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MAPPING SOCIAL VALUES FOR CULTURAL ECOSYSTEM SERVICES IN A MOUNTAIN LANDSCAPE IN THE ROMANIAN CARPATHIANS

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Abstract: Cultural ecosystem services are the non-material benefits that people obtain from ecosystems such as aesthetic quality of landscapes, recreation and learning opportunities, or even therapeutic or spiritual contributions to human wellbeing. The assessment, quantification and mapping of ecosystem services, and in particular cultural ecosystem services are essential for a proper understanding of the values of natural capital and for a better integration of these values in management and decision-making processes. Our study aims to assess and map the cultural ecosystem services in a protected area, through the perception of tourists, as their beneficiaries. To this purpose, we use the concept of social values for ecosystem services, as perceived, non-material values that the public attributes to ecosystems and landscapes. The analysis focuses on an area in the upper Râul Târgului catchment in the Romanian Carpathian Mountains, which is part of two NATURA2000 SCI sites. The data regarding the perceived social values was obtained through participatory mapping methods and was then analyzed using GIS tools. Our results showed Recreation as the most appreciated social value for cultural ecosystem services, followed closely by the Aesthetic and Education values. Important hotspots for social values were identified along the river valleys, tourist trails and on the mountain tops. These results offer useful information that can be used towards a better planning of tourism infrastructure and activities in the upper Raul Târgului catchment area.

Keywords: social values, cultural ecosystem services, participatory mapping, Romanian Carpathians

1. INTRODUCTION

Cultural ecosystem services (hereinafter abbreviated as CES) are defined by the Millennium Ecosystem Assessment (MEA, 2005) as non-material services and benefits that people obtain from ecosystems and are classified by De Groot et al., (2002) as "*goods and services related to information functions of ecosystems*"**.** CES are arguably among the most difficult to measure or quantify, which also makes them hard to be included in planning and management processes and avoid possible conflicts (Daniel et al., 2012; Hersperger et al., 2015; MEA, 2005; Milcu et al., 2013; Tengberg et al., 2012). Partly this is due to their intangibility (Milcu et al., 2013) and their dependence on the subjective perception of the people who benefit from them, and thus, on the choices people make about ecosystems (Kumar & Kumar, 2008). Another reason is that CES more often derive indirectly from ecosystems, through landscape characteristics, rather than directly from the inner workings of ecosystem functions and structures, which are easily measured and quantified by biophysical and ecological methods and techniques (Petrović et al., 2016; Tengberg et al., 2012).

As non-material services and benefits CES often times elude the monetary techniques of valuation characteristic to the utilitarian approach to ecosystem services, and as consequences of social and cultural constructs that assign them value, they also elude more nature driven sciences (Daniel et al., 2012; Kumar & Kumar, 2008).

However, in recent times, CES have received considerably more interest both from the scientific

world as well as from the policy and practice sector (Milcu et al., 2013). An increasingly popular method, bypassing the shortcomings of the monetary valuations (Kumar & Kumar, 2008), is the spatial representation and quantification of cultural ecosystem services, often obtained through participatory value assigning and mapping (Brown et al., 2015; De Vreese et al., 2016; Plieninger et al., 2013; Sherrouse et al., 2011; van Riper et al., 2012).

Human perception, preferences and needs are situated at the centre of the ES paradigm (MEA, 2005) and public participation mapping of ecosystem values and services is able to bring these human and social components to ecosystem services assessments (Brown, 2013). Previous studies confirm the ability of the public to identify cultural and provisioning services particularly well (Brown et al., 2012) and also suggest the usefulness of surveys or interviews in assessing these type of ecosystem services that depend greatly on personal perception (Mocior & Kruse, 2016; Plieninger et al., 2013).

In this context, the concept of *landscape values* (Brown & Reed, 2000; Brown & Brabyn, 2012; Reed & Brown, 2003) or *social values for ecosystem services*, as they were later called, (Bagstad et al., 2016; Clement & Cheng, 2011; Raymond et al., 2014; Sherrouse et al., 2011; Sherrouse et al., 2014; van Riper et al., 2012) comes into play. Brown & Reed (2000) define landscape values as "*perceived attributes of a landscape that are thought to result from a transactional concept of human–landscape relationships*". Further on, social values are defined as "*the perceived, nonmarket values the public ascribes to ecosystem services, particularly cultural services, such as aesthetics and recreation*" (Sherrouse et al., 2014).

Until now, this approach has been used mostly on large scale landscapes (Alessa et al., 2008; Sherrouse et al., 2014) with numerous types of social values, from all four categories of ecosystem services (supporting services, regulating services, provision services, and cultural services) (MEA, 2005). Our study focuses on a small scale landscape, part of a mountain river catchment, and on only six types of social values corresponding to cultural ecosystem services. We used an in-situ interview method, instead of the mail-back survey used by other studies **(**Clement & Cheng, 2011**),** and we were interested particularly in the visitors to the area, rather than people living close to the area.

Thus, our study aims to quantify and assess the spatial distribution of cultural ecosystem services using the perceived social values that tourists attribute to ecosystems and landscapes. Firstly, we tried to find out which areas are perceived by the public to provide the highest degree of cultural services and, secondly, how the people's appreciation is influenced by the underlying landscape elements.

To respond to these questions, our research had the following objectives: a) mapping and quantifying social values for cultural ecosystem services; b) studying the relationships between social values and landscape features and configuration.

2. DATA AND METHODS

2.1 Study area

The study area is located in a high-mountain area of the Iezer Mountains, in the Southern Carpathians, Romania (Fig. 1). It covers an area of 118 km^2, with an elevation ranging from 900-2470 m, and slopes higher than 40° on more than 30% of the surface (Oprea & Ielenicz, 2011). The land cover in 2012, according to the data extracted from orthophoto images of the area (ANCPI, 2012), consists of 65% forest, 23% grassland, 7% subalpine vegetation, 0.5% built-up areas and roads. In spite of its past management dedicated to timber production (Săvulescu, 2014), in more recent times, the area has been mostly used for touristic activities such as camping, hiking, mountain biking, motorized recreation (Enduro, ATV, etc). The study area is now part of two NATURA2000 SCI sites: ROSCI0122 *Munții Făgăraș* and ROSCI0381 *Râul Târgului - Argesel–Râusor.*

2.2 List of social values

In order to obtain a list of values (Table 1), which would be easy to understand by the people being interviewed, we used the classification of cultural services as developed by the Millennium Ecosystem Assessment (MEA, 2005) and later on adapted by De Groot et al., (2010), together with the typology of social values for forest ecosystems as designed by Brown & Reed, 2000.

We decided to use a more simplified version of the three typologies in order to keep our discourse closer to the common language and reality of the people being interviewed and to offer them adequate choices for the matter at hand, and thus limit confusion or misunderstanding (Tengberg et al., 2012).

2.3 Data sources

For this study we used two types of data: environmental and social.

Table 1 Social values for ecosystem services and their descriptions as they were used in our study (after Brown & Reed, 2000 and De Groot et al., 2010)

Value/Service	Description – *"I value this place because…"* as used in the interview.
Aesthetic	*I enjoy the scenery, sights, sounds, smells, etc.*
Recreation	*It provides a place for my favourite outdoor recreation activities.*
Education and Learning	*I can learn about the environment through scientific observation or experimentation.*
Cultural and Historical	*It is a place where to practice and pass down customs and traditions or it includes elements important for local or national history.*
Spiritual and Religious	*It offers a special spiritual experience or it is the place where I feel a strong connection with nature.*
Inspiration	*It represents an inspiration source for folklore, artistic manifestations or national symbols.*

The primary sources for the environmental data were topographic maps 1:25000 (DTM, 1980) and digital orthophotos from 2012 (ANCPI, 2012) that underwent processing (ArcGIS 10.2, ESRI, 2013) to obtain raster layers containing: elevation, slope, land cover and distances to roads, trails, buildings, water, highest peaks (shortest straight-line distance of each cell to the linear element). The land cover types were mapped from orthoimagery from 2012 and defined based on the Corine Land Cover classification (European Environment Agency, 2012), and forest management Plans (OS Câmpulung, 2006 a, b).

The social values data were gathered through interviews with tourists that consisted of a set of short questions, a value attribution section and a participatory mapping exercise (Alessa et al., 2008; Brown & Reed 2000; Clement & Cheng, 2011; Reed & Brown, 2003; van Riper et al., 2012).

The interviews (N=74) took place in-situ, from June to August 2016, and were held in key points across the study area with the highest concentrations of tourists, using a convenience sampling method. They were held either as one to one interviews or in a group discussion setting.

The questions section asked for information about the respondent's knowledge of the area and their socio-demographic characteristics.

2.3.1 Participatory mapping exercise

A value attribution task preceded the participatory mapping exercise, where the respondents were asked to decide which social values from the list provided (Table 1) are important for them and would like to maintain in the area. Then, they had to rank their importance by dividing100 points between the values they thought to matter the most.

The participatory mapping exercise asked the respondents to place between one and four points on a printed map of the area (1:43.000) that mark locations which they consider to be representative for each of the values deemed as important in the value attribution task. Each point was then digitized into a point layer (N=481, an average of 6.5 points per respondent) and imported into a GeoDatabase using ArcMap (ESRI, 2013).

2.4 Tools and software used in the analysis

In order to quantify and assess the spatial distribution of social values for cultural ecosystem services, we used the SolVES 3.0 tool (*Social Values for Ecosystem Services*), developed by the USGS (Sherrouse et al., 2014; Sherrouse & Semmens, 2015), to analyze the data gathered from the participatory mapping exercise and relate them to underlying landscape characteristics. The tool consists of three modules, of which only two were used for this study: the *Ecosystem Services Social-Values Model* and the *Value Mapping Model*. The workflow of the analysis is illustrated in figure 1.

SolVES 3.0 works as an add-on for the ArcMap 10.2 application (ESRI, 2013) and uses a combination of *Kernel Density* surfaces and the outputs from the MAXENT software (Phillips et al., 2006) to quantify and map social values through a non-monetary, spatial indicator, with values from 0 to 10 called Value Index (hereinafter abbreviated as VI). Besides serving as a spatial indicator for perceived value, the VI also compares between value types. Thus, the maximum value of 10 is obtained only by the social value type that is more highly valued by respondents than any of the other social value types regardless of location. The highest VI value (9, 8, 7, etc) for each other social value represents locations where that particular value is valued more highly than at any other location within the study area (Sherrouse et al., 2011). The lower the VI, the lower the social-value type is valued in the location considered.

The tool also calculates spatial statistics for the point data, which describe the degree of spatial clustering, and uses Zonal statistics to show the relationship between the VI indicator and landscape characteristics (Sherrouse et al., 2011, Sherrouse & Semmens, 2015).

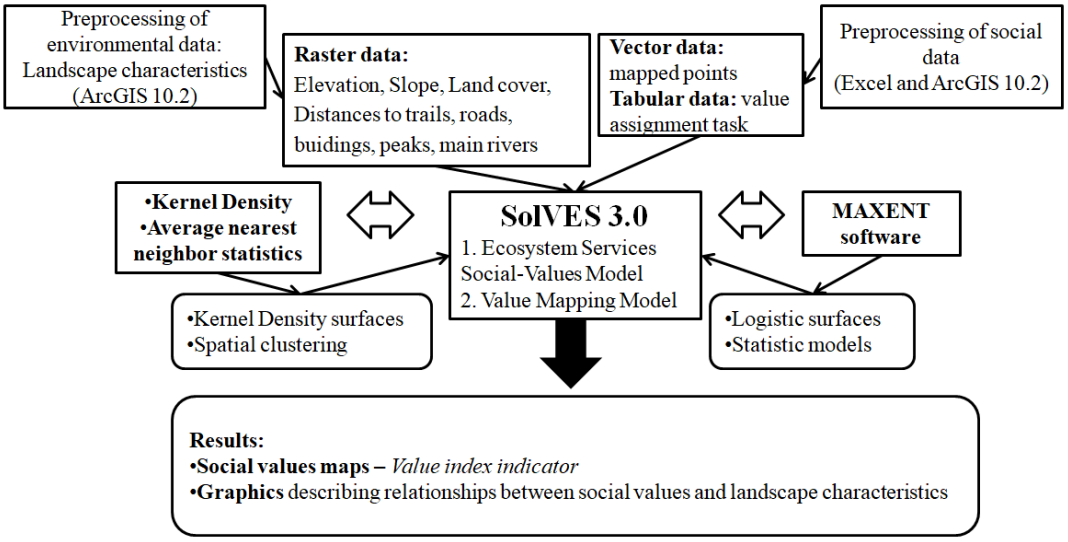

Figure 1. Workflow diagram (after Sherrouse & Semmens, 2015)

3. RESULTS

3.1 Interview and participatory mapping

The socio-demographic characteristics of the respondents show a majority of males (61%) and the predominance of people between the ages of 30 and 50 years old (47%), followed by the under 30 group. Other information obtained in the questionnaire part of the interview shows that 64% of the respondents own a higher education degree, 61% of them come from the capital city (Bucharest) and most of them (78%) spend an average of 2-3 days in the area in one visit. The respondents declared engaging in activities such as hiking or trekking (55 answers), picnics (23 answers), and camping (14 answers). Other answers included: mountain biking, meditation and rock climbing.

In the participatory mapping exercise 51% (38 respondents) selected five or all the social values types to be of importance to them (group A), while 49% (36 respondents) considered important only four or less social values types (Group B). From Group A, 79%of respondents (n=30) possessed higher education degrees, compared to only 47% (n=17) for Group B. 42% (n=16) of respondents from Group A were females, while Group B was comprised of 64% (n=23) men. When asked on a previous question to rank four types values that they generally attribute to nature (Economic, Aesthetic, Protection and Intrinsic), the intrinsic value was ranked first by 66% (n=25) of respondents from Group A and only 42% (n=15) from Group B.

The participatory mapping exercise resulted in 480 mapped points and a mean of 6.5 points per respondent (Fig. 2). 25.6% of the total mapped points represent the Aesthetic value, 25% the Recreation value 18.5% Education value, 12.5% Inspiration value and 18.3% Cultural-Historic and Spiritual-Religious values (Table 2).

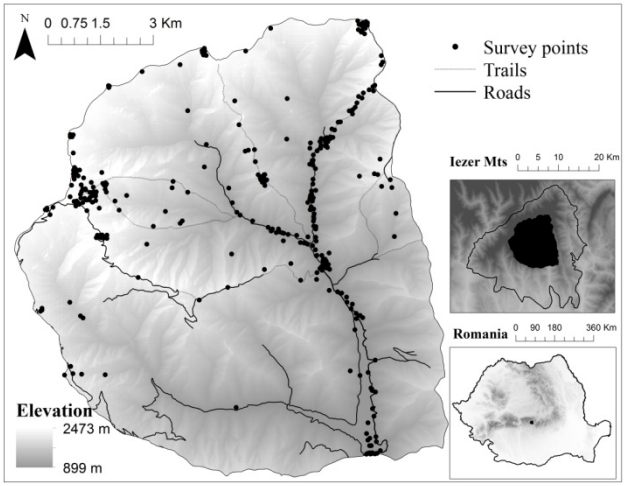

Figure 2. Mapped points and location of the study area (within Iezer Mts. and within Romania).

3.2 Spatial distribution and quantification of social values for cultural services

The spatial distribution of values was first described by the results of the first modules of SolVES, in the form of average nearest neighbour statistics, which were used to check for hotspots for each social value. Point clustering is indicated by R values of less than 1 and large negative Z scores. The results show high spatial clustering for the Aesthetic, Recreation and Education and Learning values (Table 2). Based on these results, we focused the rest of the analysis on these three social values for cultural ecosystem services.

Table 2 Number of mapped points and average nearest neighbour statistics results for each social value

Social value	Mapped points	R_ratio	Z_score
Aesthetic	123	0.415	-12.42
Recreation	120	0.582	-8.75
Education	89	0.475	-9.47
Cultural	44	0.709	-3.70
Spiritual	44	0.615	-4.89
Inspiration	60	0.554	-6.61

In order to map the hotspots indicated by the results for spatial clustering, we ran the *Value Mapping Model* from the SolVES 3.0 tool. The results show the most important social value perceived by visitors interviewed to be *Recreation* (VI max = 10), being followed by *Aesthetic* (VI max = 7) and *Education and Learning*. The most valued places are located on the river valleys and next to the trails, especially near the mountain cabins present in the area (Cuca, Voina and Refugiul Iezer), as well as the highest mountain peaks (Iezerul Mic, Iezerul Mare, Păpușa, Roșu) and the Râușor reservoir dam (Fig. 3).

3.3 Relationships between social values and landscape characteristics

Our findings show that the variables with the highest overall contribution to the MAXENT statistical models were the following: distance to trails, distance to peaks, distance to buildings, distance to the main rivers, elevation (Table 3).

The distances mentioned above were calculated as Euclidean distance rasters, showing the straight-line distance from a particular raster cell to the nearest considered feature (trail, building, road, etc). Thus, for example, if the distance to trails (DDT) variable has a high contribution to the MAXENT model for the Aesthetic value, this means that the position of trails in the landscape has a significant influence on the locations people value for their Aesthetics. The relationship between these environmental variables and social values was further investigated with Zonal Statistics (MEAN), where the zones were defined by the integer values of the VI indicator. The results of this analysis can be found in figure 4.

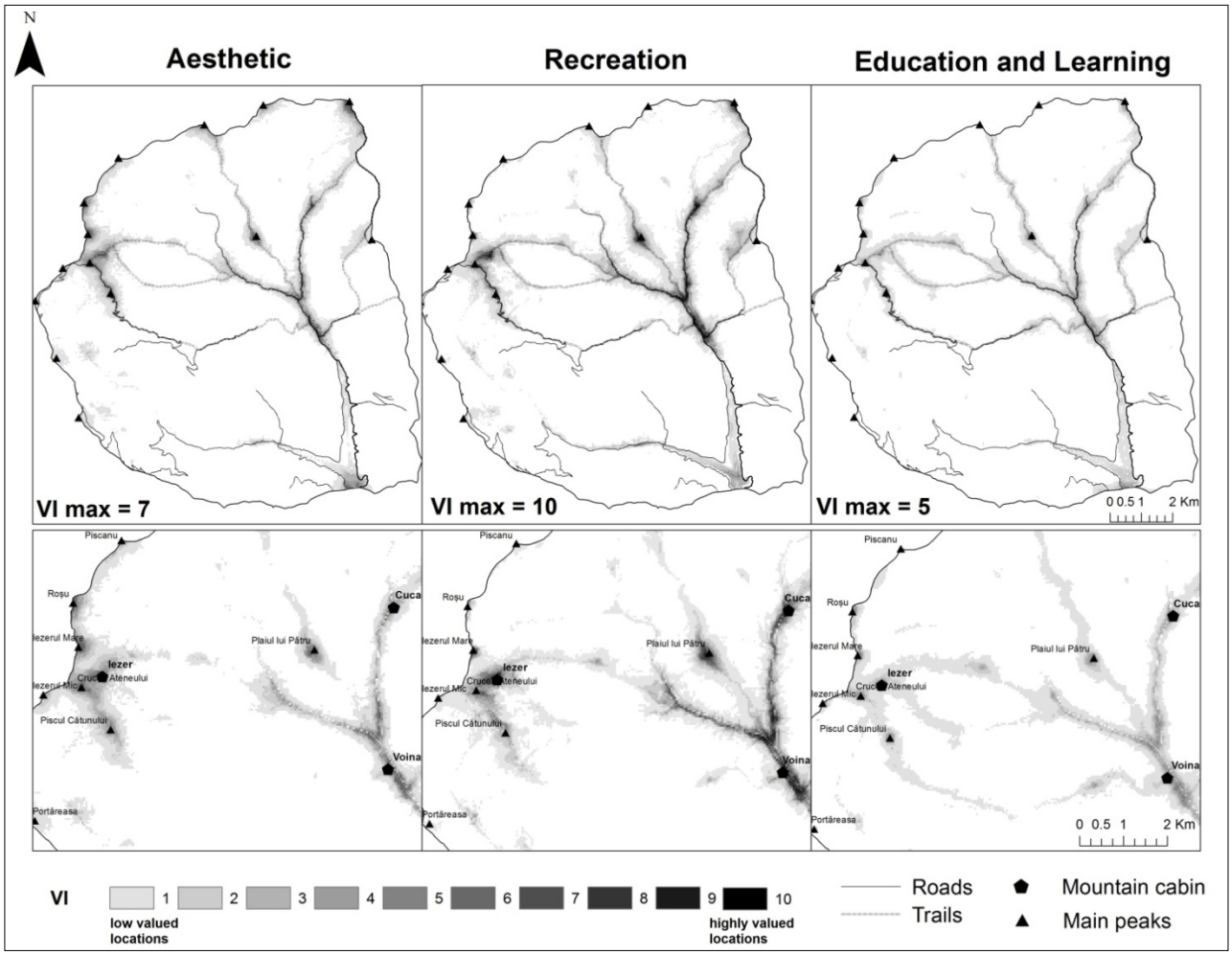

Figure 3. Social value maps – the spatial distribution and intensity on the VI scale of the Aesthetic, Recreation and Education values. The second series of maps represent close-ups of areas with hotspots for social values.

The line graphs in figure 4 describe the relationship between the VI and the first three environmental variables with the highest relative contribution to the MAXENT generated models. For each type of social value we obtained the following results: i) the perceived Aesthetic value decreases overall as the distance to trails and to main peaks increases and increases as the elevation goes up; ii) the Recreation value decreases steadily as the distance to trails, buildings and rivers increases; iii) the Education and learning value also decreases with the increase in distance to trails and buildings but, as opposed to the Aesthetic value, it decreases as the elevation increases.

3.3.1. Results by land cover

In order to analyse the link between land cover and social values, we first studied the distribution of mapped points by land cover type. The results show that the cover type with the most mapped points is *grasslands* (N=175; 36.5% of all mapped points), followed by *rocky surfaces* or *areas without vegetation* (N=86; 18% of all mapped points), *mixed forest* (N=79; 16.5% of all mapped points) and *coniferous forest* (N=75; 15.6 % of all mapped points).

Table 3 The description of the environmental and landscape variables used and their relative contributions to the MAXENT statistical models for each social value (Aest.=Aesthetic value; Rec. = Recreation value; Edu. = Education value)

Landscape variable	Description	Contribution to MAXENT model		
		Aest.	Rec.	Edu.
Distancetotrails (DTT)	Straight-line distance to nearest trail (m)	**22.7%**	**41.2%**	**36.5%**
Distance to peaks (DTP)	Straight-line distance to nearest peak (m)	**22.1%**	3.1%	6.6%
Elevation (ELEV)	Digital Elevation Model (DEM)	**20.3%**	0.4%	**10.2%**
Distance to buildings (DTB)	Straight-line distance to nearest building (m)	18.1%	**32.1%**	**34.1%**
Distance to main rivers (DTMW)	Straight-line distance to nearest main river (m)	7.8%	**15.4%**	8.7%
Land Cover (LC)	Land cover categorial data	4.7%	0.6%	2.1%
Distance to roads (DTR)	Straight-line distance to nearest road (m)	2.4%	2.8%	0.3%
Slope (SLOPE)	Value of slope in degrees	0.4%	3.8%	0.6%

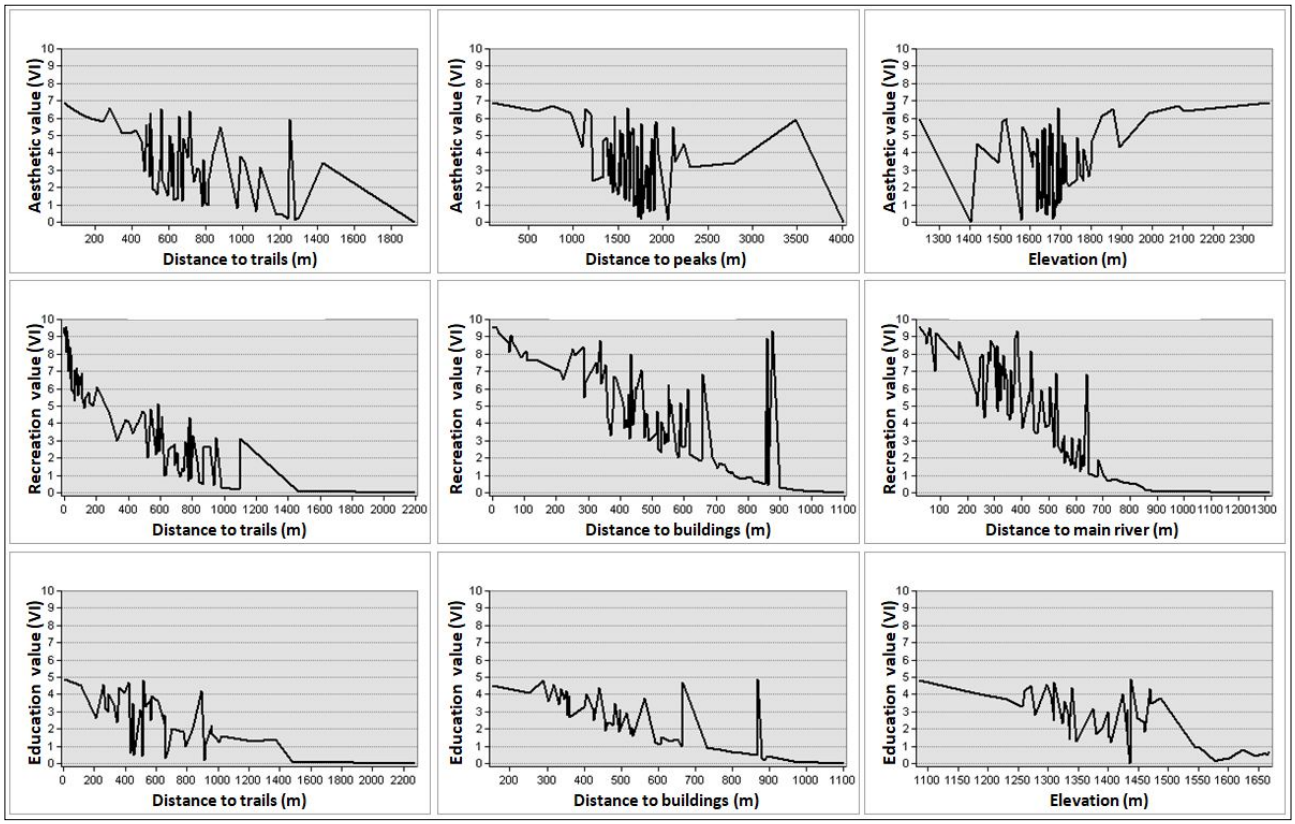

Figure 4. The relation between the Value Index (VI) and landscape characteristics, where Y-axis represents the values registered on the VI for each social value, and the X-axis represents the environmental variable (mean values obtained from Zonal Statistics).

The graph results from SolVES also confirm these findings regarding land cover. They show grassland cover with the highest VI for all three social values. Other land cover types correlated with high VI consist of rocky surfaces for the Aesthetic value, mixed forests for the Education value and artificial surfaces for the Recreation value.

The *grassland* and *mixed forest* cover types overlay the largest areas where the VI is larger than 0, followed by the *coniferous forests* and *water surfaces* (Tab. 4). Maximum values for VI, for all three social values considered, are registered in grasslands, mixed and coniferous forests and by *areas without vegetation* that include rocky surfaces on the top of the mountains and river beds. The lowest VI can be found in areas covered by *subalpine vegetation*.

Table 4 Number of mapped points and area with VI>0 for each land cover type, where Aest. = Aesthetic Value, Edu. = Education value, Rec. = Recreation value

Land Cover	**Mapped points**	**Area with VI>0 (km^2)**		
		Aest.	Rec.	Edu.
Grassland	175	6.02	6.33	4.51
Subalpine vegetation	7	0.33	0.70	1.08
Coniferous forest	75	1.54	3.28	1.54
Mixed forest	79	3.31	5.35	4.18
Deciduous forest	2	0.29	0.13	0.24
Forest damage	1	0.10	0.20	0.32
Rocky surfaces	86	2.70	2.02	1.60
Water surface	17	0.84	1.34	1.36
Built surface	23	0.01	0.01	0.01
Roads	15	0.15	0.15	0.20

4. DISCUSSIONS

4.1 Social values: quantification and spatial distribution

Our results for the most appreciated social values for cultural ecosystem services confirm previous findings: *Recreation*, *Aesthetics* (Brown, & Brabyn, 2012; Nahuelhual et al., 2013; Sherrouse et al., 2011; Sherrouse et al., 2014; van Riper et al., 2012) and *Education and Learning* (Plieninger et al., 2013; van Riper & Kyle, 2014).

Several hotspots were revealed by the analysis of the spatial distribution and quantification of the social values considered. The shapes and locations of these most valued places indicate two main interests from the public: i) linear areas of interest along the main river valleys and trails; ii) round-shaped hotspots surrounding the highest mountain tops. Further research could be done to analyze these hotspot areas from the perspective of patterns and structure with social landscape metrics (De Vreese et al., 2016; Plieninger et al., 2013). From a planning and administrative perspective, these conditions suggest two distinct management directions to enhance the visitors' experiences and also protect the ecosystems from the negative impact of human intervention: a recreation centred approach and a nature conservation or aesthetic quality oriented approach.

In terms of planning, this could translate into a series of information and observation decks along the already existing network of trails. This would provide a better experience for visitors adventuring past the main points of interests down in the valleys, with a low amount of human intervention to the natural landscape much appreciated by this category of visitors. On the other hand, the high value attributed to the space close to the river, an aspect which was also observed on site, reveals a need for a more organized form of recreation alongside the banks of the river, in order to mitigate the significant impact that recreation brings into the landscape (Špulerova et al., 2016). Ignoring this need already creates problems in terms of unsupervised fires, littering as well as air and noise pollution from motorized vehicles.

4.2 Relationships between social values and landscape characteristics

The results from the second part of the analysis contribute to the understanding of what landscape characteristics influence the perception of the public regarding the location of social values and can be related to the provision of cultural ecosystem services.

To analyze the relationship between the social values mapped and the landscape variables considered, we used two types of results: the relative contributions of the environmental variables to the MAXENT generated models and the line graphs that visually describe the relation between the VI indicator and each variable.

Our findings show a clear link between the areas perceived as providing a Recreation and Educational values and man-made elements or artificial surfaces that provide accessibility such as trails or lodging (in particular mountain cabins). This can be explained by the tendency of visitors to assign value to places that are easily accessible and familiar to them, instead of more remote areas. However, the

Aesthetic value in particular is linked to harder-to-access spots, mainly the high elevation areas surrounding the main peaks.

Similar to other studies (Brown, 2013; Plieninger et al., 2013), our findings show that coniferous forest and grassland land covers play the most important role in terms of social values for ecosystem services.

The relationships between social values for ecosystem services and environmental characteristics described by our assessment can be used in value transfer analysis (Brown et al., 2015, 2016) for other similar areas across the Carpathians. Such a module already exists in the SolVES 3.0 software (Sherrouse & Semmens, 2015), but did not represent the scope of our analysis.

4.3 Limitations of the study

The limitations of the study are determined mainly by the subjectivity ensued by the participatory mapping and interview methods and also by the convenience sampling method used to gather the social values data. Other aspects that may have influenced the results are the locations of the interviews, the number of people interviewed and the category of stakeholders chosen for the interviews.

The interviews were held in popular spots and along the river valleys, close to transportation and lodging infrastructure, which may have influenced the high values on the VI obtained along the river banks and the high contribution of the distances to trails and to mountain cabins (buildings) to the MAXENT statistical models.

Another limitation of the study is that it investigates social values and cultural services only from the perspective of visitors and tourists, a stakeholder group with limited knowledge of the area, outside the popular touristic gathering spots (e.g. river valleys, touristic trails, mountain cabins, etc).

Another aspect that may have influenced the results of this research is the fact that we used a fixed list of social values that relates only to the broad and general definition and aspects of cultural services of ecosystem service, instead of asking the recreational users to identify more specific benefits that they receive from the area.

5. CONCLUSIONS

This study contributes to the ongoing discussion on integrating the human and social component to ecosystem services assessment and mapping by using interviews and a participatory valuing and mapping technique. We mapped and quantified cultural services from the perspective of the social values people assign to ecosystems and landscapes, thus tackling the demand part of the supply-demand chain. We also identified the underlying landscape and terrain characteristics that have the greatest influence on what places people perceive as being valuable to them. The relationships between physical characteristics of the environment and social values for ecosystem services can be used in value transfer exercises to map and quantify cultural services in similar areas across the Carpathians where such social data does not yet exist.

To conclude, we consider the study of social values for ecosystem services to be an adequate means to transfer the concept of cultural ecosystem service into practice, and also to shift the focus from the capacity of ecosystems to supply services to the demands and needs of the people that assign value to these services.

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