 2006b).

Similarly, the long-term maintenance of other European oak landscapes is not secured. According to Plieninger et al. (2004a) the loss of these cultural woodland systems is an effect of urbanisation, rural abandonment and the EU Common Agricultural Policy (CAP). Also Prieto Guijarro and Martin Montero (1994) and Plieninger et al. (2012) indicated negative effects of the CAP on cultural oak landscapes. There is thus a need to reinforce and promote alternative agricultural and non-agricultural economic activities in rural areas

(Fragoso et al. 2011). New functions include leisure and recreation (Pinto-Correia 2000, García Pérez 2002, Surová and Pinto-Correia 2009). Indeed, Gaspar et al. (2009) showed that mixed livestock dehesa farms, i.e. the closest to the traditional systems with a highly diverse production, made optimal use of resources, and had little dependence on external subsidies. The Portuguese montado system is also severely threatened, and there is an urgent need to integrate policy goals and tools as well as collaboration with land managers to strengthen the multi-functional character of the system (Pinto-Correia and Godinho 2013). The maintenance of the Iberian cultural systems by management is thus a good example of how traditional practices need to give a way to diversity of forest and woodland management regimes that take into account goods, services and landscape values (Linares 2007). However, Pinto-Correia (2000) and Plieninger et al. (2004a) pointed out that this requires a holistic landscape approach including conservation incentive schemes, environmental education, and technical assistance.

6.3 Does the Oak Landscape function as a Green Infrastructure for Human Well-Being?

GI is defined as "a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services" (EC. 2013). The many benefits GI and natural capital deliver are commonly referred to as ES. Our results revealed a wide range of ES delivered by the cultural oak landscape at multiple spatial scales for a diverse group of stakeholders (see example, Figure 5). However, for some stakeholders the cultural oak landscape is a source of disservices. For instance, for landholdings focused on agriculture production, oak trees could be seen as an impediment to perform current modern agricultural practices.

Accessibility, proximity and a minimal infrastructure to convey public use to valuable areas that provide desired ES have been identified as essential factors to derive those ES and subsequent benefits. Private ownership on land might potentially be a major factor that limits accessibility of cultural oak landscapes for diverse groups of stakeholders and general public. Thus, compensation strategies and agreements with private landowners might be prioritized for the common good and access to those high quality oak areas. In Sweden this factor might be of lesser importance compared to other European countries due to the right of public access (Allemasrätt). The production of ES does not result in a direct increase of well-being. Consequently questions of access (Ribot and Peluso 2003), distribution and personal circumstances affects the transformation of ES into ecosystem benefits (Daw et al. 2011), and thus to

consider these differences is crucial to understand the mechanisms that regulate access to ecosystem benefits (Berbés-Blázquez 2012).

My study also shows that in order to sustain a provision of multiple ES, oak landscapes have to be maintained through traditional land use (Bugalho et al. 2011). This can be challenging in privately owned lands due to the scarce economic profitability of such traditional practices, for which subsidies from the CAP oriented to palliate the productivity losses are fundamental.

In this study, certain places deliver multiple ES to multiple stakeholders (see as example, Figure 5). Such areas could function as GI for human well-being, based on the convergence of varied users' interests at the same landscape unit (Figure 5, and Table 7).

Table 7. *Ecosystem services perceived by stakeholders from civil, private and public sectors at local and regional levels. To enhance clarity the conceptual content of the interviews was approximate to specific key-words.*

Local level	Sector	Provisioning	Regulating	Supporting	Cultural
Environmental NGO	Civil	Guiding tours, landscape beauty free			Recreational values, naturalness, silent, only sounds of nature, historical remains, cultural remains
Swedish Nature Conservation Association	Civil	Grazed landscape		Species rich flora	Landscape beauty, education, recreational values
Farmer/cattleholder	Private	Grazing, crop production, meet production, wood production, firewood, hunting		Landscape restoration	Hunting activities, landscape beauty
Municipal Ecologist	Public	Multipurpose management, cattle grazing, timber and wood products	Phosphorous and nitrogen alleviation by restoring wetlands	Nature conservation management, habitat restoration, biodiversity	Recreation, bird watching, traditional management, human original landscape, landscape

				beauty, therapeutic
Regional level				
Swedish ornithological association	Civil		Biological diversity, red list fauna, mosaic landscape, habitat diversity	Recreation, landscape beauty, accessibility
Tourist company	Private		Biological diversity, Bird species	Landscape beauty, accessible, recreation, human original landscape, identity
CAB	Public	Timber, wood, meat, milk	Biodiversity	Recreation, beauty, diversity, knowledge, cultural-historical remains

The studied oak landscape serves as functional GI for biodiversity conservation. This was clearly stated by a respondent as: "There are so many endanger species that need oak in the landscape in different types of habitats. We have maybe 50-60% of the endangered species that needs oaks in the landscape. There are maybe 1500 different species lichens, mosses, fungi, birds, bats who prefer oak. So it places very important role in the south Swedish ecosystem, both in forest and in more open areas like meadows and pastures". At the same time, biodiversity in terms of species, habitats and processes of cultural oak landscape associated with traditional land use create a foundation for landscape beauty and recreational values that are important for human well-being. Thus, the cultural landscape functions as GI for human well-being locally, as expressed by many interviewed stakeholders. Two claims can exemplify this: "A lot of people are stressed by their work. They need this kind of landscapes to restore their batteries and calm down from the stress" and "The recreational value of the area is the most important for people. The area is nice, undisturbed by infrastructure, beautiful, silent; only sounds of nature". However, at this stage it is hard to assess whether the cultural oak landscape functions as GI for human well-being at regional scale (Östergötland

County). In order to elucidate the latter, research in Östergötland County on stakeholder preferences, travel cost methodologies or willingness to pay approaches should be performed through random sampling to achieve a representative sample that allows for generalization for the entire case study. In conclusion, the oak landscape in Östergötland have the potential to function as GI for humans and their well-being due to the occurrence of areas of sufficient quality, but further research is needed to demonstrate whether they could regionally function as such, or how much and where areas that deliver multiple ES at multiple spatial scales might be required or needed.

6.4 Comparative Studies of Oak Landscapes

Pan-European cultural landscapes includes the full range of states in the transition from authentic to degraded landscapes, as well as different governance arrangements, and therefore can provide opportunity for knowledge production and learning among countries, regions and places (Angelstam 2006, Angelstam et al. 2013b). Hence, comparative studies of woodland landscapes with different histories and legacies, from remnant (or degraded) to reference systems, can provide valuable knowledge and perspectives (Angelstam et al. 2011) for the long term maintenance and sustainable management by bridging divides knowledge gaps, and thus foster mutual learning (ESF 2010, Angelstam et al. 2011). Comparisons of cultural oak woodlands in for example Sweden, with the reference oak woodland landscape in other parts of Europe, e.g., the dehesa and montado systems, can provide important insights. Dehesa and montado systems on the Iberian peninsula have been traditionally managed till recent times (Acosta Naranjo 2002, Plieninger 2006b), and thus provide opportunities for learning and implementation of that knowledge in other agroforestry systems such as the oak landscape in Sweden. This knowledge production for sustainable landscapes as social-ecological systems (Joffre et al. 1999, Antrop 2005, 2006) should then focuses on both the social component of the landscape as well as its ecological dimension (Elbakidze and Angelstam 2007, Angelstam et al. 2011). The former will include the identification of different stakeholders and actors at different levels of governance that manage, govern or influence the traditional agroforestry systems, whereas the latter will systematically compare the functionality of the diverse ecosystems represented at the landscape study unit. This includes further the estimation of regional (landscape) gaps in extent and representation of ecosystems, the analysis of functionality of habitat networks both for humans and species, as well as to enhance understanding

upon management practices and restoration initiatives to evaluate such practices at different scales (Angelstam et al. 2011).

6.5 Future Research

The same fieldwork and research design has been performed for the Dehesas agroforestry system of Spain, in order to compare both systems. The Spanish study area was defined to be the Cáceres province which is of similar size than Östergötland, but contains the best representation of cultural oak landscapes in Europe. At present, data analysis and writing is being produced to elucidate landscape use and ES perception in a cultural oak reference landscape, to ultimately compare both case studied systems in order to find potential alternatives for the long term maintenance of cultural oak landscapes in Europe. The coming next 2 years I will also focus on elucidating if both landscapes (i.e., Cáceres and Östergötland oak landscapes) serve as functional GI for biodiversity conservation by using certain focal animal species as a model, as well as performing regional land cover gap analyses. This research is of paramount importance to ultimately assess whether cultural oak landscapes, as socio-ecological systems can function as GI both for human and animal species at regional level. Important questions are: how much habitat would be required? Of which quality? At which distance between stands? How to achieve the required landscape structure to fulfill plural needs? These questions can be applied when focus on both humans and other animal species. To elucidate overlapping areas and potential synergies will facilitate robust knowledge production for future sustainable development increasingly needed in our world.

Spain still embraces an important representation of cultural oak landscapes, distributed over 3 to 6 million ha (differs between authors; Diaz et al.1997) in the southwestern part of the country (Gaspar et al. 2009, Moreno and Pulido 2009). The term that defines these landscapes is Dehesa (Diaz et al.1997). These systems are characterized by a dynamic combination of trees, pastures, fallows and arable land (Joffre et al. 1988, Díaz et al. 1997, Moreno and Pulido 2009). The sclerophyllous species form a sparse tree cover (30-60 trees ha-1) dominated by cork (Quercus suber) and holm oak species (Q. illex). Pastures are grazed by livestock such as Iberian pig, rustic cattle breeds, goat and merino sheep (Joffre et al. 1988, Diaz et al.1997, Moreno and Pulido 2009). Hence, cultural oak landscapes form a heterogenic matrix of multi-functional uses that co-evolved over thousands of years with human occupations (Eichhorn et al. 2006, López Sáez et al. 2007, Bugalho et al. 2011). These landscapes provide a full range of ES, including the maintenance of natural

values and cultural heritage (Pedroli et al. 2007). Simultaneously, the mosaic of integrated habitats, i.e., the Dehesa ecosystem, exerts one of the highest biodiversity and conservational values in Europe (Díaz et al. 1997, Moreno and Pulido 2009, Bergmeier et al. 2010, Bugalho et al. 2011), being considered as "hot spot" of biodiversity (e.g. exhibit two times higher species richness than the Mediterranean biome in general; 0.1 ha of Dehesa contains more than 135 species of vascular plants) (Bugalho et al. 2011). Thus, the Spanish dehesa will be used as reference system to be compared with the oak landscape in Sweden both for human well-being and biodiversity conservation.

6.6 Identified Challenges to Maintain the Oak Landscape in Sweden

Several challenges regarding the management of cultural oak landscapes have been pointed out by the respondents during the study. Too few active farmers who want to be involved in traditional farming, was highlighted as a threat for the maintenance of the Swedish cultural oak landscape. The reasons were mainly hard work conditions, and the need for constant dedication. Only 2 out of 8 interviewed farmers and landowners were under 40 years old, which might be a sign of decline, although in another two cases the sons were taking over the farm. National authorities has noticed a general steady decline in farming activities, especially related to dairy production, as well as a pattern of change in land holding size, i.e., there are fewer farmers, and they need to manage bigger areas in order to have competent market prices (SBA 2013). A landowner explained this change as: "In my estate there were 12 families living here and managing the land, with their own home gardens for subsistence farming. Today I am the only one working on the land". As a consequence, abandoned and overgrown areas of former oak landscapes with high natural values are common in Östergötland, which reduces further landscape's spatial distribution and structure (landscape diversity). Additionally, as stated by officials, the beauty of the cultural oak landscape also attract people to live closer to valuable areas, which promote fragmentation due to urbanization and grey infrastructure development with negative effects for biodiversity (Lättman et al. 2014).

Financial impediments were also mentioned as part of the problem by regional officials. Sweden compared to other European countries, does not have a large proportion of agricultural land, and therefore the money allocated to aid farming from the European Union does not suffice the financial needs for restoration of the whole oak landscape with high natural values. To cope with this and to maintain the cultural landscapes through traditional

management practices (mainly grazing regimes) with a limited number of livestock (due to limited number of farmers), a biennial grazing regime is contemplated by regional authorities, so they can manage larger areas with the same animal stock. Additionally, to currently rely almost totally on EU subsidies for the long term conservation of the cultural oak landscape entails a high risk. Thus as an alternative solution, such business related to tourism activities are currently trying to be promoted; actions generally considered for rural development elsewhere (Buijs et al. 2006, van Berkel and Verburg 2011).

The lack of oak tree regeneration (0-50 age classes missing) is also a big challenge for the long term maintenance of cultural oak landscapes in Sweden. This was pointed out both by officials and farmers. Surprisingly, a limited number of trees per hectare are required in Sweden in order to qualify for the EU Common Agricultural Policy (CAP) subsidies (otherwise they will be classified as forest land), and thus woodlands having such threshold density cannot allow the recruitment of new trees into the system. The risk in doing so entails the loss of economic compensation from the CAP and the Swedish rural development program. This is a common problem for cultural landscapes and agroforestry systems in Europe. For instance, for the dehesa system in Spain oak regeneration failure is a mayor threat for the long term survival, caused by high grazing pressure promoted by European subsidies (Prieto Guijarro and Martin Montero 1994, Bergmeier et al. 2010), with consequent adverse effects of either abandonment or intensification of land use (Plieninger 2006a). Additional abandonment of traditional practices such as transhumance, which allowed for periods without grazing pressure, emphasize even further the regeneration failure (Pulido et al. 2001, Carmona et al. 2013). The same processes highlighted in our results, i.e., urbanization, depopulation of rural areas and CAP issues, were also identified as promoting the loss of the Spanish cultural oak landscapes (Plieninger et al. 2004b, Plieninger et al. 2012). Traditional non-productive oriented multi-purpose management have been shown as highly efficient practices for the optimal use of resources, hence reducing or even neglecting dependence on external subsidies (Gaspar et al. 2009). However, the re-implementation of traditional practices requires caution (Rackham 2003) and a holistic landscape approach in which conservation incentive schemes, environmental education, and technical assistance should be implemented (Pinto-Correia 2000, Plieninger et al. 2004b).

7 Conclusions

Cultural landscapes are widely recognized as important for cultural heritage, biodiversity conservation, ES and human well-being. To foster natural solutions on landscape management and to integrate all dimensions towards sustainability, the GI concept emerged at EU political level. In ES research, the generally adopted focus on economic valuation of services, has render efforts to characterize their cultural dimension due to the especial difficulty represented by intangible aspects (Chan et al. 2012a,b, Daniel et al. 2012, Satterfield et al. 2013). Spiritual, inspirational and place values are not related nor produce by a single kind of experience, therefore valuation methodologies should adapt to account for multiple benefits and their interdependencies (Raudsepp-Hearne et al. 2010, Daniel et al. 2012, Chan et al. 2012a,b, Satterfield et al. 2013). To successfully address all important values for people, ES research must use multiple methods and tools than mere economic approaches (Daniel et al. 2012, Chan et al. 2012a,b). In valuation contexts, principles and virtues should also be taken into account to avoid valuation based on a distorted conceptual reality ignoring what people care about. To address the inclusion of cultural services in ES research, inter/transdisciplinary approaches should be adopted to create common grounds for understanding (Chan et al. 2012b, Daniel et al. 2012, Klain and Chan 2012, Hernández-Morcillo et al. 2013, Satterfield et al. 2013). Cultural services are directly experienced and intuitively appreciated by people (Daniel et al. 2012), and therefore they are motivations for owning, managing and conserving the land (Chan et al. 2012a). They are also perceived in bundles and could thus foster the orientation of ES management towards multi-functionality or multi-purpose management (Plieninger et al. 2012). In the oak landscape in Sweden active traditional multiple-use farming practices are crucial for the maintenance of cultural oak landscapes, and directly related to its most valuable qualities in terms of landscape beauty, recreation potential and biodiversity values. On the

contrary, traditional farming practices are in a steady regression that entails greater uncertainty for the long term survival of such systems and associated diversity of delivered ES important for human well-being. Solutions, including adaptations of modern farming techniques to better mimic the traditional use of oak landscapes, systematic comparative studies with reference systems, and the generation of additional income through alternative rural development initiatives such as tourism and recreation are urgently needed. Complex realities demand multi-disciplinary methods and approaches to find viable ground-based solutions. Transdisciplinary research is able to satisfy the increasingly complex needs, improved understanding of conservation objectives and demands of a changing society (Angelstam et al. 2013a).

References

Aaron, M. E., M. S. Bank, D. C. Barton, E. A. Colburn, K. Elliott, C. R. Ford, D. R. Foster, B. D. Kloeppel, J. D. Knoepp, G. M. Lovett, J. Mohan, D. A. Orwig, N. L. Rodenhouse, W. V. Sobczak, K. A. Stinson, J. K. Stone, C. M. Swan, J. Thompson, H. Betsy Von, and R. W. Jackson. 2005. Loss of Foundation Species: Consequences for the Structure and Dynamics of Forested Ecosystems. *Frontiers in Ecology and the Environment 3*:479-486.

Acosta Naranjo, R. 2002. LOS ENTRAMADOS DE LA DIVERSIDAD. Antropología Social de la Dehesa. *Diputación de Badajoz*.

Albrecht, D., G. Bultena, E. Hoiberg, and P. Nowak. 1982. Measuring Environmental Concern: The New Environmental Paradigm Scale. *The Journal of Environmental Education 13*:39-43.

Angelstam, P. 2006. Maintaining cultural and natural biodiversity in Europe's economic centre and periphery. Pages 125-143 in M. Agnoletti, editor. *The Conservation of cultural landscapes*. CAB International.

Angelstam, P., K. Andersson, M. Annerstedt, R. Axelsson, M. Elbakidze, P. Garrido, P. Grahn, K. I. Jönsson, S. Pedersen, P. Schlyter, E. Skärbäck, M. Smith, and I. Stjernquist. 2013a. Solving Problems in Social–Ecological Systems: Definition, Practice and Barriers of Transdisciplinary Research. *AMBIO 42*:254-265.

Angelstam, P., R. Axelsson, M. Elbakidze, L. Laestadius, M. Lazdinis, M. Nordberg, I. Pătru-Stupariu, and M. Smith. 2011a. Knowledge production and learning for sustainable forest management on the ground: Pan-European landscapes as a time machine. *Forestry 84*:581-596.

Angelstam, P., M. Grodzynskyi, K. Andersson, R. Axelsson, M. Elbakidze, A. Khoroshev, I. Kruhlov, and V. Naumov. 2013b. Measurement, Collaborative Learning and Research for Sustainable Use of Ecosystem Services: Landscape Concepts and Europe as Laboratory. *AMBIO 42*:129-145.

Anon. 2009. Hållbart skydd av naturområden (Sustainable protection of natural areas). *Government bill 2008/09:214, Sweden*.

Antrop, M. 1997. The concept of traditional landscapes as a base for landscape evaluation and planning. The example of Flanders Region. *Landscape and Urban Planning 38*:105-117.

Antrop, M. 2005. Why landscapes of the past are important for the future. *Landscape and Urban Planning 70*:21–34.

Antrop, M. 2006. Sustainable landscapes: contradiction, fiction or utopia? *Landscape and Urban Planning 75*:187–197.

Atkinson, R. and J. Flint. 2004. Snowball Sampling. The SAGE Encyclopedia of Social Science Research Methods. *Sage Publications, Inc. Sage Publications, Inc., Thousand Oaks*, CA.

Baker, A. R. H. 2003. Geography and history: bridging the divide. *Cambridge*.

Barthel, S., J. Colding, T. Elmqvist, and C. Folke. 2005. History and local management of a biodiversity-rich, urban cultural landscape. *Ecology and Society 10*:10.

Beatley, T. 2009. Green urbanism down under: Learning from sustainable communities in australia. *Island Press*, Washington DC.

Benedict, M. A. and E. T. McMahon. 2002. Green infrastructure: smart conservation for the 21st century. *Renewable Resources Journal 20*: 12-17.

Berbés-Blázquez, M. 2012. A Participatory Assessment of Ecosystem Services and Human Wellbeing in Rural Costa Rica Using Photo-Voice. *Environmental Management 49*:862-875.

Bergman, K.-O., L. Ask, J. Askling, H. Ignell, H. Wahlman, and P. Milberg. 2007. Importance of boreal grasslands in Sweden for butterfly diversity and effects of local and landscape habitat factors. *Biodiversity and Conservation 17*:139-153.

Bergman, K.-O., J. Askling, O. Ekberg, H. Ignell, H. Wahlman, and P. Milberg. 2004. Landscape effect on butterfly assemblages in an agricultural region. *ECOGRAPHY 27*:619-628.

Bergmeier, E., J. Petermann, and E. Schröder. 2010. Geobotanical survey of wood-pasture habitats in Europe: diversity, threats and conservation. *Biodiversity and Conservation 19*:2995-3014.

Björk, J., M. Albin, P. Grahn, H. Jacobsson, J. Ardö, J. Wadbro, P.-O. Östergren, and E. Skärbäck. 2008. Recreational values of the natural environment in relation to neighbourhood satisfaction, physical activity, obesity and wellbeing. *Journal of Epidemiology and Community Health 62*:e2.

Braat, L. C. and R. de Groot. 2012. The ecosystem services agenda:bridging the worlds of natural science and economics, conservation and development, and public and private policy. *Ecosystem Services 1*:4-15.

Brown, G. 2005. Mapping Spatial Attributes in Survey Research for Natural Resource Management: Methods and Applications. *Society & Natural Resources 18*:17-39.

Bryman, A. 2008. Social Research Methods. Third edition. *Oxford University Press Inc.*, New York.

Bugalho, M. N., M. C. Caldeira, J. S. Pereira, J. Aronson, and J. G. Pausas. 2011. Mediterranean cork oak savannas require human use to sustain biodiversity and ecosystem services. *Frontiers in Ecology and the Environment 9*:278-286.

Buijs, A., B. Pedroli, and Y. Luginbühl. 2006. From Hiking Through Farmland to Farming in a Leisure Landscape: Changing Social Perceptions of the European Landscape. *Landscape Ecology 21*:375-389.

Bullock, J. M., J. Aronson, A. C. Newton, R. F. Pywell, and J. M. Rey-Benayas. 2011. Restoration of ecosystem services and biodiversity: conflicts and opportunities. *Trends Ecol Evol 26*:541-549.

Butler, C. D. and W. Oluoch-Kosura. 2006. Linking future ecosystem services and future human well-being. *Ecology and Society 11*:30.

CAB. 2005. Multi-purpose management of oak habitats. Examples of best practice from the county of Östergötland, Sweden. *County administration of Östergötland, report 2005:16*.

CAB. 2006. *County Administration Board of Östergötland*. Eklänet Östergötland—naturinventering av ekmiljöer (The county of oaks—survey of nature conservation values in oak environments). Linköping.

Calvo-Iglesias, M. S., R. Crecente-Maseda, and U. Fra-Paleo. 2006. Exploring farmer's knowledge as a source of information on past and present cultural landscapes: A case study from NW Spain. *Landscape and Urban Planning 78*:334-343.

Cameron, R. W. F., T. Blanuša, J. E. Taylor, A. Salisbury, A. J. Halstead, B. Henricot, and K. Thompson. 2012. The domestic garden – Its contribution to urban green infrastructure. *Urban Forestry & Urban Greening 11*:129-137.

Carmona, C. P., F. M. Azcárate, E. Oteros-Rozas, J. A. González, and B. Peco. 2013. Assessing the effects of seasonal grazing on holm oak regeneration: Implications for the conservation of Mediterranean dehesas. *Biological Conservation 159*:240-247.

CE. 2000. *Council of Europe*. The European Landscape Convention. Strasbourg.

Chan, K. M. A., A. D. Guerry, P. Balvanera, S. Klain, T. Satterfield, X. Basurto, A. Bostrom, R. Chuenpagdee, R. Gould, B. S. Halpern, N. Hannahs, J. Levine, B. Norton, M. Ruckelshaus, R. Russell, J. Tam, and U. Woodside. 2012a. Where are Cultural and Social in Ecosystem Services? A Framework for Constructive Engagement. *BioScience 62*:744-756.

Chan, K. M. A., T. Satterfield, and J. Goldstein. 2012b. Rethinking ecosystem services to better address and navigate cultural values. *Ecological Economics 74*:8-18.

Chan, K. M. A., M. R. Shaw, D. R. Cameron, E. C. Underwood, and G. C. Daily. 2006. Conservation Planning for Ecosystem Services. *PLoS Biol 4*:e379.

Costa, A., M. Madeira, J. Lima Santos, and Â. Oliveira. 2011. Change and dynamics in Mediterranean evergreen oak woodlands landscapes of Southwestern Iberian Peninsula. *Landscape and Urban Planning 102*:164-176.

Costanza, R., R. d´Agre, R. S. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O´Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M. van der Belt. 1997. The value of the world´s ecosystem services and natural capital. *Nature 385*:253-260.

Daniel, T. C., A. Muhar, A. Arnberger, O. Aznar, J. W. Boyd, K. M. Chan, R. Costanza, T. Elmqvist, C. G. Flint, P. H. Gobster, A. Gret-Regamey, R. Lave, S. Muhar, M. Penker, R. G. Ribe, T. Schauppenlehner, T. Sikor, I. Soloviy, M. Spierenburg, K. Taczanowska, J. Tam, and A. von der Dunk. 2012. Contributions of cultural services to the ecosystem services agenda. *Proc Natl Acad Sci U S A 109*:8812-8819.

Daw, T., K. Brown, S. Rosendo, and R. Pomeroy. 2011. Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being. *Environmental Conservation 38*:370-379.

De Aranzabal, I., M. F. Schmitz, P. Aguilera, and F. D. Pineda. 2008. Modelling of landscape changes derived from the dynamics of socio-ecological systems. *Ecological Indicators 8*:672-685.

de Groot, R. S., R. Alkemade, L. Braat, L. Hein, and L. Willemen. 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity 7*:260-272.

de Jonge, V. N., R. Pinto, and R. K. Turner. 2012. Integrating ecological, economic and social aspects to generate useful management information under the EU Directives' 'ecosystem approach'. *Ocean & Coastal Management 68*:169-188.

Díaz, M., P. Campos, and F. J. Pulido. 1997. The Spanish dehesa: a diversity in land use and wildlife. Pages 178-209 in D. J. Pain and M. W. Pienkowski, editors. *Farming and Birds in Europe. The Common Agricultural Policy and its Implications for Bird Conservation*. Academic Press, London.

EC. 2013. *European Commission*. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. A new EU Forest Strategy: for forests and the forest-based sector. European Commission, Brussels.

EC. 2013. Green Infrastructure (GI) — Enhancing Europe's Natural Capital. European Comission. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*.

Edwards, D., M. Jay, F. S. Jensen, B. Lucas, M. Marzano, C. Montagné, A. Peace, and G. Weiss. 2012a. Public preferences for structural attributes of forests: Towards a pan-European perspective. *Forest Policy and Economics 19*:12-19.

Edwards, D. M., M. Jay, F. S. Jensen, B. Lucas, M. Marzano, C. Montagné, A. Peace, and G. Weiss. 2012b. Public Preferences Across Europe for Different Forest Stand Types as Sites for Recreation. *Ecology and Society 17*.

Ehrlich, P. R. and A. H. Ehrlich. 1981. Extinction: the causes and consequences of the disappearance of species. *Gollancz*, London.

Eichhorn, M. P., P. Paris, F. Herzog, L. D. Incoll, F. Liagre, K. Mantzanas, M. Mayus, G. Moreno, V. P. Papanastasis, D. J. Pilbeam, A. Pisanelli, and C. Dupraz. 2006. Silvoarable Systems in Europe – Past, Present and Future Prospects. *Agroforestry Systems 67*:29-50.

Elbakidze, M. and P. Angelstam. 2007. Implementing sustainable forest management in Ukraine's Carpathian Mountains: The role of traditional village systems. *Forest Ecology and Management 249*:28-38.

Elbakidze, M., P. K. Angelstam, C. Sandström, and R. Axelsson. 2010. Multi-stakeholder collaboration in Russian and Swedish Model Forest initiatives: adaptive governance toward sustainable forest management? *Ecology and Society 15*:14.

Eliasson, P. and S. G. Nilsson. 2002. You Should Hate Young Oaks and Young Noblemen. The Environmental History of Oaks in Eighteenth- and Nineteenth-Century Sweden. *Environmental History*:659-674.

Ellis, E. C. and N. Ramankutty. 2007. Putting people in the map: anthropogenic biomes of the world. *Frontiers in Ecology and the Environment 6*:439-447.

ENRD. 2014. *Eurpean Commission*. European Network for Rural Development. Accessed August 25, 2014

ESF. 2010. *European Science Foundation*. Landscape in a Changing World. Bridging Divides, Integrating Disciplines, Serving Society. SCIENCE POLICY BRIEFING 41.

Fagerholm, N., N. Käyhkö, F. Ndumbaro, and M. Khamis. 2012. Community stakeholders' knowledge in landscape assessments – Mapping indicators for landscape services. *Ecological Indicators 18*:421–433.

Farina, A. 2000. The Cultural Landscape as a Model for the Integration of Ecology and Economics. *BioScience 50*:313-320.

Farley, J. 2012. Ecosystem services: The economics debate. *Ecosystem Services 1*:40-49.

Fisher, B., R. K. Turner, N. D. Burgess, R. D. Swetnam, J. Green, R. E. Green, G. Kajembe, K. Kulindwa, S. L. Lewis, R. Marchant, A. R. Marshall, S. Madoffe, P. K. T. Munishi, S. Morse-Jones, S. Mwakalila, J. Paavola, R. Naidoo, T. Ricketts, M. Rouget, S. Willcock, S. White, and A. Balmford. 2011. Measuring, modeling and mapping ecosystem services in the Eastern Arc Mountains of Tanzania. *Progress in Physical Geography 35*:595-611.

Fisher, B., R. K. Turner, and P. Morling. 2009. Defining and classifying ecosystem services for decision making. *Ecological Economics 68*:643-653.

Flyvbjerg, B. 2011. Case Study. Pages 301-316 in N. K. Denzin and Y. S. Lincoln, editors. *The Sage Handbook of Qualitative Research*. Sage, Thousand Oaks, CA.

Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources 30*:441-473.

Fragoso, R., C. Marques, M. R. Lucas, M. B. Martins, and R. Jorge. 2011. The economic effects of common agricultural policy on Mediterranean montado/dehesa ecosystem. *Journal of Policy Modeling 33*:311-327.

Fransson, N. and T. Gärling. 1999. Environmental concern: conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology 19*:369-382.

García Pérez, J. 2002. Ascertaining Landscape Perceptions and Preferences with Pair-wise Photographs: Planning rural tourism in Extremadura, Spain. *Landscape Research 27*:297-308.

Gaspar, P., F. J. Mesías, M. Escribano, and F. Pulido. 2009. Sustainability in Spanish Extensive Farms (Dehesas): An Economic and Management Indicator-Based Evaluation. *Rangeland Ecology & Management 62*:153-162.

Gerring, J. 2004. What is a case study and what is it good for? *The American Political Science Review 98*:341-354.

GHGWI. 2014. *GALLUP-HEALTHWAYS GLOBAL WELL-BEING INDEX*. State of Global Well-Being.

Gillman, B. 2000. The research interview. *Continuum*, London.

Gómez-Baggethun, E., R. de Groot, P. L. Lomas, and C. Montes. 2010. The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics 69*:1209-1218.

Graves, A. R., P. J. Burgess, F. Liagre, A. Pisanelli, P. Paris, G. Moreno, M. Bellido, M. Mayus, M. Postma, B. Schindler, K. Mantzanas, V. P. Papanastasis, and C. Dupraz. 2009. Farmer Perception of Silvoarable Systems in Seven European Countries. Pages 67-86 in A. Rigueiro-Rodríguez, J. H. McAdam, and M. R. Mosquera-Losada, editors. *Agroforestry in Europe*. Current Status and Future Prospects. Springer Sceince + Business Media B.V.

Haines-Young, R. and M. Potschin. 2010. The links between biodiversity, ecosystem services and human well-being. Pages 110–139 in D. G. Raffaelli and C. L. J. Frid, editors. *Ecosystem Ecology: A New Synthesis*. Cambridge University Press.

Hartel, T. and T. Plieninger. 2014. European Wood-Pastures in Transition. A social-ecological approach. *Routledge, Park Square, Milton Park, Abingdon, Oxon and Third Avenue*, New York.

Hasund, K. P., M. Kataria, and C. J. Lagerkvist. 2011. Valuing public goods of the agricultural landscape: a choice experiment using reference points to capture observable heterogeneity. *Journal of Environmental Planning and Management 54*:31-53.

Hernández-Morcillo, M., T. Plieninger, and C. Bieling. 2013. An empirical review of cultural ecosystem service indicators. *Ecological Indicators 29*:434-444.

Holme, I. M., B. K. Solvang, and B. Nilsson. 1997. Forskningsmetodik: om kvalitativa och kvantitativa metoder (Research methodology: about qualitative and quantitative methods). *Studentlitteratur*.

Hunziker, M., M. Buchecker, and T. Hartig. 2007. Space and Place – Two Aspects of the Human-landscape Relationship. Pages 47– 62 in F. Kienast, O. Wildi, and S. Ghosh, editors. *A Changing World. Challenges for Landscape Research*. Springer.

Jansson, N., K.-O. Bergman, M. Jonsell, and P. Milberg. 2008. An indicator system for identification of sites of high conservation value for saproxylic oak (Quercus spp.) beetles in southern Sweden. *Journal of Insect Conservation 13*:399-412.

Joffre, R., S. Rambal, and J. P. Ratte. 1999. The dehesa system of southern Spain and Portugal as a natural ecosystem mimic. *Agroforestry Systems 45*:57-79.

Joffre, R., J. Vacher, C. de los Llanos, and G. Long. 1988. The dehesa: an agrosilvopastoral system of the Mediterranean region with special reference to the Sierra Morena area of Spain. *Agroforestry Systems 6*:71-96.

Kambites, C. and S. Owen. 2006. Renewed prospects for green infrastructure planning in the UK. *Planning Practice & Research 21*:483-496.

Kaplan, R. and S. Kaplan. 1989. The Experience of Nature, *Cambridge*: University Press.

Kirby, K., R. Thomas, R. Key, I. McLean, and N. Hodgetts. 1995. Pasture-woodland and its conservation in Britain. *Biological Journal of the Linnean Society 56*:135-153.

Klain, S. C. and K. M. A. Chan. 2012. Navigating coastal values: Participatory mapping of ecosystem services for spatial planning. *Ecological Economics 82*:104-113.

Kvale, S. and S. Brinkmann. 2009. Interviews. Learning the Craft of Qualitative Research Interviewing. *SAGE Publications, Inc.*, Thousand Oaks, California

Lantmäteriverket. 2013. National Land Survey. *Allmän beskrivning: GSD - Blå kartan* [General description: GSD - blue map]. Stockholm.

Lättman, H., K.-O. Bergman, M. Rapp, M. Tälle, L. Westerberg, and P. Milberg. 2014. Decline in lichen biodiversity on oak trunks due to urbanization. *Nordic Journal of Botany 32*:518-528.

Linares, A. M. 2007. Forest planning and traditional knowledge in collective woodlands of Spain: The dehesa system. *Forest Ecology and Management 249*:71-79.

Lindbladh, M. and D. R. Foster. 2010. Dynamics of long-lived foundation species: the history of Quercus in southern Scandinavia. *Journal of Ecology 98*:1330-1345.

Liu, J., T. Dietz, S. R. Carpenter, C. Folke, M. Alberti, C. L. Redman, S. H. Schneider, E. Ostrom, A. N. Pell, J. Lubchenco, W. W. Taylor, Z. Ouyang, P. Deadman, T. Kratz, and W. Provencher. 2007. Coupled Human and Natural Systems. *AMBIO: A Journal of the Human Environment 36*:639-649.

Logan, A. C. and E. M. Selhub. 2012. Vis Medicatrix naturae: does nature "minister to the mind"? *Biopsychosoc Med 6*:11.

Loman, J. 2008. Statistical yearbook of forestry. Official statistics of Sweden. *Swedish Forest Agency*, Jönköping.

López Sáez, J. A., P. López García, L. López-Merino, E. Cerrillo Cuenca, A. González Cordero, and A. Prada Gallardo. 2007. Origen prehistórico de la dehesa en Extremadura: una perspectiva paleoambiental. *Revista de estudios extremeños 63*:493-510.

Lucius, I., R. Dan, D. Caratas, F. Mey, J. Steinert, and P. Torkler. 2011. Green infrastructure: sustainable investments for the benefits of both people and nature. *WWF Danube-Carpathian Programme, WWF Germany, Giurgiu County Council*, Miruna Dudau. .

Luengo, A. and M. Rössler. 2012. *World Heritage Cultural Landscapes*. Elche.

MA. 2005. Millenium Ecosystem Assessment. Ecosystems and Human Well-being: Synthesis Report. *Island Press*.

Manning, A. D., J. Fischer, and D. B. Lindenmayer. 2006. Scattered trees are keystone structures – Implications for conservation. *Biological Conservation 132*:311-321.

Marañón, T. 1988. Agro-Sylvo-Pastoral Systems in the Iberian Peninsula: Dehesas and Montados. *Rangelands 10*:255-258.

Mascia, M. B., J. P. Brosius, T. A. Dobson, B. C. Forbes, L. Horowitz, M. A. McKean, and N. J. Turner. 2003. Conservation and the Social Sciences. *Conservation Biology 17*:649-650.

McAdam, J. H., P. J. Burgess, A. R. Graves, A. Rigueiro-Rodríguez, and M. R. Mosquera-Losada. 2009. Classifications and Functions of Agroforestry Systems in Europe. Pages 21-41 in A. Rigueiro-Rodríguez, J. McAdam, and M. R. Mosquera-Losada, editors. *Agroforestry in Europe*. *Current Status and Future Prospects*. Springer.

MCPFE. 2003. The MCPFE Report on Sustainable Forest Management in Europe. State of Europe's Forests 2003. *Ministerial Conference on the Protection of Forests in Europe Liaison Unit Vienna*. Vienna, Austria.

Mikusiński, G., P. Angelstam, and U. Sporrong. 2003. Distribution of Deciduous Stands in Villages Located in Coniferous Forest Landscapes in Sweden. *AMBIO: A Journal of the Human Environment 32*:520-526.

Moreno, G. and F. Pulido. 2009. The Functioning, Management and Persistence of Dehesas. Pages 127-160 in A. Rigueiro-Rodríguez, J. McAdam, and M. R. Mosquera-Losada, editors. *Agroforestry in Europe. Current Status and Future Prospects*. Springer.

Moseley, D., M. Marzano, J. Chetcuti, and K. Watts. 2013. Green networks for people: Application of a functional approach to support the planning and management of greenspace. *Landscape and Urban Planning 116*:1-12.

Nilsson, K., M. Sangster, C. Gallis, T. Hartig, S. de Vries, K. Seeland, and J. Schipperijn. 2011. Forests, trees and human health. *Springer*, New York, Dordrecht, Heidelberg and London.

Noss, R. F. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. *Conservation Biology 4*:355-364.

Öckinger, E., K.-O. Bergman, M. Franzén, T. Kadlec, J. Krauss, M. Kuussaari, J. Pöyry, H. Smith, I. Steffan-Dewenter, and R. Bommarco. 2012. The landscape matrix modifies the effect of habitat fragmentation in grassland butterflies. *Landscape Ecology 27*:121-131.

OECD. 2012. Greening Development: Enhancing capacity for environmental management and governance. *OECD Publishing*, Paris.

Paltto, H., A. Nordberg, B. Norden, and T. Snäll. 2011. Development of Secondary Woodland in Oak Wood Pastures Reduces the Richness of Rare Epiphytic Lichens. *Plos One 6*: e24675.

Paltto, H., I. Thomasson, and B. Norden. 2010. Multispecies and multiscale conservation planning: setting quantitative targets for red-listed lichens on ancient oaks. *Conserv Biol 24*:758-768.

Pedroli, B., A. van Doorn, G. de Blust, M. L. Paracchini, D. Wascher, and F. Bunce. 2007. EUROPE´S LIVING LANDSCAPES. Essays on exploring our identity in the coutryside. *KNNV publishing*.

Pinto-Correia, T. 2000. Future development in Portuguese rural areas: how to manage agricultural support for landscape conservation? . *Landscape and Urban Planning 50*:95-106.

Pinto-Correia, T. and S. Godinho. 2013. Changing agriculture – changing landscapes: What is going on in the high valued montado landscapes of southern Portugal? Pages 75–90, *Agriculture in Mediterranean Europe: Between Old and New Paradigms Research in Rural Sociology and Development*. Emerald Group Publishing Limited.

Platt, F. 1992. "Case study" in American methodological thought. *Current Sociology 40*: 17-48.

Plieninger, T. 2006a. Habitat loss, Fragmentation, and Alteration – Quantifying the Impactof Land-use Changes on a Spanish Dehesa Landscape by Use of Aerial Photography and GIS. *Landscape Ecology 21*:91-105.

Plieninger, T. 2006b. Las dehesas de la penillanura Cacereña. Origen y evolución de un paisaje cultural. *Universidad de Extremadura, Servicio de Publicaciones*, Cáceres.

Plieninger, T., S. Dijks, E. Oteros-Rozas, and C. Bieling. 2013. Assessing, mapping, and quantifying cultural ecosystem services at community level. *Land Use Policy 33*:118– 129.

Plieninger, T., J. Modolell y Mainou, and W. Konold. 2004a. Land manager attitudes toward management, regeneration, and conservation of Spanish holm oak savannas (dehesas). *Landscape and Urban Planning 66*:185-198.

Plieninger, T., F. J. Pulido, and H. Schaich. 2004b. Effects of land-use and landscape structure on holm oak recruitment and regeneration at farm level in Quercus ilex L. dehesas. *Journal of Arid Environments 57*:345-364.

Plieninger, T., C. Schleyer, H. Schaich, B. Ohnesorge, H. Gerdes, M. Hernández-Morcillo, and C. Bieling. 2012. Mainstreaming ecosystem services through reformed European agricultural policies. *Conservation Letters 5*:281-288.

Plieninger, T. and C. Wilbrand. 2001. Land use, biodiversity conservation, and rural development in the dehesas of Cuatro Lugares, Spain. *Agroforestry Systems 51*:23-34.

Pressouyre, L. 1996. The World Heritage Convention, twenty years later. Paris, *UNESCO, UNESCO Publishing* Paris.

Prieto Guijarro, A. and L. Martin Montero. 1994. Incidencia de la PAC en las rentas de sistemas agrosilvopastorales (dehesas) de Salamanca. Pages 1719-1734. *4 Congreso de Economía Regional de Castilla y León, Análisis Económicos Provinciales: Salamanca y La Frontera*. Castilla y León. Junta. Consejeria de Economía y Hacienda, Burgos.

Pulido, J. F., M. Díaz, and S. J. Hidalgo de Trucios. 2001. Size structure and regeneration of Spanish holm oak Quercus ilex forests and dehesas: effects of agroforestry use on their long-term sustainability. *Forest Ecology and Management 146*:1-13.

Rackham, O. 1998. Trees and Woodland in a Cultural Landscape: the History of Woods in England. Pages 139-147 in K. Sassa, editor. *Environmental Forest Science*. Springer Netherlands.

Rackham, O. 2003. Ancient Woodland its history, vegetation and uses in England. 2003 edition. *Castlepoint Press*.

Rackham, O. 2008. Ancient woodlands: modern threats. *New Phytologist 180*:571-586.

Ragin, C. C. 1992. "Casing" and the process of social inquiry. Pages 217-226 in C. C. Ragin and H. S. Becker, editors. *What is a case? Exploring the foundations of social inquiry*. Cambridge University Press, Cambridge, UK.

Ragin, C. C. and H. S. Becker. 1992. What is a case? Exploring the foundations of social inquiry. *Cambridge University Press*, Cambridge, UK.

Rametsteiner, E. and P. Mayer. 2004. Sustainable Forest Management and Pan: European Forest Policy. *Ecological Bulletins*:51-57.

Ranius, T., L. O. Aguado, K. Antonsson, P. Audisio, A. Ballerio, G. M. Carpaneto, K. Chobot, B. Gjurasin, O. Hanssen, H. Huijbregts, F. Lakatos, O. Martin, Z. Neculiseanu, N. B. Nikitsky, W. Paill, A. Pirnat, V. Rizun, A. Ruicanescu, J. Stegner, I. Sda, P. Szwalko, V. Tamutis, D. Telnov, V. Tsinkevich, V. Versteirt, V. Vignon, M. Vögeli, and P. Zach. 2005. Osmoderma eremita (Coleoptera, Scarabaeidae, Cetoniinae) in Europe. *Animal Biodiversity and Conservation 28*.1.

Raudsepp-Hearne, C., G. D. Peterson, and E. M. Bennett. 2010. Ecosystem service bundles for analyzing tradeoffs in diverse landscapes. *Proceedings of the National Academy of Sciences of the United States of America 107*:5242–5247.

Raymond, C. M., B. A. Bryan, D. H. MacDonald, A. Cast, S. Strathearn, A. Grandgirard, and T. Kalivas. 2009. Mapping community values for natural capital and ecosystem services. *Ecological Economics 68*:1301-1315.

Ribot, J. C. and N. L. Peluso. 2003. A Theory of Access*. *Rural Sociology 68*:153-181.

Ritchie, J. and J. Lewis. 2003. Qualitative research practice : a guide for social science students and researchers. *SAGE*, London.

Rockstrom, J., W. Steffen, K. Noone, A. Persson, F. S. Chapin, E. F. Lambin, T. M. Lenton, M. Scheffer, C. Folke, H. J. Schellnhuber, B. Nykvist, C. A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sorlin, P. K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R. W. Corell, V. J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. A. Foley. 2009. A safe operating space for humanity. *Nature 461*:472-475.

Roe, M. and I. Mell. 2012. Negotiating value and priorities: evaluating the demands of green infrastructure development. *Journal of Environmental Planning and Management 56*:650-673.

Rössler, M. and H. Cleere. 2001. Connecting nature and culture. World Conservation. *The IUCN Bulletin No 2* (special issue: Vision and reality - The World Heritage Convention in action). IUCN, Gland.

Ryan, R. M. and E. L. Deci. 2001. ON HAPPINESS AND HUMAN POTENTIALS: A Review of Research on Hedonic and Eudaimonic Well-Being. *Annual Review of Psychology 52*:141-166.

Satterfield, T., R. Gregory, S. Klain, M. Roberts, and K. M. Chan. 2013. Culture, intangibles and metrics in environmental management. *Journal of Environmental Management 117*:103-114.

SBA. 2005a. Ängs- och betesmarksinventeringen 2002–2004. *Swedish Board of Agriculture [Jordsbruksverket]*, Jönköping.

SBA. 2005d. Svenskt jordbruk i siffror 1800–2004. *Swedish Board of Agriculture [Jordsbruksverket]*, Jönköping.

SBA. 2013. Yearbook of agricultural statistics. *Jordbruksverket*, Örebro.

Schaich, H., C. Bieling, and T. Plieninger. 2010. Linking Ecosystem Services with Cultural Landscape Research. *GAIA - Ecological Perspectives for Science and Society 19*:269-277.

SEPA. 2005. *Swedish Environmental Protection Agency [Naturvårdsverket]*. Frekvensanalys av skyddsvärd natur. Förekomst av värdekärnor i skogsmark. Stockholm.

SEPA. 2006. *Swedish Environmental Protection Agency [Naturvårdsverket]*. Sweden's 16 Environmental Goals. Stockholm.

SEPA and NBF. 2005. *Swedish Environmental Protection Agency and National Board of Forestry*. National strategy for the formal protection of forest. SEPA, Stockholm, and NBF, Jönköping.

Surová, D. and T. Pinto-Correia. 2009. Use and assessment of the 'new' rural functions by land users and landowners of the Montado in southern Portugal. *Outlook on Agriculture 38*:189-194.

Svensson, R. 1988. Floravård i jordbrukslandskapet. *Svensk botanisk tidskrift 82*:458–465.

TEEB. 2010. *The Economics of Ecosystems and Biodiversity*: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.

Tress, B., G. Tress, and G. Fry. 2006. Defining concepts and the process of knowledge production in integrative research. Pages 13-26 in B. Tress, G. Trees, G. Fry, and P. Opdam, editors. *From landscape research to landscape planning,* Springer.

Tyrväinen, L., K. Mäkinen, and J. Schipperijn. 2007. Tools for mapping social values of urban woodlands and other green areas. *Landscape and Urban Planning 79*:5-19.

Tzoulas, K., K. Korpela, S. Venn, V. Yli-Pelkonen, A. Kaźmierczak, J. Niemela, and P. James. 2007. Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landscape and Urban Planning 81*:167-178.

UNEP. 2014. Environmental sustainability for human well-being in the post-2015 development agenda. *United Nations Environment Assembly of the United Nations Environment Programme*, Nairobi, Kenya.

van Berkel, D. B. and P. H. Verburg. 2011. Sensitising rural policy: Assessing spatial variation in rural development options for Europe. *Land Use Policy 28*:447-459.

van Berkel, D. B. and P. H. Verburg. 2012. Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. *Ecological Indicators*.

Von Droste, B., H. Plachter, and M. Rössler. 1995. *Cultural Landscapes of Universal Value*. Components of a Global Strategy.

Wickson, F., A. L. Carew, and A. W. Russell. 2006. Transdisciplinary research: characteristics, quandaries and quality. *Futures 38*:1046-1059.

Wilkinson, C., T. Saarne, G. D. Peterson, and J. Colding. 2013. Strategic Spatial Planning and the Ecosystem Services Concept – an Historical Exploration. *Ecology and Society 18*:37.

Wright, H. 2011. Understanding green infrastructure: the development of a contested concept in England. *Local Environment 16*:1003-1019.

Acknowledgements

In this journey I would like to thank first of all to my supervisors, Marine Elbakidze, Per Angelstam and Robert Axelsson for giving me the change to enroll the PhD education at SLU, and for supporting, helping and advising me both at personal and professional level. Secondly, to all stakeholders both in Spain and Sweden with whom I could learn about the complexity of ancient social-ecological systems, practices, cultures, species... The list is quite extensive but in Sweden special thanks to Micke Angelstam to help me in everything, to Karl-Olof Berman at Linköping University for introducing me the Swedish case study landscape; to Linköping municipality officials for their patience and time to answer all our questions; to Tommy Ek at CAB Östergötland, to Christer Segersteen for providing first contacts, as well as to all participants form local to national level in Sweden.

In Spain special thanks to Fernando Pulido, Javier Ezquerra and Gerardo Moreno for suggesting places, organizations and people to visit and contact. To Edu for helping me to find farmers at any time, and who by doing so became a friend. At the regional level, special attention deserves Jose Luis del Pozo, Jefe de Servicio de Ordenación y Gestión Forestal, Dirección General de Medio Ambiente, Consejería de Agricultura, Desarrollo Rural, Medio Ambiente y Energía, for his time and help in organizing all meetings at the administration with all departments involved in the management of the Dehesa system. To Suso (Jesus Garzón) to invite us to see and experience a day with trashumant herders and share his knowledge and experiences with me. Special attention to the people from Aldeanueva del Camino, to make me feel at home from the very first time there, and make it so easy to work there for 3 months. I have to reiterate my deep gratitude to all stakeholders involved in the study to make it possible and fun; many of them deserve special attention but in particular Enrique from dehesa Casablanca, to Marce (forillo) for his social skills and getting me involved with farmers and the landscape around Aldeanueva, and to

Gero, and Miguel, to show me two really good examples of dehesas estates, and many endangered breeds respectively.

To my family and friends both in Spain and Sweden to support my uneven mood swings when needed, especially to Sara Lindqvist and Janire Gonzalez de Mendibil, two angels from a different world. My father, Francisco Javier Garrido López, deserves a particular mention for long term economic support of my studies and most importantly, for contaminating me with the passion for nature and wildlife. I know there are many anonymous people I have not mentioned, consequently I also thank to everyone that has contributed directly or indirectly to the project and make with their contribution this personal and professional journey come true.

Pablo Garrido
Skinnskatteberg, November 2014.