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Analysis

What matters and why? Ecosystem services and their bundled qualities

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ABSTRACT

Much ecosystem service (ES) research is structured around four often implicit assumptions about ES, benefits, and stakeholders' conceptions of these: 1) ES assessors can identify and characterize priority ES across stakeholders without local participation; 2) Stakeholders derive one kind of benefit from each ES in a one-to-one, production function manner; 3) Most ESs are amenable to market or non-market economic valuation; and 4) Stakeholders primarily conceive of the importance of nature in terms of ecosystems' production of benefits. We empirically evaluated these assumptions with a map-based interview protocol to characterize what can be managed (ES and related activities), what matters (benefits) and why (values). Based on interviews with residents of coastal communities in British Columbia, 87% of responses to cultural ES interview prompts conveyed bundles of linked services, benefits and values. Many ES-related values (e.g., transformative and identity) matter in ways that are not adequately expressed using market or non-market valuation. Respondents used diverse metaphors about why the ocean is important, not only the ES production metaphor, which assumes that values are a function of ecosystem processes. Our research demonstrates the utility of our interview protocol for providing a fuller representation of ecosystem-related values and benefits, potentially informing environmental decision-making processes.

1. Introduction

The widespread adoption of the ecosystem service (ES) concept in environmental science, management and policy circles demonstrates that this concept has become a primary vehicle for communicating human consequences of ecological change (MA, 2003; TEEB, 2010; UNESCO, 2003). Ecologists and economists, who have led the advancement of this research (Daily, 1997; Levine and Chan, 2011), have largely focused on biophysical units (Balvanera et al., 2006; Palumbi et al., 2009; Worm et al., 2006) and monetary valuation as it relates to provisioning (e.g., food, fiber and fresh water) and regulating services (e.g., flood regulation, climate regulation) (Boyd and Banzhaf, 2007; Costanza et al., 1998; TEEB, 2010). Many ES studies segregate the category of *cultural ecosystem services* (CES) (Carpenter et al., 2009; Daily et al., 2009; MA, 2003), which has been defined as the contribution from ecosystems to the non-material benefits to humans from human-ecological relations, such as experiences and capabilities (Chan et al., 2012b). We seek to build upon past conceptual efforts (Chan et al., 2011, 2012b) to improve the ES framework's integration of social and cultural values into ES assessments and decision-making processes.

Neglecting these layers of social and cultural importance in natural resource management can lead to detrimental outcomes, including the exacerbation of social inequalities (Chan et al., 2012a; Poe et al., 2013). For example, the privatization of fishing fleets in Canada overlooked many social and cultural values. This privatization contributed to diminished First Nation access to commercial fisheries, consequently reducing incomes, access to the ocean and social capital (Burke, 2010). Omitting CES in decision-making can also result in "invisible losses," defined as losses to lifestyle, identity, health, psychological and emotional well-being, knowledge systems, self-determination, and opportunities (Turner et al., 2008). Overlooking social and cultural dimensions of how humans interact with ecosystems can reduce community resilience, decrease or eliminate mitigating practices (such as customary tenure), generate conflict, diminish trust and obstruct collaborative management (Poe et al., 2013). Including CES may improve the acceptability of decisions, reduce conflict and negotiation expenses and produce superior alternatives for those most impacted by a natural resource decision (Poe et al., 2013; Turner et al., 2008; Wondolleck and Yaffee, 2000).

Widely adopted ES research methods, including benefit transfer and production functions, are ill suited in the assessment of CES. Benefit transfer, whereby an estimate of economic benefit from one location is transferred to another (Bateman et al., 2002; Troy and Wilson, 2006), tends to ignore context-specific social and ecological details that influence how people value a location (Spash and Vatn, 2006). Ecological production functions model how ESs are derived from ecological structures and functions (Daily and Matson, 2008; Lester et al., 2010). For example, a production function might express how a bay's fishery biomass or productivity is affected by seagrass nursery habitat extent and local water quality. Production functions tend to demonstrate how degrading a natural ecosystem often has negative consequences

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for the provision of particular ESs. For this reason, ES researchers have often approached ES valuation by modeling a select few biophysical ESs through production functions based on cause and effect relationships between ecosystem processes and a commodity (Boyd and Banzhaf, 2007; Chee, 2004; Knowler et al., 2003; Nelson et al., 2009). The production function requires that researchers can identify *a priori* separate categories of benefits, where each benefit is represented as the product of a set of ecosystem processes and structures, and each can be valued separately (Boyd and Banzhaf, 2007; Nelson et al., 2009; Tallis and Polasky, 2009). But what if several benefits (e.g., aesthetics, spiritual benefits, social capital, nutritional benefits) are experienced together by some stakeholders in a given activity (e.g., subsistence fishing including material benefits of the fish consumed, social benefits from bonding over shared experiences with friends or family, and cultural benefits from the enjoyment of the activity itself)? Such psychological interdependence of benefits—'bundling'—can interfere with separate modeling and valuation of these ESs. Whereas ES bundles have largely been explored as regulating and provisioning services that co-vary spatially in their production across heterogeneous landscapes (Bennett et al., 2009; Costanza et al., 2011; Cumming, 2005; de Groot et al., 2010; Nelson et al., 2008; Raudsepp-Hearne et al., 2010), we focus our research on interdependence and connectivity between ES within individual stakeholder experiences.

Given the limitations of production-function and benefit transfer research (Bateman et al., 2002; Plummer, 2009; Troy and Wilson, 2006), we test a semi-structured interview protocol to assess social and cultural dimensions of why the marine environment is important to people. This study identifies and characterizes 1) What can be managed (ES and related activities, e.g., aquaculture policy, fisheries allocations); 2) What matters (benefits, e.g., material, aesthetic, spiritual); and 3) Why (values, e.g., market, non-market, metaphysical). We focus on identifying and linking services, benefits and values (see Table 1). We define *services* as processes involving biotic features of the environment that produce *benefits*. *Benefits* are goods, conditions and experiences that are important to people. We define *values* as preferences, principles and virtues that are evaluative statements referring to both benefits and services. Through this investigation, we question the following four assumptions underlying much ES research.

Assumption 1. Experts can identify and characterize priority ES across stakeholder groups without local participation.

The majority of ES studies eschew public involvement altogether. Reviewing ES studies from 1990 to 2010, Seppelt et al. (2011) found that 60% of ES publications did not involve stakeholders. Studies that engage stakeholders often present respondents a menu of ESs as derived from academic typologies (e.g., Iceland et al., 2008) and surveys of scientists, planners and industry leaders (e.g., Nahuelhual et al., 2013). Such approaches implicitly assume that ES assessment experts can identify what matters to stakeholders and communicate with them using academic frameworks (Satterfield et al., 2013a). In this study, we explore what can be gained through an approach that asks respondents in conversational language what they perceive as benefiting them, obliquely targeting academic categories and later coding their responses according to the same academic typology. Our study does not directly address a controlled comparison between approaches, but rather sought to examine what other complexities might be uncovered when freeing respondents from rigid constraints of terms and categories (see Assumptions 2–4).

Assumption 2. Stakeholders derive one kind of benefit from each ES in a one-to-one, production function manner.

Production function approaches seek to characterize a biophysical production function for each benefit (e.g., fish for subsistence consumption; fish for ceremonial purposes), and to value each of these benefits separately (Kareiva et al., 2011). While this approach is arguably appropriate—and an important advance—for marketed goods, it effectively assumes that the value of one good (fish for consumption) is not linked to other goods (whether the fish is used in ceremonies). In this study, we address Assumption 2 by asking whether respondents connect multiple diverse kinds of benefits in their responses, as occurring through sets of activities.

Assumption 3. Most ESs are amenable to market or non-market economic valuation.

We seek to improve upon ES valuation studies, which tend to apply monetary metrics, biophysical units and/or "coarse and largely arbitrary categorical indicators or classifications" (Seppelt et al., 2011, p. 632). A suite of cultural benefits, including sense of place, spiritual values, and transformational values, is widely acknowledged to be inappropriately valuated in monetary terms. Chan et al. (2012b) argue that the inappropriateness of monetary metrics stems from the nature of the values (the preferences, principles, and virtues) that govern people's experience of the benefits.

In this study, we address Assumption 3 by examining the frequency by which respondents refer to values that are known to conflict with the assumptions of economic valuation.

Assumption 4. Stakeholders primarily conceive of the importance of nature in terms of ecosystems' production of benefits.

By seeking to inform decision-making through the valuation of benefits, ES assessment approaches often implicitly assume that what matters most to people is the fulfillment of consumer preferences (utilitarian values), rather than—say—the correspondence of management and policy with deeply held principles or 'citizen preferences' (termed deontological values in philosophical circles) (Moore and Russell, 2009; Sagoff, 1998). Such assessments implicitly assume the primacy of the metaphor of *nature as a service provider*. Metaphors significantly structure how people understand the world and how we act (Lakoff and Johnson, 1980). Critics of the ES metaphor of *nature as a service provider* contend that this metaphor constricts how people can legitimately value nature (Norton and Noonan, 2007). Diverse stakeholders, from different cultures that strongly influence cognition and priorities (Henrich et al., 2010), may value nature in ways that are conceptually incompatible with *nature as a service provider*. Consequently, the imposition of this metaphor may suppress the expression of intrinsic values, such as kinship with or concern for nature (Blackmore et al., 2013).

We addressed Assumption 4 by documenting respondents' use of alternative metaphors to explain what they perceived to be right ways of managing ecosystems, given that we did not explicitly adopt ES language and consciously avoided the service production metaphor. We asked people questions that addressed a range of benefits and values, theorized as connected to marine ES. We assessed the degree to which respondents' expressions of values and benefits meshed or clashed with the metaphor of ES. Do people employ this metaphor or others in describing the benefits, which may be multiple and interlinked, that they derive from ecosystems? For example, to what extent do interviewees discuss nature's importance primarily as a "service provider" or do people relate to nature using other metaphors, such as "nature as kin"?

We recognize that many ES studies do not make these four assumptions. For instance, several studies have involved non-expert public participation in identifying and characterizing priority ES (Brown, 2012; Sherrouse et al., 2011). Other studies focus on ES bundling (de Groot et al., 2010; Martín-López et al., 2012; Raudsepp-Hearne et al., 2010). Some researchers have used qualitative, non-economic methods to assess social and cultural values linked to ES (Kumar and Kumar, 2008; Sagie et al., 2013). Such studies informed our research aimed at providing empirical evidence to support or reject these four common ES research assumptions. Our research and methods add to these studies by eliciting ES values in relation to spatial planning, testing these four ES research assumptions, via a synthesis of qualitative (semi-structured interviews), quantitative (weighting) and spatial data (compilation of