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ORIGINAL PAPER

Visual complexity and the montado do matter: landscape pattern preferences of user groups in Alentejo, Portugal

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Abstract
• ***Context*** The current paradigms for the sustainable development of forests and agriculture involve territorial organization of these activities as well as the multifunctionality of the related landscapes. Accordingly, the new management strategies need to take into account the suitability of the resulting landscapes to produce the goods and services expected by society.
• ***Aims*** The aim of the study was to assess the preferred landscape patterns by different groups of users. In focus were the relations between the landscape metrics of preferred patterns and the individual characteristics of respondents.
• ***Methods*** A regional quantitative survey of both production and different consumption landscape users was conducted in the Alentejo region, southern Portugal. Respondents composed their preferred patterns on a block diagram representing an area of landscape seen from a single view according to the existing topographic conditions in the study area.
• ***Results*** In general, the visually complex landscape patterns were preferred more than the homogeneous ones. However, the metrics of preferred patterns varied between the user groups. The montado was the only land cover class that was present in the majority of preferred patterns.
• ***Conclusion*** For landscape users in southern Portugal, the visually complex landscapes including the montado are essential to satisfy their expectations. This may be an important fact to be taken into account for policy and landscape management in the future.

Keywords Landscape preferences · User groups · Amenity services · Landscape metrics · Landscape pattern · Land cover · The montado

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1 Introduction

An overview of the research themes in forest journals shows that the term "landscape" has emerged frequently in recent years. A landscape perspective on forests and agriculture is considered one of the most important issues to be dealt with in order to gain better knowledge for sustainable management (Dobbertin and Nobis 2010).

The multifunctionality paradigm in the quest for sustainable management assumes that rural landscapes can provide a variety of amenities in addition to productive functions, namely, carbon sequestration, watershed protection, biodiversity, recreation, and cultural and societal uses (Andersson et al. 2005; Dobbertin and Nobis 2010). Furthermore, the challenge

of the multifunctional perspective is accepted as an aim for landscape management, both in the scientific community (Marsden and Sonnino 2008; van der Ploeg and Roeg 2003) and in the definition of policy objectives, e.g., the Second Pillar of the Common Agricultural Policy (CAP 2010).

Incorporation of multifunctional management into forest and agricultural sectors requires also a more comprehensive level of understanding of societal issues (Innes 2005) and more socioeconomic and policy-oriented research (Seppälä 2004). Understanding and considering user groups' demands for landscape has become an important issue for the societal acceptability of policy and management (Barroso et al. 2012; Selman 2012).

For the agroforestry systems of southern Iberia, this debate is particularly relevant. These are unique systems, managed extensively for centuries through careful human intervention in the natural ecosystem and a wise respect for the constraints imposed by such a harsh environment. They have therefore developed into highly appreciated and nature-rich landscapes. But nowadays, their production income is low and maintenance of the balance in these systems has long been threatened by both intensification and extensification (Bugalho et al. 2011; Pinto-Correia et al. 2011). The agroforestry system dominant in the region of Alentejo is called the montado. A recent study (Sergio Godinho 2012, personal communication) confirms that its total area has been decreasing for decades through abandonment or replacement by other land uses. In order to maintain the specific landscape produced by this land use system, there is an urgent need to recognize the multiple values of the montado so as to find efficient mechanisms for its support. The new societal demand regarding nature conservation, hunting, recreation, and aesthetic quality, if reflected in new markets or adapted compensation mechanisms, may be one of the ways to help sustain these kinds of valuable land use systems such as the montado.

It is unfeasible to propose effective and efficient policy and management recommendations for landscape services without considering users' preferences. Previous studies show that the landscape visual complexity is an important factor for preferences. In a cognitive theory of landscape preferences (Kaplan and Kaplan 1989), complexity provides content and possibilities for exploration. Research by Bestard and Font (2009) shows that recreational visitors are interested in sites with high landscape fragmentation and uneven land uses. Moreover, higher color contrast in a landscape can increase the visual preference for a specific site (Hands and Brown 2002). Likewise, Scott (2002) also found that from valued landscape features, diversity, color, and contrast were amongst the most important. At the same time, landscape preferences can be influenced by a variety of human factors, such as age, gender, education, profession, cultural background, and recreational activity, as well as by differences between geographical regions (e.g., Edwards et al. 2012; Swanwick 2009; Zandersen and Tol 2009). Since the 1990s, the body of literature on group differences in landscape preferences has been increasing (Sevenant and Antrop 2010).

Despite the quantity of literature, some gaps in knowledge about landscape preferences still remain, such as, for example, how user groups with different interests in the landscape prefer a complexity of landscape patterns and what kind of land cover classes (LCC) they wish to be present on their preferred landscape pattern.

The aim of the paper was to assess the preferred landscape pattern of different user groups. The results are based on a survey undertaken in the region of Alentejo, where a novel method was applied. Respondents were asked to compose their preferred landscape pattern from the perspective of a particular activity. The patterns were outlined by using photographs of LCC on a block diagram sketch representing a landscape area possible to see in a single view according to specific topographic conditions in the study region.

The sample design went beyond the "general" public perspective, in which the public are treated as a single entity. The particular focus here was to assess the preferences of different user groups including both the production as well as the consumption users. The specific focus of the analysis was on the landscape complexity metrics of preferred patterns and their relation to the individual characteristics of respondents.

The following section focuses on providing a description of the novel methodology applied in the study. Subsequently, the results are presented and discussed. At the final part of the paper, the conclusions depicting the main results as recommendations to landscape policy and management are provided.

2 Material and methods

2.1 Sample design

The study area was representative of the Alentejo NUT II region in southern Portugal, and the survey was conducted in ten municipalities representing the region's variability of land cover patterns and socioeconomic dynamics. The study used an approach based on the Corine Land Cover (CLC) distribution. The municipalities were chosen according to two complementary approaches: automatic and expert-based. The first approach, more automatic and quantitative, was developed through a cluster classification of the CLC distribution across the municipalities. The land covers considered in the study were based on the class distribution in 2006. Subsequently, an expert panel, including members from both research teams and members of the regional development agencies, conducted a qualitative evaluation and selection of the case municipalities, considering the results from the automatic approach, and knowledge about the socioeconomic dynamics in specific municipalities. The figure showing the location of the

ten selected municipalities (Castelo de Vide, Ponte de Sor, Elvas, Montemor-o-Novo, Reguengos de Monsaraz, Grândola, Ferreira do Alentejo, Vidigueira, Serpa, and Almôdovar) where the survey was conducted is published in Carvalho-Ribeiro et al. (2013).

The aim of the sample design was to obtain a sample of production as well as different consumption perspectives of landscape users. Therefore, a purposeful sample (Patton 2002) was collected based on a spatially stratified sample design. Each region has specific characteristics reflected in the variety of ways in which people use the landscape. In the case of the Alentejo region, systematic monitoring of landscape use by society is lacking. Thus, to capture a variety of societal demands, the results of previous studies addressing landscape preferences in the Alentejo region (Pinto-Correia et al. 2010; Surová & Pinto-Correia 2009) were used. Accordingly, five selected groups were distinguished during the survey: inhabitants, frequent visitors, tourists, hunters, and land managers primarily represented by private landowners. Although most of the respondents were Portuguese, the majority of the tourists and some inhabitants were from northwestern Europe.

2.2 Data collection

In each of the ten municipalities, around 100 questionnaires were completed including respondents from each user group. First, a meeting was held with municipal planning officers in order to get contacts for first respondents. Later, a "snowball approach" was used to enlarge the sample. With each respondent, a face-to-face interview was conducted. Seven research team members worked from February through September 2010 to complete the survey. The full questionnaire used in the study area dealt with a variety of issues related to the regional landscape. This paper focuses merely on preferred landscape compositions. In general, the survey was performed in Portuguese. For respondents with little knowledge of the native language, English was used. Each respondent was asked to choose one user group and to respond from that perspective throughout the questionnaire.

The LCC were displayed on 16 photographs. Each photograph represented one LCC within the agricultural areas and within forests and semi-natural areas from level 3 of the CLC nomenclature. The CLC classes considered by the research team to be without significance in the study area were excluded from the survey. Photographs taken in the field were edited with the Adobe Photoshop CS3 graphic editing program. Elements of the photographs inconsistent with the focus of the study, i.e., human artifacts such as roads, electric poles, and walls, were eliminated from the real photographs. Moreover, the same sky and the same level of horizon were applied to each photograph. The photographs used in the survey were published in Carvalho-Ribeiro et al. (2013).

The block diagram (Table 4) used in the survey was adapted to the gentle hilly morphology of Alentejo from a 3D diagram used in a landscape study in France by Michelin et al. (2011). According to the abovementioned study, comparing the appropriateness of different tools for landscape studies, the 3D diagrams, and models are the most relevant for discussions of planning since such representations are more general and are less linked to specific places where private interests or competition can exist. The adapted diagram was divided into five segments of land and represented common land forms in the region, which included a valley (segment 3 shown in Table 4) surrounded by undulating plains (segments 1,2, 4, and 5 shown in Table 4). The number of segments was a compromise between the possibility for expression of preferences for landscape complexity and the ability of respondents to understand and fulfill the questionnaire without exaggerated effort. Furthermore, using more segments increases substantially the complexity of analysis and subsequently the interpretation of results.

The scale of the block diagram was related to an area that could be seen from any viewpoint on terrain with moderate topography in the study region. This corresponded to a horizontal plane of 3.14 km^2 and to an area of 200 ha approximately (Carvalho-Ribeiro et al. 2013). Each segment of the diagram had similar dimensions, which were 20 % of the landscape, in view. Considering this distribution, the results can be adapted to any part of the region with similar land forms. This is undoubtedly a great simplification of the landscape pattern in reality, but it has the strong advantage of allowing the respondents to place themselves without difficulty in the overall landscape pattern they prefer for the activities in which they participate (Barroso et al. 2012). Each respondent was asked to fill in a block diagram, designed in A4 format, according to his/her preferences. For example, hunters were asked to compose their preferred landscape for hunting activity and inhabitants completed the block diagram to represent an ideal landscape to surround the place where they lived. In the final part of the questionnaire, respondents were asked about their individual characteristics like age, gender, education level, childhood and current residence, and farming background.

2.3 Data analysis

The data from the survey were analyzed with analytics software SPSS 18.0 (IBM Corporation, New York, USA) for descriptive statistics. The individual characteristics of respondents were used in the analyses to examine whether there were any differentiating factors affecting preferences for landscape patterns. The binary variables were age (age up to 40 years, age >40 years), gender, education level (university degree, no/yes), and farming background (no/yes). In the childhood and the current residence variables, different geographical

distances from the study area were distinguished: the Alentejo region, other parts of Portugal, and other countries. The user group variable divided the respondents into five groups: residents, frequent visitors, tourists, hunters, and land managers. The variables of landscape metrics, age, education level, and residence place distance from the study areas were considered as ordinal variables. The remaining variables were considered as nominal. In this study, the dependent variables were the metrics of preferred landscape patterns and the independent variables were the individual characteristics of respondents. For the variables that showed statistical significance, post hoc tests were used as well.

The land cover diversity of preferred landscape patterns was calculated using the Shannon diversity index (SHDI). The SHDI is a measure of the relative diversity of landscape and is based on two components: richness and evenness. Richness refers to the number of patch (segment) types (compositional component) and evenness to the area distribution of classes (structural component). The SHDI is calculated as follows:

$$\mathrm{SHDI} = -\sum_{i=1}^{m} (Pi \times \ln Pi)$$

where m is the number of patch types and Pi the proportion of area covered by patch type (land cover class) i.

The value of SHDI increases as the number of different LCC increases and/or the proportional distribution of the area among LCC becomes more equitable. In this study, the proportional distribution of area among segment types was not a continuous variable, but rather an ordinal one as the block diagram was pre-divided into five segments with similar dimensions, where each segment could include only one LCC.

For the sum of visual contrast weights on each preferred pattern, the visual contrast between LCC pairs was identified first (Table 1). The adjacency of two segments with high visual contrast received a value of 2 (e.g., forest adjacent to an open area), adjacency with low visual contrast between two segments received a value of 1 (e.g., irrigated culture adjacent to pasture), and two adjacent segments with the same LCC received contrast weight zero. The exception was the adjacency of two segments including the agricultural mosaic which received a value of 2 due to existing visual contrast in this land cover class. Subsequently, all the adjacency values within the preferred patterns were summed and the sums were related to the individual characteristics of the respondents.

3 Results

In all, 1,057 respondents created their preferred land cover composition on the sketch diagram. For each preferred landscape pattern, the SHDI was calculated to assess the land cover diversity. The diversity values of preferred landscapes ranged from 0.000, where all bloc diagram segments were filled by the same LCC, to 1.609, where each segment included different LCC. The latter value was actually the highest land cover diversity possible to create on the bloc diagram. The mean value of SHDI considering all respondents together was 1.27 (Table 3) and the standard deviation was 0.38, indicating the higher preference of respondents for visually complex patterns than a homogeneous one.

The number of LCC on preferred patterns ranged from 1 to 5. In general, the particular LCC were rarely repeated on the same pattern. The majority of respondents used five (35.8 %) or four (28.7 %) different LCC to compose their preferred landscape. The mean number was 3.8 LCC for the pattern. This showed the preference of most of respondents for land cover diversity in the landscape.

Both the values of SHDI as well as the number of LCC were significantly related with user group membership, gender, and farming background (Table 2). The values of SHDI and the number of LCC are significantly correlated (Spearman's $\rho = 0.881$). There were, however, some relations between the number of LCC and age as well as the childhood residence which were not observed in the SHDI values. The post hoc tests show that the preferred landscape patterns of land managers had a significantly lower SHDI ($p = 0.000$) than the patterns of tourists and residents. The average SHDI value of land managers was 1.15, while in the case of tourists and residents the values were 1.34 and 1.32, respectively. Most of the land managers were men (87 %) and all of them had a farming background. When analyzing respondents without the group of land managers, the gender and farming background differences were not significant in relation to the SHDI values of preferred landscape patterns.

In the case of LCC numbers, land managers (average LCC number, 3.6) used a lower ($p = 0.000$) number of LCC to compose their preferred landscape pattern in comparison with tourists and residents with childhood residence outside of Portugal (average LCC number, 4.1). Some small, but statistically significant, differences were also found between age classes and the average number of LCC on the patterns (Table 2). Younger people (up to 40 years old) used on average a higher number of LCC (average LCC number, 3.92) than the older respondents (average LCC number, 3.82).

The values of the sums of contrast weights ranged from 0, where all block diagram segments were filled in by the same land cover type, to a value of 12, where all segments included LCC visually contrasting with each neighbor. The frequency statistics showed that most of the respondents (73.7 %) composed landscape patterns with the sum of visual contrast values between 8 and 11. This means that from the total value of six adjacencies on the block diagram, a great part of preferred landscapes included from three to five contrasting adjacencies.

A subsequent analysis of relations between the sums of visual contrasts and individual characteristics revealed user

Table 1 Values of visual contrast weights between land cover classes

LCC	C	IC	RF	IP	NP	SA	MS	VN	OR	IO	OG	MT	EC	PN	MF	SF
C	0															
IC	1	0														
RF	1	1	0													
IP	1	1	1	0												
NP	1	1	1	1	0											
SA	2	2	2	2	1	0										
MS	2	2	2	2	2	2	0									
VN	2	2	2	2	2	2	2	0								
OR	2	2	2	2	2	2	2	1	0							
IO	2	2	2	2	2	2	2	1	1	0						
OG	2	2	2	2	2	2	2	1	1	1	0					
MT	2	2	2	2	2	2	2	2	2	2	1	0				
EC	2	2	2	2	2	2	2	2	2	2	2	1	0			
PN	2	2	2	2	2	2	2	2	1	1	1	1	1	0		
MF	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0	
SF	2	2	2	2	2	1	2	2	2	2	2	1	1	1	1	0

LCC land cover classes, *C* cereal, *IC* irrigated culture, *RF* rice field, *IP* irrigated pasture, *NP* natural pasture, *SA* shrubs in agricultural area, *MS* heterogeneous agricultural land, *VN* vineyard, *OR* orchard, *IO* intensive olive grove, *OG* olive grove, *MT* montado, *EC* eucalyptus, *PN* pinus, *MF* mixed forest, *SF* scrubs in forest land

group membership, farming background, childhood residence, and age as significant variables. Land managers preferred significantly less visually contrasting landscape patterns than others ($p = 0.000$). In the case of land managers, the mean visual contrast of preferred landscape patterns was "8.2", while in case of other respondents it was "9.0". In the remaining groups of respondents, the differences were not significant. This can be explained by the different land owners' backgrounds in comparison to the other respondents. The percentage of land managers older than 40 years was higher (84 %) than in the case of consumption landscape users (62 %).

For the percentage of open area calculation, the following LCC were considered: cereal, irrigated culture, rice field, irrigated pasture, vineyard, agricultural mosaic, natural pasture, and low shrubs in agricultural land. On average, respondents filled 46 % of their preferred landscape pattern with an open area. The significant individual characteristics related to the proportion of open land on the pattern are shown in Table 2. Respondents with higher education and those less familiar with the study area during their childhood preferred a lower proportion of open land on their landscape patterns than others.

3.1 Composition of preferred landscape patterns

Respondents composed a huge variety of different patterns (in mathematical terms, permutations) which were rarely repeated. After grouping similar LCC into four categories (Table 3), the results on the composition of preferred landscape patterns could be interpreted with higher legibility (Table 4). The montado was maintained as a separate category due to its specificity in the region.

In terms of the spatial arrangement of LCC on the block diagram, there was verified that in the valley (segment 3 on the block diagram) respondents located more frequently ($p =$

Table 2 Results from statistical tests examining the relation between individual characteristics and landscape metrics values of preferred patterns

Tests	Independent variables	Dependent variables				
		SHDI	Number of CLC	Sum of contrast weights	Proportion of open land	*df*
Chi-square	User group	69.953***	53.706**	15.807**	28.767	4
	Gender	20.108**	16.342**	10.398	3.570	1
	Farming background	17.908**	15.791**	23.248*	2.028	1
Spearman correlation	Residence[a]	0.054	0.047	0.033	−0.051	2
	Childhood residence[a]	0.035	0.061*	0.062*	−0.076*	2
	Age	−0.056	0.068*	−0.088**	0.012	1
	University degree	−0.022	−0.031	0.021	−0.087**	1

*10; **5; ***1 (significant at the percent level)

[a]Distance from the study region

Table 3 Landscape metrics of preferred landscape patterns

	LCC (level 3)	All	Residents	Frequent visitors	Tourists	Hunters	Land managers
LCC categories							
Irrigated agriculture	Irr. culture	25.8	31.4	27.7	22.1	8.4	38.5
	Rice field	9.7	10.6	9.6	10.6	9.4	8.3
	Orchard	16.9	26.9	18.6	16.1	2.0	19.0
	Irr. pasture	13.2	15.5	10.6	6.9	11.4	21.0
	Int. Olive grove	13.2	11.4	19.7	6.9	7.4	21.5
Non-irrigated agriculture	Cereal	35.6	33.9	33.5	22.6	50.0	39.0
	Vineyard	37.8	47.8	45.7	33.2	14.4	46.8
	Nat. pasture	14.1	7.3	5.3	10.6	29.2	19.0
	Olive grove	43.1	44.5	44.7	38.2	52.0	36.6
	mosaic	34.9	41.6	42.6	47.5	23.8	17.6
The montado		54.9	56.7	50.5	53.5	58.9	54.1
Forests	Eucalyptus	8.1	8.1	2.7	14.7	13.9	3.9
	Pinus	19.2	19.6	15.4	31.8	13.4	14.6
	Mixed	25.7	29.0	20.2	43.8	22.3	11.2
Scrub vegetation	In agriculture	17.1	9.8	12.2	18.4	42.6	3.9
	In forest	15.7	11.8	14.4	23.5	28.2	1.0
SHDI <0.0, 1.6>	Mean	1.270	1.318	1.229	1.338	1.294	1.155
	SD	0.374	0.355	0.405	0.349	0.328	0.404
	Variance	0.140	0.126	0.164	0.122	0.108	0.163
Number of LCC <1, 5>	Mean	3.9	4.0	3.7	4.0	3.9	3.6
	SD	1.1	1.1	1.2	1.1	1.0	1.1
	Variance	1.2	1.2	1.3	1.3	1.0	1.1
Sum of contrast weights <0, 12>	Mean	8.8	9.3	8.6	9.0	8.9	8.2
	SD	2.5	2.2	2.9	2.5	2.1	2.6
	Variance	6.2	4.8	8.5	6.2	4.5	6.7
Proportion of open area <0, 5>	Mean	2.3	2.3	2.4	2.0	2.4	2.4
	SD	1.2	1.2	1.3	1.2	1.2	1.2
	Variance	1.5	1.3	1.6	1.5	1.6	1.5
No. of respondents		1,057	245	188	217	202	205

Frequencies referring to LCC indicate the percentage of respondents including a particular LCC on the preferred landscape pattern

0.000) LCC representing open land than other LCC. The other land cover types were more frequently located on the moderate slope sides.

The majority of the respondents (54.9 %, $N=580$) chose the montado as a part of their preferred landscape pattern. The results (Table 3) reveal also that the montado was the most frequent LCC occurring on the preferred patterns of each studied user group.

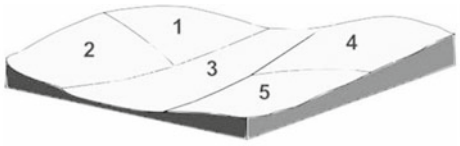
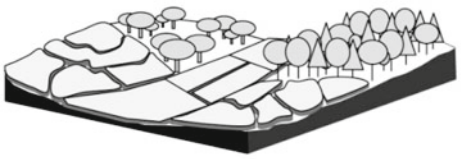
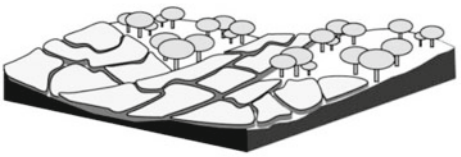
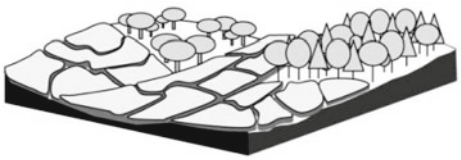
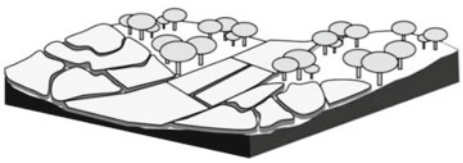
Most of the respondents filled one (51, 6 %) or two segments (36, 9 %) with the montado. Only 5 % of respondents filled three or more segments with the montado and just a few respondents (2, 4 %) filled the entire block diagram with the montado. More than a third of the respondents also included the olive grove, vineyard, cereal, and agricultural mosaic in their preferred pattern (Table 3).

The commonly adjacent LCCs were the montado with another segment of the montado ($n=412$). The second most frequent was the adjacency of the montado with the olive grove ($n=277$), followed by the montado with cereal ($n=210$). The montado was rarely adjacent to eucalyptus ($n=24$), to intensive olive grove ($n=34$), and to orchard ($n=47$).

The subsequent results focus on the composition of the most preferred landscape patterns for particular user groups.

A cross-tabulation statistic using the chi-square test revealed that user groups differed significantly in the LCC they used for the composition of their preferred landscape patterns, except for the montado and rice field. The majority of each user group occupied their preferred pattern with 60 % (corresponding to three segments on block diagram) of agricultural land, except for hunters where only 40 % of the pattern was filled by agriculture. The montado mostly occupied 20 % of the pattern area, except for farmers and frequent visitors who mostly preferred to have 40 % occupied by the montado. The presence of forest on the landscape pattern was relatively important for tourists.

Table 4 Block diagram with labeling numbers of segments and the most frequent compositions of preferred landscape patterns by different user groups

Block diagram	segment number	
		
Residents 	1	the montado
	2, 5	*less intensive agriculture:* olive grove (45%), mosaic (40%), cereal (32%)
	3	*intensive agriculture:* irrigated culture (24%)
	4	*forests:* mixed (41%)
Frequent Visitors 	1, 4	the montado
	2, 3, 5	*less intensive agriculture:* olive grove (43%), vineyard (40%), mosaic (30%), cereal (27%)
Tourists 	1	the montado
	2, 3, 5	*less intensive agriculture:* mosaic (41%), olive grove (40%), vineyard (29%)
	4	*forests:* mixed (42%), pinus (21%)
Hunters 	1	the montado
	2, 3	*less intensive agriculture:* olive grove (48,7%), cereal (47,9%)
	4	*forests:* mixed (17,6%), eucalyptus (13,4%)
	5	*scrub vegetation:* low scrubs (43,7%), high scrubs (27,7%)
Landowners 	1, 4	the montado
	2, 5	*less intensive agriculture:* cereal (38%), vineyard (36%) olive grove (30%),
	3	*intensive agriculture:* irrigated culture (29%), irrigated pasture (23%)

Values in parentheses are the percentages of user groups combining specific LCC with the montado

Table 4 demonstrates the most frequent landscape patterns preferred by different user groups. Most of the residents (57 %) included on their preferred landscape pattern the montado, together with agricultural and forest land. They included significantly more times than other studied user groups vineyard and orchard ($p=0.000$) into their preferred pattern. On the other hand, pasture land covers ($p=0.001$) and low shrubs ($p=0.001$) appeared less frequently on their favorite patterns.

Frequent visitors differed from other groups by less frequently including eucalyptus ($p=-0.002$), natural pasture ($p=0.000$), and intensive olive grove in their preferred

landscape patterns. Most of the group (51 %) added the montado to their preferred pattern. The montado was combined with several patches of non-irrigated agriculture (93 %). Montado mostly (60 %) occupied two or more segments on the preferred pattern. Comparing patterns including the montado with other patterns, it can be observed that patterns with the montado include, less frequently, irrigated culture ($p=0.007$), orchard ($p=0.012$), agricultural mosaic ($p=0.000$), and mixed forest ($p=0.003$) than those without the montado.

Tourists were less frequent than other respondents in adding cereal ($p=0.000$), irrigated pasture ($p=0.002$), and intensive olive grove ($p=0.002$) to their patterns, but more frequent in adding agricultural mosaic ($p=0.000$), high scrubs in forest ($p=0.000$), and forest areas ($p=0.000$) like eucalyptus, pinus, and mixed forest. Montado was combined most frequently with forests and non-irrigated agriculture (60 % of tourists). Pine forest was more frequently ($p=0.000$) added to patterns without the montado.

The preferred landscape patterns of hunters in 59 % of cases were a combination of the montado, scrub land, and non-irrigated agricultural land. There was no significant difference between the LCC in landscape patterns with montado and patterns without montado. In comparison with other respondents, this group was unique in more frequently choosing cereal, natural pasture, high scrubs and low scrubs (all with $p=0.000$), olive grove ($p=0.005$), and eucalyptus ($p=0.001$). They less frequently included irrigated culture ($p=0.000$), vineyard ($p=0.000$), orchard ($p=0.000$), intensive olive grove ($p=0.007$), and mosaic ($p=0.000$) than other groups on their preferred compositions.

Landowners, similar to frequent visitors, preferred two or more segments of the montado (66 % of pattern with the montado). They principally preferred montado in combination with both irrigated and non-irrigated agriculture. This group preferred significantly more ($p=0.000$) the presence of irrigated agriculture than other groups, especially irrigated pasture, irrigated culture, intensive olive grove, and vineyard ($p=0.003$). Furthermore, they preferred less than others ($p=0.000$) the presence of agricultural mosaic, mixed forest, and high scrubs and low scrubs on their patterns.

4 Discussion

The present study focused mainly on the relation between landscape complexity metrics of preferred patterns and the individual characteristics of respondents.

Several studies already showed that visual complexity (Corral-Verdugo et al. 2009; Kaplan and Kaplan 1989; Ode and Miller 2011; Tveit et al. 2006), also expressed as a number of woodland patches (Ode et al. 2009) is an important predictor of public landscape preferences. In the work of De la Fuente de Val et al. (2004), the most appreciated landscapes were those with perceived complexity measured by SHDI and with uniform distribution of land uses expressed through the Shannon evenness index.

Similar to findings in the abovementioned studies, this paper also shows that landscape users in the Alentejo agree on higher preferences for landscapes including diverse and visually contrasting land covers in comparison with homogeneous landscapes.

Up to this date, there are few studies relating the landscape complexity metrics to individual characteristics. Frank et al. (2013) studied the influence of personal factors on visual assessment of the landscape, but have not revealed significant relations. In relation to public groups, the study of Dramstad et al. (2006) discovered some differences in preference for landscapes with high visual diversity; local respondents did not show higher preference for heterogeneous landscape, contrary to non-local students.

In this study, land managers—in relation to consumption landscape users—preferred less diverse and less visually contrasting landscape, especially when compared with tourists and residents. But still, the preferred landscape patterns of land managers were not fully homogeneous and included several LCC, mainly combining the montado with different types of agriculture. In general, around half of the landscape pattern area is preferably formed by an open area. Tourists, however, prefer the open area to be less extensive. Also interesting is the fact that the preferred proportion of open land decreases with higher education and with distance of childhood residence from the Alentejo. This observation would probably merit some attention in future studies.

The montado is an important component of the preferred Alentejo landscape for land managers, inhabitants, frequent visitors, tourists, and hunters. Most of the landscape users prefer 20–40 % of the landscape in view to be occupied by the montado, with the remaining landscape covered by agricultural areas, especially those non-irrigated types. These results could indicate a preference for the landscape composition that appears today on a large scale in Alentejo: montado patches with changing densities of tree cover in combination with patches of open pastures, annual crops, or permanent cultures such as vineyards and olive groves.

The revealed importance of the montado in preferred landscape mosaics in the Alentejo is not its unique value. As previous studies have already shown; this agroforestry system has a vital role in the regional identity, biodiversity conservation, in the preservation of natural resources such as soil and water, as well as in the regional production of cork and livestock (Aronson et al. 2009; Bugalho et al. 2011; Pinto-Correia et al. 2011). Such results can support a clear targeting of public policies for the valuation and the preservation of this agroforestry system, within a territorial perspective rather than a sectorial one.

Although considerable agreement was found across the user groups on the concentration of preferences for the

montado, clear differences were also seen, specifically in the distribution of preferences relating to other LCC, such as irrigated agriculture, forests, and scrub vegetation. The presence of irrigated agriculture in the landscape is appreciated much more by land managers. On the other hand, scrub vegetation was particularly appreciated by hunters, and forests were appreciated mainly by tourists.

In this survey, a large number of tourists were from northwestern Europe. Based on previous studies which have revealed a preference variation for forest characteristics across the regions of Europe (Edwards et al. 2012; Rametsteiner et al. 2009), a tentative explanation can be offered about the different preferences for forests between the tourists and the other user groups in southern Portugal. A European survey (Rametsteiner et al. 2009) discovered that Portuguese citizens gave the lowest importance to recreation when they ranked forest functions. Conversely, in northwestern Europe, recreation is generally placed in a high position on the list of forest functions. In addition, the percentage of forest cover is higher in these countries (MCPFE 2007), and the use of forests for amenity activities is more popular. The attractiveness of the forests evaluated should be considered in this context. Most of the pinus, eucalyptus, and mixed forests in southern Portugal are managed relatively intensively for production. In these forests, the trees are evenly spaced and even-aged. From this point of view, the montado can also be seen as a strong forest competitor in the Alentejo region due to its characteristic open woodland and higher visual diversity (Antrop 1993) compared with forest plantations.

The novel element of the current study is that it goes beyond the evaluation of separate land cover types and asks people to compose their own preferred pattern using the block diagram. The study thus allows more complex assessment of the landscape pattern. The simplified version of the 3D diagram of Michelin et al. (2011), adapted to the gentle, hilly morphology of Alentejo, facilitated the visualization of the abstract landscape forms. As a result, the respondents composed their preferred landscape mosaic without problems and even with interest.

This type of tool appears to be appropriate for the evaluation of preferred landscape patterns in defined landscape topography in an explicit manner and generally without a linkage to a specific place. It must be depicted as well that respondents are sensitive also to specific topography of the block diagram. This study shows differences between land cover classes occupying valley unit and those occupying other polygons. There seems to be a predisposition to choose certain polygons for certain land covers (e.g., water availability in the valley), and thus the space is not equally likely to be chosen for all land covers. The challenge for future studies assessing preferred landscapes is to overcome these kinds of biases and also to develop tools to assess not only the land cover diversity, contrast, and percentage of open land but also the preferred shape and size variations of landscape patches.

By using interest-catching tools in landscape-related studies, public willingness to participate can most likely increase. Even if other methods have also been used to identify public landscape preferences—like expert panels or student surveys—the involvement of a robust sampling of members of the public is considered to be the most appropriate approach (e.g., Blasco et al. 2009).

5 Conclusions

Landscape visual complexity is an important feature for human preferences. However, the level of visual complexity of preferred landscape can vary across individual characteristics, especially, as this study shows, between different user groups.

Moreover, in specific territorial contexts, certain LCC can represent an essential feature of preferred landscape pattern. In the Alentejo region in southern Portugal, the montado has this important role for landscape users.

The results provide knowledge for landscape policy and management regarding preferred visual features of the rural landscape and thus facilitate the identification and choice of areas with the potential to satisfy different societal demands.

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