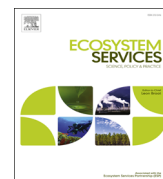




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The relationship between social values for ecosystem services and global land cover: An empirical analysis

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ABSTRACT

Considerable effort has been directed into separate but related research foci—the study of ecosystem services and participatory mapping methods. The two research foci intersect in the mapping of place-based values, an operational form of social values for ecosystem services that uses public participation GIS (PPGIS) methods. The social valuation of ecosystem services through participatory mapping offers an alternative valuation approach to economic valuation of ecosystem services. This study analyzes the spatial associations between global land cover which provides a proxy indicator of ecosystem services, and place-based values from 11 PPGIS studies completed in the U.S., Australia, and New Zealand that comprise a diverse set of temperate ecoregions. Key findings include: the highest frequencies of social values for ecosystem services were associated with forested land cover; water bodies were highly valuable relative to area occupied; and agricultural land and areas of permanent snow and ice were least valuable. Most land cover classes demonstrated high diversity of social values. The importance of different land cover types varies based on the selected evaluation criteria. Additional research is needed to determine whether economic and social valuation approaches provide complementary, contradictory, or redundant measures of the importance of landscapes for providing ecosystem services.

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1. Introduction

Over the last decade, considerable research has been directed into separate but related research foci—ecosystem services and public participation GIS (PPGIS). Ecosystem services research seeks to identify, describe, and quantify the importance of natural landscapes that provide necessary and beneficial services for human well-being (Costanza et al., 1997; Daily, 1997; Millennium Ecosystem Assessment (MEA), 2003), while PPGIS uses geospatial technologies to support public participation with the goal of including and empowering marginalized populations. The two research foci intersect in the participatory mapping of place-based values for natural landscapes that provide an operational bridge between the geography of place and the psychology of place (Brown, 2005).

The concept of ecosystem services has garnered considerable academic attention with the publication of over 2400 papers (Costanza and Kubiszewski, 2012). Within this literature, considerable effort has focused on ways to identify and estimate the economic value of these services. Some concerns have been voiced that non-economic, social valuation of ecosystem services should also have a role in the decision-making process (Kumar and

Kumar, 2008; Peterson et al., 2009) because “prices are not to be confused with values, and prices are not the only values that are important” (Cowling et al., 2008). If the identification and protection of ecosystem services is an important goal for humanity, it would appear essential to understand both the economic and non-economic social trade-offs that confront society in important land use and development decisions.

An alternative to the economic-based valuation of ecosystem services is place-based assessment which Potschin and Haines-Young (2013) argue provides a better understanding of landscape multi-functionality, the valuation of natural capital, and the role of landscape in framing debates about ecosystem services. A place-based assessment looks at bundles of ecosystem services across landscape units that have strong social relevance. But how does one assess the importance of these place-based services across landscapes, if not economically? The emergence of participatory mapping methods in the last decade provides an alternative valuation paradigm for analyzing ecosystem services that are place rather than economic-based. Place-based values explicitly link benefits to a physical landscape. Some researchers use the term “landscape services” as a bridging concept between landscape ecology and sustainable development where spatially explicit assessment methodologies can be used in local collaboration to better accommodate perceptions of value (Termorshuizen and Opdam, 2009; Fagerholm et al., 2012). Although the assessment of landscape or ecosystem services through participatory mapping

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is a valuation method, the analysis of the resulting place-based values shares more in common with landscape ecology than with economics. The importance of place-based values representing landscape or ecosystem services is determined by analyzing the spatial distribution of place-based values, often with analytical techniques and metrics used in landscape ecology (Brown and Reed, 2012).

Public participation GIS (PPGIS) is a type of GIS that seeks to enhance public participation and empower nongovernmental organizations, grassroots groups, and local communities. While the formal definition of PPGIS remains “nebulous” and inconsistent across applications (Tulloch, 2007), PPGIS generally describes the practice of having non-experts identify spatial information to augment expert information. Since the 1990s, the range of PPGIS applications has been extensive from community and neighborhood planning to environmental and natural resource management (see Dunn, 2007; Landscape Values & PPGIS Institute, (2012); Sieber, 2006).

In recent publications, the mapping of place-based values using PPGIS has been characterized as measuring the “social values of ecosystem services” (Bryan et al., 2010; Sherrouse et al., 2011; van Riper et al., 2012) which are defined as “the perceived qualities carried by a natural environment that provides benefits...to support human well-being...” (van Riper et al., 2012, p. 164). The MEA (2003) acknowledges the role of human perception in the assessment of conditions related to the ecosystem’s ability to provide desired services and this ability can be assessed by a variety of quantitative and qualitative methods (p. 49). In PPGIS, human perception is a key process by which individuals assess landscapes for the presence of place-based values. These perceptions are usually solicited from individuals with lay knowledge and experience with the chosen study area using maps (hardcopy or digital). In one of the first PPGIS studies to examine the general public’s ability to identify a range of provisioning, supporting, regulating, and cultural ecosystem services identified in the MEA (2003), the authors concluded that the general public has the capacity to identify cultural and provisioning ecosystem services but were skeptical about its ability to identify regulating and supporting services (Brown et al., 2012).

The purpose of this paper is to examine the capacity of PPGIS methods to identify the social values of ecosystem services found in a range of landscape types using global land cover. The use of land cover as a proxy indicator for the presence of various ecosystem services is a common technique used in ecosystem valuation (see e.g., Costanza et al., 2007; Naidoo et al., 2008; Troy and Wilson, 2006). The primary research question is whether place-based values, as operationalized through PPGIS methods, are spatially associated with landscape types found in different ecosystems. The methodological challenge is that perceived place-based values are contextual and depend on the needs, choices, and values of the people while ecosystems are likewise, highly diverse globally. The inherent variability and diversity in both humans and ecosystems make a meta-study of place-based values and ecosystems impossible without consistently applied PPGIS data collection measures and a uniform, global landscape classification system. Over the last decade, 11 different PPGIS studies were completed in diverse ecosystems in the U.S., Australia, and New Zealand that shared similar place-based value typologies and regional population sampling methods. In 2009, the European Space Agency produced a global, high resolution GIS land cover database (Bontemps et al., 2011) that provides a common landscape reference system across diverse ecosystems. These fortuitous circumstances provide the opportunity to explore whether significant spatial associations exist between place-based values, obtained through PPGIS, and landscape type as identified and mapped in global land cover.

Following a review of the literature relevant to this study context, this paper presents an inductive, spatial analysis of multiple PPGIS data sets to determine what claims, if any, can be made about the spatial association between place-based values identified using PPGIS methods and landscape types across diverse ecosystems.

1.1. Place-based value typologies in PPGIS

The systematic, participatory mapping of place-based values using a pre-defined typology began with a 1998 study of the Chugach National Forest in Alaska (Brown and Reed, 2000). The original values typology consisted of 13 values (see Table 1) adapted from Rolston and Coufal’s (1991) forest values typology. These values were operationalized as place-based values and subsequently used in a variety of PPGIS applications related to public lands planning and management. In the evolution of the values typology, different terminology was applied to the same or similar pre-defined place values. The values were alternatively called *forest values* (Brown and Reed, 2000), *ecosystem values* (Reed and Brown, 2003), *environmental values* (Brown et al., 2002), *landscape values* (Alessa et al., 2008; Beverly et al., 2008; Brown, 2005; Zhu et al., 2010), *community values* (Raymond et al., 2009), and most recently, *social values for ecosystem services* (Bryan et al., 2010; Sherrouse et al., 2011; van Riper et al., 2012).

The original values typology was not explicitly linked with the concept of ecosystem services, but the typology became linked with ecosystem service frameworks through more recent publications (Raymond et al., 2009; Sherrouse et al., 2011). Place-based values collected for a national forest study in Colorado (Clement-Potter, 2006) were used to help the U.S. Geological Survey (USGS) develop a GIS model called Social Values of Ecosystem Services or SolVES (Sherrouse et al., 2011; USGS, 2012) with the capacity to extrapolate or *value-transfer* mapped place values to landscapes where the values were not collected. The model’s authors argued that the place-based value typology measures social values for ecosystem services because the values elicited represent measurable ecological end-products or endpoints of ecosystem services at their interface with human well-being (Boyd and Banzhaf, 2007). This characterization of place-based values as social values for ecosystem services was further justified on the grounds of expediency because the ecosystem service typology defined by the MEA (2003) or alternative ecosystem service typologies such as those proposed by Wallace (2007) or Raymond et al. (2009) would require additional research and data collection to validate while place-based value data was currently available for GIS modeling.

1.2. The inference from place-based values to ecosystem services

The supporting logic for linking place-based values in the typology with ecosystem services may derive from interpreting place-based values as part of a ‘structure–function–value chain’ (Termorshuizen and Opdam, 2009) wherein ecosystem functions become services when their benefits are valued by humans. The inferential difficulty with this position, however, is that in the PPGIS mapping of place-based values, the structure–function–value chain is likely unknown or at best, latent to mapping participants. PPGIS participants are not generally instructed to contemplate the structure and function of landscapes, but rather to reflect on the values and benefits they perceive or have experienced in the study area. Thus, the methodological focus on identifying values at the end of the chain without reference to the landscape structure–function component raises an important question about how much the perception of place-based values arises from the personal experience and knowledge of the participant (i.e., a phenomenological perspective) versus the participant’s ability to identify (whether consciously or not) some

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