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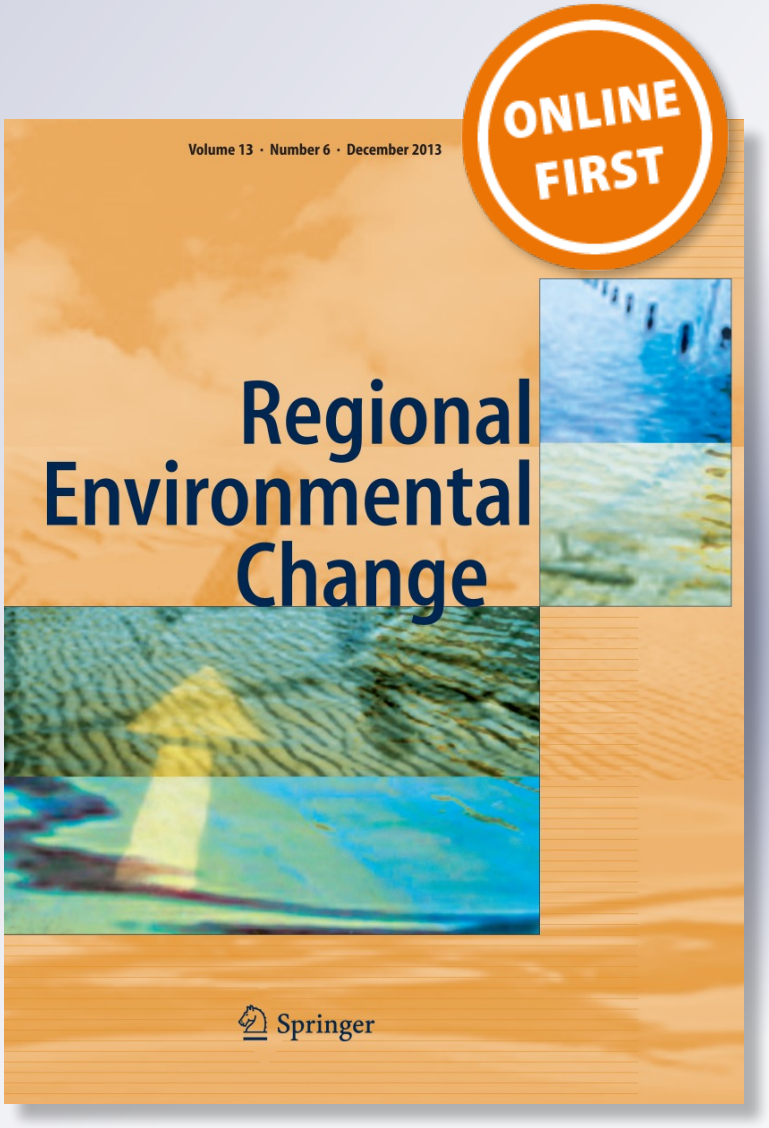

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ORIGINAL ARTICLE

Socio-cultural valuation of ecosystem services in a transhumance social-ecological network

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Abstract The ecosystem services framework is receiving increasing attention in the fields of policy and research. The assessment of human attitudes and perceptions regarding ecosystem services has been proposed as a promising tool for addressing complex problems associated with environmental change, particularly in the context of cultural landscapes. Transhumance is not only a farming practice responsible for shaping cultural landscapes but also an adaptive strategy based on mobility that may represent a useful approach to overcoming the growing challenges posed by accelerated environmental change. A socio-cultural valuation of ecosystem services associated with the Conquense Drove Road, one of the major transhumant networks still in use in Mediterranean Spain, was conducted via the distribution of questionnaires to 416 local residents and visitors to capture their perceptions regarding the importance of 34 ecosystem services (10 provisioning, 12 regulating, and 12 cultural) for both social and personal well-being. Overall, the ecosystem services considered to be the most important for social well-being were fire prevention, air purification and livestock. Most of the ecosystem services in question were perceived as declining, with the exception of those associated with recreation, scientific knowledge and environmental education. This study revealed that perceptions regarding the value of ecosystem services differed among respondents, depending on their age, place of origin and gender. Several methodological issues, as well as the implications of socio-cultural valuation for policy making, are also discussed here.

Keywords Drove roads · Ecosystem services · Human well-being · Perception · Rangelands · Spatial and temporal locations · Value

E. Oteros-Rozas (✉) · B. Martín-López · J. A. González · C. A. López · C. Montes
Social-Ecological Systems Laboratory, Universidad Autónoma de Madrid, Madrid, Spain
e-mail: elisa.oterosrozas@wur.nl

E. Oteros-Rozas
Public Administration and Policy Group, Wageningen University, Wageningen, The Netherlands

T. Plieninger
Department of Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen, Denmark

Introduction

The ecosystem services framework is increasingly being used in environmental management policy and practice (e.g., de Groot et al. 2002; TEEB 2010; Gómez-Baggethun et al. 2010; Hauck et al. 2013). Clear indications of this trend include the recent creation of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) and the call from the European Union for all member countries to map and assess their ecosystem services by 2014 (European Commission 2011). Such efforts are being built on the science of ecosystem services, which has been fostered globally over the past 10 years (Fisher et al. 2009; Vihervaara et al. 2010). The original objective of ecosystem services assessments was to clarify the multiple interdependencies between human well-being, ecosystems and biodiversity (Daily 1997). Ecosystem services assessments have been performed at different spatial scales (from global to local; MA 2005; EME 2011; Pereira et al. 2005), from various value perspectives (i.e., biophysical, socio-cultural and economic), and with a range of objectives, such as policy-making support, ecosystem services markets information, or academic aims. The central focus of policy-

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oriented assessments has been to depict the current state, trends and drivers of change in ecosystem services at the national, sub-global and global levels. Local- or regional-scale valuations can also provide important information for larger-scale assessments, as they permit a more in-depth understanding of certain social-ecological systems, ecosystem services and/or land uses. At the same time, local- and regional-scale valuations provide local or regional decision makers with information regarding ecosystem services, their trade-offs and people's preferences, revealing that the interests of social agents may cause them to value ecosystems differently, depending on the ecosystems' capacity to provide services that fulfil their own interests (Martín-López et al. 2012).

The mainstreaming of ecosystem services in the policy context has resulted in the application of this framework not only for its original purpose (i.e., as an educational concept to raise public interest concerning biodiversity conservation and human dependence on ecosystems) but increasingly for the quantification of ecosystem services as potentially marketable commodities (Peterson et al. 2010; Gómez-Baggethun et al. 2010). Ecosystem services research has been shaped by the integration of ecological and economic perspectives, which has contributed to a better understanding of human–nature relationships (Turner and Daily 2008); however, several important factors to consider in ecosystem services research have been overlooked by these economic and ecological approaches (Chan et al. 2012a). For example, to date, most studies have focused primarily on monetary and biophysical perspectives, while very few studies have chosen to explore socio-cultural preferences regarding ecosystem services (Vihervaara et al. 2010; Martín-López et al. 2012; Nieto-Romero et al. in press). Hence, the value of ecosystem services should be assessed by focusing not only on the biophysical and the economic dimensions of their value but also on the socio-cultural dimension (Cowling et al. 2008; de Groot et al. 2010), as these three value dimensions can provide complementary information about ecosystem services (Martín-López et al. 2013). If values are defined as "the preferences, principles and virtues that we (up)hold as individuals or groups" (Chan et al. 2012a), valuation methods are not ideologically neutral (Gómez-Baggethun et al. 2010) but rather are culturally constructed and, as such, act as value-articulating institutions that are hence responsible for the articulation of decision-making processes related to the environment (Vatn 2005; Martín-López et al. 2013). Non-economic valuations are particularly appealing, as they offer insights into the motivations for conserving ecosystem services, which are frequently invisible in monetary valuations. Socio-cultural valuation approaches appear to be appreciated in understanding the diversity of values emerging from the ecosystem services spectrum and in analysing how human well-being may be affected by ecological change (Chan et al. 2012a, b). In the present study, we focus specifically on the socio-cultural valuation of ecosystem services.

Socio-cultural valuation approaches specifically explore human attitudes and perceptions regarding ecosystem services; thus, they may be a particularly relevant tool for valuating ecosystem services in landscapes that have been shaped by long-term human impacts, namely, in so-called "cultural landscapes" (Martín-López et al. 2012). Mediterranean cultural landscapes have developed as a result of the close coevolution of human societies and biophysical systems (Blondel 2006). In such landscapes, high degrees of biodiversity (Myers et al. 2000) and resilience (Cabell and Oelofse 2012) are particularly linked to cultural values and to social behaviours and perceptions. Within cultural landscapes, agroecosystems have been recognised as important providers of ecosystem services (Swinton et al. 2007; Zhang et al. 2007; Power 2010; Harrison et al. 2010; Lamarque et al. 2011a; Nieto-Romero et al. in press). Increasing calls for sustainable agriculture are also drawing attention to the social-ecological nature of agroecosystems and to the idea that agriculture produces landscapes that are at once social, cultural, and ecological (Wittman 2009; Bacon et al. 2012). Agroecosystems supply provisioning services, such as food and fibre; regulating services, such as soil fertility and pollination; and cultural services, such as ecotourism, local ecological knowledge and cultural identity. Recently, Seppelt et al. (2011), Vihervaara et al. (2010) and Nieto-Romero et al. (in press) have called for more research specifically focused on ecosystem services provided by agroecosystems. Robertson and Swinton (2005), among others, have proposed that a stronger understanding of the services provided by agroecosystems is needed if depletion trends are to be reversed. Specifically, the ecosystem services framework could help minorities to effectively communicate the multidimensional value of their practices to society (Chan et al. 2012b), which could be particularly valuable for peasants and pastoralists.

Particularly since the 1960s, Mediterranean agroecosystems have become increasingly vulnerable to the pressures of global drivers of change (e.g., Gómez-Baggethun et al. 2010; EME 2011) that have (a) favoured the maximisation of outputs from single ecosystem services (mainly food production) over the traditional multifunctional mosaic in fertile areas (Gordon et al. 2010) and (b) triggered rural abandonment of less productive and remote areas (Caraveli 2000; Bugalho et al. 2011; García-Llorente et al. 2012). Pastoral practices in the Mediterranean are renowned for significantly contributing to biodiversity, especially in mountain ecosystems and rural areas (Hatfield et al. 2006). Heikkinen et al. (2012) have recently discussed whether herding should be viewed as a user and/or a producer of ecosystem services. Some of the ecosystem services for which clear links to

pastoralism and transhumance in particular have been demonstrated include (a) provisioning, such as meat and dairies (Harrison et al. 2010; Lamarque et al. 2011b), (b) regulating, such as seed dispersal (Manzano and Malo 2006) and tree regeneration (Carmona et al. 2013) and (c) cultural services, such as traditional ecological knowledge (Oteros-Rozas et al. 2013a), cultural identity (López-Santiago et al. in press) and recreational values (Pereira et al. 2005). Current livestock farming systems in mountains and other less-favoured areas are considerably diverse (Ruben and Pender 2004) and, as farming systems in general, are constantly changing in response to biophysical and socio-economic drivers (Mottet et al. 2006); as such, their study is of particular interest in the context of the on-going environmental change. Pastoralism in particular is a vulnerable practice that is globally declining (Dong et al. 2011) but which may, however, be crucial for food security under global climate change (Krätli et al. 2012).

Transhumance is a customary practice consisting of the regular, seasonal migration of livestock between summer pastures (usually highlands or more extreme latitudes) and winter pastures (lowlands or latitudes closer to the equator) (Ruiz and Ruiz 1986). As with other adaptive strategies based on mobility (Agrawal 2008), transhumance is important as a useful strategy for dealing with the growing challenges posed by accelerated environmental change (Oteros-Rozas et al. 2013a). Consequently, however, of the progressive integration of animal production into the global market economy, as well as of the sedentarisation policies and institutional constraints that disfavour nomadic lifestyles, mobile pastoralism is globally declining (Davies and Hatfield 2007; Galvin 2009). The decline of transhumant practices is contributing to the current trend towards the decreased capacity of Mediterranean agroecosystems to provide a diverse flow of ecosystem services (Gordon et al. 2010) and to their lowered social-ecological resilience to global change (Oteros-Rozas et al. 2012a).

Here, we conceptualise the transhumance cultural landscape as a social-ecological network (Janssen et al. 2006), that is, as a "network of biophysical and social flows generated and maintained by the movement of herders and livestock" (Oteros-Rozas et al. 2012b). Our overall aim is to explore the socio-cultural perceptions of ecosystem services provided by such a transhumance social-ecological network. Our specific objectives are (1) to analyse perceptions of the "social" (for the well-being of society) and "personal" (for the well-being of the respondent) importance of ecosystem services and compare them; (2) to assess perceptions of ecosystem services' trends and their importance for social well-being; (3) to explore the perceived spatial and temporal locations of the delivery of ecosystem services; (4) to relate the socio-demographic characteristics of respondents to their perceptions of important ecosystem services and (5) to explore the perceived role of transhumance in the delivery of ecosystem services. Figure 1 shows the relationships established among these objectives. Finally, we discuss the political and practical implications for safeguarding ecosystem services provided by transhumant pastoralism.

Methods

Study area: the Conquense Drove Road social-ecological network

Transhumance has persisted in Spain from ancient times to the present, although with a different structure and at a much smaller scale than in the past (Bunce et al. 2006; Manzano and Malo 2006; Fernández-Giménez and Fillat 2012). The most recent estimates tally approximately 250,000 transhumant sheep, of which 90 % are moved by truck and 10 % by foot (MARM 2011). Recent increases in oil and fodder prices appear to be motivating some shepherds to resume transhumance on foot (Oteros-Rozas et al. 2012a; Fernández-Giménez and Fillat 2012). This tentative revitalisation is made more feasible by an existing public network of drove roads that connect winter and summer pasturelands—covering 125,000 km in length and 422,000 ha in overall area and comprising 0.83 % of the entire country (Cazorla et al. 2008)—which has been granted legal protection (Drove Roads Act, Ley 3/1995). The network is formed by nine main Royal Drove Roads (*cañadas reales,* 75 m wide) and hundreds of smaller droves (*cordeles, cordones* and *veredas*).

Our study area covers a total of 15,297 km^2 in 77 municipalities and is divided into three areas related to transhumance through the Conquense Drove Road (CDR): a summering area, a wintering area and the drove road itself (Fig. 2). The CDR is the most extensive drove road in Spain (approximately 410 km long) that is still in use by herders to migrate cattle and sheep on foot.

The CDR's summering area is located in the eastern forests of the Montes Universales (Teruel, Guadalajara, and Cuenca provinces) and is characterised by semi-deciduous and coniferous forests (largely transformed by humans into pine plantations) mixed with agricultural patches of fodder crops. From July to October, sheep and cattle herds graze in these highland pastures, and in early November, when primary productivity drastically decreases, shepherds and herds start the 25- to 30-day journey along the drove road that crosses the central Iberian plateau, predominantly a cultivated landscape (mostly vineyards and fields containing sunflowers, cereals and olive orchards). The wintering area is located in southeastern Sierra Morena and in the southern fields of Castilla-La Mancha and north of Andalusia (Ciudad Real and Jaén provinces), characterised by a

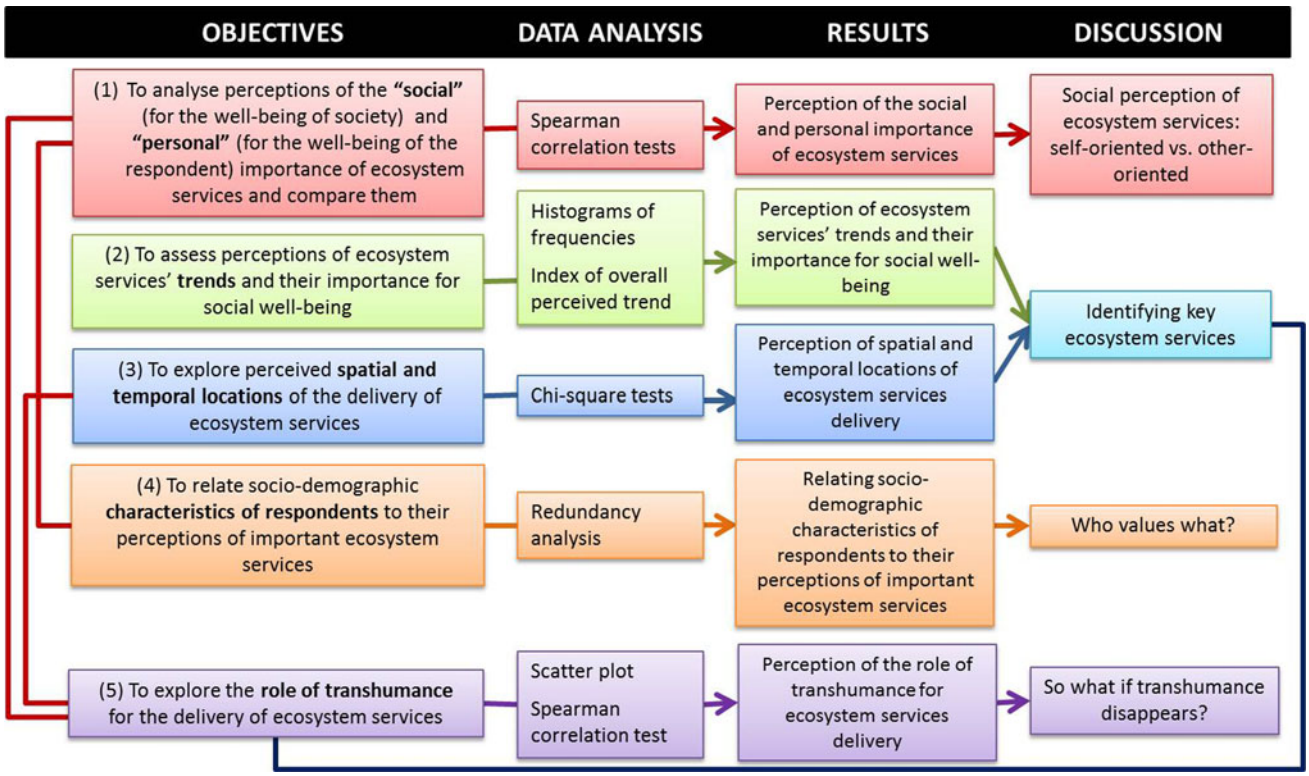

Fig. 1 Roadmap of the paper indicating the links between the specific objectives, the data analyses and the corresponding Results and Discussion sections

typical Mediterranean *dehesa* landscape (agrosilvopastoral ecosystems, consisting of pasturelands with scattered trees, primarily holm oaks). The altitude of the study area ranges from 270 m (wintering area) to 1,930 m (summering area).

Every year, between 13 and 17 transhumant shepherds with nearly 9,000 ovine heads and 1,200 cows walk the drove road (Oteros-Rozas et al. 2012a); however, these constitute only 17 % of transhumants in the study area, as most livestock (approximately 57,000 heads) are transported between the summering and the wintering areas by truck.

Data collection

Data were collected in three consecutive steps: (1) review of background information, (2) semi-structured interviews and (3) systematic data collection (survey). Steps (1) and (2) provided the groundwork necessary to document the ecosystem services that would later be valued through the questionnaire (3). In the first step (1), a preliminary identification and characterisation of ecosystem services was performed by reviewing previous work on ecosystems and ecosystem services related to pastoralism and livestock movements in general and to transhumance in particular (Oteros-Rozas et al. 2012b). The second phase (2) consisted of semi-structured interviews ($N = 58$) with key informants, selected via a snowball sampling technique (Bernard 2005). Informants included shepherds (33 %), farmers (21 %), hunters (19 %), decision makers (23 %), employees from the tertiary sector (8 %) and university researchers (6 %). Interviewees were asked about the "direct and indirect contributions of ecosystems in the study area to the well-being of people" to complete the identification of ecosystem services performed in the first step (1). According to the results of steps (1) and (2), a total of 34 ecosystem services were identified: 10 provisioning, 12 regulating, and 12 cultural ("Appendix 1"). Drawing on the information gathered in the first two steps (i.e., the identification of ecosystem services provided by the ecosystems of the study area), a questionnaire was then designed, pre-tested ($N = 20$) and applied through face-to-face conversations with a sample of respondents ($N = 416$) representative of both the local population and visitors of the study area in 39 sampling points (Fig. 2). The sample population was restricted to individuals older than 18 years of age. All incomplete questionnaires were excluded from the analysis (final $N = 381$, Table 1). Field work was conducted from May 2009 to March 2010 by E.O.R, J.A.G. and B.M.L., together with a team of six trained field assistants with a background in environmental sciences.

The questionnaire included items on the socio-cultural valuation of ecosystem services (general as well as those

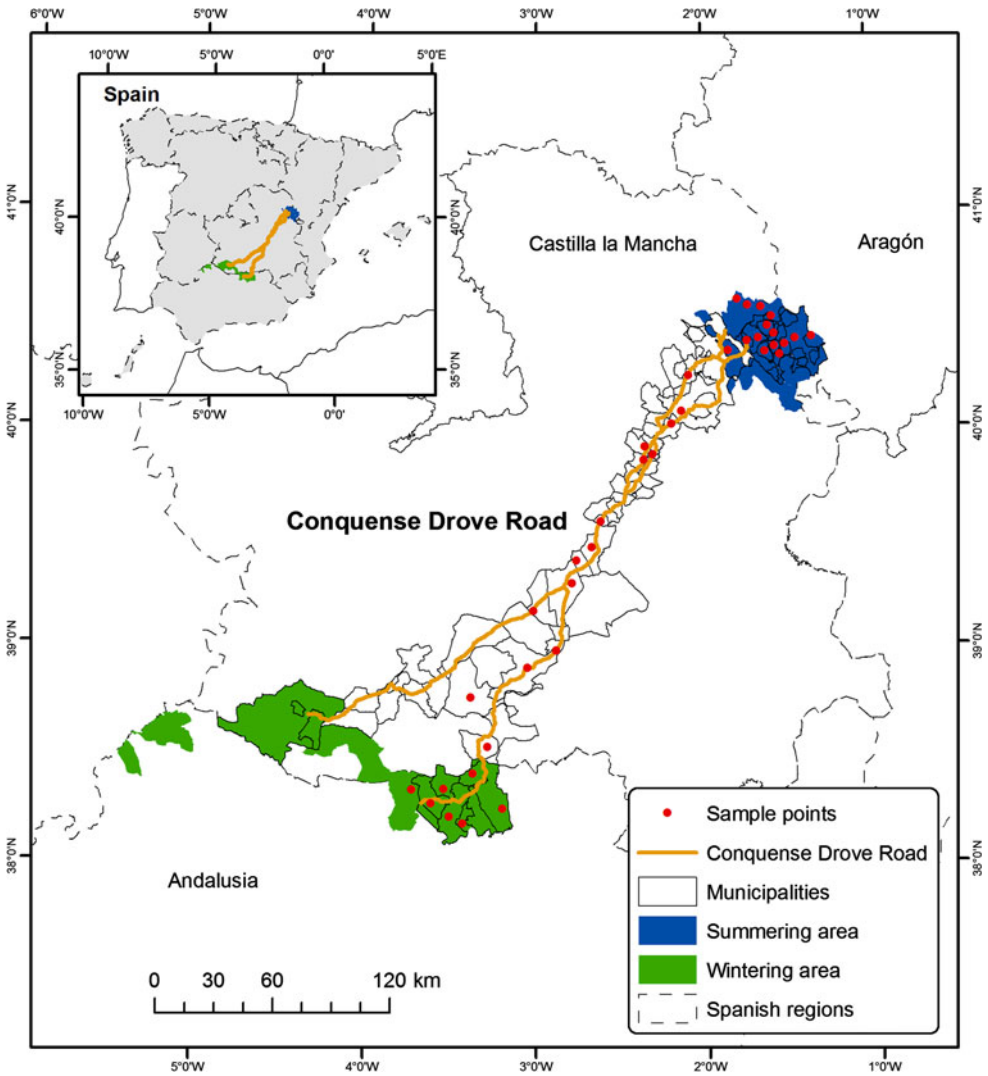

Fig. 2 Map of the study area. *Red dots* indicate sampling points

specifically related to transhumance), on environmental awareness and behaviour (e.g., readers of environmental publications, members of environmental associations, visitors of protected areas) and on socio-demographic characteristics (e.g., age, gender, income) of the respondents (objective 4). For the valuation of ecosystem services, respondents were (1) given a brief explanation regarding the study area (with the assistance of a map). Next, they (2) received a brief explanation of the ecosystem services concept, i.e., "the benefits that ecosystems provide for human well-being." Other studies have shown that participants may not be familiar with the term "ecosystem services" (Plieninger et al. 2013); however, by providing explanations, we were able to avoid this issue. Afterwards, the participants were asked to what extent they considered the ecosystems of the study area to provide services to society (nothing, little, some or much), and they were asked to list the ecosystem services they perceived. The interviewer then presented three visual panels ("Appendix 2") listing, describing and presenting examples and pictures of the 34 ecosystem services (provisioning, regulating and cultural) identified by the research team. We then asked respondents to select, from the 34 ecosystem services listed in the panels ("Appendix 2"), the three ecosystem services they considered to be the most important for social well-being and to rank them in terms of their importance (objectives 1, 4 and 5). Subsequently, we enquired where (wintering, summering and/or drove road) respondents perceived those ecosystem services to be, as well as when (summer, autumn, winter and/or spring) they were primarily delivered (objective 3). Afterwards, we asked which trend (increasing, decreasing or stable) the chosen ecosystem services appeared to be following (objective 2). Respondents then scored each of the three selected ecosystem services according to their importance for their own personal well-being (objective 1). Finally, they selected a maximum of three ecosystem services that would be lost or degraded if transhumance on foot (as opposed to by truck)

Table 1 Characteristics of the sample

	Frequency	%
Sampling area		
Summering	97	25.46
Wintering	118	30.97
Drove road	166	43.57
Residence		
Local summering	63	16.54
Local drove road	143	37.53
Local wintering	111	29.13
Non-local	64	16.80
Family		
From the study area	262	68.77
From somewhere else	199	31.23
Protected areas (PA)		
Visitor	287	75.33
Non-visitor	94	24.67
Reading environmental publications		
Never	56	18.54
Rarely	119	39.40
Frequently	87	28.81
Always	40	13.25
Home garden/organic food		
Never	55	14.44
Rarely	65	17.06
Frequently	180	47.24
Always	81	21.26
Recycling		
Never	59	15.49
Rarely	34	8.92
Frequently	62	16.27
Always	226	59.32
Gender		
Men	223	58.53
Women	158	41.47
Age		
<20	7	1.84
20–30	88	23.10
31–40	99	25.98
41–50	102	26.77
51–60	54	14.17
61–70	25	6.56
>70	6	1.58
Educational level		
None	11	2.89
Primary school	99	25.98
Secondary school	129	33.86
University	142	37.27
Professional background		
Primary sector	44	11.55
Secondary sector	7	1.84
Tertiary sector	261	68.5
Student	14	3.67
Education/research	39	10.24
Retired	16	4.2
Monthly net income (Euros)		
<700	68	17.85
700–1,400	189	49.61
1,401–2,100	75	19.69
2,101–2,800	28	7.35
>2,801	12	3.15
Not declared	9	2.35

disappeared (objective 5). Two models of the questionnaires and panels ("Appendix 2"), each having different orders of the ecosystem service listings, were used to avoid position bias (Bateman et al. 2002).

Data analysis

In relation to objective (1), the importance for social well-being was expressed as a mean, calculated according to the position in the ranking (1st = 3; 2nd = 2 and 3rd = 1), and the importance for personal well-being was calculated as the mean score (no importance = 1; little importance = 2; some importance = 3; very important = 4) that interviewees assigned to the selected ecosystem services for the satisfaction of their personal well-being. A Spearman correlation test was used to explore associations between personal and social well-being.

To address objective (2), we depicted histograms of frequencies for the perception of the trends followed by ecosystem services and developed an index reflecting the overall perceived trend as:

$$\text{overall perceived trend} = \left[\frac{I - D}{I + D + M}\right]$$

where I = frequency of "increases"; D = frequency of "decreases"; M = frequency of "is stable".

To explore the perception of the temporal and spatial location of ecosystem services delivery (objective 3), we performed Chi square tests to analyse the associations between the delivery of ecosystem services and season (i.e., winter, spring, summer or autumn) or location (i.e., wintering area, drove road or summering area). The significant associations for each season/location were then graphically represented.

Regarding objective (4), we performed a redundancy analysis (RDA) to identify socio-demographic factors underlying the importance of particular ecosystem services for social well-being (Martín-López et al. 2012). A Monte Carlo permutation test (500 permutations) was performed to determine the significance of independent variables in influencing perception of the importance of ecosystem services for social well-being. The inertia of the factors was used to identify the most important variables, according to socio-cultural perceptions.

To accomplish objective (5), namely, to explore perceptions of the relationship between transhumance and the delivery of ecosystem services considered to be important for social well-being, we employed a scatter plot and a Spearman correlation test to compare the portion of subjects that believed a particular ecosystem service would be lost or degraded if transhumance disappeared with the portion of subjects agreeing that a particular ecosystem service is important for social well-being.

Results

Perception of the social and personal importance of ecosystem services

Among the provisioning services, livestock, food from agriculture and the genetic pool were considered to be the most important for social well-being and were also scored among the most important for personal well-being, together with feed for animals and food from hunting. The ecosystem services considered to be most important for social well-being were all regulating: air purification, followed by habitat for species and fire prevention (Fig. 3, "Appendix 3"). In addition, tree regeneration, microclimate regulation and hydrological regulation were also frequently selected as important for social well-being. All regulating services, with the exception of biological control and ditch maintenance,[1] were scored as considerably important (>3) for personal well-being. The cultural services perceived as most important for social well-being were cultural identity and spiritual value. Other services considered to be important for personal well-being included tranquillity/relaxation, scientific knowledge, environmental education, bullfighting events, aesthetic value and local ecological knowledge. A significant positive correlation was found between the average importance score for social well-being and the average importance score for personal well-being ($\rho = 0.582$; p value <0.001).

Perception of ecosystem services' trends and their importance for social well-being

The index of overall perceived trends showed that the delivery of most ecosystem services was perceived as either decreasing or stable, with the exception of three cultural services (Fig. 3): nature recreation activities, scientific knowledge, and rural tourism. In contrast, livestock, fire prevention and air purification were the most frequently perceived as decreasing. Fire prevention, however, was also perceived as increasing by 49 % of the population sampled, thus indicating some dissent within the population. Considering the index of overall perceived trends and the averages of importance for social and for personal well-being, the ecosystem services showing the strongest decreasing trends but the highest importance for human well-being at different scales were air purification and hydrological regulation. In contrast, two out of the three increasing ecosystem services (i.e., nature recreation activities and rural tourism) were perceived as being among the least important for both social and personal well-being.

Perception of spatial and temporal locations of ecosystem services

Participants in the study perceived a differentiated delivery of ecosystem services at each time of year (Fig. 4a) and in the three different areas involved (Fig. 4b). Different cultural services were related to each of the four seasons: recreational hunting in autumn and winter; rural tourism in summer; and nature recreation and aesthetic value in spring. Provisioning services, in contrast, were perceived to be provided primarily in autumn (gathering) and winter (fibres). Some regulating services were particularly associated with spring (connectivity and seed dispersal, tree regeneration and pollination), and fire prevention was perceived to be preferably delivered in summer.

Only four ecosystem services were considered to be significantly more highly associated with a particular area (Fig. 4b). Fire prevention was clearly perceived to be provided in the summering area. The drove road was particularly related to food from agriculture, maintenance of soil fertility and as the way of cultural exchange.

[1] Particularly in the summering area, the ditches (where herbaceous vegetation tends to proliferate due to higher humidity) are grazed by sheep, hence avoiding accumulation of potentially inflammable biomass and facilitating the drainage of rain so that roads are not flooded. The cleaning of biomass from the ditches is usually performed mechanically, but sheep grazing also delivers this service.

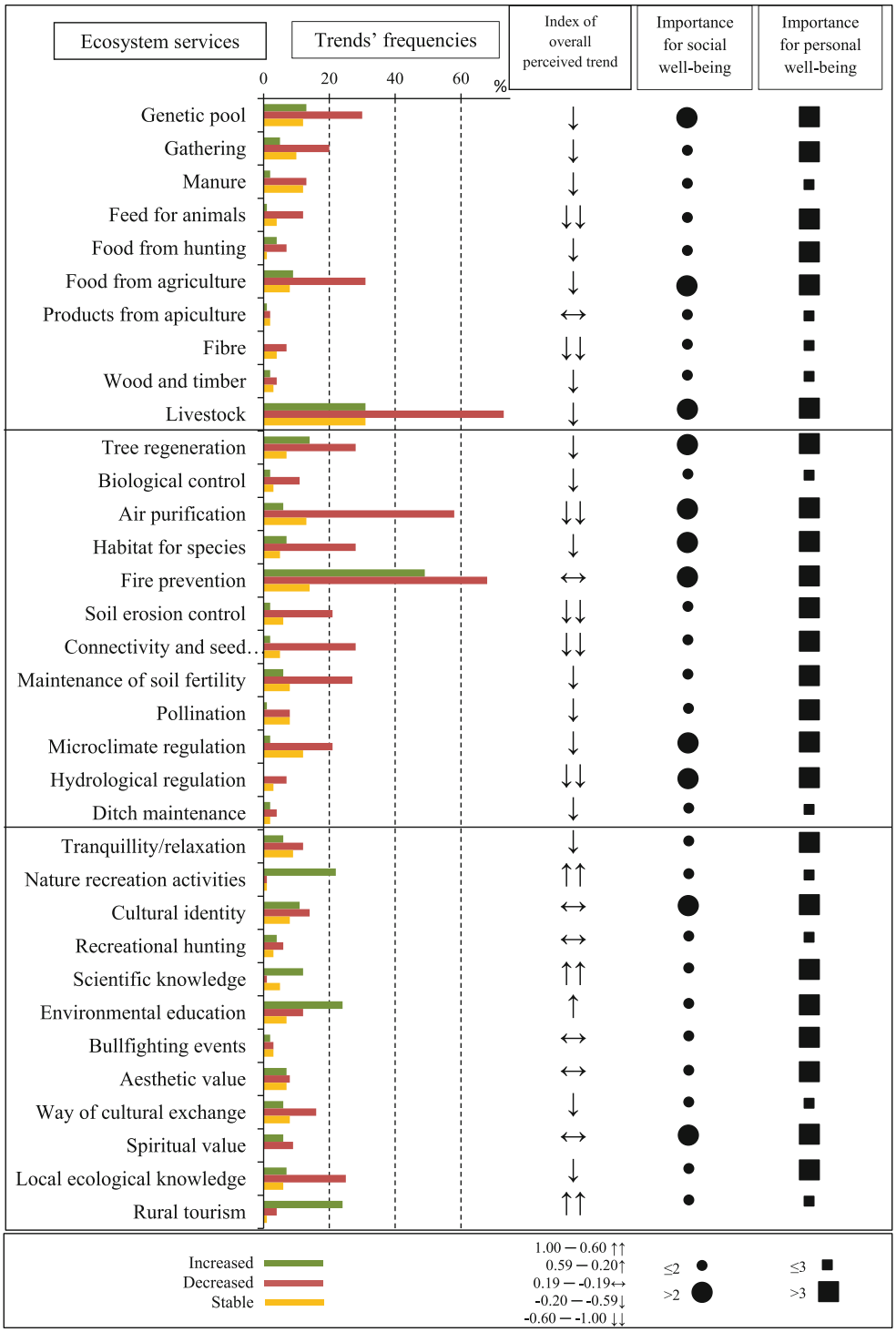

Fig. 3 Perceived trends in ecosystem services and their importance for social and personal well-being. For "Trend frequencies": "Increased" represents the percentage of respondents selecting an ecosystem service that they considered to be increasing; "Decreased" represents the percentage of respondents that consider an ecosystem service to be decreasing; and "Stable" represents the percentage of respondents who believed that an ecosystem service is not changing. For more details regarding social well-being and personal well-being, see the "Methods" section and "Appendix 3"

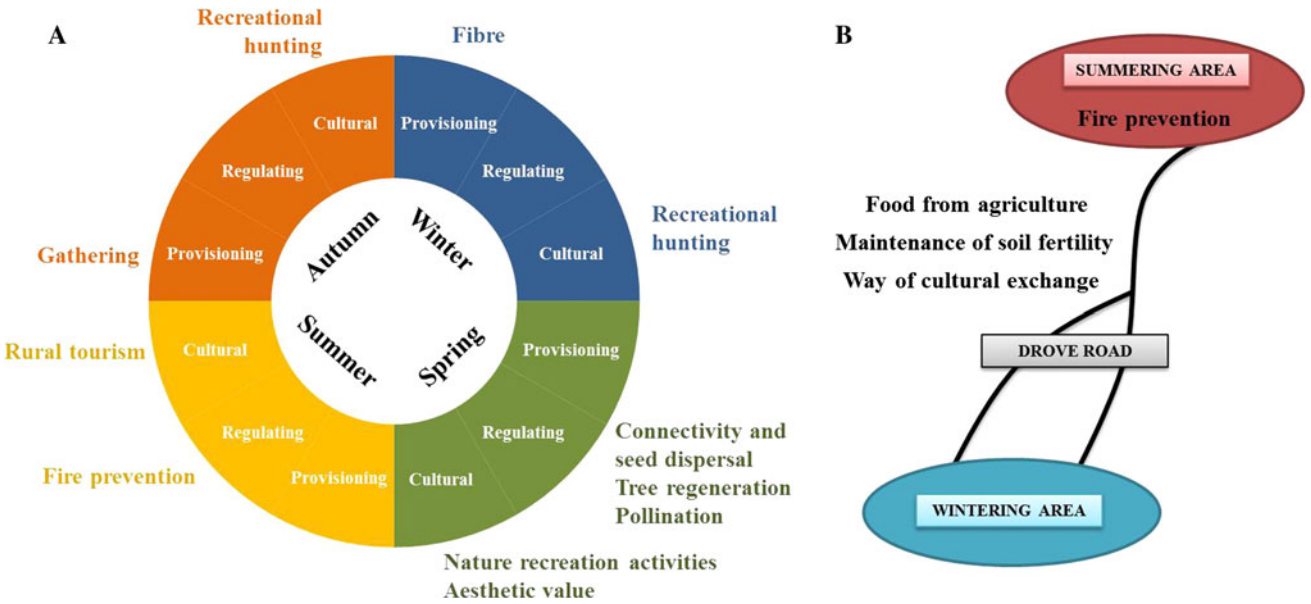

Fig. 4 **a** Significant associations between seasons of the year and ecosystem services delivery perceived by respondents and determined by χ^2 tests (p value <0.05). **b** Significant associations between spatial location and ecosystem services delivery perceived by respondents and determined by χ^2 tests (p value <0.05)

Relating socio-demographic characteristics of respondents to their perceptions of important ecosystem services

The RDA indicates a statistically significant relationship between the ecosystem services perceived as being important for social well-being and the socio-demographic characteristics of respondents (p value <0.0001, from 500 permutations). The three principal axes of the RDA accounted for 71 % of the total variance (Table 2). The first axis was positively related to local ecological knowledge, fire prevention, soil erosion control and feed for animals, which were primarily selected by elders, readers of environmental literature, locals from the summering areas and/or farmers. The negative values on this axis were related to air purification, ditch maintenance and food from agriculture, preferentially selected by locals from the drove road area (Fig. 5).

In the positive extreme of the second axis, we found nature recreation activities, maintenance of soil fertility, pollination and gathering, mainly selected by older interviewees living in the wintering area. On the negative side of axis 2, people with higher educational levels, higher income levels, and/or not living in the study area tended to perceive species' habitat and the genetic pool as important (Fig. 5).

Finally, along the third axis, bullfighting events, connectivity and seed dispersal, manure and livestock were grouped on the positive side and were identified by locals from the summering area, men and/or farmers. Meanwhile, on the negative side of this axis were tree regeneration and soil erosion control, usually selected by interviewees employed in research or education, women and/or people with higher educational and/or income levels.

Perception of the role of transhumance for ecosystem services delivery

A positive correlation ($\rho = 0.616$; p value <0.001) was found between the percentage of the sample that believe an ecosystem service would be lost/degraded if transhumance disappeared and the percentage of people considering a particular ecosystem service to be important for social well-being. Livestock and fire prevention were perceived as highly important for social well-being and related to transhumance (Fig. 6). The perception of the delivery of certain regulating services (tree regeneration, maintenance of soil fertility and connectivity and seed dispersal) and cultural services (local ecological knowledge, way of cultural exchange and cultural identity) were noted by 7–13 % of the sample as being closely related to the existence of transhumance and were largely thought to be decreasing but important for social well-being. Finally, 60 % of the ecosystem services perceived as being important for social well-being were considered to be related to the maintenance of transhumance.

Table 2 Scores for the redundancy analysis variables and statistics

	Axis 1	Axis 2	Axis 3
Dependent variables (ecosystem services)			
Provisioning			
Genetic pool	−0.098	**−0.441**	0.036
Gathering	−0.043	**0.122**	−0.020
Manure	0.063	0.032	**0.129**
Feed for animals	**0.153**	−0.068	−0.011
Food from hunting	−0.052	0.019	0.050
Food from agriculture	**−0.277**	0.192	−0.024
Products from apiculture	−0.001	0.024	−0.010
Fibre	−0.019	0.001	0.001
Wood and timber	−0.026	0.030	0.007
Livestock	0.071	0.216	**0.324**
Regulating			
Tree regeneration	−0.074	0.061	**−0.373**
Biological control	−0.034	−0.047	0.016
Air purification	**−0.674**	−0.035	0.187
Habitat for species	−0.091	**−0.319**	−0.056
Fire prevention (natural hazard)	**0.769**	0.006	0.084
Soil erosion control	**0.220**	−0.009	**−0.220**
Connectivity and seed dispersal	0.023	0.048	**0.187**
Maintenance of soil fertility	0.051	**0.130**	−0.086
Pollination	0.058	**0.146**	0.012
Microclimate regulation	−0.084	−0.010	−0.103
Hydrological regulation	−0.020	−0.023	−0.078
Ditch maintenance	**−0.058**	−0.048	−0.007
Cultural			
Tranquillity/relaxation	−0.075	0.088	−0.040
Nature recreation activities	−0.113	**0.040**	−0.035
Cultural identity	0.127	−0.200	0.041
Recreational hunting	−0.051	0.017	0.027
Scientific knowledge	0.031	0.028	−0.003
Environmental education	−0.069	0.163	−0.166
Bullfighting events	0.003	−0.030	**0.081**
Aesthetic value	−0.003	−0.047	−0.024
Way of cultural exchange	0.053	−0.015	0.011
Spiritual value	0.065	−0.022	0.073
Local ecological knowledge	**0.180**	−0.069	0.045
Rural tourism	−0.020	0.018	−0.007
Explanatory variables			
Age (ln)	**0.189**	**0.248**	−0.086
Educational level	0.031	**−0.156**	**−0.181**
Income	0.056	**−0.108**	**−0.162**
Environmental readers	**0.203**	−0.062	−0.078
Local: drove-road	**−0.187**	0.066	−0.047
Local: summering	**0.210**	−0.032	**0.109**
Local: wintering	−0.025	**0.130**	0.025
Non-local	0.065	**−0.211**	−0.077
Men	0.088	−0.096	**0.109**
Women	−0.088	0.096	**−0.109**
Farmers	**0.228**	0.076	**0.136**
Education/research	0.010	−0.022	**−0.163**
Eigenvalue	0.237	0.096	0.083
% Variance explained	40.867	16.506	14.278
Cumulative % of variance explained	40.867	57.372	71.650
Total inertia	1.977	0.798	0.691

Bold values represent those ecosystem services (dependent variables) with a squared cosine>0.3 and those explanatory variables with scores>0.1

Discussion

Socio-cultural valuation has proved to be a useful approach that enables the identification of a range of ecosystem services. Although several ecosystem disservices can also be identified in relation to the study area (e.g., dirtiness in some areas of the drove road that, as public spaces, might be misused as dumpers), we did not explore them in the present study. Furthermore, trade-offs among ecosystem services were not analysed in this case, but have already been explored through a participatory scenario planning exercise (Oteros-Rozas et al. 2013b). In the following four sections, the five objectives are addressed in accordance to the corresponding results presented (Fig. 1): in the first sub-section ("Social perception of ecosystem services: self-oriented versus other-oriented"), the assessment of ecosystem services' importance for social and personal well-being (objective 1) is discussed; objectives 2 and 3, regarding perceptions of trends and spatial and temporal locations in the delivery of ecosystem services, are addressed in the second sub-section ("Identifying key ecosystem services"); the identification of links between socio-demographic factors and ecosystem services perception (objective 4) is addressed in the sub-section titled "Who values what?"; finally, the perception of the role of transhumance for ecosystem services delivery is discussed under the sub-section titled "So what if transhumance disappears?".

Social perception of ecosystem services: self-oriented versus other-oriented

Social scientists have documented that, when an individual expresses values based on the benefits (consequences) that something offers him or her, this response also reflects an implicit willingness to contribute to a moral cause (Kahneman and Knetsch 1992) and can thus be regarded as a measure of an index of support for a morally right or just

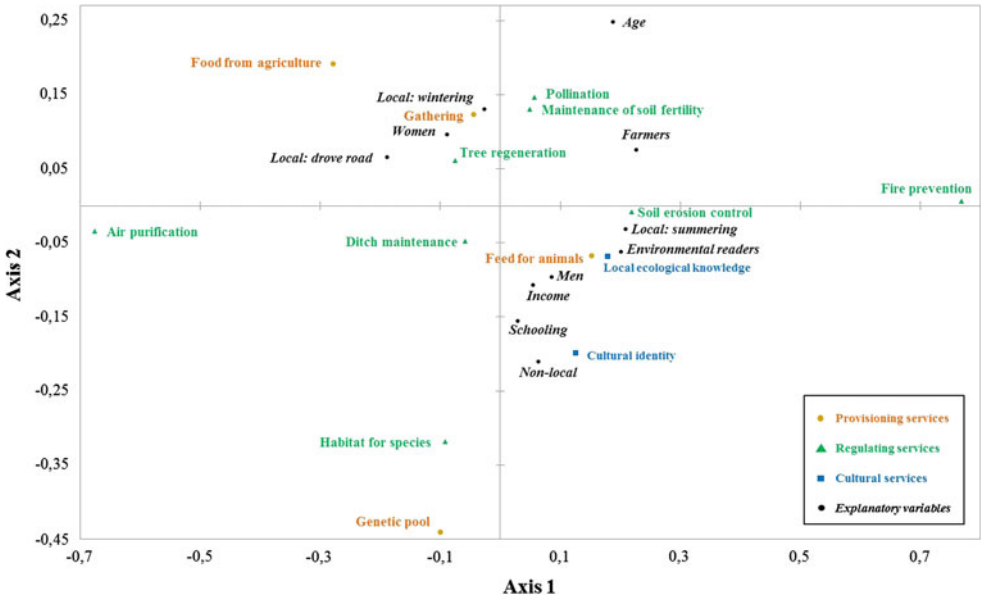

Fig. 5 *Scatter plot* showing the first two axes of the Redundancy Analysis (RDA). The tags shown correspond to active variables (ecosystem services) with a squared cosine >0.3 in either axis 1 or axis 2 of the RDA and to explanatory variables (socio-demographic, in *italics*)

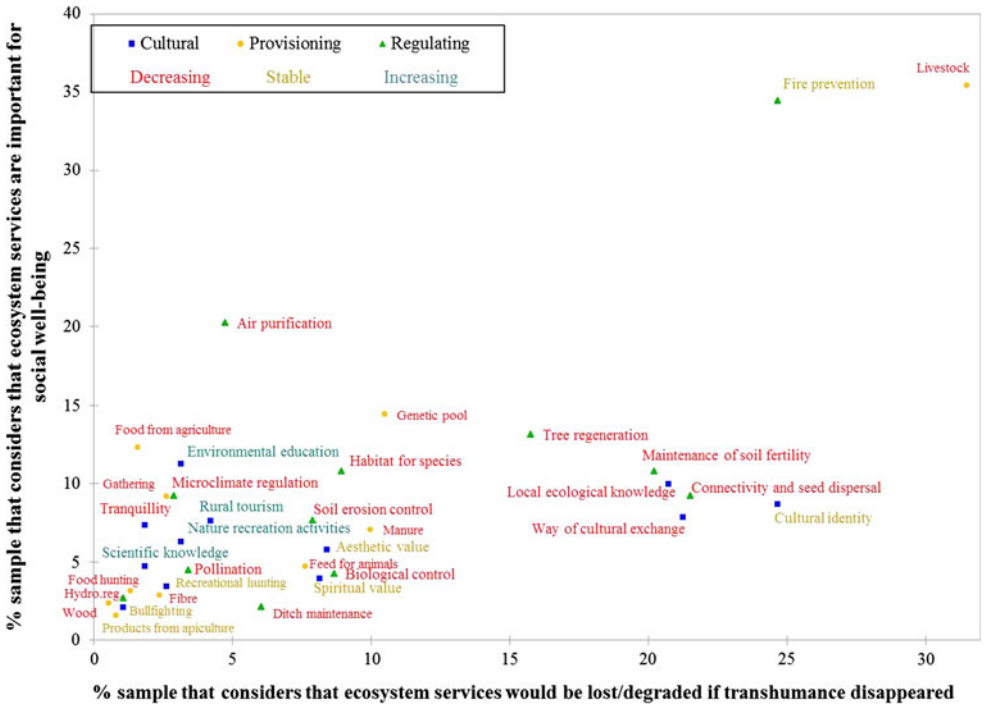

Fig. 6 Scatter plot of the percentage of respondents believing that ecosystem services would be degraded or lost if transhumance disappeared (*x* axis) and the percentage of respondents considering particular ecosystem services important for social well-being (*y* axis). *Symbol* indicates type of ecosystem service, and *tag colour* corresponds to the overall perceived trend (see Fig. 1)

society but not as an individual preference (Sagoff 1998). Accordingly, respondents were primarily asked to select ecosystem services according to their importance for social well-being and, afterwards, score them according to their personal importance. The combination of the two approaches allowed us to distinguish between self-oriented and other-oriented preferences (Chan et al. 2012a). The significance of the scale of perceptions in socio-cultural ecosystem services assessment is important because each perspective can provide different types of information. While perception of the importance of regulating services was similar for both social and personal well-being, these patterns differed regarding cultural and provisioning services ("Appendix 3"). When asked about social well-being, a subjective perception of general needs and preferences was apparent: in this case, respondents tended to give higher values to provisioning services. When questioned about personal well-being, subjective values became even more clear, and higher values corresponded to cultural services. Based on our results, we suggest that both

personal and social well-being scales should be explored in future socio-cultural valuations.

Identifying key ecosystem services

Only three ecosystem services were perceived as increasing: nature recreation activities, rural tourism and environmental education (Fig. 3). All of these are ecosystem services demanded mainly by urban users (EME 2011; Martín-López et al. 2012), and two are related to recreation, which is consistent with the results of previous studies in Europe (e.g., Harrison et al. 2010). Our findings are not surprising, considering that the rural development policies within existing European and Spanish policies have arguably widened the gap between intensively productive areas and abandoned or extensively managed areas. The tertiary sector of the economy, particularly tourism and recreation, has been promoted as a source of income diversification in disadvantaged areas. These strategies have, on the one hand, provided some rural communities with economic alternatives in the face of lowered market competitiveness of European agrarian products, therefore downshifting or reversing abandonment. On the other hand, the substitution of primary and secondary sector activities with tertiary sector activities (mainly tourism) has triggered abandonment of most low-impact extensive and traditional farming practices and their related cultural landscapes (Caraveli 2000).

Ecosystem services that are considered to be important for social well-being and that are thought to be in decline should be regarded as key ecosystem services and should, therefore, receive priority attention in decision-making processes. In the study area, regulating services (air purification and hydrological regulation in particular) and food provision (genetic pool—e.g., landraces and livestock breeds—as well as food from agriculture and from livestock) displayed an overall decreasing trend, despite being very important for both social and personal well-being.

Moreover, we found that the perceived delivery of key ecosystem services varied according to spatial and temporal locations. On the one hand, we found that all ecosystem services related to the drove road are decreasing (Fig. 4b), specifically food from agriculture and maintenance of soil fertility, which are considered to be important for personal well-being. These ecosystem services are likely associated with the drove road because the road is frequently embedded in a matrix of croplands. On the other hand, our results indicate that some of the ecosystem services that are delivered primarily during one season, such as fire prevention or tree regeneration, are also important for personal well-being (Fig. 4a). In this context, a calendar of ecosystem services functions as an interesting tool to (a) depict possible complementary activities (e.g., gathering and recreational hunting in the autumn and the winter, and recreation activities in the summer) and (b) identify different possible interpretations of ecosystem functions or survey questions (e.g., fire prevention is perceived as being provided mostly in the summer, when fire frequency is highest, while the accumulation of inflammable biomass occurs primarily during the spring).

The case of fire prevention merits specific attention. Fire hazards constitute a common concern of the Spanish population, and fire prevention was identified as a key ecosystem service in the study area. Fire occurrence has been recognised as negatively associated with livestock grazing (Zumbrunnen et al. 2012). The experience of natural hazards influences human perception of social-ecological dynamics and, therefore, determines the socio-cultural value of ecosystem services. Preferences, such as those for biophysical processes, are context-specific (Johnson et al. 2012). This survey was conducted in 2010, but what might the results have been if we had repeated the survey in the summer of 2012? In that year, fire hazards were particularly frequent and severe: the number of fire events larger than 500 hectares increased by 154 %, and the area affected increased by 250 %, relative to the average values of the previous 5 years (MAGRAMA 2012). Socio-cultural valuation is therefore particularly advisable in the case of natural hazard prevention, because it can be used as (a) an early warning of ecosystem services deterioration and (b) a proxy for risk perception of the increasing probability of natural hazards. Here, the dissensus observed in the perceived trend of fire prevention could be attributed to a misunderstanding of this ecosystem service; although we tried to clarify that we were referring to the benefits provided by ecosystems—that is, "natural prevention by herbivorous consumption of biomass"—some interviewees may very well have been thinking in the context of "human prevention" (with public investment in mechanical means). This type of misinterpretation can be considered a caveat; hence, we should use caution when interpreting the results regarding this particular service. The proposed index of an overall perceived trend is particularly interesting when a strong consensus regarding the perceived trend exists, thereby permitting the synthesis of information. Such an index is not as helpful, however, (1) when there is a clear dissensus among respondents (e.g., fire prevention) or (2) when attempting to measure the degree of perception (e.g., fire prevention and aesthetic value appear to be equally 'stable' even though there is a large difference in their perceived trends). A possible improvement to this index might involve efforts to overcome such caveats.

Who values what?

Individuals perceive and therefore value ecosystem services differently according to their socio-cultural backgrounds (e.g., Castro et al. 2011; Lamarque et al. 2011a;

Martín-López et al. 2012; van Berkel and Verburg 2014; Plieninger et al. 2013). Analyses such as the RDA (Fig. 5), which explore the association between ecosystem services and socio-cultural factors, can be used to identify ecosystem service bundles based on social perceptions (Martín-López et al. 2012). In the case presented here, most of the ecosystem services that were perceived differently among respondents were regulating and provisioning. Particularly, non-locals and locals from the three different areas valued different ecosystem services, likely because certain types of values cannot be adequately appreciated without first being experienced (Chan et al. 2012a). Locals from the drove road perceived food from agriculture to be important for social well-being, while locals from the summering area expressed a greater appreciation for food from livestock, likely reflecting the relative importance of these farming practices in each of the local economies. Awareness and familiarity with local surroundings have been previously identified as important determinants of landscape perception (Soini et al. 2012).

Age was also a significant factor influencing perception of the relative importance of ecosystem services for social well-being. While older people typically perceived local ecological knowledge, nature recreation activities, soil fertility and erosion control, fire prevention, pollination and gathering as important, younger people more often perceived food from agriculture, air purification, habitat for species and the genetic pool as important services. Is this observation a sign of a change in preferences consonant with life experience? Is there an intergenerational change in values? Or does it signal, perhaps, a change in the ecosystem services delivered? It seems likely that a confluence of these three factors is occurring. Needs change over the course of a lifetime, usually in relation to one's main occupation. While the elders enjoy recreation and value their local knowledge, the young may have received more formal environmental education and therefore value regulating services; additionally, as active workers, the young are likely to value food production activities and thus food provision services. Further research should be conducted in this regard.

A gender difference also emerged in the valuation of ecosystem services: while men tended to consider the most important ecosystem services to be those related to raising livestock (i.e., livestock, manure, connectivity and seed dispersal and bullfighting events), women typically perceived regulating services (i.e., tree regeneration and soil erosion control) as more valuable. Gender differences in the valuation of ecosystem services have previously been identified (Martín-López et al. 2012) and explained, in accordance with gender-differentiated environmental awareness (Dietz et al. 2002) and the gender division of work (Rocheleau et al. 1996; Reyes-García et al. 2010).

So what if transhumance disappears?

The existence of transhumance is perceived to be an influencing element in the delivery of ecosystem services, some of which (more than half), particularly fire prevention and livestock, are valued as highly important for human well-being. Policy action toward the conservation of transhumance on foot can positively influence the delivery of ecosystem services in the study area, particularly tree regeneration, maintenance of soil fertility, connectivity, seed dispersal, local ecological knowledge, way of cultural exchange and cultural identity, as well as the resilience of the social-ecological network (Oteros-Rozas et al. 2012a). Transhumance, as a mobility strategy, has been recognised as an important adaptive strategy in the face of global change (Berkes and Jolly 2001). We also argue that it can be considered to be an "intermediate disturbance," capable of managing ecosystems for the delivery of a diverse flow of ecosystem services. Between the extremes of management for the satisfaction of urban demands and worldviews (looking for either the production of food, as in intensive croplands, or the optimisation of regulating and cultural services, as in protected areas) and land abandonment, peasant multifunctional management models associated with low-impact farming practices should attract greater attention for their role in preserving cultural landscapes responsible for the delivery of a wide range of ecosystem services (Harrop 2007; García-Llorente et al. 2012). We believe the maintenance of transhumance could be particularly important in the Mediterranean basin, when taking into account the future scenarios of regional climate and land-use change and the forecasted alterations in ecosystem services supply (Schröter et al. 2005). When exploring the socio-cultural perception of the delivery of ecosystem services under different participatory future scenarios at a regional scale in the summering area, two of the four scenarios explored included the reduction or disappearance of livestock and, consequently, a reduction in the quality or quantity of most ecosystem services delivery (Oteros-Rozas et al. 2013b). The promotion of multifunctional landscapes through a form of transhumance preservation that seeks to guarantee delivery of a diverse flow of ecosystem services should be considered for the design of future agro-environmental measures in the face of the current reform of the Common Agricultural Policy of the European Union for the period of 2014–2020.

Conclusions

The present study has shown the potential of socio-cultural valuation for the (a) identification of a diverse flow of ecosystem services, without risk of double counting (e.g.,

food is usually considered as one ecosystem service to avoid double counting, hence hiding the heterogeneity of food, sources, including agriculture, livestock, honey, wild edible plants gathering, hunting, etc.); (b) visibility of socio-cultural preferences at different perception scales (self-oriented or for personal well-being versus other-oriented or for social well-being); (c) identification of different needs within different times (i.e., seasons of the year) and spaces (i.e., areas); (d) elucidation of perceived trends as an early warning of ecosystem service deterioration (e.g., fire prevention); (e) possibility of revealing perceived bundles of ecosystem services that can inform management decisions (e.g., links between livestock, connectivity and seed dispersal); (f) exploration of the link between ecosystem services and traditional management practices (i.e., transhumance); and (g) achievement of all of these objectives through relatively inexpensive research, yet using primary data.

Therefore, we propose that the socio-cultural approach to valuing ecosystem services, as related in the foregoing study to a living transhumant social-ecological network, can demonstrate how traditional low-intensity agrarian landscapes are responsible for the delivery of a diverse flow of ecosystem services. These outcomes, we believe, should be adequate to attract policy interest in and institutional support for their preservation.

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Appendix 1

See Table 3.

Table 3 Classification of ecosystem services assessed, descriptions, examples and correspondence classification according to Millennium Assessment (MA; description based on de Groot et al. 2002)

Type of ecosystem services	Ecosystem services	Description	Examples	MA
Provisioning	Genetic pool	Genetic material and evolution in animals and plants	Local breeds	Genetic resources
	Gathering	Wild edible plants and mushrooms	*Boletus eduli*	Food
	Manure	Fertilization of soil for crop production	Use of manure to fertilize home gardens	Biochemicals
	Feed for animals	Cereal crops for animal feeding	Barley, stubble	Food
	Food from hunting	Wild meat	Rabbit meat	Food
	Food from agriculture	Crops for human consumption	Olives, wine, garlic	Food
	Products from apiculture	Food, medicines and wax produced by bees	Honey, propolis	Food/ Biochemicals
	Fibre	Natural fibres for textiles	Wool	Fibre
	Wood and timber	Forest products used as fuel or as building materials	Holm oak timber	Fuel/Fibre
	Livestock	Food from livestock	Lamb and veal	Food
Regulating	Tree regeneration	Influence of temporal and low stocking grazing (transhumance) in tree regeneration, by helping seeds germination through trampling, and ecosystem structure regeneration by low- pressure browsing	Regeneration of holm oaks in *dehesas*	–
	Biological control	Population control by trophic-dynamic relations	Insect plague regulation	Pest regulation
	Air purification	Role of ecosystems in bio-geochemical cycles	Clean air	Air quality regulation

Table 3 continued

Type of ecosystem services	Ecosystem services	Description	Examples	MA
	Habitat for species	Provision of suitable living and nursing places for wild species	Rabbits, birds	Provision of habitat
	Fire prevention (natural hazard)	Influence of ecosystem structure on reducing frequency and extension of fire events	Consumption of inflammable biomass by herbivores	Natural hazard regulation
	Soil erosion control	Role of vegetation root matrix and soil biota in soil retention	Retention of soil via pasture roots	Erosion regulation
	Connectivity and seed dispersal	Role of ecosystem structure for allowing animal and plant movement and colonisation	Dispersal of pasture species	Seed dispersal
	Maintenance of soil fertility	Accumulation of organic matter and role of soil structure and biota in storage and recycling of nutrients	Trampling by animals	Soil formation
	Pollination	Role of biota in movement of floral gametes	Pollination	Pollination
	Microclimate regulation	Influence of land cover and biologically mediated processes on climate at local scales	Maintenance of green pasture under forest canopy in summer	Climate regulation
	Hydrological regulation	Role of land cover in regulating the water cycle	Evapotranspiration	Water regulation/ cycling
	Ditch maintenance	Role of animals in the consumption of biomass along road margins (avoiding human work for fire prevention and roads conservation)	Sheep grazing in ditches	–
Cultural	Tranquillity/ relaxation	Influence of ecosystems on human physical and psychological well-being via relaxation activities	Pleasure of walking in the woods	Aesthetic values/ Inspiration
	Nature recreation activities	Influence of ecosystem in human well-being through outdoor activities	Horse riding, cycling, hiking	Recreation and ecotourism
	Cultural identity	Variety of natural features that embody or reinforce cultural values	Music, pictures, symbols	Cultural diversity
	Recreational hunting	Influence of ecosystems on human well-being through hunting	Rabbit, partridge	Recreation and ecotourism
	Scientific knowledge	Ecosystem features of scientific value	Research	Knowledge systems
	Environmental education	Ecosystem features of educational value	School visits	Educational values
	Bullfighting events	Role of ecosystems in provision of necessary elements (e.g., landscapes, bulls/cows) for bullfighting events	Local celebrations featuring bulls	Recreation and ecotourism
	Aesthetic value	Attractive landscape features	Pleasure of beautiful views	Aesthetic values
	Way of cultural exchange	Variety in natural features that allow exchange and mutual enriching between human populations	Exchange of recipes	Cultural diversity
	Spiritual value	Natural features with spiritual value	Churches in the Drove Road	Spiritual and religious values
	Local ecological knowledge	Ecosystem features related to locally/traditionally developed knowledge, practices or beliefs	How to shepherd a transhumant herd	Knowledge systems
	Rural tourism	Influence of ecosystems on human well-being through activities related with rurality	Gastronomic tourism	Recreation and ecotourism

Appendix 2

See Table 4.

Table 4 Panels used in the survey for the identification of ecosystem services

Beneficios que el ser humano obtiene de la naturaleza de manera directa a través del ABASTECIMIENTO de productos		
Beneficio	***Ejemplo***	***Foto***
Recolección	Setas, espárragos, collejas, caracoles, bellotas, cardillos, cascarrias, etc.	
Abono	Restos fecales de animales para abonar cultivos	
Alimento para animales	Pastos y forraje	
Apicultura	Miel	
Alimento de caza	Perdices, liebres, conejos, jabalíes, etc.	
Ganado	Carne y lácteos de alta calidad	
Tejidos	Lana y cuero	
Combustible	Madera y leña	
Alimento de agricultura	Vino, aceite, cereales, ajos, etc.	
Acervo genético	Razas autóctonas, aves esteparias	

Table 4 continued

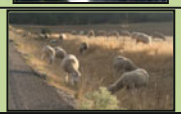
Beneficios que el ser humano obtiene de la naturaleza de manera indirecta a través de la REGULACIÓN de procesos		
Beneficio	***Ejemplo***	***Foto***
Regeneración de especies vegetales	Rebrote de encinas y pinos, hongos, calidad del pasto	
Control de especies	Eliminación de malas hierbas	
Aire limpio	"corredor verde"	
Hábitat para especies	Refugio y guardería de especies, conectividad ecológica	
Prevención de incendios	Por el desbroce de los animales	
Control de la erosión	Cobertura de vegetación que retiene suelo en las raíces	
Dispersión de semillas	Animales que ayudan a dispersar frutos, semillas y esporas	
Fertilización del suelo	Fertilización del suelo con los desechos animales	
Polinización	Insectos polinizadores	
Regulación del microclima	Papel de la vegetación en el secuestro de CO_2 y en la lluvia	
Regulación hídrica	Evapotranspiración de la vegetación	
Mantenimiento de cunetas	En caminos y carreteras	

Table 4 continued

Beneficios que el ser humano obtiene de la naturaleza de manera intangible relacionados con aspectos CULTURALES		
Beneficio	***Ejemplo***	***Foto***
Tranquilidad, relajación	Paseos a la sombra	
Turismo activo en la naturaleza	Senderismo, equitación, ciclismo	
Identidad cultural	Cultura pastoril, mezcla de culturas	
Caza recreativa	Caza menor (perdiz, liebre, conejo), caza mayor (gamos, corzo, jabalí)	
Conocimiento científico	Investigaciones en ecología, etnografía, historia	
Educación ambiental	Educación ambiental, libros sobre trashumancia	
Espectáculos taurinos	Encierros, corridas, novilladas…	
Paisajes	VP:elemento diversificador, escenas bonitas→ fotografía, documentales	
Vía de comunicación	Cañada →Entre fincas/pueblos, para personas y animales	
Valores espirituales	Satisfacción de que exista la ganadería trashumante	
Conocimiento tradicional	Manejo de los animales, salir a ver el paso del ganado por el municipio	
Turismo rural	Cortijos, gastronomía, agroturismo	

Appendix 3

See Table 5.

Table 5 Ecosystem service preferences

Type of ecosystem services	Ecosystem services	Social well-being		Personal well-being	
		Mean	SD	Mean	SD
Provisioning	Genetic pool	2.05	0.73	3.36	0.89
	Gathering	1.74	0.85	3.51	0.89
	Manure	1.67	0.68	2.81	1.08
	Feed for animals	2.00	0.77	3.06	0.97
	Food from hunting	2.00	0.85	3.14	0.66
	Food from agriculture	2.13	0.82	3.50	0.83
	Products from apiculture	1.83	0.75	2.60	1.52
	Fibre	1.73	0.79	2.27	1.35
	Wood and timber	1.33	0.50	2.89	1.05
	Livestock	2.16	0.85	3.03	1.09
Regulating	Tree regeneration	2.12	0.77	3.46	0.92
	Biological control	1.81	0.83	2.88	0.96
	Air purification	2.35	0.77	3.74	0.70
	Habitat for species	2.27	0.74	3.13	1.03
	Fire prevention (natural hazard)	2.25	0.80	3.56	0.87
	Soil erosion control	1.86	0.83	3.67	1.36
	Connectivity and seed dispersal	1.91	0.78	3.15	0.97
	Maintenance of soil fertility	1.71	0.68	3.24	0.92
	Pollination	2.00	0.94	3.19	1.05
	Microclimate regulation	2.06	0.87	3.73	0.52
	Hydrological regulation	2.20	0.42	3.80	0.42
	Ditch maintenance	1.63	0.74	2.50	0.76
Cultural	Tranquillity/ relaxation	1.93	0.81	3.46	1.07
	Nature recreation activities	1.75	0.74	2.78	1.17
	Cultural identity	2.03	0.88	3.47	0.73
	Recreational hunting	1.69	0.75	2.62	1.45
	Scientific knowledge	1.67	0.77	3.18	1.01
	Environmental education	1.84	0.81	3.57	0.70
	Bullfighting events	2.00	0.93	3.14	1.21
	Aesthetic value	1.64	0.73	3.30	0.98
	Way of cultural exchange	1.73	0.78	2.86	1.04
	Spiritual value	2.07	0.96	3.40	0.83
	Local ecological knowledge	1.74	0.79	3.18	1.09
	Rural tourism	1.69	0.85	2.62	1.15

Importance for social well-being was a mean, calculated according to position in the ranking (1st = 3; 2nd = 2 and 3rd = 1); importance for personal well-being was calculated as the mean score (no importance = 1; little importance = 2; some importance = 3; very important = 4) that interviewees gave an ecosystem service for the satisfaction of their personal well-being. (SD: standard deviation)

References

Agrawal, A (2008). The role of local institutions in adaptation to climate change. Paper presented at the social dimensions of climate change workshop, World Bank, Washington DC, USA

Bacon CM, Getz C, Kraus S, Montenegro M, Holland K (2012) The social dimensions of sustainability and change in diversified farming systems. Ecol Soc 17(4):41

Bateman I J, Carson RT, Day B, Hanemann WB, Hanley N, Hett T, Lee MJ, Loomes G, Mourato S, Özdemiroglu E, Pearce DW (2002). Economic valuation with stated preference techniques: A manual. (E. Elgar Ed.). Publishing, Cheltenham

Berkes F, Jolly D (2001) Adapting to climate change: social-ecological resilience in a Canadian western Arctic community. Conserv Ecol 5(2):18

Blondel J (2006) The "Design" of mediterranean landscapes: a millennial story of humans and ecological systems during the historic period. Hum Ecol 34:713–729

Bugalho MN, Caldeira MC, Pereira JS, Aronson J, Pausas JG (2011) Mediterranean cork oak savannas require human use to sustain biodiversity and ecosystem services. Front Ecol Environ 9:278–286

Bunce R, De Aranzabal I, Schmitz M, Pineda F (2006) A review of the role of Drove Roads (Cañadas) as ecological corridors. Alterra Reports 1428.Wageningen. http://www.alterra.wur.nl/UK/publications/Alterra+Reports. Accessed 20 June 2012

Cabell JF, Oelofse M (2012) An indicator framework for assessing agroecosystem resilience. Ecol Soc 17(1):18

Caraveli H (2000) A comparative analysis on intensification and extensification in mediterranean agriculture: dilemmas for LFAs policy. J Rural Stud 16:231–242

Carmona CP, Azcárate FM, Oteros-Rozas E, González JA, Peco B (2013) Assessing the effects of seasonal grazing on holm oak regeneration: Implications for the conservation of Mediterranean dehesas. Bio Cons 159:240–247

Castro AJ, Martín-López B, García-Llorente M, Aguilera PA, López E, Cabello J (2011) Social preferences regarding the delivery of ecosystem services in a semiarid Mediterranean region. J Arid Environ 75:1201–1208

Cazorla A, De los Ríos-Carmenado I, Alier JL, Merino J (2008) A multicriteria assessment model for evaluating droving route networks. Biosyst Eng 100:601–611

Chan KMA, Satterfield T, Goldstein J (2012a) Rethinking ecosystem services to better address and navigate cultural values. Ecol Econ 74:8–18

Chan KMA, Guerry AD, Balvanera P, Klain S, Satterfield T, Basurto X, Bostrom A et al (2012b) Where are cultural and social in ecosystem services? A framework for constructive engagement. Bioscience 62(8):744–756

Cowling RM, Egoh B, Knight AT, O'Farrell PJ, Reyers B, Rouget M, Roux DJ, Welz A, Wilhelm-Rechman A (2008) An operational model for mainstreaming ecosystem services for implementation. Proc Natl Acad Sci USA 105:9483–9488

Daily GC (1997) Nature's services: societal dependence on natural ecosystems. Island Press, Washington

Davies J, Hatfield R (2007) The economics of mobile pastoralism: a global summary. Nomadic Peoples 11:91–116

De Groot RS, Alkemade R, Braat L, Hein L, Willemen L (2010) Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol Complex 7:260–272

De Groot RS, Wilson MA, Boumans RMJ (2002) A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol Econ 41:393–408

Dietz T, Kalof L, Stern PC (2002) Gender, values, and environmentalism. Soc Sci Quart 83:353–364

Dong S, Wen L, Liu S, Zhang X, Social S, Systems E (2011) Vulnerability of worldwide pastoralism to global changes and interdisciplinary strategies for sustainable pastoralism. Ecol Soc 16(2):10

Fernández-Giménez ME, Fillat F (2012) Pyrenean pastoralists' ecological knowledge: documentation and application to natural resource management and adaptation. Hum Ecol 40(2):287–300

Fisher B, Turner R, Morling P (2009) Defining and classifying ecosystem services for decision making. Ecol Econ 68:643–653

Galvin K (2009) Transitions: pastoralists living with change. Ann Rev Anthropol 38:185–198

Gordon LJ, Finlayson CM, Falkenmark M (2010) Managing water in agriculture for food production and other ecosystem services. Agric Water Manage 97:512–519

García-Llorente M, Martín-López B, Iniesta-Arandia I, López-Santiago CA, Aguilera PA, Montes C (2012) The role of multifunctionality in social preferences toward semi-arid rural landscapes: an ecosystem service approach. Environ Sci Pol 19–20:136–146

Gómez-Baggethun E, de Groot R, Lomas PL, Montes C (2010) The history of ecosystem services in economic theory and practice: from early notions to markets and payment schemes. Ecol Econ 69:1209–1218

Harrison PA, Vandewalle M, Sykes MT, Berry PM, Bugter R, Bello F, Feld CK, Grandin U, Harrington R, Haslett JR, Jongman RHG, Luck GW, Silva PM, Moora M, Settele J, Sousa JP, Zobel M (2010) Identifying and prioritising services in European terrestrial and freshwater ecosystems. Biodivers Conserv 19:2791–2821

Harrop SR (2007) Traditional agricultural landscapes as protected areas in international law and policy. Agric Ecosyst Environ 121:296–307

Hatfield R, Davies J, Wane A, Kerven C, Dutilly-Diane C, Biber JP, Merega JL, Odhiambo MO, Behnke R, Gura S (2006) Global review of the economics of pastoralism. World Initiative for Sustainable Pastoralism, UICN, Nairobi

Hauck J, Görg C, Varjopuro R, Ratamäki O, Jax K (2013) Benefits and limitations of the ecosystem services concept in environmental policy and decision making: Some stakeholder perspectives. Environ Sci Pol 25:13–21

Heikkinen H, Sarkki S, Nuttall M (2012) Users or producers of ecosystem services? A scenario exercise for integrating conservation and reeindeer herding in northeast Finland. Pastoralism: Reserach. Policy Practice 2:11–24

Janssen M, Bodin O, Anderies JM, Elmqvist T, Ernstson H, McAllister RRJ, Olsson P, Ryan P (2006) Towards a network perspective of the study of resilience in socio-ecological systems. Ecol Soc 11(1):15

Johnson KA, Polasky S, Nelson E, Pennington D (2012). Uncertainty in ecosystem services valuation and implications for assessing land use tradeoffs: an agricultural case study in the Minnesota River Basin. Ecol Econ 35:71–79

Kahneman D, Knetsch JL (1992) Valuing public goods: the purchase of moral satisfaction. J Environ Econom Manage 22:57–70

Krätli S, Huelsebusch C, Brooks S, Kaufmann B (2012) Pastoralism: a critical asset for food security under global climate change. Animal Front 3(1):42–50

Lamarque P, Tappeiner U, Turner C, Steinbacher M, Bardgett RD, Szukics U, Schermer M, Lavorel S (2011a) Stakeholder perceptions of grassland ecosystem services in relation to knowledge on soil fertility and biodiversity. Reg Environ Change 11:791–804

Lamarque P, Quétier F, Lavorel S (2011b) The diversity of the ecosystem services concept and its implications for their assessment and management. C R Biol 334:441–449

Ley 3/1995. Ley de Vías Pecuarias (Drove Roads Act). http://www.boe.es/buscar/doc.php?id=BOE-A-1995-7241

López-Santiago C, Oteros-Rozas E, Martín-López B, Plieninger T, González E, González JA (in press) Using visual stimuli to explore the social perceptions of ecosystem services in cultural landscapes: the case of transhumance in Mediterranean Spain. Ecol Soc

MA (Millennium Ecosystem Assessment) (2005) Ecosystems and human well-being: synthesis. Island Press, Washington, DC

MAGRAMA (Ministerio de Agricultura, Alimentación y Medio Ambiente) (2012). Incendios forestales del 1 de enero al 30 de noviembre de 2012. http://www.magrama.gob.es/es/biodiversidad/temas/defensa-contra-incendios-forestales/avance_informativo_1_enero_30_noviembre_2012_tcm7-235101.pdf

Manzano P, Malo JE (2006) Extreme long-distance seed dispersal via sheep. Front Ecol Environ 4(5):244–248

MARM (Ministerio de Medio Ambiente y Medio Rural y Marino) (2011). Libro Blanco de la trashumancia. Dirección de Desarrollo Sostenible del Medio Rural, Ministerio del Medio Ambiente, y Medio Rural y Marino

Martín-López B, Iniesta-Arandia I, García-Llorente M, Palomo I, Casado-Arzuaga I, Del Amo DDG, Gómez-Baggethun E, Oteros-Rozas E, Palacios-Agundez I, Willaarts B, González JA, Santos-Martín F, Onaindia M, López-Santiago C, Montes C (2012) Uncovering ecosystem service bundles through social preferences. PLoS ONE 7(6):e38970

Martín-López B, Gómez-Baggethun E, García-Llorente M (2013) Trade-offs across value-domains in ecosystem services assessment. Ecol Ind 37(A):220–228

Millennium Ecosystem Assessment of Spain (2011) Millennium Ecosystem Assessment of Spain (EME): managing biodiversity and ecosystem services for human well-being. Fundación Biodiversidad, Madrid

Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GA, Kent J (2000) Biodiversity hotspots for conservation priorities. Nature 403:853–858

Mottet A, Ladet S, Coque′ N, Gibon A (2006) Agricultural land-use change and its drivers in mountain landscapes: a case study in the Pyrenees. Agric Ecosyst Environ 114:296–310

Nieto-Romero M, Oteros-Rozas E, González Nóvoa JA, Martín-López B (in press) Exploring the knowledge landscape of ecosystem services assessments in Mediterranean agroecosystems: insights for future research. Environ Sci Policy. http://dx.doi.org/10.1016/j.envsci.2013.09.003

Oteros-Rozas E, González JA, Martín-López B, López CA, Montes C (2012a) Ecosystem services and social-ecological resilience in transhumance cultural landscapes: learning from the past, looking for a future. In: Plieninger T, Bieling C (eds) Resilience and the cultural landscape. Understanding and managing change in human-shaped environments. Cambridge University Press, Cambridge

Oteros-Rozas E, González JA, Martín-López B, López CA, Zorrilla-Miras P, Montes C (2012b) Evaluating ecosystem services in transhumance cultural landscapes: an interdisciplinary and participatory framework. Gaia 21:185–193

Oteros-Rozas E, Ontillera-Sánchez R, Sanosa P, Gómez-Baggethun E, Reyes-García V, González JA (2013a) Traditional Ecological Knowledge among transhumant pastoralists in Mediterranean Spain: learning for adaptation to global change. Eco Soc 18(3):33

Oteros-Rozas E, González JA, Martín-López B, López CA, Palomo I, Montes C (2013b) Envisioning the future of transhumant pastoralism through participatory scenario planning: the Conquense Drove Road (Spain). Rangel J 35:251–272

Pereira E, Queiroz C, Pereira HM, Vicente L (2005) Ecosystem services and human well-being: a participatory study in a mountain community in Portugal. Ecol Soc 10(2):14

Peterson MJ, Hall DM, Feldpausch-Parker AM, Peterson TR (2010) Obscuring ecosystem function with application of the ecosystem services concept. Conserv Biol 24:113–119

Plieninger T, Bieling C, Ohnesorge B, Schaich H, Schleyer C, Wolff F (2013) Exploring futures of ecosystem services in cultural landscapes through participatory scenario development in the Swabian Alb, Germany. Ecol Soc 18(3):39

Power AG (2010) Ecosystem services and agriculture: tradeoffs and synergies. Philos Trans Roy Soc Lond Series B Biol Sci 365:2959–2971

Reyes-García V, Vila S, Aceituno-Mata L, Calvet-Mir L, Garnatje T, Jesh A, Lastra JJ, Parada M, Rigat M, Valles J, Pardo-de-Santayana M (2010) Gendered homegardens: a study in three mountain areas of the Iberian Peninsula. Econ Bot 64:235–247

Robertson GP, Swinton SM (2005) Reconciling agricultural productivity and environmental integrity: a grand challenge for agriculture. Front Ecol Environ 3(1):38–46

Rocheleau D, Thomas-Slayer B, Wangari E (1996) Feminist political ecology: global issues and local experiences. Routledge, London

Ruben R, Pender J (2004) Rural diversity and heterogeneity in less-favored areas: the quest for policy targeting. Food Pol 29:303–320

Ruiz M, Ruiz J (1986) Ecological history of transhumance in Spain. Biol Conser 37:73–86

Sagoff M (1998) Aggregation and deliberation in valuing environmental public goods: a look beyond contingent pricing. Ecol Econ 24:213–230

Schröter et al (2005) Ecosystem service supply and vulnerability to global change in Europe. Science 310:1333–1337

Seppelt R, Dormann CF, Eppink FV, Lautenbach S, Schmidt S (2011) A quantitative review of ecosystem service studies: approaches, shortcomings and the road ahead. J Appl Ecol 48:630–636

Soini K, Vaarala H, Pouta E (2012) Residents' sense of place and landscape perceptions at the rural–urban interface. Landscape Urban Plan 104:124–134

Swinton SM, Lupi F, Robertson GP, Hamilton SK (2007) Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits. Ecol Econ 64:245–252

TEEB (2010) The economics of ecosystems and biodiversity: ecological and economic foundations. Earthscan, London

Turner R, Daily G (2008) The ecosystem services framework and natural capital conservation. Environ Resour Econ 39:25–35

Vatn A (2005) Rationality, institutions and environmental policy. Ecol Econ 55:203–217

van Berkel DB, Verburg PH (2014). Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. Ecol Indic 37(A):163–174

Vihervaara P, Rönkä M, Walls M (2010) Trends in ecosystem service research: early steps and current drivers. Ambio 39:314–324

Wittman H (2009) Reworking the metabolic rift: La Vía Campesina, agrarian citizenship, and food sovereignty. J Peasant Stud 36(4):805–826

Zhang W, Ricketts TH, Kremen C, Carney K, Swinton SM (2007) Ecosystem services and dis-services to agriculture. Ecol Econ 64:253–260

Zumbrunnen T, Menéndez P, Bugmann H, Conedera M, Gimmi U, Bürgi M (2012) Human impacts on fire occurrence: a case study of hundred years of forest fires in a dry alpine valley in Switzerland. Reg Environ Change 12(4):935–949