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Validating a method for transferring social values of ecosystem services between public lands in the Rocky Mountain region

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ABSTRACT

With growing pressures on ecosystem services, social values attributed to them are increasingly important to land management decisions. Social values, defined here as perceived values the public ascribes to ecosystem services, particularly cultural services, are generally not accounted for through economic markets or considered alongside economic and ecological values in ecosystem service assessments. Social-values data can be elicited through public value and preference surveys; however, limitations prevent them from being regularly collected. These limitations led to our three study objectives: (1) demonstrate an approach for applying benefit transfer, a nonmarket-valuation method, to spatially explicit social values; (2) validate the approach; and (3) identify potential improvements. We applied Social Values for Ecosystem Services (SolVES) to survey data for three national forests in Colorado and Wyoming. Social-value maps and models were generated, describing relationships between the maps and various combinations of environmental variables. Models from each forest were used to estimate social-value maps for the other forests via benefit transfer. Model performance was evaluated relative to the locally derived models. Performance varied with the number and type of environmental variables used, as well as differences in the forests' physical and social contexts. Enhanced metadata and better social-context matching could improve model transferability.

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1. Introduction

1.1. A role for social values

With growing pressures on ecosystem services across the globe, the ability to adequately assess the social value of these services alongside their ecological and economic values is essential for effective decision-making by land managers. We define social values as representing the nonmarket values perceived by ecosystem stakeholders, which although generally applicable to ecosystem services, largely correspond to and are more readily identifiable for cultural ecosystem services such as aesthetic, recreational, and spiritual services. Their consistent absence from ecosystem service assessments has been widely noted in the literature (e.g., Carpenter et al., 2006; Chan et al., 2012; Cowling et al., 2008; de Lange et al., 2010; Kumar and Kumar, 2008; Millennium Ecosystem Assessment, 2005; Nijkamp et al., 2008; Raymond et al., 2009; Tyrväinen et al., 2007). Because of their close association with cultural ecosystem services, which are themselves inadequately represented within the ecosystem services framework (Daniel et al., 2012), accounting for social values within the decision-making process is an even greater challenge.

1.2. Operationalizing the social values concept

What we define here as social values have been presented alternatively as ecosystem values (Reed and Brown, 2003), environmental values (Brown et al., 2002, 2004), landscape values (Alessa et al., 2008), and wilderness values (Brown and Alessa, 2005), to name a few examples. They are based on previously proposed (Rolston and Coufal, 1991) and validated (Brown and Reed, 2000) value typologies. Data representing social values, including the locations to which the values are ascribed, have been frequently elicited from the public through various forms of value and preference surveys and then mapped for various purposes. Among these purposes are evaluating the consistency between management prescriptions and publicly held values for an area through values suitability analysis (Reed and Brown, 2003), identifying hotspots where social and ecological values overlap suggesting areas possibly requiring additional management attention (Alessa et al., 2008), and assessing value differences between consumptive and non-consumptive recreationists (van Riper et al., 2012). What results from the mapping of social

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values is an expression of value, including its spatial component, which allows us to relate variation in social-value intensity to the underlying environment. It also allows us to consider relative social value in a manner similar to expressions of economic value (Brown, 2005). Although this expression of value is not readily quantifiable in monetary terms, monetary values are not always desirable (Daily et al., 2009; USDA, 2008) or necessary (Wainger et al., 2010) for decision-making purposes. These considerations have, in part, guided our previous efforts to operationalize social values by using a geographic information system (GIS) to develop and apply a nonmonetary, spatially explicit indicator of relative social value, the "value index" (Sherrouse et al., 2011, 2014).

Given the current dependency of social-value assessments on the availability of data obtained through public value and preference surveys, whether they be conducted by mail (e.g., Clement and Cheng, 2011; Nielsen-Pincus, 2011) or online using public participation GIS (PPGIS) methods (e.g., Brown et al., 2011; Brown and Reed, 2011; Brown and Weber, 2012; Cole, 2012), limitations in accounting for social values arise where such survey data are unavailable. Brown and Reed (2009) describe several resource, institutional, and legal constraints that can prevent the collection of these types of data including prohibitive development and implementation costs as well as a lack of directives for public land managers to do so. Although caution is warranted when attempting to estimate social values for specific locations where management decisions would lead to significant environmental changes (Brown and Brabyn, 2012), the various obstacles to obtaining primary survey data lead us to consider what options exist for leveraging existing social-value data to estimate social values for areas lacking primary data as an alternative to having no social-value information at all. A promising option exists in the economic, nonmarket-valuation method of benefit transfer.

1.3. Benefit transfer

Benefit transfer involves taking value information from a "study" site where data have been collected and applying it to a "policy" site where data are unavailable (Rosenberger and Loomis, 2000). Benefit transfers usually are conducted due to constraints similar to those noted for the collection of social-values data. There are two primary categories of benefit transfer: value transfers, which apply a single value such as an average from one or more study sites to a policy site; and function transfers, which use an equation calibrated at one or more study sites to estimate a value at the policy site based on attributes of the policy site represented by the function variables (Boyle et al., 2010). The capability to conduct spatially explicit benefit transfers of economic values using GIS has been demonstrated previously by Troy and Wilson (2006).

Among the many challenges associated with conducting benefit transfer is the need to ensure that the physical and social contexts of the study and policy sites are similar enough to provide reasonably accurate estimates of value for the policy site (Rosenberger and Loomis, 2001; Spash and Vatn, 2006; Troy and Wilson, 2006). As this similarity diminishes, so does the potential performance of benefit transfer (Navrud and Ready, 2007). Additionally, estimates generated through benefit-transfer methods will be only as good as the quality of the information from the study site (Navrud and Ready, 2007); so the errors associated with benefit transfer will consist of both measurement errors in the primary study area as well as the generalization or transfer errors associated with the actual transfer to the policy site (Johnston and Rosenberger, 2010). Although there are some suggestions regarding what might be considered "acceptable" transfer error rates (e.g., 20–40% by Navrud and Ready, 2007; 35% by Boyle et al., 2010), there is a lack of consensus in the literature because what might be considered acceptable error depends on the type of decisions for which the information will be used (Johnston and Rosenberger, 2010).

1.4. Study objectives

Navrud and Ready (2007) describe how questions regarding the validity and effectiveness of benefit-transfer methods have evolved over time, from "is the method always valid?" and "does it work?" to "under what conditions is the method valid?" and "how can we make it work better?" These questions became a starting point for developing our three objectives for the current study: (1) demonstrate a systematic, repeatable, and flexible approach for applying a benefit-transfer methodology to a quantitative, spatially explicit measure of social values; (2) validate the approach while identifying its limitations; and (3) identify options for improving future implementations of the approach. To address these objectives, we used Social Values for Ecosystem Services (SolVES), a GIS tool to assess, map, and quantify social values (Sherrouse et al., 2011, 2014). SolVES is a public-domain tool developed by the U.S. Geological Survey (USGS) as an ESRI ArcGIS toolbar for ArcMap[1] and is available for download at http://solves.cr.usgs.gov. SolVES offers three primary capabilities: (1) the generation of social-value maps, rendered as a nonmonetary, 10-point value index (VI), for various stakeholder groups as derived from spatial and nonspatial responses to public value and preference surveys; (2) the spatial modeling of relationships between VI and explanatory, environmental variables (GIS data layers); and (3) the ability to apply these models to physically and socially similar areas to generate estimated social-value maps where primary survey data are unavailable. We should acknowledge here that although the benefit-transfer methodology applied by SolVES is most accurately categorized as function transfer (see Boyle et al., 2010), for the ease of discussing the methodology in the context of transferring social values, we will refer to our methods as value transfer or social-value transfer.

2. Methods

2.1. Study area

The study area extends across three national forests located in the Middle and Southern Rocky Mountains of Wyoming and Colorado (Fig. 1). These national forests, although similar in several aspects, exist across a range of varying physical and social contexts. The Pike and San Isabel (PSI) are adjacent to the urbanized Colorado Front Range corridor. Visitors from nearby population centers and beyond are drawn to its high mountain ranges and scenic byways, which contribute to the PSI being the third most visited national forest in the nation (USDA, 2012). The Bridger-Teton (BTNF) and Shoshone (SNF) border Yellowstone National Park and include some of the most remote wilderness areas in the contiguous United States. Primarily rural, but growing, areas around both the BTNF and SNF support economic activities including recreation and tourism in addition to agriculture and natural gas development in the BTNF and timber and livestock grazing in the SNF (Taylor et al., 2008a, 2008b).

[1] Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.