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Mapping recreation supply and demand using an ecological and a social evaluation approach

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ABSTRACT

This paper provides a framework for addressing recreation as an example of Cultural Ecosystem Services and a methodology to support landscape management based on recreation activities at a regional scale. A GIS-based approach was used to estimate and map ecological and social factors illustrating recreation supply and demand in the Basque Country (northern Spain). The proposed methodology for recreation supply was based on recreation potential and accessibility, and the social demand was determined using a convenience sample of 629 persons that reported preferences for recreation activities using photo-questionnaires. Results showed that 23% of the viewsheds showed a high demand and higher recreation potential than accessibility, whereas only 3% showed a high demand and higher accessibility than potential. Approximately 74% of the territory showed a medium-low demand. We concluded that people's assessments on the basis of their aesthetic preferences may serve as a reasonable proxy for mapping recreation demand. The proposed visual method is fast, efficient and may be easily replicable in other regions. The proposed framework can be used as an input to support landscape management, to identify areas most demanded by society and to quantify spatially recreation supply and demand for supporting political strategies.

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1. Introduction

Policy and decision-making for environmental management, land use planning and development at different scales requires robust quantification of ecosystem service (ES) supply and demand (MEA, 2005; TEEB, 2010). The explicit quantification and mapping of ES is considered one of the main requirements for the implementation of the ES concept into environmental institutions and decision making. Therefore, The Economics of Ecosystems and Biodiversity (TEEB, 2010) called for extra effort in mapping the flow of services, a wider set of ES (including Cultural Ecosystem Services (CES)) and the connections between the final benefits because mapping ES is a useful tool for spatially explicit prioritization and problem identification.

The European Union (EU) 2020 Biodiversity Strategy recognized the high potential of mapping ES for policy support and decision-making because maps are valuable representations of real conditions and very powerful tools for communicating complex data and information (Hauck et al., 2013). Recent studies on mapping ES have focused more on the supply side and have tended to overlook society's demand for the services (Burkhard et al., 2012), despite the wide agreement about the importance of incorporating the demand side into ES assessments (van Jaarsveld et al., 2005). Whilst biophysical and economic values are often included in spatial planning for conservation and environmental management, social values are rarely considered. However, the social values that people attach to the landscape are also important to consider in planning for environmental management (Bryan et al., 2010), and its quantification based on interviews or questionnaires can provide useful and spatially explicit results (Sherrouse et al., 2011).

Different reviews on ES quantification, modeling and mapping (Crossman et al., 2013; Egoh et al., 2012; Martínez-Harms and Balvanera, 2012) showed that the CES are the least commonly quantified and mapped ES. CES are defined as the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (MEA, 2005). One broadly agreed upon characteristic of CES is their intangibility, which has been advanced as an explanation for their poor appraisal (Daw et al., 2011). Currently, there are different methods available to quantify these ES (see Milcu et al., 2013). Some of them explicitly link ecological functions with cultural values and benefits (Koschke et al., 2012), but they do not incorporate social evaluation approaches. Others try to map only the community values based on surveys (Brown et al., 2012; Sherrouse

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et al., 2011) and others use economic techniques (de Groot et al., 2010). However, there is still a lack of well-established and reproducible research frameworks and methodologies (Milcu et al., 2013).

This paper aims to provide a framework for addressing recreation as an example of CES, and an easily replicable GIS-based methodology to support landscape management based on recreation activities at a regional scale, which uses ecological and social factors for mapping recreation supply and demand. Recreation ES is defined as the "recreational pleasure people derive from natural or cultivated ecosystems" (MEA, 2005; TEEB, 2010). It was selected due to its importance for millions of people as it offers an array of benefits (aesthetics, therapeutic value, and psychological restoration) that are interpreted differently across stakeholder groups (van Riper et al., 2012). A landscape aesthetic service is defined as the pleasure that people receive from scenic beauty provided by natural areas and landscapes (MEA, 2005; TEEB, 2010). Although some authors considered both CES separately (Casado-Arzuaga et al., 2014; Maes et al., 2011), others considered them together (Burkhard et al., 2012; Koschke et al., 2012) or used some variables related to aesthetics when calculating the recreation service (Nahuelhual et al., 2013). We consider that aesthetics contribute significantly to recreational experiences (Daniel et al., 2012). Thus, in this study, we consider both CES together, using variables related to aesthetics when calculating the recreation supply and demand.

We propose a methodology for mapping recreation supply based on two components: the recreation potential and accessibility (Maes et al., 2011). Recreation potential is defined as the capacity of ecosystems to provide recreation according to their scenic beauty or specific characteristics. In this study all ecosystems are considered to be potential providers of recreation services. Accessibility is the other component of the proposed methodology because it is necessary that people reach sites in order to benefit from this ES.

We used a visual survey method based on preferences for recreation activities as a proxy to map recreation demand. This type of the visual method can help inform understanding of indicators that address the demand for ES (Maes et al., 2012). Other studies have previously analyzed the public perceptions of landscapes using time-consuming surveys based on questionnaires (Conrad et al., 2011); however, in this study we proposed a fast, efficient and easily replicable innovative visual method.

2. Methods

2.1. Study area

This study was conducted in the Basque Country, northern Spain (42°78′ N, 02°44′ W) (Fig. 1). It has an area of 722,436 ha and a population of 2,191,682, located mainly in the provincial capitals (Bilbao, Donostia-San Sebastián and Vitoria-Gasteiz) and their surroundings. This entails a high population density compared with the Spanish average (303 inhabitants per km^2 compared to 93, inhabitants per km^2). In this area, the bedrock at elevations up to 900 m consists of limestone and sandstone, and loam soils emerge in the middle elevations. The climatic conditions are characterized by moderately warm summers and mild winters, and the long-term annual mean precipitation and temperature are 1100 mm and 13 °C, respectively. The landscape is very diverse despite the small size of the region, and it attracts multiple types of visitors. The northern and central region is mountainous, with mountains of 600–1700 m; however, the southern region is flatter and used for agriculture. The region extends from the coastal landscape with cliffs, beaches and estuaries to the mosaic landscape dominated by forest plantations of *Pinus radiata* and *Eucalyptus* spp. and native forests (*Fagus sylvatica*, *Quercus robur*, *Quercus pyrenaica*, *Quercus faginea*, *Quercus coccifera*, and *Quercus ilex*) with grasslands and rivers. Urban areas are situated in the valleys along the main rivers. One of the main natural and cultural attractions for recreation activities in the region is the Urdaibai Biosphere Reserve (UBR), due to its outstanding natural ecosystems (estuary, littoral ecosystems and Cantabrian evergreen-oaks) and cultural sites (the painted forest, Santimamiñe cave, and others). It offers a wide range of open-air activities and nature sports in beautiful surroundings near human communities.

2.2. Database development

The methodological approach (Fig. 2) was designed based on a review of previous methods used to map selected CES (Casado-Arzuaga et al., 2014; Frank et al., 2013; Kienast et al., 2009; Maes et al., 2011, 2012; Nahuelhual et al., 2013; Norton et al., 2012; Paracchini et al., 2014; Schulp et al., 2012; van Berkel and Verburg, 2014; van Oudenhoven et al., 2012; Willemen et al., 2008) and considering the characteristics of the study area and the information available. First, we developed a multi-source database composed of different geospatial data in GIS format (Table 1). Data preparation involved projection to the same datum and coordinate system and homologation of scales and resolution. The GIS software used for the geoprocessing was ArcGIS 10 ESRI Inc., and the spatial resolution of all the raster datasets used in this study was 10 m.

2.3. Visual survey method

Firstly we identified 25 environmental units based on the habitat type's classification of the European Nature Information System (EUNIS) map for the Basque Country in a scale of 1:10,000 (Basque Government, 2009). We grouped EUNIS categories to level 4 as we considered that at this level all ecosystem types were represented (see Table 2). Subsequently, we designed a photo-questionnaire with a battery of 25 photos of the environmental units defined

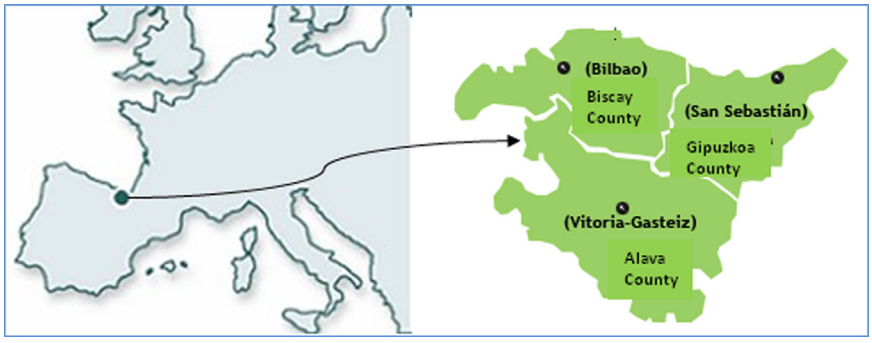

Fig. 1. Location of the study area.

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