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The role of multi-functionality in social preferences toward semi-arid rural landscapes: An ecosystem service approach

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ABSTRACT

The present study analyzes the relationship between landscape multi-functionality and social preferences toward Mediterranean landscapes in terms of monetary and non-monetary techniques. Twenty landscape views were selected as representative of the landscape units characterizing Nacimiento and Adra semi-arid watersheds (southeastern Spain). Face-to-face questionnaires were used to assess social factors that influence willingness to pay for aesthetic landscape enjoyment (use value) and landscape conservation (non-use value). Meanwhile, an expert focus group analyzed the capacity of the selected semi-arid ecosystems for supplying services to society. The favorite landscape views mainly contained steeper reliefs, water flows, and traditional human activities. Our results suggest a strong positive effect between respondents' place attachment and the level of support for landscape conservation. Respondents were more willing to pay for the conservation of semi-arid rural landscapes when their sense of belonging was greater. We also found that multi-functional landscapes, which provide higher numbers of regulating and cultural services, were also preferred in terms of their visual quality (use value). Additionally, they had more social support for their conservation (non-use value). The conversion of multi-functional landscapes to mono-functional ones disturbs the stability of rural areas, their capacity to provide other ecosystem services, and the social support toward their preservation. To reverse this tendency, two major ideas should be emphasized. The first is the necessity of considering the ecological components and processes behind landscapes, and the second is the role of the local population on rural landscape conservation.

1. Introduction

Currently, European landscapes are intensively changing because human impacts on ecosystems are increasing at unprecedented and accelerated rates (Antrop, 2005; Pearson and McAlpine, 2010). Land-use change is the most important driver for landscape alterations over the last century (MA, 2005). In this context, landscape management rises up as one of the most important challenges in environmental policy. This concern is illustrated by many European policies that

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have taken place over last decades to regulate landscape conservation, including the Pan-European Biological and Landscape Diversity Strategy (Council of Europe et al., 1996), the Action Plan for European Landscapes (ECNC, 1997), and the European Landscape Convention (Council of Europe, 2000). These policies have recognized the key role of human perceptions and attitudes as the drivers of landscape change and preservation of sustainable landscapes. As a consequence, the EU Sixth Environmental Action Program (European Commission, 2002), as well as some authors (Sevenant and Antrop, 2010), recognized the need for assessing public preferences for landscapes. The European Landscape Convention defines a landscape as 'an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe, 2000). This definition underlines the necessity of understanding how people perceive and value landscapes as a component of determining appropriate land use policies (Pearson and McAlpine, 2010; Sevenant and Antrop, 2009).

In this context, studies focused on public preferences toward landscapes have been conducted from two methodological perspectives: (1) non-monetary techniques, where landscape assessment is accomplished through aesthetic preferences in which one landscape is compared with another (pair-wise comparison technique) (e.g., Bernáldez et al., 1987; DeLucio and Múgica, 1994) or a number of photographs are ranked (e.g., Arriaza et al., 2004) or ranged (e.g., Rogge et al., 2007) in terms of how well people like landscapes; and (2) monetary techniques, where an economic valuation exercise is performed to estimate use values (e.g., aesthetic values) and/or non-use values (e.g., the individual satisfaction that a user obtains from knowing that this landscape exists) (e.g., Sayadi et al., 2009).

In the Mediterranean basin, landscapes are characterized by the historical co-evolution of social systems and ecosystems (Blondel, 2006). Cultural shaping of landscapes encouraged the provision of multiple ecosystem services to society (Jones-Walters, 2008; O'Farrell et al., 2010), which have been understood as the direct or indirect contributions of ecosystems and biodiversity to human wellbeing (de Groot et al., 2010; EME, 2011). However, the current human transformation of land cover promotes the loss of most ecosystem services, especially those involved in the regulation of ecosystem processes (regulating services) or those related with the spiritual enrichment, culture, recreation and aesthetic experiences (cultural services) (Foley et al., 2005; Gordon et al., 2010; Padilla et al., 2010). In this way, since the beginning of the Industrialization period, agricultural intensification and urbanization, as well as rural abandonment, have had severe consequences for the ecosystem services provided by Mediterranean ecosystems (Antrop, 2005; Rescia et al., 2010). The area where this research took place (southeastern (SE) Spain) is suffering from land use changes in terms of abandoned farms in the high mountains and intensification of farming on the coast (García-Latorre et al., 2001; Sánchez-Picón et al., 2011).

The main objective of the present study was to explore the links between the degree of landscape multi-functionality (defined as the perception of ecosystem experts on the capacity of ecosystems to provide ecosystem services to society) and public perceptions toward landscapes (in terms of social preferences and economic values) in a semi-arid region of SE Spain. Specifically, we (1) explored social preferences toward ecosystems by landscape views, taking into account local residents, visitors, and environmental and rural development professionals, (2) quantified the monetary value of use values (landscape aesthetic values), and non-use values (existence values). Additionally, we (3) identified ecosystem services provided by semi-arid ecosystems and (4) analyzed the relationships among social preferences toward landscapes, monetary estimations of both use and non-use values, and degree of multi-functionality.

2. Study region: Nacimiento and Adra watersheds (SE Spain)

The study area coincides with a natural region limited to the south by the Mediterranean Sea and bordered by the Sierras de Gador, Filabres, Contraviesa and Nevada. The area covers the watersheds of the Adra and the Nacimiento rivers. Both watersheds are characterized by semi-arid conditions, and it is part of the most important arid zone of Europe (García-Latorre et al., 2001). Both the Adra (744 km^2 of extension) and Nacimiento (598 km^2) watersheds are rural areas in the Mediterranean Basin Hydrographic Demarcation, and they are protected by a natural protected area in its upper region (Fig. 1).

The landscapes in the area cover a variety of environments, which range from alpine to semi-arid, and the transitions between them are sudden and occur over very short distances (PORN, 1994). Economic activities in the region have also modulated and shaped the landscape characteristics (Sánchez-Picón et al., 2011). Farming in the high mountains has been gradually abandoned because of the rural exodus in the 1970s, resulting in an increase in local population aging, relief impediments (high steeps), and semi-arid climatic conditions. Among other reasons, these factors have caused soil erosion problems and a loss of aesthetic value (Sayadi et al., 2009). Meanwhile, in the low watersheds, new irrigation technologies and intensification of agriculture in greenhouses from the 1980s have generated aquifer depletion, an unstructured territorial planning with the occupation of areas of environmental interest (García-Latorre et al., 2001; Sánchez-Picón et al., 2011), negative consequences for biodiversity, loss of soil fertility, and pollution problems (Paracuellos, 2008).

3. Methods

The data sampling was structured in three phases: (1) identification of landscape units according to the existing Andalusian landscape map classification (for more details see Moreira et al., 2005) and selection of landscape views that are representative of the land units, (2) assessment of social preferences toward landscape views through monetary and non-monetary techniques, and (3) identification of multi-functional landscapes through expert criteria. Data processing and the particular methodologies employed in the different phases are shown in Appendix A.

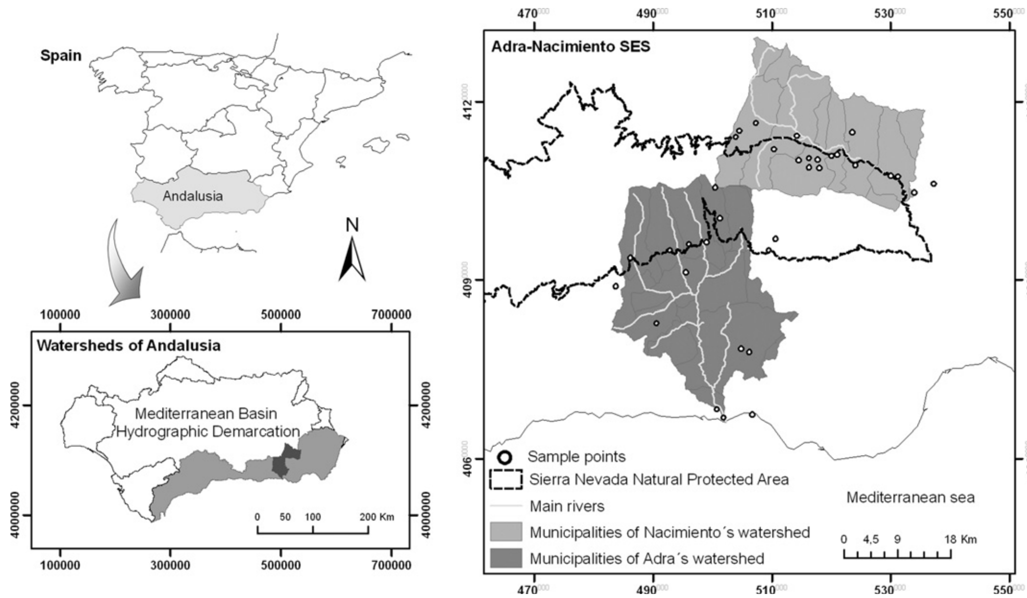

Fig. 1 – Study area and sample points.

3.1. *Phase 1: Identification of the main landscape units and landscape views selection*

Landscape units were defined according to the Andalusian landscape classification (Moreira et al., 2005). Following this definition process, landscape units were first classified in four superior categories, which were natural landscapes (e.g., forests, river courses), traditional agriculture (e.g., almond orchards, vineyards), geomorphologic landscapes (e.g., mountain tops, ravines), and urban or altered and modified landscapes (e.g., dams, wind farms). Second, 16 landscape units could be distinguished in our study area, and each was represented with specific landscape views (for more details see Appendices A and B). To proceed, we took into account the spatial representation of all previously defined land units and then checked their representation in the study area through different visits to the field (November–December 2008) and information obtained from 18 semi-structured interviews (April 2009) conducted with key informants in the area. Then, we related the landscape units with 20 landscape views taken from a set of more than 200 color photographs (Appendix B). To make the landscape views as representative as possible, we used panoramic color pictures taken at eye-level. All photographs were taken in the spring (April 2009), with constant weather and approximately 30% visible sky.

Appendix C presents a brief description of the landscape units present in our study area and the selected target landscape views.

3.2. *Phase 2: Social preferences toward landscape views*

A total of 381 face-to-face questionnaires were completed from May 2009 to February 2010, covering 44 different sample points (Fig. 1). The questionnaires were tested through prior pre-sampling. The sampled population was randomly selected with the aim of covering a wide range of backgrounds, including local residents (e.g., farmers, local government staff), workers in the study area (e.g., managers of the Protected Area, researchers), and tourist populations (e.g., natural and rural tourists). The sampling population was restricted to citizens over 18 years old.

Questionnaires compiled information regarding the respondent's (1) relationship with the study area, (2) perception of the important ecosystem services in the area, (3) landscape preferences, as demonstrated the attractiveness of each landscape view, (4) economic valuation as a quantitative measure under two different scenarios, including aesthetic use value and existence non-use value, and finally their (5) environmental behavior and (6) socio-demographic information.

In the third section, a photo-questionnaire technique was used to identify individual preferences toward landscape views. The validity of using this technique has been established by previous studies of social preferences toward biodiversity (i.e., Martín-López et al., 2007). A5 size pictures were randomly given to each respondent. Then, they ranked the 20 landscape views into five levels (choosing four landscape views per level; ranging from 1 = ''do not like at all'' to 5 = ''like very much''), according to how attractive they found each picture (see Appendix A). Afterward, we placed each picture in a magnet panel. At the beginning of the fourth section, we explained the contingent valuation (CV) exercise under two different scenarios to explore the difference between use values (aesthetic value) and non-use values (existence value). The two economic valuation questions were as follows regarding (i) aesthetic value and (ii) existence value: (i) '*Would you be willing to pay an extra quantity of money for a night spent in a standard room of a standard hotel if you could enjoy the landscapes views you ranked before from the window?*' and (ii) '*Would you be willing to pay an amount of money in a single lump sum donation to a local environmental organization to conserve the ecosystems represented by these landscape views?*'

Validation of these questions was checked in previous studies of social preferences toward landscapes (Sayadi et al., 2009) and ecosystem services (García-Llorente et al., 2011) in the study area. Two questionnaire models were used, changing the order in which both questions were formulated to avoid possible sequence effects (Carson and Mitchell, 1995).

After each willingness to pay (WTP) question, if respondents answered 'No' to any of the two conditions, they were asked the reasons for not contributing to differentiate between protest answers and real zero values. If respondents answered 'Yes', we asked the maximum amount of money they would be willing to pay (€). All respondents were told in advance that they would answer two independent WTP questions, that the economic contribution in each question started at zero and that the amount given was not cumulative.

We analyzed the data through a Heckman model, which is an appropriate model for open-ended elicitation formats (Heckman, 1979; Lee and Maddala, 1985). The Heckman model uses two different equations. The first equation explains the respondent's decision to pay or not to pay through a probit regression, and the second explains the positive value of the WTP through ordinary least squares (Sigelman and Zeng, 1999). The model maintains the assumption of dependence between the two decisions by analyzing the covariance between the error terms. Furthermore, the Heckman model supposes that there is a distribution for the second stage variable (the amount of WTP) that exists but that is not observed when the dependent variable is beyond some threshold (e.g., when $WTP < 0$). Following Sigelman and Zeng (1999), the Heckman model is a response to sample selection bias, which arises when data are available only for cases in which a variable reflecting 'pay', z^*, exceeds zero. For more details about the Heckman model, see García-Llorente et al. (2008). We selected the best model from among all possible combinations of variables, guided by the Akaike information criterion (AIC) statistics (Burnham and Anderson, 1998). To explore the statistical differences between the WTP estimations, we used non-parametric Kruskal–Wallis statistical test.

Finally, in the fifth section, attitudes of the respondents on environmental issues were elicited through a series of questions regarding readings of environmental publications, purchase of organic products or fair-trade and recycling. Based on Birol et al. (2006), these attitudes were measured using a Likert-scale ranging from 1 (never) to 4 (always) and then codified through an environmental behavior measure. The sixth section focused on the respondents' socio-economic characteristics (e.g., age, income, gender, residence) to characterize the sampling.

3.3. *Phase 3: Identification of multi-functional landscapes through expertise focus group*

Deliberative and participative processes enable individuals in groups to construct well-considered and informed decisions rather than express prior preferences (Hermans et al., 2008). Therefore, an expert focus group was held at the University of Almeria in summer 2010 to identify the ecosystem services provided by each ecosystem. We selected seven participants from different disciplines (i.e., Geography, History, Economy, Ecology, and Environmental Sciences) with experience working in the study area.

The main goal of the meeting was to identify ecosystem services provided for the 20 different ecosystems represented in the landscape views. Ecosystem disservices related with each landscape view were also identified. In order to proceed, we started the session with a presentation of the research project and the main objectives to involve the experts in the topic. Then, they were supposed to fill out a form with their decisions regarding the relationship between the landscape and the different ecosystem services categories (i.e., provisioning, regulating, and cultural). This relationship was defined as: strong (when experts found clear or explicit evidence of a relationship), weak (when experts found lower relationship), or non-existing (when experts found no evidence of a relationship between the ecosystems represented in the landscape views and the different ecosystem services categories) (Appendix A). Afterward, experts specified the principal ecosystem services provided by each ecosystem from a list of potential services provided by the area. Each service was explained by an example in the area and illustrated by a picture (Appendix D). Each landscape view was projected twice for one minute each time. Later, we collectively had a participatory discussion about the different answers given to obtain a consensus panel of the ecosystem service deliveries.

The results obtained from the Heckman model, together with the results of the landscape preferences (ranking aesthetic preferences) and the information obtained in the focus group about the ecosystem services provided by each ecosystem, were analyzed by Spearman correlation test to determine the relationship between multi-functionality and social preferences toward Mediterranean semi-arid landscapes.

4. Results

4.1. *Social preferences toward landscapes in semi-arid watersheds*

Respondents' perceptions based on how well they liked each of the landscape views are shown in Table 1. The pictures presented in the questionnaire elicited diverse responses with a range of 2.86 units on the five-point scale. The highest value, 4.43, was given to *snow summits*, and the lowest value, 1.58, was given to *greenhouse farms*. The favorite landscape views included *snow summits*, *riparian vegetation*, *dam*, *shady agricultural valley*, and *rocky and icy summits*. The least attractive views included scenes that portrayed more modern economical activities, such as *wind farms* or *greenhouse farms*, and arid (i.e., *badlands*, *rambla*) landscapes. The standard deviation in the responses ranged from 0.99 for *snow summits* to 1.44 for *wind farms*.

4.2. *Monetary value for use values (aesthetic values) and non-use values (existence value)*

Under the consideration of use values, the probability of participating in the economic exercise for the enjoyment of

Table 1 – Ranking of public preferences toward landscape views.

No.	Landscape view	Mean ranking	Std. deviation
1	*Badlands*	2.08	1.16
2	*High mountain shrub lands*	2.52	1.26
3	*Reforested pines*	3.05	1.39
4	*Snow summits*	4.43	0.99
5	*Dam*	3.76	1.37
6	*Montane shrub lands*	2.72	1.19
7	*Ravines*	2.74	1.22
8	*Shrub lands steppes*	2.85	1.23
9	*Vineyards*	2.98	1.30
10	*Shady agricultural valley*	3.53	1.19
11	*Rocky and icy summits*	3.45	1.42
12	*Holm oak dehesa*	3.43	1.25
13	*Almond orchard*	2.94	1.22
14	*Rambla*	2.51	1.34
15	*Greenhouse farms*	1.58	1.16
16	*Olive grove*	3.19	1.30
17	*Terraces*	3.37	1.20
18	*Sunny agricultural valley*	2.92	1.20
19	*Riparian vegetation*	3.77	1.23
20	*Wind farms*	2.19	1.44

the beauty of the landscape (first column, Table 2) was influenced by the respondent's age and place attachment. Participants that were young or local were more willing to participate in the economic exercise. Higher WTP for landscape enjoyment was mainly influenced by respondent income and age. Younger respondents with higher salaries were more willing to pay higher amounts to enjoy the landscape views (second column, Table 2).

In the economic exercise for landscape conservation, younger women, living closer to the study area, with higher levels of income and higher environmental behavior were more willing to participate in this economic exercise (third column, Table 2). The highest economic contributions were chosen by younger people that lived closer to the study area with higher levels of income and higher environmental behavior. Gender did not play a significant role (fourth column, Table 2).

WTP for landscapes' beauty enjoyment varied between 4.76€ and 0.45€, with significant differences among the views (Kruskal Wallis, $X^2 = 365.41$, $p < 0.001$) (Table 3). Economic contributions for landscape conservation varied between 19.17€ and 3.41€, also with significant differences between these values (Kruskal Wallis, $X^2 = 223.58$, $p < 0.001$). Both

Table 2 – Heckman model results showing the determinant factors for being willing to pay for landscape beauty enjoyment and/or ecosystem conservation. Probit regression results for the first stage of the Heckman model and sample selection two-stage least squares regression (OLS) results for second stage of the Heckman model (standard errors in parentheses).

Variables	Beauty enjoyment (use WTP)		Conservation (non-use WTP)	
	Probit Coefficient	OLS Coefficient	Probit Coefficient	OLS Coefficient
Constant	−0.056	1.168	−0.435	0.668
	(1.134)	(1.642)	(1.156)	(2.509)
Place attachment	−0.141***	−0.266	−0.537***	−1.309***
	(0.177)	(0.255)	(0.178)	(0.391)
Environmental behavior	–	–	0.413***	0.815***
			(0.110)	(0.23)
Age (years)	−0.722***	−1.030***	−0.504**	−0.924*
	(0.219)	(0.313)	(0.178)	(0.481)
Gender (men)	–	–	−0.341**	–
			(0.148)	
Income (Ln €)	0.443***	0.687***	0.323**	0.711**
	(0.135)	(0.189)	(0.133)	(0.286)
Λ	–	1.967***	–	3.034***
		(0.070)		(0.104)
Log likelihood	−230.95	−404.68	−250.53	−521.13
Chi-square	20.62****		30.74****	
Pseudo-R^2	0.10		0.13	
AIC	1.31		1.32	
Percent correct predictions	64%		61%	
Adjusted R^2		0.81		0.85

Dependent variable in PROBIT regression is 0 when WTP = 0 and 1 when WTP > 0. Dependent variable in OLS is Ln (WTP). Place attachment was measured as the inverse of the distance from the respondent's place of residence to the study area in kilometers.
Environmental behavior: the attitudes of the respondents toward reading environmental publications, purchase of organic or fair-trade products, and recycling.
* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.
**** Statistical significance at 0.1% level.

Table 3 – WTP estimations.

No.	Landscape view	Beauty enjoyment (use WTP, single lump sum mean €)		Conservation (non-use WTP, annual mean €)	
		Mean	Standard error	Mean	Standard error
1	*Badlands*	5.81	0.90	0.73	0.14
2	*High mountain shrub lands*	8.74	1.00	1.15	0.16
3	*Reforested pines*	12.78	1.31	2.62	0.27
4	*Snow summits*	19.77	1.53	4.76	0.33
5	*Dam*	15.39	1.40	3.64	0.31
6	*Montane shrub lands*	9.44	0.98	1.37	0.17
7	*Ravines*	10.63	1.17	1.37	0.18
8	*Shrub lands steppes*	9.98	0.95	1.66	0.20
9	*Vineyards*	9.03	0.98	1.33	0.18
10	*Shady agricultural valley*	14.48	1.33	2.53	0.24
11	*Rocky and icy summits*	16.04	1.44	2.83	0.27
12	*Holm oak dehesa*	12.97	1.25	2.61	0.25
13	*Almond orchard*	10.50	1.01	1.49	0.18
14	*Rambla*	7.43	0.86	1.05	0.15
15	*Greenhouse farms*	3.41	0.64	0.45	0.10
16	*Olive grove*	11.66	1.07	1.91	0.21
17	*Terraces*	12.49	1.08	2.11	0.23
18	*Sunny agricultural valley*	9.89	1.02	1.80	0.18
19	*Riparian vegetation*	13.84	1.13	2.90	0.26
20	*Wind farms*	6.68	0.96	0.79	0.12

followed the same WTP rank, higher donations were chosen for *snow summits*, *rocky and icy summits*, *dam*, *riparian vegetation*, and *shady agricultural valley* (Table 3). Meanwhile, lower values were given to the most intensified land uses (i.e., *wind farms*, *greenhouse farms*), and arid landscapes (i.e., *badlands*, *rambla*) landscapes.

4.3. *Ecosystem services provided by semi-arid ecosystems: Identification of multi-functional landscapes*

Experts distinguished among provisioning, regulating, and cultural ecosystem services through the different landscape views. The most common provisioning ecosystem services were traditional agriculture, timber, and forest harvesting. Habitat for species, water regulation, microclimate regulation, and natural accidents mitigation were the ones mainly categorized in the regulating ecosystem services category. Finally, aesthetic values, local identity preservation and nature tourism were important cultural services in the watersheds (Appendix E).

Six landscapes were related with the generation of disservices. In particular, the *reforested pines*, despite its strong relation with timber and forest harvesting, could compromise ecosystem functioning through increasing erosion, decreasing of species diversity, decreasing water regulation, and increasing the possibilities of suffering from fires. In the same way, the *dam* landscape was related with nutrient retention, loss of habitat for species, and erosion problems. *Vineyards* were associated with a higher risk of suffering from the presence of invasive alien species and a decrease in soil fertility. *Wind farms* were positively related with the delivery of provisioning services, but negatively with regulating services, such as the loss of habitat for species. *Greenhouse farms* dominated with intensive horticulture compromised a number of regulating and cultural services (Appendix E).

All the landscape views associated with disservices had in common a strong relation with the delivery of provisioning services (Table 4). Most of the disservices associated with these landscapes were related with the ecosystem functioning degradation, implying a loss of regulating and cultural services. In this sense, we found that landscapes related with cultural and regulating services had less probability of generating disservices (regulating services: Spearman's rho = −0.789, $p < 0.01$; cultural services: Spearman's rho = −0.753, $p < 0.01$).

4.4. *The effect of multi-functionality on social preferences toward landscapes views*

There was a clear association between ecosystems providing more diversified ecosystem services and favorite landscape views (Table 4).

Exceptions to this trend were the *dam* and the *reforested pines*. Both of these landscapes were highly preferred and valued; however, their relationship with ecosystem service delivery was limited to provisioning services. All measures of social preferences (ranking, use, and non-use WTP) were positive and significantly correlated with the number of regulating and cultural services, but not with the number of provisioning services (Table 5). In this sense, mono-functional landscapes that focused on the intensification of one ecosystem service, such as *reforested pines*, *greenhouse farms* or *wind farms*, were the least diverse in terms of ecosystem services provided and were less supported by respondents in both WTP questions. Meanwhile, multi-functional landscapes were more preferred and valued (e.g., *snow summits*, *shady agricultural valley*, *terraces*) (Tables 4 and 5).

Positive and significant correlations were found between the preferred landscapes and those with higher WTP contributions for their conservation (Spearman's rho = 0.925,

Table 4 – Type of relationship between the landscapes and the ecosystem service delivery for each of the landscape views following the expertise focus group (for more details see Appendix E). Landscape views are ordered by the preference ranking obtained in the questionnaires (see Table 1).

		Ecosystem services categories		
View nº	Landscape name	Provisioning	Regulating	Cultural
4	*Snow summits*	Red	Red	Red
19	*Riparian vegetation*	Orange	Red	Orange
5	*Dam*	Yellow	Pale yellow	Pale yellow
10	*Shady agricultural valley*	Orange	Red	Red
11	*Rocky and icy summits*	White	Yellow	Red
12	*Holm oak dehesa*	Orange	Red	Orange
17	*Terraces*	Yellow	Orange	Red
16	*Olive grove*	Orange	Orange	Orange
3	*Reforested pines*	Yellow	Pale yellow	White
9	*Vineyards*	Yellow	White	Orange
13	*Almond orchard*	Yellow	Yellow	Pale yellow
18	*Sunny agricultural valley*	Yellow	Red	Orange
8	*Shrub land steppes*	Orange	Red	Pale yellow
7	*Ravines*	Yellow	Orange	Red
6	*Montane shrub lands*	Orange	Yellow	Yellow
2	*High mountain shrub lands*	Yellow	Orange	Red
14	*Rambla*	White	White	White
20	*Wind farms*	Yellow	Pale yellow	Pale yellow
1	*Badlands*	Pale yellow	Orange	Orange
15	*Greenhouse farms*	Yellow	White	Pale yellow

Color	Relationship	Relationships description
White	Non-existing relation	Landscape views with no evidence of a relationship between the ecosystems represented and the ecosystem services categories
Pale yellow	Weak relation and non-diversified	Landscape views with a weak relationship between the ecosystems represented and the ecosystem services category, and where just one or two services were particularly associated
Yellow	Strong relation and non-diversified	Landscape views with a strong relationship between the ecosystems represented and the ecosystem services category and where just one or two services were particularly associated
Orange	Strong relation and partially diversified	Landscape views with a strong relationship between the ecosystems represented and the ecosystem services category, and where three or four services were particularly associated
Red	Strong relation and highly diversified	Landscape views with a strong relationship between the ecosystems represented and the ecosystem services category, and where at least five services were particularly associated

Table 5 – Spearman correlations among the ecosystem services provided and the social preferences toward the landscapes.

Variables	Preference ranking	Non-use WTP	Use WTP
Preference ranking	–	–	–
Non-use WTP	**0.925*** **	–	–
Use WTP	**0.961*** **	**0.962** **	–
Number of provisioning ecosystem services	0.326	0.361	0.306
Number of regulating ecosystem services	**0.552** **	**0.588*** **	**0.578*** **
Number of cultural ecosystem services	**0.416***	**0.489** **	**0.381***

* Statistical significance at 10% level.
** Statistical significance at 5% level.
*** Statistical significance at 1% level.

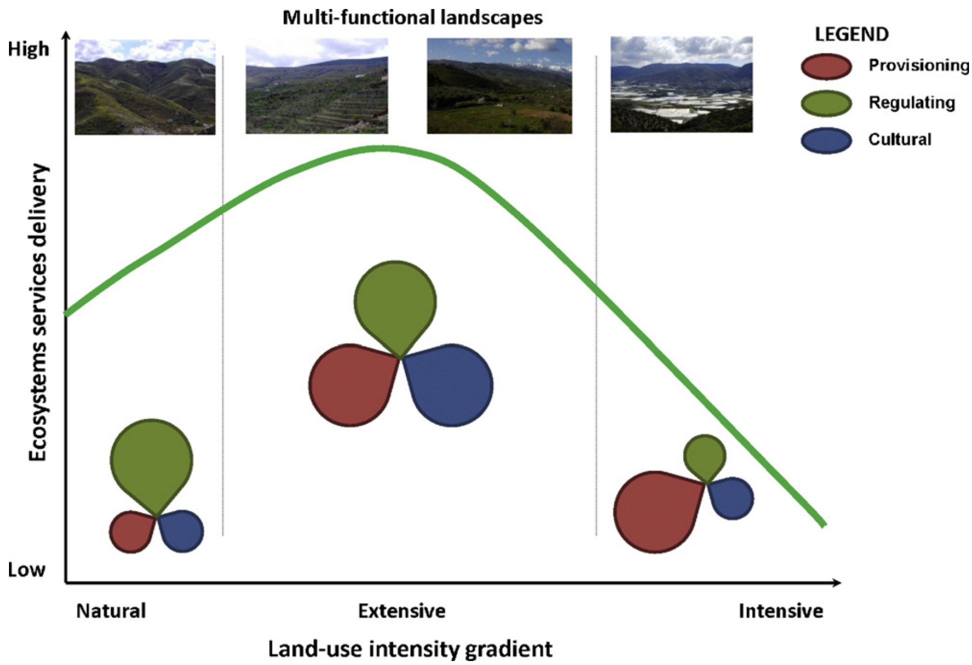

Fig. 2 – Graphical representation of the associations between ecosystem service delivery and human interventions on the landscapes. Target landscape views appear as a guidance example. Ecosystem service categories are presented in colorful petals; smaller sizes indicate a decrease in the ecosystem services delivery.

$p < 0.01$) and aesthetic enjoyment (Spearman's rho = 0.961, $p < 0.01$). Additionally, they demonstrated a positive and significant correlation between use and non-use economic values (Spearman's rho = 0.962, $p < 0.01$).

5. Discussion and conclusions

5.1. *Experts and public preferences toward landscapes*

Landscape aesthetic preferences are related with the affective and cognitive constructions generated depending on our relationship with our physical surroundings (Bernáldez, 1981; Gobster et al., 2007; Kaltenborn and Bjerke, 2002a). Previous studies have found that, because of different backgrounds, expert judgments and public criteria could differ in their preferences toward landscapes (Herzog et al., 2000). Scott (2002) stated that the general public usually sees the landscape as a whole and rarely highlights any special characteristics. Experts tend to associate their specialized knowledge to the landscapes preferences, with a risk of drawing attention to elements that are irrelevant for the rest of the respondents (Rogge et al., 2007). Although expert analysis is important in the evaluation process in a scientific manner, the public role should be highlighted to explore the diversity of social preferences (Sadler, 1982) and involvement with the landscape types. Here, the importance on combining both profiles was taken into account by using the opinion of experts to evaluate the capacity of deliver ecosystem services and the opinion of the tourist and resident populations to determine aesthetic preferences. As Bernáldez (1981) found, the combination of both perspectives constitutes a key point in any successful landscape planning.

5.2. *Landscape aesthetic preferences*

Landscapes with steeper reliefs constitute a traditional predictor for landscape preference (Bell, 1999; DeLucio and Múgica, 1994; Herzog et al., 2000). In fact, *snow summits* from Sierra Nevada and *rocky and icy summits* from el Chullo were highly preferred and valued. Moreover, these views, together with *dam* of Beninar, were emblematic and recognizable landscapes to the respondents. The degree of legibility (Kaplan, 1987) and the respondents' attachment to place (Kaltenborn and Bjerke, 2002b) could be behind the high preferences score of these locations. Our results suggest that there is a strong positive effect of respondents' place attachment at the level of support for landscape conservation. In other words, respondents were more willing to pay for conserving semi-arid landscapes when they have a greater sense of belonging to these areas, which may influence their motivations for preserving landscapes (Kaltenborn and Bjerke, 2002b; Lokocz et al., 2011).

Additionally, landscapes directly related with water flows, such as *snow summits*, *riparian vegetation*, or *dam*, were higher valued in terms of preferences and values. Water is an essential element in any ecosystem, but particularly in semi-arid watersheds, as they are the key factor in the provision of ecosystem services. Additionally, water is a limiting ecosystem service itself, such as in the amount of available freshwater for human use (Tielbörger et al., 2010). The existent literature in social preferences toward landscapes suggests that the presence of visible water in semi-arid systems contributes largely to the perception of aesthetic values. This phenomenon has been called ''hydrophilia'' (Bernáldez, 1985; López-Santiago et al., 1994). Furthermore, the *reforested pines* view was highly valued in spite of its low ecological integrity because of a ''phytophilia'' phenomenon (Bernáldez, 1985; López-Santiago, 1994; Ulrich, 1993).

However, landscapes involving new land uses like *wind farms* or *greenhouse farms* were the least valued. Previously, Soini et al. (2011) found that energy infrastructures are generally perceived as negative landscape elements. In the same way, Tempesta (2010) indicated that modern farming practices are less visually attractive than traditional farming because of the greater homogeneity of agricultural landscapes (Arriaza et al., 2004; Rogge et al., 2007). Finally, in some landscape views, such as *badlands* or *rambla*, an aridity syndrome could emerge (Bernáldez, 1985). In fact, DeLucio and Múgica (1994) found that Spanish protected areas with aridity characteristics are difficult for the majority of the public to appreciate.

5.3. *Looking for multi-functional landscapes through management of ecosystem services*

Previous research has recognized that landscapes, as the perceptible component of ecosystems, are related with a wide range of important ecosystem services to society (Jones-Walters, 2008; Schaich et al., 2010; Termorshuizen and Opdam, 2009). In this sense, previous studies shown that landscapes that are perceived as more beautiful are those that contain symbols related with the development of fruitful practices, fertility indicators, or domesticated and control patterns that guarantee a successful and sustainable human subsistence (Barret et al., 2009a; Bernáldez, 1981; Falk and Balling, 2010). However, current landscape management strategies in the Mediterranean basin are focused on production objectives, entailing an ecosystem intensification or degradation, even if it implies an important decrease of regulating and cultural services (Martín-López et al., 2011).

Different authors have attempted to describe the relationship between ecosystem service delivery and human interventions on landscape. In this sense, it is suggested that ecosystems with certain degrees of extensive human management, particularly in the Mediterranean region, could reach a peak of services diversity (Braat and ten Brink, 2008; Bugalho et al., 2011; Gómez-Sal, 2007; Haines-Young, 2009; Schneiders et al., 2011). In our study, we found that landscape views representing ecosystems with an intermediate human intervention, such as *shady agricultural*, *terraces*, *holm oak dehesa*, and *olive grove*, were perceived as aesthetically pleasant, highly valued, and multi-functional (Fig. 2). Meanwhile, intensified systems focused on the delivery of a single service, such as commonly provisioning, were less supported and valued by society.

5.4. *Rethinking multi-functional landscapes as coupled social–ecological systems*

In multi-functional landscapes, ecosystem services have been sustained through a complex historical relationship between human cultural management and ecosystems (Jones-Walters, 2008). However, current changes in Mediterranean multi-functional landscapes are occurring, following two problematic divergent directions. There is farming intensification in the more productive areas and an abandonment of traditional activities in the less profitable or less accessible lands (Plieninger et al., 2006; Schmitz et al., 2003). The conversion of multi-functional landscapes into more simple, productive, and mono-functional ones endangers the permanence of rural areas (Schmitz et al., 2003). Additionally, it threatens the ability of an ecosystem to provide a diverse flow of services (de Groot, 2006; Gordon et al., 2010), maintain an aesthetic quality (Tempesta, 2010) and, as we found here, maintain social support toward landscape conservation.

To reverse this tendency, we propose the following two cornerstones for future policy: re-link the ecological components and processes to their social aesthetic valuation, and emphasize the role of local populations on keeping and shaping rural landscapes according to that premise. Regarding the first point, we understand that the landscape should be defined from a holistic approach, incorporating the interrelationships between ecological integrity and social-perceptual factors (Barrett et al., 2009b). Gobster et al. (2007) found that landscapes perceived as aesthetically pleasing were more likely to be conserved than non-attractive ones, whatever their ecological importance. Therefore, landscape research and planning could suffer from risky shortcomings if the visible or perceptible component is studied in an isolated way. Therefore, the observable appearance of ecosystems (i.e., phenosystem) and the non-perceptive components and processes underlying landscapes (i.e., cryptosystem) (Bernáldez, 1981) should be integrated to interpret landscapes from a coupled social–ecological approach. Regarding the second point above, there is growing evidence that people recognize the value of multi-functional landscapes in rural areas, and their contribution to landscape preservation (Kline and Wichelns, 1996; Lokocz et al., 2011) is directly connected to their aesthetic experiences. Extensively managed agricultural systems, such as traditional terraces, orchards, or olive groves, are characterized by high ecological coherence (Gómez-Sal and González-García, 2007), which is socially perceived as highly aesthetical. We consider that the empowerment of local communities and the stimulation of their local identity are vital for the maintenance of multi-functional rural landscapes, either traditional or modern. This bottom-up management proposal of coupled social–ecological systems represents a way to look for a balance between economic and ecological needs, implying a diversified flow of ecosystem services.

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Appendix A–E. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.envsci.2012.01.006.

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