



## Original Articles

# Recreation potential assessment at large spatial scales: A method based in the ecosystem services approach and landscape metrics



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## ABSTRACT

Ecosystem services (ES) is a useful framework for land-use decision making oriented to, ensure human well-being. Outdoor recreation potential, as a cultural ecosystem service, pose, particular challenges to its evaluation and mapping: it depends to a greater extent that other ES on, stakeholders' perception and values, it has lower generalization capacity, the delimitation of, provisioning areas is not straightforward and it should be evaluated at different spatial scales. In this, study, we propose a conceptual framework and method that is intended to cope with these challenges. Our method is based on landscape metrics measured at coarse scale, and campsite density as an, indicator of ecosystem service supply and benefit capture. We applied this method to a case study in, Argentina. We estimated outdoor recreation potential level using a quantile multiple regression, analysis of the 0.9 quantile of campsite density with nine landscape metrics determinants of ecosystem, service supply. We also explored two determinants of benefit capture with a linear stepwise regression, analysis of differences between the predicted recreation potential and actual use. We stratified the, analysis by ecoregion to distinguish the different weight of determinants of ecosystem service supply, and benefit capture.

The examined landscape determinants showed differences in their explicative capacity of outdoor, recreation potential across ecoregions, showing that their generalization capacity is limited. For, example, and contrary to our expectations, crop area did not have a negative effect for any of the 15, analyzed ecoregions. In fact, significant correlations are positive for three cases. Forest cover, on the, other hand, had a positive effect only in the Pampas ecoregion, originally dominated by grasslands and, where current forests consist in plantations of exotic trees. Results also showed that, in general, unrealized benefit increases with road and population density.

Our method makes a contribution to the study of recreation potential under the framework of ES by, taking into account important aspects that are sometimes overlooked. It considers the differences with, other ecosystem services in terms of the underlying processes that control ecosystem service supply, and benefit capture and it can be applied at a very wide spatial extent, at which approaches with other, methods that are more information demanding is difficult. Yet complementary methods at more, detailed spatial scales would provide additional information for a comprehensive estimation of, outdoor recreation potential.

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## 1. Introduction

The concept of ecosystem services (ES) is being increasingly adopted as a framework for guiding decision making in land use. ES are defined as the contributions that ecosystems make to human well-being, including biotic and abiotic outputs (Haines-Young and Potschin, 2010). ES are classified as provisioning, regulating and maintenance, and cultural services.

Cultural services include “all non-material ecosystem outputs that have symbolic, cultural or intellectual significance”

(Haines-Young and Potschin, 2011). Their special importance for human well-being relies in the fact that these services are irreplaceable by technological means (Hernández-Morcillo et al., 2013). Among cultural services, the recreation and community activities services group is associated to aesthetic experiences and symbolic values of ecosystems (Gobster et al., 2007; Hunziker, 1995) as well as conditions that facilitate recreational and touristic activities<sup>1</sup> (Daniel et al., 2012).

<sup>1</sup> Tourism is distinguished from recreation as the first involves an overnight stay in the site, while recreation is a diary activity that normally takes place near the recreationist's residence. Given that the indicator we use for this work does not allow us to distinguish between tourism and recreation, we will use the term recreation in a broad sense to refer to both concepts indistinctly.

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Nature-based recreation value is thought to be dependent upon environmental conditions and landscape attributes such as climate (Gül et al., 2006), type of vegetation (Edwards et al., 2012), slope (Roovers et al., 2002; Colson et al., 2010), presence of water bodies (Faggi et al., 2011) and number of cultural attractions (Nahuelhual et al., 2013). Facilities (campsites, services, roads, etc.) and accessibility are also important factors that influence recreationist' experience (Goossen and Langers, 2000; Gursoy and Chen, 2012). Although, the importance of these factors for distinct recreational activities varies across different types of landscapes (Goossen and Langers, 2000).

Despite these general patterns, the study of recreation potential under the framework of ES is relatively recent and needs further development. In fact, most cultural ES are relegated in the research and policy agenda due to the inherent conceptual and methodological difficulties in their evaluation (Daniel et al., 2012). Even when recreation potential is among the most studied cultural ecosystem service, there are still lacking proper conceptual frameworks and methods to cope with the particular challenges of this ES (Hernández-Morcillo et al., 2013).

In this work, we aim at developing a conceptual framework to describe recreation potential at a landscape scale and a method to quantify its supply level. We first discuss the relevant aspects that should be taken into account for the study of recreation potential under the framework of ES. Then, we make a brief review of the most common methodological approaches that have been used to date. Finally, we present our proposed conceptual framework and we test its validity and utility with a case study in Argentina.

### 1.1. Recreation as an ES

The study of any ES involves different aspects like the definition of the ES, its generalization possibilities, the delimitation of the provisioning areas, and the spatial scale of analysis. Each ES presents peculiarities in these aspects that should be taken into account for evaluation, mapping, trade-off analysis and management.

An accurate definition of an ES is important for identification of the underlying ecosystem processes and the stakeholders involved, as well as for comparison of studies (Nahlik et al., 2012). In the case of recreation, as well as other cultural services, explicit definitions are normally absent within the natural sciences bibliography (Daniel et al., 2012). The most common way to define recreation is through the measured indicators or the particular recreation activities studied (fishing, hiking, cycling, etc.). We define landscape recreation potential based in Chan et al. (2006), as the provision of outdoor recreation opportunities by natural and semi natural landscapes. The recreation potential differs from the realized service (the recreation benefit), which is a result from the combination of natural and social assets that directly contribute to human well-being through the actual capture of the recreation ES. Therefore, landscapes with a high provision level for this ES are those that offer the optimal conditions given by its biophysical attributes and cultural elements for use in recreation activities, regardless of these being actually carried out. The level of use, measured as recreationists flow, is one of the possible proxies of the benefit delivered by the service.

The second aspect of relevance is the capacity of generalization of the underlying processes that determine the ES for comparing studies and extrapolating results (ecological production functions). ES supply depends on biophysical processes interlinked with cultural factors associated to human values. Biophysical processes influence provisioning and regulation services to a great extent, although cultural factors play an important role as well. This

makes the generalization to different regions relatively straightforward (Fisher et al., 2009). Cultural services have a more indirect relation (Daniel et al., 2012). In the case of recreation potential, landscape attributes (landforms, vegetation, climate, etc.) are differently perceived by people depending on their cultural context (Buijs et al., 2006). As a consequence, there is a great heterogeneity in the appreciation of the same landscape settings by different social groups and individuals of the same group given by factors such as age, economic condition and education (Faggi et al., 2011; Gobster, 2001; Lindborg et al., 2009). Although, some general environmental attributes consistently affect recreation potential across ecological and socio-cultural contexts. Generalization of underlying factors can be made based on these attributes taking into account the peculiarities of the case study under analysis.

A third aspect involves the delimitation of the ES provisioning areas. An adequate delimitation allows calculating the provision as a flow (level of provision by unit of area and time), evaluating benefit propagation and determining the appropriate institutional level for management policies (Hein et al., 2006; Syrbe and Walz, 2012). The delimitation of provisioning areas of cultural services is not as straight forward as other ES. The limits of a recreation area are fuzzy, depending on different factors such as terrain topography or type of activity. If recreation is associated to landscape visual appreciation, the view shed from a panoramic point is a provisioning area (Baerenklau et al., 2010; Gimona and Horst, 2007; Reyers et al., 2009). The extent of this area is highly variable depending on the terrain topography. For other recreational activities, such as angling, it can be assumed that the provisioning area is the water body and its recreational value is influenced only by local factors. Nonetheless, management far away from the water body can have an indirect influence. For instance, nutrient or pesticide run-off from surrounding agricultural areas may affect water quality and fish availability (Carpenter et al., 1998). For these reasons, there is not any a priori ruling for the establishment of provisioning areas for recreation potential. The most common methods for delimitating a recreation provisioning area are the explicit identification of high recreation potential sites by stakeholders (Raymond et al., 2009), the delimitation of biomes with clear limits (valley, woodland, lake, etc.) or other managerial land units like parks and reserves (Colson et al., 2010; Larsen et al., 2008; Velazquez and Celemin, 2012).

The extent of the spatial scale at which ES operate is relevant for determining underlying ecosystem processes, extrapolation capacity, benefit propagation and capture, as well as for management at institutional level (Hein et al., 2006; Paruelo et al., 2011). Cultural services can be provided at very different spatial scales (Hernández-Morcillo et al., 2013). This sets some methodological challenges, as it implies a trade-off between extension and sampling effort (Eigenbrod et al., 2010). The recreation potential assessment demands a great effort in information collection about preferences that is usually gathered in situ or via telephone surveys (Eigenbrod et al., 2010; Goossen and Langers, 2000). This restricts the possibility of making large scale evaluations. On the other hand, the benefit of recreation is not propagated as a tangible good to other areas. Instead, recreation benefit is always captured in provisioning sites. Nonetheless, if we consider the recreationists' residence place we can think of a non-material propagation of the recreation benefit in terms of memories or stress level reduction (aspects of well-being associated to this ES). As recreationists' origin can be from nearby areas or as far as other continents the benefit of a recreational experience can have an effect at very distant areas. So it is important to define the scale at which benefit can be propagated to assess the importance of the recreation site for local or international recreationists.

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