Ecological Indicators 72 (2017) 278–287

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park

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ARTICLE INFO

Article history:
Received 16 February 2016
Received in revised form 8 July 2016
Accepted 20 July 2016

Keywords:
Ecosystem services
Social value indicator
Social-ecological system
GIS
Protected areas
Biodiversity

ABSTRACT

In spatial planning and management of protected areas, increased priority is being given to research that integrates social and ecological data. However, public viewpoints of the benefits provided by ecosystems are not easily quantified and often implicitly folded into natural resource management decisions. Drawing on a spatially explicit participatory mapping exercise and a Social Values for Ecosystem Services (SolVES) analysis tool, the present study empirically examined and integrated social values for ecosystem services and environmental conditions within Channel Islands National Park, California. Specifically, a social value indicator of perceived biodiversity was examined using on-site survey data collected from a sample of people who visited the park. This information was modeled alongside eight environmental conditions including faunal species richness for six taxa, vegetation density, categories of marine and terrestrial land cover, and distance to features relevant for decision-makers. Results showed that biodiversity value points assigned to places by the pooled sample of respondents were widely and unevenly mapped, which reflected the belief that biodiversity was embodied to varying degrees by multiple locations in the park. Models generated for two survey subgroups defined by their self-reported knowledge of the Channels Islands revealed distinct spatial patterns of these perceived values. Specifically, respondents with high knowledge valued large spaces that were publicly inaccessible and unlikely to contain on-ground biodiversity, whereas respondents with low knowledge valued places that were experienced first-hand. Accessibility and infrastructure were also important considerations for anticipating how and where people valued the protected land and seascapes of Channel Islands National Park.

1. Introduction

The ecosystem services framework has enhanced understanding of the multiple benefits that nature provides to society. Since publication of the Millennium Ecosystem Assessment (2005), progress has been made to illustrate how ecosystem structures and functions provide benefits to sustain human health and well-being (Carpenter et al., 2009; Costanza et al., 1997; Daily, 1997). Within this literature, scholars have largely focused on economic valuation, ecosystem service policies and programs, and various aspects of ecological change (Schröter et al., 2014). However, the socio-cultural domain of ecosystem services, requiring a range of social science tools and alternative evaluation approaches, has been underrepresented in the literature (Chan et al., 2012a). Moreover, there is growing recognition that assigning monetary values to stocks and flows of ecosystem services risks commodification of the environment (Daniel et al., 2012), overemphasizing tangible values in research may neglect cultural benefits that are ecologically and ethically important (Chan et al., 2012b) and disregarding the moral and normative concerns of stakeholders decreases the odds of reaching open, deliberative solutions to conservation problems (Raymond et al., 2013). Research on "social values for ecosystem services," defined as the social aggregation of diverse benefits that ecosystems provide to society (Ives and Kendal 2015; Kenter et al., 2015; Sherrouse et al., 2011), is crucial because unlike other services, social values are directly experienced by individuals and

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http://dx.doi.org/10.1016/j.ecolind.2016.07.029
1470-160X/

tied to intrinsic motivations for people to own, manage, and protect natural resources (Brown and Fagerholm, 2015; Milcu et al., 2013; Plieninger et al., 2015). This information not only advances knowledge of the reasons why people feel compelled to appreciate and act on nature's behalf, it provides a platform to democratize decision-making and engage people in environmental planning and management (Gould et al., 2015; Klain and Chan 2012; Martín-López et al., 2009).

Geographic Information System (GIS) techniques have facilitated integration between social and ecological data to determine spatial priorities for management of people and the ecosystems on which they rely (Villa et al., 2014; Hein et al., 2006; St. Martin and Hall-Arber, 2008; Whitehead et al., 2014). Particularly within coastal and marine contexts, a substantive body of past work has examined public interests across spatial and temporal scales to provide insight into how people and their environments evolve together over space and time (Cogan et al., 2009; McLeod and Leslie, 2009; Pollnac et al., 2010). One method that has become particularly useful for eliciting and analyzing social value indicators in relation to environmental conditions is known as Public Participation GIS (PPGIS) (Sieber, 2006). This tool has been used to map values that characterize collective expressions of meaning and place-based knowledge (Fagerholm et al., 2012), frame potential conflicts between science and policy (Cutts et al., 2011), and better understand ecosystem services to inform environmental planning and management (Brown et al., 2012; Raymond et al., 2009). Particularly in the context of protected areas (Brown and Weber 2011; Palomo et al., 2014), PPGIS research has helped to identify socially acceptable and defensible planning outcomes (e.g., Bryan et al., 2011), and address recent calls by initiatives such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) for the co-production of knowledge on ecosystem services (Díaz et al., 2015).

Within the PPGIS literature, particular attention has been paid to the social value indicator of "perceived biodiversity" that reflects the importance of a place because of the variety of plants, wildlife, marine life, and other living organisms provided therein (Brown et al., 2004). Although past research has suggested the public is largely unfamiliar with the number of species encountered (Dallimer et al., 2012; Lindemann-Matthies and Bose 2008), this body of literature has offered helpful insights into synergies and conflicts between stakeholder interests and natural resource management conditions (Bagstad et al., 2015). In particular, perceived biodiversity can be conceptualized as an "assigned" value that indicates individual beliefs and suppositions about qualities that exist in an environment, as opposed to "held" values that refer to more stable psychological processes and orientations (Brown, 1984), and "relational" values that reflect virtuous, eudemonic pursuits that underline environmental behavior (Chan et al., 2016). These different types of values reflect what people care about and can be distinguished from objectively defined metrics that indicate what exists in the physical world (Ives and Kendal, 2014). In this body of literature, several studies have focused exclusively on the assigned value of perceived biodiversity. For example, Alessa et al. (2008) found that perceived biodiversity values ascribed to the Kenai Peninsula, Alaska correlated with measures of net primary productivity for three of six communities surveyed. Also under a PPGIS methodological frame, Bryan et al. (2011) mapped a suite of social values elicited through interviews with residents in the Southern Australia Murray-Darling Basin and identified conservation strategies on the basis of different value configurations. This research activity signals a growing interest in PPGIS, particularly its ability to provide insight into perceived biodiversity, and its potential to blend social, ecological, and economic data that can inform natural resource management decisions (Martín-López et al., 2014).

Public engagement in environmental planning is increasingly prioritized by management agencies; however, stakeholder groups are often varied and require different intervention strategies which can complicate decision-making (Flint et al., 2013). Consequently, previous studies have aimed to account for variation in preferences for resource conditions by investigating psychological processes such as attitudes (Sherrouse et al., 2011) and environmental worldviews (van Riper and Kyle, 2014) that shape ecosystem service valuation. Tailoring research questions to address place-based concerns and considering characteristics of particular constituencies are critical steps to ensure the relevance and salience of research outcomes (Kyttä et al., 2013). One factor that is particularly difficult to account for in PPGIS research is knowledge, which we define as individual awareness and familiarity of one's surroundings. Knowledge propels human behavior that affects the environment and lies at the heart of individual decisions and ownership over places (Olli et al., 2001). Although knowledge is an inherently complex and multi-faceted concept (Raymond et al., 2010), previous research has offered insights into how self-reported knowledge can help frame communications that foster environmental stewardship (Kollmuss and Agyeman 2002; D'Antonio et al., 2013), promote psychological restoration from nature (Fuller et al., 2007), and address questions about the co-production of different forms of knowledge in relation to the provision of ecosystem services (Díaz et al., 2015). Additionally, past research has established a linkage between knowledge and concerns about biodiversity (Holl et al., 1995; Hunter and Rinner 2004); however, this relationship has yet to be empirically tested across spatial scales.

The present study examined the relationship between perceived biodiversity values and environmental conditions on Santa Cruz Island for two survey subgroups defined by their self-reported knowledge of Channel Islands National Park. Survey data from a PPGIS mapping exercise and a Social Values for Ecosystem Services analysis tool were used to address three objectives: 1) determine the spatial dynamics of perceived biodiversity value points assigned to places by survey respondents; 2) examine the relationship between perceived biodiversity and eight landscape metrics that reflected environmental conditions in the protected area; and 3) compare social and environmental data for two survey subgroups that reported different degrees of self-reported knowledge. This paper aims to create space for discourse on the multiple values of protected areas and stimulate thinking about how self-reported knowledge can be more effectively integrated into resource management decisions.

2. Methods

2.1. Study area

This research was conducted on Santa Cruz Island, which is the largest (25,000 ha) of five islands within Channel Islands National Park. It is situated 30 km off the coast of southern California, including nearly 22 million inhabitants from metropolitan areas such as Los Angeles and San Diego. Santa Cruz has a Mediterranean climate and mountainous terrain reaching an elevation of 747 m at its highest point. The island has landforms such as a central valley, canyons, and year-round streams, as well as a 77-mile coastline of cliffs, giant sea caves, sandy beaches, and tidepools. The Channel Islands National Marine Sanctuary surrounds Santa Cruz and protects a rich and biologically diverse marine environment (Davis, 2005). Landing permits are available for use of the island's coastline, while the island's adjacent waters are utilized by commercial and recreational fishers, boaters and divers, and maritime shipping operations.