Abstract

Ecosystem services (ES) research is currently widely utilized. However, qualitative approaches and socio-cultural valuations of ES are still limited. This may undermine future landscape conservation initiatives because important services for people may not be captured. We performed 29 face-to-face semi-structured interviews to capture stakeholders' perceptions of ES from the largest area with oak wood-pasture landscapes in Sweden (Östergötland County). A total of 34 ES were mentioned, and compared among stakeholders from public, private and civil sectors at local and regional level of governance. Cultural ES were highlighted the most by respondents from both levels of governance. At the local level, respondents appreciated especially provisioning services. In contrast, regional level respondents showed more appreciation for supporting services. Private sector stakeholders emphasized provisioning ES, whereas the civil and public sector stakeholders highlighted cultural ES in terms of recreational values and landscape beauty. Supporting ES were considered only in relation to biodiversity, especially species and habitats linked to old oaks. Farmers and farming activities (especially grazing regimes) are crucial to support important oak wood-pasture ES. We discuss important ES as expressed by stakeholders and challenges for wood-pasture conservation in Sweden and elsewhere. To integrate the different demands of stakeholder groups into policy and to enable cross-sectorial flexibility and policy regional adaptation for wood-pasture conservation, is a current challenge future research should focus upon.

1. Introduction

Wood-pastures are one type of agroforestry system and combine scattered trees, grasslands and grazing animals (Rackham, 2008), and were maintained by traditional land use practices

(Antrop, 2005; Elbakidze & Angelstam, 2007). This form of complex land use has been an important part of European cultural landscapes for millennia (Mosquera-Losada, McAdam, Romero-Franco, Santiago-Freijanes, & Rigueiro-Rodríguez, 2009). However, political, social and economic changes in many European countries have exerted a significant negative impact on these landscapes (Bergmeier, Petermann, & Schröder, 2010).This has altered the composition, structure and function of wood-pastures, and led to their disappearance in most European countries (Bergmeier et al., 2010; Bugalho, Caldeira, Pereira, Aronson, & Pausas, 2011; Eichhorn, Paris, Herzog, Incoll, Liagre, Mantzanas, Mayus, Moreno, Papanastasis, Pilbeam, Pisanelli, & Dupraz, 2006).

As a response many international agreements, processes and programs have pointed out the importance of cultural landscapes, including wood pastures, as a foundation for sustainable rural development that maintains multiple goods, services and values (CE, 2000; MCPFE, 2003). Re-vitalization of cultural landscapes may then foster sustainable rural development (McAdam, Burgess, Graves, Rigueiro-Rodríguez, & Mosquera-Losada, 2009).

Also in Sweden wood-pastures were traditionally used for animal husbandry, including grazing and hay-making (Jørgensen & Quelch, 2014). Today a high diversity of saproxylic beetles (Ranius, Aguado, Antonsson, Audisio, Ballerio, Carpaneto, Chobot, Gjurasin, Hanssen, Huijbregts, Lakatos, Martin, Neculiseanu, Nikitski, Paill, Pirnat, Rizun, Ruicanescu, Stegner, Sda, Szwalko, Tamutis, Telnov, Tsinkevich, Versteirt, Vignon, Vögeli, & Zach, 2005), butterflies (Bergman, Ask, Askling, Ignell, Wahlman, & Milberg, 2007; Bergman, Askling, Ekberg, Ignell, Wahlman, & Milberg, 2004) and lichen species (Paltto, Thomasson, & Norden, 2010) are associated to oak wood-pastures. However, such wood-pastures are currently threatened by insufficient or non-existent traditional land management (Paltto, Nordberg,

Norden, & Snäll, 2011), and are severely fragmented (Bergman et al., 2004). The Swedish Environmental Protection Agency (SEPA) states that "The value of cultivated landscapes shall be protected, while the biodiversity and the cultural heritage values are preserved and strengthened" (SEPA, 2006). To operationalize this ambition requires understanding of stakeholders' benefits in terms of both material and immaterial dimensions of wood-pastures as social-ecological systems (Plieninger, Hartel, Martín-López, Beaufoy, Bergmeier, Kirby, Montero, Moreno, Oteros-Rozas, & Van Uytvanck, 2015).

The ecosystem services (ES) framework is increasingly used in environmental policy and practice (de Groot, Alkemade, Braat, Hein, & Willemen, 2010; Gómez-Baggethun, de Groot, Lomas, & Montes, 2010), and has proven useful to communicate changes in ecosystems, and to identify priority areas for policy implementation (MA, 2005; TEEB, 2010). However, biophysical assessments and economic valuation approaches have dominated ES research (Nieto-Romero, Oteros-Rozas, González, & Martín-López, 2014; Vihervaara, Rönkä, & Walls, 2010). In contrast, efforts to understand the perspectives of different groups of stakeholders on ES, as well as to document cultural ES, are less common (Chan, Guerry, Balvanera, Klain, Satterfield, Basurto, Bostrom, Chuenpagdee, Gould, Halpern, Hannahs, Levine, Norton, Ruckelshaus, Russell, Tam, & Woodside, 2012; Chan, Satterfield, & Goldstein, 2012; Daniel, Muhar, Arnberger, Aznar, Boyd, Chan, Costanza, Elmqvist, Flint, Gobster, Gret-Regamey, Lave, Muhar, Penker, Ribe, Schauppenlehner, Sikor, Soloviy, Spierenburg, Taczanowska, Tam, & von der Dunk, 2012). These aspects are, however, of paramount importance to contribute to land stewardship and management implementation strategies (Ban, Mills, Tam, Hicks, Klain, Stoeckl, Bottrill, Levine, Pressey, Satterfield, & Chan, 2013; Mascia, Brosius, Dobson, Forbes, Horowitz, McKean, & Turner, 2003).

Ecological processes operate at different spatial scales. ES generated at a certain ecological scale (i.e., plant, plot, ecosystem, landscape, biome, globe) may benefit stakeholders at different institutional scales (i.e., local, regional, national, international levels of governance) (Hein, van Koppen, de Groot, & van Ierland, 2006). Each institutional scale comprises different stakeholders, whose interests might be conflicting (Tacconi, 2000). Stakeholders at local and regional level may ascribe different values to ES based on their cultural background and upon the impact of such services on their well-being (Hein et al., 2006). It is therefore crucial to consider different spatial and institutional scales on ES valuation since it may exert a significant effect on valuation results (Martín-López, Gómez-Baggethun, Lomas, & Montes, 2009) or lead to sub-optimal management alternatives otherwise (Hein et al., 2006).

Most studies assessing stakeholders' demands for ES have been performed at the local level, and have focused on a few services and narrow stakeholder profiles (Martín-López, Iniesta-Arandia, García-Llorente, Palomo, Casado-Arzuaga, Gracía del Amo, Gómez-Baggethun, Oteros-Rozas, Palacios-Agundez, Willaarts, González, Santos-Martín, Onaindia, López-Santiago, & Montes, 2012). Grouping stakeholders in different homogeneous categories might give more accurate information on ES demands among groups of stakeholders (Martín-López, Montes, Ramírez, & Benayas, 2009). While quantitative research on socio-cultural valuation of ES has emerged (Oteros-Rozas, Martín-López, González, Plieninger, López, & Montes, 2014; Scholte, van Teeffelen, & Verburg, 2015; Villamor, Palomo, Santiago, Oteros-Rozas, & Hill, 2014), qualitative approaches based on stakeholder participation are nevertheless limited, as revealed by a recent review on ES assessments of European agroforestry systems (Fagerholm, Torralba, Burgess, & Plieninger, 2016). To tackle current ES research gaps they pointed out the need to widen research approaches with special attention to qualitative socio-cultural valuations and stakeholder participation (Fagerholm et al., 2016).

Qualitative approaches “interpret phenomena in terms of the meanings people bring to them” (Denzin & Lincoln, 2011), and are therefore fundamental to articulate the expression of ES important for people (Chan et al., 2012a; Chan et al., 2012b). We present a qualitative socio-cultural assessment of ES for the oak wood-pastures in Östergötland County in Sweden. The aim of this study is to perform an in-depth inventory of ES provided by wood-pastures as perceived by different groups of stakeholders at local and regional level. In particular we want to answer the following questions: What ES do people appreciate in the oak wood-pastures in Östergötland? Are any similarities/differences in perceived ES among stakeholders from public, private and civil sectors? Do perceived ES change at local and regional levels of governance? We then discuss the current challenges for the long-term management and conservation of oak wood-pasture landscapes, including traditional wood-pasture management practices in Sweden.

2. Material and methods

2.1. Study area

Östergötland County (58º N, 15º E) covers about 120 x 150 km^2 and is located in the south of Sweden (Figure 1). Here material (biophysical) (Bergman et al., 2007; Paltto et al., 2010; Ranius et al., 2005), and immaterial (aesthetic and recreational) values associated with oak wood-pastures are high (Garrido, 2014). Östergötland County consists mainly of forests (59%), arable land (19%), pastures (4%) and urban areas (4%), as well as exposed bedrock (8%) (Loman, 2008). Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) consist of 81% of the standing volume, broadleaved tree species 15%, and oak trees (*Quercus robur and Q. petraea*) represent about 2% of the standing volume of trees in Östergötland (Loman, 2008). Currently, remnants of valuable oak wood-pastures cover around 180 km^2 in Östergötland County (1.7% of the land area in the county; CAB, 2005; CAB, 2006). This is the focal land

cover in this study, and is are characterized by scattered patches of open wooded grasslands with pedunculate oak trees (*Quercus robur*) (Paltto et al., 2011)(Figure 1). Traditional mowed meadows and oak wood-pastures are the most species-rich habitats in Sweden (Svensson, 1988), and are also very valuable in terms of cultural heritage and recreational potential (Hasund, Kataria, & Lagerkvist, 2011). However, due to land use changes and the abandonment of traditional practices these habitats and their quality have declined dramatically over time (SBA, 2005a, 2005d). Core areas for oak wood-pastures conservation have been identified by the county board based on the Hermit beetle requirements (*Osmoderma eremita*) as focal species (Figure 1).

2.2. Data collection and analysis

To carry out a qualitative socio-cultural assessment of ES, stakeholders involved with governance and management of oak wood-pastures in Östergötland County were identified based on discussions with land owners, experts and officials from the County Administrative Board as well as through snow-balling (Atkinson & Flint, 2004). The selection included respondents that represented 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 1).

All selected respondents involved in land use, management, or governance of the studied oak wood-pastures were grouped according to two variables (Elbakidze, Angelstam, Sandström, & Axelsson, 2010). First, we defined three groups of stakeholders according to the sector 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 the public sector, which was represented by officials handling public interests through governmental agencies and local governmental units. Second, all respondents were

148 classified into two groups according to their level of activity at different institutional scales:
149 stakeholders from local (e.g., local land owners or farmers), and regional (e.g., counties or
150 governmental organizations on the level of counties) levels (Table 1).
151
152 In total, 29 semi-structured interviews (Bryman, 2008; Kvale & Brinkmann, 2009) were
153 conducted with the selected stakeholders during June to September 2013. An interview manual
154 was developed (see Appendix S1) to obtain sufficient information from all potential stakeholder
155 perspectives present in the study area. We began the interviews with a brief introduction about
156 the purpose of the study. Respondents were then asked about the perceived ES provided by oak
157 wood-pastures. Each respondent had full freedom to answer the questions. The interviews lasted
158 from 40 to 125 minutes, and were taken in Swedish or English. All interviews were digitally
159 recorded and fully transcribed.
160
161 The interviews were analysed using qualitative content analysis (Bryman, 2008). The responses
162 were translated into the ES categories (MA, 2005). The themes that emerged during the analysis
163 were coded and grouped into main categories. To identify how ES had been addressed in the
164 interviews we applied the Ecosystem Service Coding Protocol (CP) proposed by Wilkinson,
165 Saarne, Peterson, and Colding (2013) which allowed for consistence of coding among all
166 analysed interviews. The CP included four categories of ES: supporting (coded A), provisioning
167 (B), regulating (C) and cultural services (D) (MA, 2005). Additionally, each category contained
168 a number of ES (Table 2, 3). Besides the ES that were included in the CP, we incorporated a
169 number of additional ES' categories (e.g., biodiversity including species, habitats and
170 ecosystem processes; Noss, 1990) to increase the resolution on specific ES of interest from the
171 oak wood-pastures (see Table 2, 3). The informants' perceived ES were then compared among
172 different groups of stakeholders.

3. Results

3.1. Local stakeholders' perceptions on ecosystem services

Provisioning ES were the most commonly mentioned services for the private sector, mainly for landowners who practiced farming, including crop and livestock production, and forestry on their land, and whose financial income depended on such type of land use (Table 2, 3). Fodder (16/19), meat (10/19), crops (8/19) and timber (8/19) were the most mentioned ES from private sector stakeholders (Table 2). Respondents highlighted the value of the oak wood-pastures as spring-summer grazing grounds. Predominantly, farmers raised cattle for meat production. Breeding dairy cattle was in clear regression in comparison to the past. Other provisioning services were related to egg and lamb production. The cultivated crops 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*".

Coniferous forests and plantations on former agricultural land were a source of timber through commercial forestry. Local stakeholders also obtained firewood from oaks for own

consumption and some of them also produced oak timber (Table 2, 3). Commercial oak forestry was possible only for stakeholders who owned large mature oak stands (over 120 years). One respondent, 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*". Respondents also mentioned and valued game (4/19) (wild animal species for hunting), fish (pike (*Esox lucius*), perch (*Perca fluviatilis*)) and crayfish (*Pascifastacus leniuslucis*) for own consumption and to get an additional income (Table 2). However, none of the latter activities were significant for their livelihoods any longer. For an ecotourism company, the provision of mushrooms and wild berries was mentioned as important in developing traditional cooking workshops, and timber for traditional house building.

Cultural ES were the most frequently mentioned services for stakeholders from the civil and public sectors (Table 2, 3 and Figure 2). These stakeholders highlighted landscape beauty (13/19), recreation and ecotourism (13/19), cultural landscape (11/19), education and knowledge (7/19), as well as health (7/19) as services delivered by the oak wood-pastures (Table 2, 3). As one respondent commented, "*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 very much 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, and one hears only sounds of nature*". Respondents representing the public and civil sectors also

commented on the importance of accessibility of green space for public use. One local official 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*". Farmers and landowners (private sector) mentioned the importance of traditional farming, knowledge and legacy for the conservation of cultural values of oak wood-pastures. 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*". A local ecotourism company also acknowledged recreational values, and traditional knowledge in handcrafting, pruning techniques, and pastoralism. Local private stakeholders also valued landscape beauty (9/16), cultural landscape (7/16), cultural heritage values (6/16), recreation and eco-tourism, (6/16) and well-being and health (5/16) as important services from oak wood-pastures (Table 3). 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 (Table 2, 3 and Figure 2) were expressed in terms of species (10/19) and ecosystem functions (5/19), and mentioned as an important intrinsic quality of the oak landscape. Respondents from all sectors (Table 3) strongly emphasized species richness connected to oak wood-pastures, and stressed the importance of cattle grazing and multi-purpose land management to maintain an open landscape structure, and thus enhance the

generation of ES such as landscape beauty, recreation and eco-tourism and identity (Table 2, 3). Nevertheless, local officials claimed that there were not enough farmers to maintain the oak wood-pastures 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 respondents mentioned that the EU and the Swedish government provided subsidies for organic farming and landscape restoration. As one landowner expressed it "*I do a lot of work and get money for that, from the rural development program*". Another respondent, a cattle holder, stated 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*". Private sector respondents were concerned about species richness and proud of having endangered species in their land. 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 an endangered species*". Other stakeholders commented the importance of protecting oak seedlings for the future, whereas others stressed 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 of wood-pastures. 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 (1/19), and noise regulation (2/19) (Table 2).

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*".

3.2. Regional stakeholders' perceptions on ecosystem services

Provisioning ES were highlighted by private sector stakeholders (Table 2, 3 and Figure 2). They emphasized provisioning ES as outcomes of traditional landscape management supported by EU subsidies, and specially fodder (3/10), meat (3/10) and timber (3/10) (Table 2). 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 wood-pastures with high natural values were overgrown by encroaching vegetation and needed restoration. A civil sector respondent perceived game as a valuable service by saying: "*Wild boar is probably the most common game today. Then I think it is fallow deer, then moose, red deer, roe deer*…".

Cultural ES were perceived in terms of landscape beauty (7/10), recreation and eco-tourism (8/10) services and, education and knowledge (5/10) (Table 2, Figure 2) by stakeholders from all sectors at regional level. Respondents from the civil sector also pointed out the aesthetic component of the wood-pastures and its importance for human well-being (Table 3). One respondent from the civil sector stated regarding hunting activities: "*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 wood-pastures was also commonly mentioned as a precondition to enjoy nature. One respondent explained "*It is rather easy bird watching in the oak landscape. There are prepared tourists areas, bird watching towers etc.*". Regarding the recreational values of oak wood-pastures 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. That it is why people like this oak landscape". Regional officials highlighted the significance of historical remains, as well as educational values and knowledge systems (Table 2, 3). The latter can be exemplified in the following claim: "*In this landscape you could arrange guiding tours for specialists where you show certain species, ecological problems such as extinction debt and so on*". Tourism services were also considered by regional officials as a potential viable solution to help farmers financially, and therefore to maintain oak wood-pastures in the future, taking into account the current constrains, i.e. lack of farmers and farmland (livestock to graze oak wood-pastures), and financial limitations (low farming profitability). "*From a nature management perspective 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 3, Figure 2). The most mentioned service was species richness (9/10) related to the mosaic habitat of wood-pastures and red-listed species (Table 2). The respondents from the civil sector stressed the importance of the oak landscape for species that were exclusively associated or dependent of this kind of landscapes. For instance, one respondent stated: "*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*". Private sector respondents explained that they set-aside forest patches for biodiversity conservation purposes (at least 5%, normally broadleaved species) in the commercially used forest stands according to forest certification schemes. The state owned forest company Sveaskog did the same, but the percentage of set aside productive land was much higher. Regional officials were concerned about the urgent need for restoration of the two

thirds of the former wood-pasture landscapes with high natural values that currently had been abandoned and overgrown.

Regulating ES were not mentioned by respondents at regional level.

4. Discussion

4.1. The oak wood-pasture landscape in eyes of stakeholders

Our study shows that the oak wood-pastures exerted a multi-functional character by delivering multiple ES to stakeholders from different sectors at local and regional level (Table 2, 3). The most mentioned ES were recreation and eco-tourism, and landscape beauty as cultural ES, biodiversity in terms of species richness as supporting ES, and fodder (pastures) and meat (from livestock) as provisioning ES (Table 2, 3 and Figure 2). These results are in line with other socio-cultural valuation studies on ES of wood-pastures. For example, Oteros-Rozas et al. (2014) reported that nature recreation activities, rural tourism, and livestock were considered among the most important ES for social well-being among stakeholders in Spain. This may be a consequence of urban users increasingly demanding environmental education and, recreational and eco-tourism activities (Martín-López et al., 2012).

There were differences in the perception of ES among local and regional stakeholders. While local respondents appreciated cultural and provisioning ES the most, regional stakeholders highlighted cultural and supporting ES (Table 2). There were also differences in the demand of ES among the different sectors. Public sector respondents mentioned regulating ES such as nutrient cycling (Table 3), and provisioning ES were highly appreciated by private stakeholders. Furthermore, civil and private sector respondents perceived noise reduction as an important

345 regulating service delivered by the oak wood-pasture landscape, while the public sector stressed
346 water regulation and purification.
347
348 Considering supporting ES, all respondents mentioned biodiversity, but while the civil sector
349 emphasized primarily species, the private and especially public sector respondents mentioned
350 structural and functional aspects of biodiversity (Table 3). Overall, cultural ES were the most
351 appreciated services among all sectors and levels of governance. Thus, we argue that cultural
352 ES may play an important role and aid to elucidate current drivers of land use change which
353 may be also fundamental to tackle potential future management issues (Szücs, Anders, &
354 Bürger-Arndt, 2015). Additionally, integrative approaches, such as High Nature Value (HNV)
355 farming systems (Oppermann, Beaufoy, & Jones, 2012), may become valuable tools to
356 understand the connections of ecosystem functioning and associated ES, as well as the role of
357 the different components of wood-pasture landscapes (Plieninger et al., 2015; Sohel, Ahmed
358 Mukul, & Burkhard, 2015).
359
360 Grouping stakeholders into different homogeneous categories as done in this study, provides
361 more accurate information on ES demands among different groups of stakeholders (Martín-
362 López et al., 2009), and therefore might lead to more optimal landscape stewardship and land
363 management strategies (Hein et al., 2006). The plural demands and changes in wood-pastures as
364 complex social-ecological systems stress the need for further investigation of multiple ES
365 provision in relation to land use change, and to consider the relationship between supply and
366 demand of ES (Wolff, Schulp, & Verburg, 2015). Andersson, Nykvist, Malinga, Jaramillo, and
367 Lindborg (2015) demonstrated that contrasting management intensities in Swedish farming
368 systems generate different supply and demand of ES, and the value (demand) ascribed to certain
369 services also differed among respondents. In our study, for example, cultural heritage was only

mentioned locally by private sector respondents, which might imply that the value ascribed to some ES need to be experienced in order to be valued (Chan et al., 2012a; Chan et al., 2012b).

The ES delivered by wood-pastures are co-generated by coupled human-nature interactions, and have therefore recently been considered as social-ecological services (Huntsinger & Oviedo, 2014). In Swedish wood-pastures, as well as in other traditional pastoral systems such as of California's Mediterranean and Iberian wood-pastures, the provision of ES are the result of traditional land use practices as a necessary condition for the delivery of multiple services (Bugalho et al., 2011; Huntsinger & Oviedo, 2014). In Sweden, an economic valuation based on people's preferences on agricultural landscapes (Hasund et al., 2011) showed that oak wood-pastures scored the highest among other agricultural land-cover categories, and highlighted the public's positive attitude towards their maintenance. We found that ES important for different stakeholders were not only related to the biological or aesthetic values of the landscape *per se*, nor to its recreational potential alone. Additionally, accessibility in order to get desired benefits in terms of outdoor recreational activities was also highlighted.

4.2. Challenges to maintain oak wood-pasture landscapes

Throughout Europe the importance of wood-pasture landscapes has been recognized (Bergmeier et al., 2010; Eichhorn et al., 2006). However, wood-pastures are still subjected to changing processes and are thus commonly becoming degraded and fragmented (Bergmeier et al., 2010). Current threats such as urban sprawl, land abandonment or agricultural intensification entail even greater uncertainty for the long term conservation of valuable wood-pasture landscapes at the European level (Bergmeier et al., 2010; Bugalho et al., 2011; Moreno & Pulido, 2009; Plieninger et al., 2015). Similarly in Sweden, oak wood-pasture landscapes are deteriorating due to (1) land abandonment and the absence of livestock (CAB, 2005), (2) active transformation of agricultural land to Norway spruce plantations (Paltto et al., 2011), and (3)

habitat fragmentation (Öckinger, Bergman, Franzén, Kadlec, Krauss, Kuussaari, Pöyry, Smith, Steffan-Dewenter, & Bommarco, 2012). All these three processes have negative effects for biodiversity and richness of specialized species of oak wood-pasture habitats (Paltto et al., 2011; Öckinger et al., 2012). Additionally, the beauty of wood-pastures also attract people to live closer to such areas in Östergötland, which promotes further fragmentation of wood-pasture habitats due to urbanization and grey infrastructure development (Lättman, Bergman, Rapp, Tälle, Westerberg, & Milberg, 2014). According to regional public officials, two thirds of the former oak wood-pastures with high nature values in the study area need to be restored to sustain biodiversity and ES important for people. This calls for applying landscape restoration initiatives to maintain biodiversity levels in the long term while supplying valuable ES for people. Restoration of oak wood-pastures is of limited effect unless they are maintained in the long term by traditional grazing regimes and recruitment of large oak trees is secured. Therefore the role of farmers and management practices to maintain the oak wood-pastures is fundamental. In contrast, such management practices (grazing) are currently of marginal profitability, which endangers the overall land-use system and the provision of those ES important for people. Farmers also stated hard working conditions, lack of financial support and concerns about new entrants into farming. Oak regeneration failure was also mentioned and perceived as compromising the long term conservation of wood-pastures. Other activities such as recreation and eco-tourism have already been emphasized as a potential alternative for rural development (van Berkel & Verburg, 2011), promoting the generation of external incomes and thus fostering landscape conservation (Buijs, Pedroli, & Luginbühl, 2006). Research on farmers' perceptions of agroforestry systems in seven European countries revealed that with appropriate promotion, support, and extension services, agroforestry practices may be a plausible alternative for rural development (Graves, Burgess, Liagre, Pisanelli, Paris, Moreno, Bellido, Mayus, Postma, Schindler, Mantzanas, Papanastasis, & Dupraz, 2009). Additionally,

holistic landscape planning and management is crucial for integrating both traditional (forestry and agriculture) and emerging sectors' (tourism and outdoor recreation) into oak wood-pasture landscape conservation (Plieninger, 2006). Such holistic landscape approach should include conservation incentive schemes, environmental education, and technical assistance (Pinto-Correia, 2000; Plieninger, Modolell y Mainou, & Konold, 2004).

5. Conclusion

Oak wood-pastures demonstrate a multi-functional character by delivering multiple ES to stakeholders from different sectors at local and regional level. The most mentioned ES were recreation and eco-tourism, and landscape beauty as cultural ES, biodiversity in terms of species richness as supporting ES, and fodder (pastures) and meat (from livestock) as provisioning ES. There were differences in the perception of ES among local and regional stakeholders. While local respondents appreciated cultural and provisioning ES the most, regional stakeholders highlighted cultural and supporting ES. Cultural ES were the most appreciated services by all sectors at local and regional level of governance, and might thus play an important role for wood-pasture conservation. Traditional management practices, especially related to grazing regimes, are crucial for the sustainable provision of ES in wood-pastures. However, such practices are in steady regression, which entails greater uncertainty for wood-pasture conservation and associated diversity of ES, important for humans. European policy plays an important role in steering funding priorities for agri-environmental schemes. To integrate the different demands of stakeholder groups into policy and to enable cross-sectorial flexibility policy and regional adaptation for wood-pasture conservation, is a current challenge future research should focus upon.

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Table 1. Number of interviews with stakeholder representing different sectors at local and regional level in Östergötland County, Sweden.

Table 2. Ecosystem services as perceived by respondents at local and regional level of governance. Integers represent number of respondents who mentioned a particular service. The categories were adapted from Wilkinson et al. (2013). In parenthesis, the total number of respondents at that level, is represented.

Table 3. Ecosystem services as perceived by respondents from civil, private and public sectors. Integers represent number of respondents who mentioned such service. The categories are adapted from Wilkinson et al. (2013). In parenthesis, the number of respondents per sector, is represented.

	Local level	**Regional level**	**Total**
Civil	Environmental NGOs (2)	Hunting association (1) Ornithological association (1)	**4**
Private	Farmers and landowners (8) Oak management expert (1) Common Agricultural Policy consultant (1) Hunter (1) Ecotourism company (1)	Forest companies (2) Farmers association (1) Tourist guide (1)	**16**
Public	Municipal officials (5)	Regional officials (3) Regional Forest agency (1)	**9**
Total	**19**	**10**	**29**

A. Supporting Services	**Local (n=19)**	**Regional (n=10)**	**B. Provisioning Services**	**Local (n=19)**	**Regional (n=10)**
A1. Water cycling	0	0	B1. Food Agriculture		
A2. Soil formation	0	0	B1a. Crops	8	0
A3. Nutrient cycling	1	0	B1b. Fodder	16	3
A4. Primary production	0	0	B1c. Meat	10	3
A5.Photosynthesis	0	0	B1d. Milk	3	2
A6. Biodiversity			B2. Wild food		
A6a. Species	10	9	B2a. Wild game	4	1
A6b. Structure	2	4	B2b. Berries and mushrooms	1	0
A6c. Function	5	4	B2c. Fish and crayfish		
			B2d. Other	4	0
			B3. Fresh water	4	0
			B4. Water-energy	1	0
			B5. Water-transportation	0	0
			B6. Biochemicals/genetic	0	0
			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***	**68**	**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	0	0	D3. Heritage	6	0
purification	1	0	D4. Historical remains	4	3
C4. Disease and pest			D5. Sense of place	4	0
regulation	0	0	D6. Aesthetic	5	3
C5. Natural hazard			D7. Landscape beauty	13	7
regulation	0	0	D8. Inspirational	2	0
C6. Erosion regulation	0	0	D9. Recreation and eco-	13	8
C7. Pollination	0	0	tourism		
C8. Seed dispersal	0	0	D10. Education and	7	5
C9. Noise regulation	2	0	Knowledge		
			D11. Health	7	2
			D12. Human original landscape	1	1
			D13. Spiritual and Religious		
			values	1	0
Total-Regulating	**3**	**0**	***Total-Cultural***	**77**	**33**

A. Supporting ecosystem services	**Civil (n=4)**	**Private (n=16)**	**Public (n=9)**	**B. Provisioning ecosystem services**	**Civil (n=4)**	**Private (n=16)**	**Public (n=9)**
A1. Water cycling	0	0	0	B1. Food Agriculture			
A2. Soil formation	0	0	0	B1a. Crops	0	8	0
A3. Nutrient cycling	0	0	1	B1b. Fodder	0	15	4
A4. Primary production	0	0	0	B1c. Meat	0	8	5
A5.Photosynthesis	0	0	0	B1d. Milk	0	4	1
A6. Biodiversity				B1e. Other	0	0	0
A6a. Species	3	7	9	B2. Food wild			
A6b. Structure	1	2	3	B2a. Wild game	1	4	0
A6c. Function	1	4	4	B2b. Berries and mushrooms	0	1	0
				B2c. Fish and crayfish	0	4	0
Total supporting ecosystem services	**5**	**13**	**17**	B2d. Other	0	4	0
				B3. Fresh water	0	1	0
C. Regulating ecosystem services				B4. Water-energy	0	0	0
				B5. Water-transportation	0	0	0
C1. Climate regulation	0	0	0	B6. Biochemicals/genetic resource	0	0	0
C2. Air quality regulation	0	0	0				
C3. Water regulation and purification	0	0	1	B7. Fiber	0	7	3
				B7a. Timber	0	3	0
C4. Disease and pest regulation	0	0	0	B7b. Wood	0	1	0
C5. Natural hazard regulation				B7c. Other			
C6. Erosion regulation	0	0	0	B8. Fuel	0	2	0
C7. Pollination	0	0	0	B8a. Firewood	0	0	0
C8. Seed dispersal	0	0	0	B8b. Charcoal	0	1	0
C9. Noise regulation	0	0	0	B8c. Peat/soil energy	0	1	0
	1	1	0	B8d. Other			
Total regulating ecosystem services	**1**	**1**	**1**	***Total provisioning ecosystem services***	**1**	**64**	**13**
D. Cultural ecosystem services							
D1. Social relations	1	3	0				
D2. Cultural landscape	3	7	4				
D3. Heritage	0	6	0				
D4. Historical remains	1	3	3				
D5. Sense of place	0	3	1				
D6. Aesthetic	2	1	5				
D7. Landscape beauty	3	9	8				
D8. Inspiration	0	2	0				
D9. Recreation and eco-tourism	4	6	9				
D10. Education and Knowledge	4	4	4				
D11. Health	1	5	3				
D12. Human original landscape	0	1	1				
D13. Spiritual and Religious	0	1	0				
Total cultural ecosystem services	**19**	**51**	**38**				

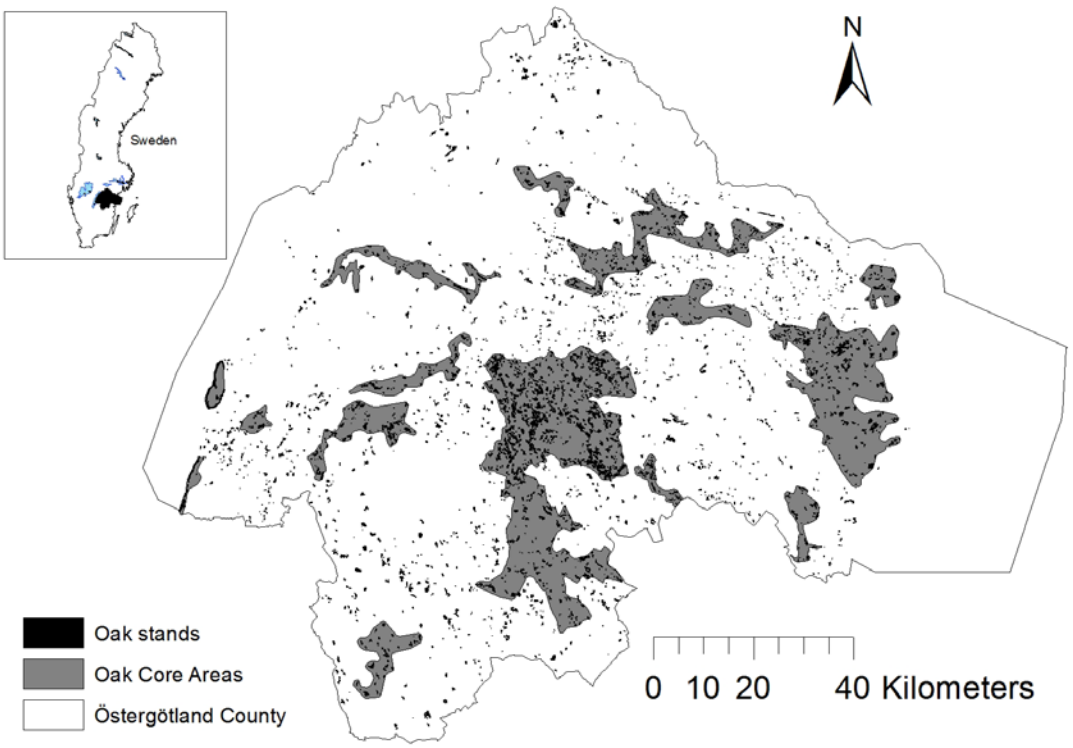

Figure 1. The Östergötland County study area and its location in Sweden. Oak stands with high nature values (black areas) are shown as well as oak core areas for conservation priority (grey areas) (CAB 2005).

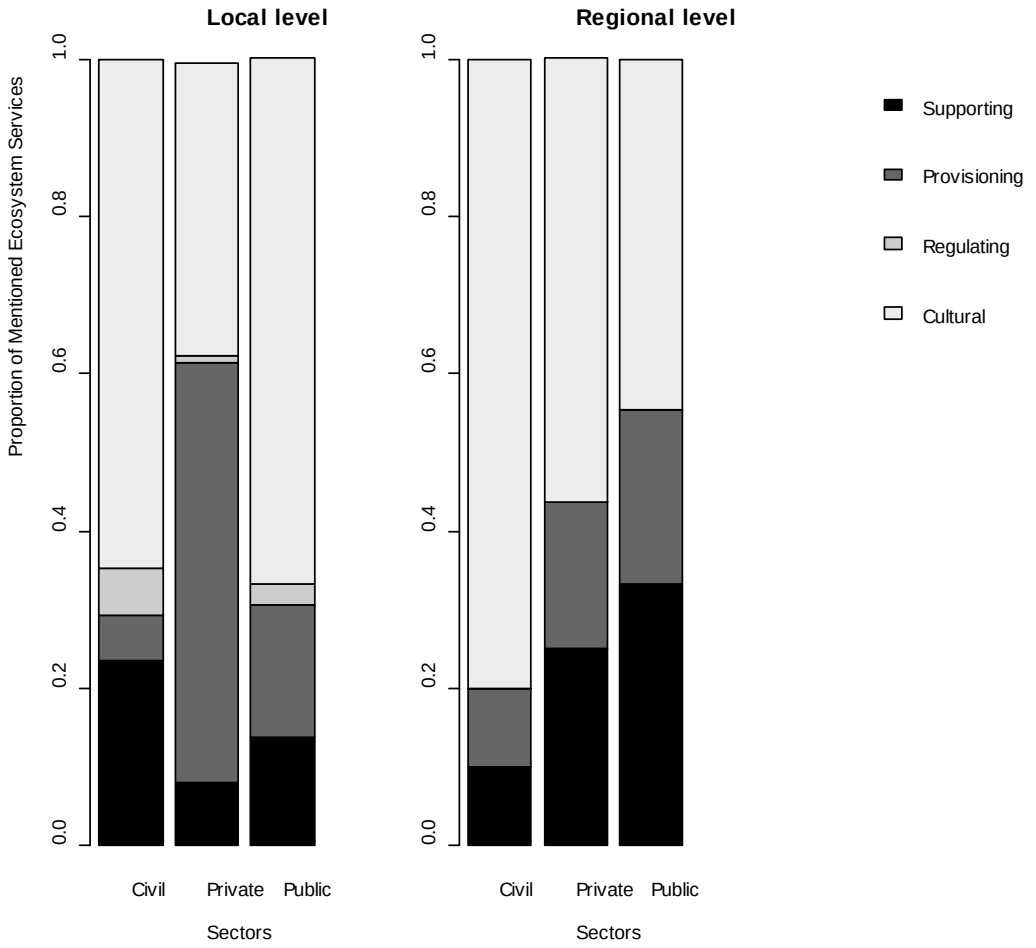

Figure 2. Relative proportion of ecosystem services mentioned by stakeholders at local and regional level of governance representing civil, private and public sectors.