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A salience index for integrating multiple user perspectives in cultural ecosystem service assessments

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ABSTRACT

Cultural ecosystem services (CES) include non-material values such as recreation, aesthetic enjoyment, and spiritual fulfilment. Such values are culturally specific, and frequently difficult to measure and monetarize. The standard methodology to assess CES is through social surveys, though these are often costly, lack standardization and are geographically restricted. An alternative to surveys is to use information from social media. Here, we propose a novel salience index to quantify and compare CES provision for multiple user groups (local residents, researchers and visitors) of Catimbau National Park in Brazil using data derived from distinct methodologies: i) a traditional social survey; ii) an online survey, and iii) analysis of photos published on Flickr and Instagram. Our index allowed direct comparison between groups despite the data being collected using different approaches. As predicted, residents identified more locations providing CES and a higher overall diversity of CES. Correspondingly, researchers and visitors identified CES from a more restricted set of locations and were biased towards educational services and aesthetic value, respectively. Since multi-stakeholder, multi-method approaches are essential for a comprehensive understanding of CES, integrating results using standardized metrics such as our salience index will allow broad scale analysis of this poorly quantified class of ecosystem services.

1. Introduction

Protected Areas (PAs) worldwide are under increasing pressure as competition for land intensifies (Smith et al., 2010). In this increasingly uncertain political climate, enhancement of public support for PAs is essential to ensure their long term existence. One way to generate such support is to quantify and communicate the variety of 'services' (e.g. maintenance of the hydrological cycle, fertilization of crops) that natural ecosystems provide for societies (Costanza et al., 1997; Potts et al., 2010; TEEB, 2010). The characterization of most ecosystem services (ES) has focused on aspects that are easily quantifiable and frequently monetizable. These data are then used to: (i) demonstrate the importance of maintaining intact services and promote discussions linking ecological structures and functions with values and benefits; (ii) provide evidence-based information to support policy decisions at different scales; (iii) support powerful socioeconomic arguments for continued investment in natural habitats and landscapes; and (iv) raise public awareness and knowledge about their role in contributing to human well-being. However, there is one important class of ecosystem services that has consistently defied easy measurement, namely cultural ecosystem services (CES). Perhaps the most popular definition of CES comes from the Millennium Ecosystem Assessment (MA) which defined them as the "non-material benefits people obtain from ecosystems such as recreation, aesthetic enjoyment, and spiritual fulfilment" (Millennium Ecosystem Assessment, 2005). Since the MA, a large variety of definitions and classifications of ES (and CES) have emerged from local to global scale and across scientific, policy, non-government and business communities, including, those proposed in: the Economics of Ecosystems and Biodiversity (TEEB), the Common International Classification of Ecosystem Services (CICES), the UK National Ecosystem Assessment (UKNEA), the US National Ecosystem Services Classifications Systems (NESCS) and the Final Ecosystem Goods and Services Classification System (FEGS).

CES are clearly of enormous potential importance for generating and maintaining public interest in natural areas. However, they are necessarily difficult to measure and to be translated into quantitative

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and/or monetary values (Costanza et al., 1997; Millenium Ecosystem Assessment, 2005; Chan et al., 2011; Satz et al., 2013). Placing an economic value on a cultural service (or any other form of ES) is a critical step, but could be viewed as supporting a damagingly anthropocentric or instrumental view of biodiversity conservation (reviewed in Costanza et al., 2017). This debate is unlikely to be quickly and simply resolved, given that the economic framing of nature (including CES) clearly aligns with currently prevalent neoliberal political ideologies (McCauley, 2006; Gómez-Baggethun and Ruiz-Pérez, 2011). From a practical perspective, a key issue is that economic valuation of CES should be firmly rooted in the normative values of the cultures that consume those services (Farley, 2012). This is mainly because the 'value' of a CES is relational (Chan et al., 2016; Tadaki et al., 2017), emerging from the complex history of interactions between people and the environment and taking the form of improved physical and mental health, higher quality of life and/or self-actualization (Millenium Ecosystem Assessment, 2005; Wu, 2013; Bragagnolo et al., 2017). CES may have an indirect economic impact in terms of reduced use of health services and increased economic productivity (e.g. increased tourism demand, decrease of public expenditure on health care systems), though this is hardly a basis for generating precise economic estimates of replacement costs (as with other categories of ecosystem services). Nevertheless, many studies have demonstrated the importance of direct interactions with nature for health and social relations, often emphasizing the role of parks in human well-being (Bowler et al., 2010; Brown et al., 2014; Burls, 2007; Clark et al., 2007; Pröbstl-Haider, 2015; Romagosa et al., 2015). These arguments have deep historical roots that can be traced back to social reformers and advocates of the open spaces movement in England in the mid-19th Century (Ladle and Whittaker, 2011). Conversely, cutting the cultural ties that bind people to ecosystems often leads to the loss of cultural identity and decreases opportunities to enjoy natural and cultural landscapes (De Groot et al., 2005; Soga and Gaston, 2016). In turn, this can have a knock-on effect on human health and well-being (Milner-Gulland et al., 2014; Carrus et al., 2015; Dallimer et al., 2017), in addition to altering cultural landscapes through changes in natural resource management practices and ultimately leading to environmental degradation and undermining social support for the conservation of wildlife and protected areas (Infield, 2001).

To date, most attempts to estimate the utilitarian value of CES have adopted a contingent valuation approach (Hernández-Morcillo et al., 2013; Tadaki et al., 2017), typically focused on the assessment of citizen's 'willingness-to-pay' [for nature or natural areas] or 'willingness-to-accept' [compensation] (Loomis et al., 1991; Farber et al., 2002). Thus, quantitative valuation of CES has tended to focus on attributes with clear financial components such as recreation, tourism (Jim and Chen, 2006) and, more recently, education (Feld et al., 2009) and artistic expressions (Coscieme, 2015). There is, of course, ample scope for developing non-monetary evaluations of CES (Tadaki et al., 2017) through deliberative methods such as structured interviews (Plieninger et al., 2013), stakeholder interviews and participatory techniques associated with geographic information (Brown, 2004). Such methods have been successfully applied to assess national/regional identity and sense of place (Asah et al., 2014; Bieling, 2014). Nevertheless, social survey based evaluations of CES (monetary or non-monetary) have major disadvantages. Specifically, they: i) are often costly to design and implement; ii) generally lack standardization (Bragagnolo et al., 2016), and; iii) are geographically restricted. This makes the scaling-up, mapping and comparison of CES studies highly problematic and limits their capacity to support policy and management.

Some authors have recently suggested that traditional survey techniques to measure CES could be complemented with big data approaches that infer human value and sentiment towards the environment from the digital representation of words and images (Ladle et al., 2016; Sherren et al., 2017). The formal study of human culture through the analysis of changes in word frequencies in large bodies of texts (corpora) is known as culturomics (Michel et al., 2011). Research in this area has recently expanded due to the digitization of a significant proportion of the world's written resources. Culturomic approaches are being applied to conservation problems (reviewed in Ladle et al., 2016), including the assessment of CES. Closely related to culturomics is the analysis of digital photos posted on file-sharing sites such as Flickr, social networks such as Facebook and microblogging platforms such as Twitter (Di Minin et al., 2015; Ladle et al., 2016, 2017; Sherren et al., 2017). Many of these photos have been taken with smartphones and contain geographic data from the phone's GPS function, potentially allowing researchers to analyse and map human interactions with nature in a more straightforward manner and at high spatial resolutions (Richards and Friess, 2015; Richards and Tunçer 2017).

Although photo analysis of CES is potentially applicable at broad spatial scales, its representativeness may be biased towards the subsets of society that post photos on file-sharing sites and influenced by sociodemographic characteristics of individuals. This is a problem because systematic assessment of CES for a given natural area ideally requires a multiple-user perspective, incorporating a diverse and broad cross-section of the actors who interact with the landscape. This is clearly illustrated by landscape perception, which is a process of interpretation, mediated by emotional responses to sites, perceived meanings and physiological reactions (Kara, 2013) that differ between different user groups (Swetnam et al., 2017; Komossa et al., 2018). Evaluating CES considering the perspective of different user groups has been the focus of several studies (Raymond et al., 2009; Allendorf and Yang, 2013; Sherrouse et al., 2017; Swetnam et al., 2017), though direct comparisons and integration of data gathered from multiple approaches are, to our knowledge, unavailable.

Here, we aim to assess and compare the salience of different locations within the Catimbau National Park (northeast Brazil) in terms of their CES provision for multiple user groups. To achieve this, we apply a salience index (Smith and Borgatti, 1997) to facilitate the comparison of different user group' preferences, characterized using three independent approaches: i) a traditional social survey approach, ii) an online survey, and iii) content analysis of photos published on social media sites (big data approach).

2. Material and methods

2.1. Study region

Catimbau National Park (CNP) covers an area of 625 km^2 in the central region of Pernambuco state in Northeast Brazil. The park was established in 2002 with the aim to preserve an area of biological importance with high levels of endemism and a well preserved area of Caatinga dry forest – a vulnerable and unique semi-arid ecosystem exclusively located in Northeast Brazil (Leal et al., 2003, 2005) (Fig. 1). CNP is also part of a broader valley of great scenic beauty with mountains and hills shaped from the deformations occurring since the end of the Cretaceous on the Jatobá Basin (Vieira et al., 2016). CNP also includes many archaeological sites hosting pre-historical rock engravings and paintings (Sociedade Nordestina de Ecologia, 2002).

The buffer zone of CNP is home to about 5000 inhabitants and about