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Where are *Cultural* and *Social* in Ecosystem Services? A Framework for Constructive Engagement

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A focus on ecosystem services (ES) is seen as a means for improving decisionmaking. In the research to date, the valuation of the material contributions of ecosystems to human well-being has been emphasized, with less attention to important cultural ES and nonmaterial values. This gap persists because there is no commonly accepted framework for eliciting less tangible values, characterizing their changes, and including them alongside other services in decisionmaking. Here, we develop such a framework for ES research and practice, addressing three challenges: (1) Nonmaterial values are ill suited to characterization using monetary methods; (2) it is difficult to unequivocally link particular changes in socioecological systems to particular changes in cultural benefits; and (3) cultural benefits are associated with many services, not just cultural ES. There is no magic bullet, but our framework may facilitate fuller and more socially acceptable integrations of ES information into planning and management.

Keywords: ecosystem-based management, resource management, marine spatial planning, participatory processes, economic valuation, social-ecological systems

In response to increasing pressures on ecosystems and the need for a sustained flow of benefits to human societies (MA 2005, Halpern et al. 2008), communities and governments are directing their attention to ecosystem-based management (EBM; McLeod and Leslie 2009) and spatial planning (UNECE 2008, Lubchenco and Sutley 2010). In these and other contexts, the *ecosystem services* (ES) concept has been advanced and widely adopted as a framework for identifying and weighting the social and ecological values at stake in comprehensive management schemes (Daily 1997, MA 2005, TEEB 2009, Kareiva et al. 2011).

ES are broadly defined as the conditions and processes through which ecosystems sustain and enrich human life (Daily 1997); they are ecological processes or functions that have value for people. The ecologists and economists working in this field have primarily focused on provisioning and regulating services, particularly on understanding their ecological underpinnings (Kremen and Ostfeld 2005); projecting services on the basis of such correlations (e.g., Díaz et al. 2007); and measuring, mapping, and valuing ES (MA 2005, Kareiva et al. 2011). Although informing decisionmaking is one of the major motivations for ES research (Daily et al. 2009), little of the ES research characterizes ES in a manner intended to explicitly assist decisionmaking, which would make explicit both how potential decisions might affect human well-being by causing changes in ecosystems and how much such changes matter (Daily et al. 2009). For example, in most conservation assessments that mention ES, ecological processes that are not directly linked to human well-being are actually addressed (Egoh et al. 2007), which does not fulfill the potential of ES to inform decisionmaking. Furthermore, throughout this research, cultural services are regularly mentioned as a category of ES and thus recognized as important, but the incorporation of such services into decisionmaking remains far behind that associated with more tangible services (de Groot et al. 2002, MA 2005).

The Millennium Ecosystem Assessment (MA) defined cultural ES as "the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values" (MA 2005, p. 40; see also de Groot et al. 2005).

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Phrased alternately to distinguish explicitly among services, benefits, and values, cultural ES are "ecosystems' contribution to the nonmaterial benefits (e.g., experiences, capabilities) that people derive from human–ecological relations" (Chan et al. 2011, p. 206). The MA connected ES to human well-being in a coarse way, but most work under the MA fell short of characterizing ES contributions to human well-being in ways that could assist decisionmaking. That is, studies under the MA frequently pointed to the fact that ecosystem good or condition *X* was important to human well-being for reason *Y*, but they did not generally characterize how a given decision might result in changes in *Y* in terms comparable with those of other important considerations.

One of the most powerful aspects of an ES approach is that it focuses decisionmaking and research specifically on what people care about. And although they are unquestionably difficult to measure, ecosystem-based cultural benefits are clearly valuable to people. For example, in the Puget Sound region of Washington State, a broad stakeholder survey found that recreation, tourism, and ethical and existence values were consistently among the five ES reported as most important (Iceland et al. 2008). Omitting such ubiquitously shared cultural benefits from explicit consideration risks decisionmaking and planning that is not connected to what matters to many people.

Neglecting cultural values and services in the design of interventions can produce dire unintended consequences and can impede the achievement of program goals. For example, West (2006) documented how marketing cultural forest goods in Papua New Guinea, an economic-development strategy to offset the consequences of conservation interventions, overlooked the numerous ways in which local peoples used the land and how wildlife contributed to their sociocultural system. These blind spots resulted in systemic changes to marital relations and the division of labor associated with producing such goods and to the cultural values attached to them. Both the biodiversity objectives and the well-being of local people were undermined (West 2006).

A systematic consideration of the cultural values associated with ecosystems could therefore benefit many kinds of initiatives, including spatial planning, EBM, integrated conservation and development schemes, and payments for ES (PES). Whereas one might think that PES schemes require only the assessment of the target ES, any scheme that is designed to change human influences on ecosystems will simultaneously influence multiple ES and affect multiple values. Therefore, whether to set up a PES scheme, how to design it, how extensively to fund it, and how to monitor its success are all decisions that might benefit from a comprehensive assessment of ES, social context, and cultural values.

In this article, we point out that many cultural ES are overlooked in much ES research, which diminishes its applicability for decisionmaking, and we sketch an approach to ameliorate this deficiency by providing a conceptual framework for the role of ES research in decisionmaking—in particular, research that articulates cultural ES and values. In so doing, we aim (a) to provide decisionmakers with an understanding of how ES research might elucidate how sociocultural and economic benefits may vary across scenarios, resulting in previously invisible trade-offs; (b) to empower practitioners and stakeholders to effectively communicate how issues important to them might be affected by management options and their associated ecosystem changes; and (c) to clarify for researchers how ecological and ES research could contribute to improved management and policy.

The place of *cultural* in ES to date: Everywhere and nowhere

In practice, the ES concept has become widely associated with the monetary valuation of ecosystems—an association that elicits enthusiasm from some (e.g., Economist 2005) and contestation from others (Nature 1998, Weigel et al. 2004). This association with monetary valuation is understandable, given that ES have been characterized in prominent ES research in dollar values with a variety of market and nonmarket valuation methods (Costanza et al. 1997, Nelson et al. 2009, USEPA 2009, Kareiva et al. 2011). In a decisionmaking context, monetary valuation can be designed to contribute the marginal values needed for cost–benefit analyses (e.g., Naidoo and Ricketts 2006), which could potentially inform many policy decisions (Arrow et al. 1996).

Partly because of the focus on economic valuation, many cultural ES remain conspicuously absent from efforts to characterize ES. There are many studies of ecosystem-based recreation (e.g., Cisneros-Montemayor and Sumaila 2010) and landscape scenic beauty (e.g., Grêt-Regamey et al. 2008, Daniel et al. 2012), but other cultural services have not generally been characterized in this manner—for instance, those associated with spiritual values, cultural identity, social cohesion, and heritage values. These cultural ES are especially difficult and contentious to value in monetary terms and have consequently been rendered invisible in most ES planning and management. Even though decisions are seldom based exclusively on economic value (Ariely 2008, Stiglitz et al. 2010), this exclusion often relegates cultural ES to implicit components of decisionmaking frameworks.

Most ES, cultural and otherwise, have nonmaterial or intangible dimensions. In some cases, these intangible dimensions (changes of a principally psychological nature) can matter more to people than do the affiliated material benefits (money and desirable physical changes such as sustenance or shelter). For example, fishing provides food but may also be a way of life with ethical, political, or spiritual aspects. An ES framework in an area where fishing is practiced should explicitly include ecosystems' contribution to valued ways of life through fishing and should also recognize the concurrent food-provisioning service.

Reformulating the problem(s): Valuation, causation, and identification

This prevalence of cultural dimensions across ES highlights a great gap in the methods of valuing ES. In most

frameworks for ES research, the primacy of market-oriented valuation has been implicitly defended through a restriction of their application to more navigable domains of provisioning, regulating, and supporting services, with the recognition that many cultural services could likely never be appropriately represented by such monetary valuation. If intangible benefits are generated by all kinds of services, ES valuation cannot sidestep the challenges of intangibility and incommensurability (Chan et al. 2012). Borrowing from the example above on fish and fishing, one cannot make decisions about fisheries solely on the basis of monetary values without inviting uproar, because such decisions affect other social values, not all of which are well represented by monetary valuations. Accordingly, the lack of a defensible framework for cultural ES could undermine the whole framework for ES.

An additional gap in ES research becomes especially obvious as we characterize cultural dimensions—the problem of attributing causation to ES change. In a socioecological context, it is always difficult to distinguish the ecological from the social causes of ES change. But ES research has emphasized the former by identifying the social and economic gains and losses associated with ecological change, even though social and ecological changes may be fundamentally interlinked. For example, in British Columbia, Canada, one cannot talk to fishermen about losses due to degrading fish stocks without also discussing the losses and shocks to coastal communities associated with changes in licensing practices (Burke 2010). In this case, the losses to fishermen with diminished access cannot be attributed completely or separately to the ecological change; they must also be attributed to the licensing changes that were triggered in part by perceptions of a declining resource. Once we recognize the crucial importance of intangible benefits (e.g., the emotional attachment to coastal areas or the identity and sense of purpose and belonging one derives from ownership of a boat and a license) and the implications for local ways of life, it becomes clear that social, economic, and political arrangements play critical roles in shaping the benefits that people experience from their interactions with ecosystems.

A third gap in ES research, which also becomes apparent when considering intangible dimensions, is the dearth of participatory methods of identifying priority ES. In many ES assessments and in much of the research, it seems to be assumed that the priority ES in a region are self-evident, despite the intangible nature of much of the associated value. Accordingly, there has been little attention paid to methods of cataloging or identifying priority ES on the basis of stakeholder input (for exceptions, see Shelton et al. 2001, Iceland et al. 2008).

In brief, the central problem is as follows: ES decisionmaking tools are being and will be employed in many places, but the intangible dimensions of ES values—and cultural ES in general—are little considered, despite widespread recognition of their importance (MA 2005). These values are crucial for ecosystem and resource management, but they are not adequately reflected in monetary valuations. How then to characterize ES values to enable their more appropriate representation in decisionmaking? In this article, we start filling this gap by providing a framework for ES research that is defensible in light of prevalent cultural dimensions. We do so by (a) integrating research and concepts from the study of socioecological (sometimes called *social-ecological*) systems (Berkes et al. 2003, Ostrom 2009), in which the problem of multiple social and ecological causes is intended to be addressed, and (b) by drawing on concepts and methods from anthropology, sociology, risk perception, applied ethics, ecosystem management, and other disciplines.

A new framework for ES research to support decisionmaking

As was illustrated above, because of the pervasiveness of intangible values across services, an inclusion of cultural ES must go far beyond an addition to a framework for ES research designed for material values. Instead, inclusion of cultural values involves a reenvisioning of ES as a whole, with accompanying changes in the research and decisionmaking processes. Because of the complexity and difficulty of this task, it is helpful to proceed in three stages. First, we identify and explicitly state the core challenges posed by cultural ES and by intangible values. Second, we set out a series of stages of work (a "framework") that might enable the better reflection of cultural ES in the broader ES context. Third, we explicitly address possible approaches to (a) identify the values associated with intangible cultural services, (b) to assign metrics to better enable the use of such values in contexts that include discussions of comparability and trade-offs, and (c) to characterize the dependence of benefits on social and ecological components and processes.

Core challenges and strategies. The characteristics of some of the values that people associate with ecosystems impede the straightforward integration of ES research and valuations into decisionmaking. These characteristics can be determined, and each is associated with one or more proposed strategies for addressing the associated challenge (box 1). These strategies are by no means a checklist of necessary tasks but, rather, are a set of possible approaches to motivate the proposed framework below.

Although explicitly characterizing complex webs of values and ES may help researchers and, ultimately, stakeholders, this requires intimate knowledge of the system being studied. As was stated above, the appropriate characterization of a service or value (including valuation) is dependent on appropriate methods, and no method is universally applicable. Accordingly, researchers are unlikely to be able to identify a subset of especially important services, values, or methods without first engaging stakeholders in identifying those crucial services and values—and such *value identification* requires its own methods. Accordingly, we recommend an approach of iteratively involving local experts and then other stakeholders while gradually defining the study on

Box 1. Characteristics of services and strategies for addressing challenges.

We identify a set of characteristics of cultural and other ecosystem services (ES), their benefits, and associated values (especially nonmaterial ones), and proposed strategies for addressing the challenges to the valuation and expression of these values for decision-making. Many strategies address several challenges, and not all challenges will pertain to any particular context.

Multiple causality. Changes in benefits and services result from many processes operating simultaneously—some social, some biophysical, and some socioecological. Our proposed strategy for addressing multiple causality is to characterize the social, biophysical, and socioecological contexts and interactions. See the "Proposed framework" section in the text for more details.

Interdependence. Many different kinds of benefits and services are inextricably linked in their contribution to value to humans. For example, all benefits and services contribute to *place value* (the value that people derive from their sense of place), heritage value, and cultural identity in ways that are probably nonadditive and nonlinear (Chan et al. 2011, Chan et al. 2012). To address this interdependence we suggest employing open-ended or semistructured stakeholder interviews to identify the key benefits, services, and values and their relationships; conceptual diagrams depicting these relationships; and valuation of bundles of services and benefits—as they would be combined by the stakeholders.

Values pertaining to the distribution and process. Not all of the important values at stake are products of ES; some rights and moral principles pertain to the distribution of benefits and the process of management (e.g., equitable distribution of resources, restitution for past wrongs, the right to sovereignty over traditional territories). To address this issue, one should include stakeholders in various stages of planning and decisionmaking; perform scenario-based valuation (not just valuations of isolated benefits); and use different valuation approaches to capture the different types of principles involved.

Plural values. Most ES are valued for many kinds of reasons. To address these many values, one should employ a diversity of valuation approaches (table 1): Values should be represented in multiple formats, including influence diagrams, stories, and other visual and verbal summaries.

Incommensurable values. Some ES values are not appropriately judged by the same standard (e.g., cultural identity, market values). To address this issue, we suggest employing deliberative approaches (which require contemplation and usually discussion) to decide on appropriate trade-offs.

Values held for or by collectives. Some values pertain to what an individual considers to be appropriate for a group, not necessarily better for him- or herself (e.g., an individual can prefer publicly funded health care for a national policy without gaining from these at an individual level). Such values can often be said to be characteristic of groups, although they are generally not shared equally by all individuals. To account for these values, one should include group valuation and deliberative decisionmaking forums to decide on and express group values (see table 1).

Values embedded within worldviews at odds with nature as a service provider. Especially in indigenous or traditional communities, some values may be fundamentally linked to systems of practice and knowledge (e.g., traditional ecological knowledge) that conflict with a conception of nature as a provider of services for people. To address this issue, one should avoid terms, phrases, and diagrams that may trigger reactions to this anthropocentric perspective, and in interviews, one should focus on the benefits that people derive from nature, rather than on the ecosystem processes that give rise to them (which are often invisible to people or thought of differently).

Values that defy monetary valuation. Some values trigger considerable discomfort with expression in dollar terms (e.g., some principle- and virtue-based values, sacred values). To account for this, we suggest applying nonmonetary valuation and using decisionmaking forums to express values in nonmonetary terms (see also the strategies for plural values and incommensurable values above).

the basis of researcher and stakeholder needs or limitations. The value-identification process blends into a value-characterization process, which can inform decisionmaking at several stages (including after initial steps that are practical, quick, and informative; e.g., Iceland et al. 2008).

Proposed framework

This suggested framework is intended to facilitate the characterization of the diverse values associated with ecological and socioecological change through a series of steps, with identified possibilities for greater iteration and sophistication (figure 1). As was noted above, because of the pervasiveness of nonmaterial values across ES and the interrelated nature of services and benefits, this is a framework for *general* ES research and practice, but one attentive to the complications stemming from cultural benefits and values. It is not intended to supplant or compete with frameworks for management or decisionmaking (e.g., adaptive management; Walters 1986) but, rather, to facilitate the inclusion of research about ES and values within any such framework. Because of this, the steps below are not comprehensive but, rather, are those we deemed necessary to explicitly integrate ES into decisionmaking. We developed this framework on the basis of our insights from the literature on intangible values as distilled in the core challenges and strategies, from our experiences with socioecological research and from the pilot application of our interview protocol as part of the framework in three locations (Klain 2010, Gould 2011, Satterfield et al. 2011).

The framework addresses the core challenges (box 1) by disentangling social, biophysical, and socioecological contexts and interactions; by employing methods to explicitly

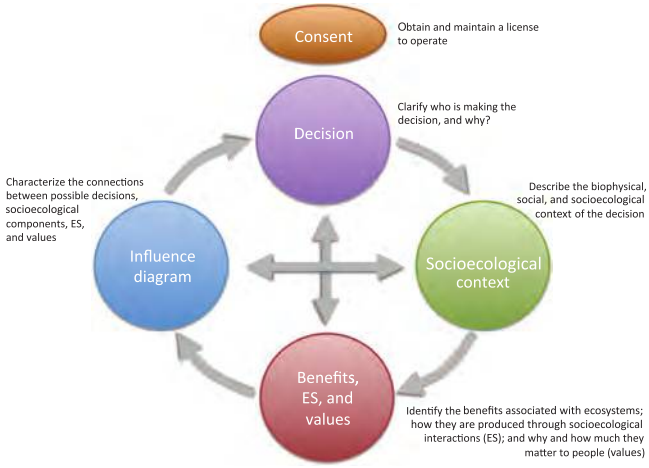

Figure 1. The proposed framework for characterizing ecosystem services (ES) that might be affected by management or planning. Note that although the arrows depict the possible routes by which understanding of the system might be deepened, such understanding might be reached in many ways (e.g., understanding of benefits, ES, and values might call for a deeper characterization of the socioecological context, or it might call immediately for further elucidation of the benefits, ES, and values). Like Haines-Young and Potschin (2010), we distinguish among benefits, ES, and values: "Services are the production of benefits (which may take the form of activities), which are of value to people" (Chan et al. 2012, p. 9). See the text for more details on the framework.

Figure 2. Location of the illustration-study region, the Regional District of Mount Waddington, in British Columbia, Canada. Abbreviation: PNCIMA, Pacific North Coast Integrated Management Area.

identify relevant benefits, services, values, and their relationships; and by eliciting valuations through diverse approaches. In order to roughly illustrate this framework in a real place, we incorporate some details from one of the pilot projects by some of the authors (SK, KMAC, TS) in the Regional District of Mount Waddington (RDMW), in British Columbia, Canada (figure 2). For each component of the framework below, we provide coarse explanations of the kind of information needed and examples of information pertinent to decisionmaking contexts. The framework is designed both for researchers—who might focus on particular steps with an awareness of the whole—and for practitioners—who might address all components of the framework, at least in simplified fashion, possibly with minimal investment.

Step 1: Obtain consent. Before beginning a project, and at various stages throughout the project, it is crucial for the research team to obtain and maintain consent to engage in research (Berg 2001). Identifying and measuring intangible values can be successful only when those with stakes in the decision context participate as collaborators throughout. Researchers involved in such endeavors can coproduce relevant knowledge only when they are invited. Good research practice goes beyond the standards of informed consent (see, e.g., AAA 2009) to respect the diversity and variability in local context and culture. Although developing local partnerships may create challenges to scientific objectivity or researcher legitimacy (see step 3 below), good research practice requires a multiparty partnership with local institutions or organizations, which may include formal memoranda of understanding with indigenous groups or governments, local government, and key stakeholder groups.

Step 2: Determine the decision context. Define the relevant decision context or contexts. What is the nature of the decision being made? Who is or will be making the decision and why? What is the range of possible alternatives (and what is not negotiable)? And what decisionmaking processes does this entail? Furthermore, what is the opportunity that motivates identifying and measuring values, and what is the role of the researcher in the decision context? Such explicit consideration of decision context is critical for ES characterization and valuation to contribute to policy and management change.

In-depth elucidation of the decision context requires consultation with decisionmakers. For example, in the RDMW,

the regional government is deciding which types of marine-related investments to support in order to boost employment in the area. Alternatives include facilitating the growth of open net pen salmon aquaculture (a currently profitable industry with controversial environmental impacts) or investing in closed-containment salmon aquaculture (an unproven but promising industry that would have little to no marine ecosystem impact). An alternative that currently appears to be off the table is removing fish farms: Although environmentalists argue for this, the RDMW does not appear ready to consider the option.

The researchers (authors SK, KMAC, and TS) were invited to conduct an analysis of the benefits of marine activities in the region by the Living Oceans Society, which had recently formed a formal partnership with the RDMW government.

Step 3: Determine the socioecological context. Roughly characterize the relevant components of the socioecological system to provide context for the decision. This step includes setting boundaries of all kinds and characterizing two dimensions of the context—the biophysical dimension (e.g., abiotic conditions, characteristics of the biota, interactions among them) and the social dimension (e.g., social, economic, political, cultural characteristics)—and the interactions between them (e.g., decisionmaking context for ecosystem management). To connect to Ostrom's (2009) terminology for socioecological systems, our biophysical dimension is Ostrom's *resource systems* and their *units*, and our social dimension is Ostrom's *governance systems* and their *users*.

Whereas many frameworks for research and decision-making take as implicit the need for understanding the local context, we have elucidated particular elements of context that are critical for value identification, valuation, understanding causation, and connecting these processes to decisions.

Boundaries must be defined: On the basis of the decision to be made and the initial understanding of the biophysical, social, and political contexts, define the limits of the study area and the system—spatially and temporally (Stanford and Poole 1996). This step in particular relies on iteration with the steps below. Because different processes have different boundaries, this task of setting boundaries for a study system is a challenging one that has received considerable treatment elsewhere (Norton and Ulanowicz 1992, Chester 2006).

In our example in British Columbia, the physical boundaries of the study area are the waters of the RDMW; it must also be recognized that fish stocks important to First Nations (local indigenous peoples and their governments) and commercial fisheries, including wild salmon, migrate through this region. The limited boundary of the region of interest was driven by the recognition that although many marine resource decisions are made at the provincial or federal level, the regional government is instrumental in choosing which development projects to support. We constrain our time horizons to match those of local planning processes: changes that might happen in the near future (months to less than 3 years) with implications both for the immediate and for the medium-term future (between 3 and 10 years).

The biophysical context must be determined: Characterize the current state of the most critical biophysical conditions and the past trends of these conditions. Identify the components of the ecosystem and the ecological processes that are key to the provision of ES and those that are at stake in the decisionmaking process (Maass et al. 2005, Balvanera et al. 2011).

Historically, the RDMW region supported numerous large runs of salmon, eulachon, and herring. Many of these runs have declined dramatically, and salmon stocks have fluctuated substantially. After a 15-year decline, the sockeye salmon population that migrates through this area crashed in 2009 (Angelo et al. 2010) and came back at remarkably high numbers in 2010 (Pacific Salmon Commission 2011). With its protected inlets and substantial tidal flow, an archipelago within the region is well suited for salmon aquaculture and has one of the highest densities of salmon aquaculture farms in British Columbia. Open net pen salmon aquaculture is suspected to have numerous negative impacts on marine ecosystems through diseases and parasites (Krkošek et al. 2007), although this issue is subject to considerable controversy.

The social context must be determined: Assess the social (inclusive of social, political, and cultural) context first by identifying the range of players—the people that are likely to be directly or indirectly involved with the decisionmaking process or that are likely to be positively or negatively affected by it (Chan et al. 2013). This includes stakeholders (i.e., those with interests at stake; Grimble and Wellard 1997) and researchers, who will generally not be seen as disinterested parties despite efforts to promote this view. This process should involve identifying the most relevant players at several administrative (e.g., town, county), social (e.g., individual, family, ethnic group), and temporal or generational scales.

Identify key relationships among the players, with special emphasis on power relations, and determine as necessary those parties whose status is codified by institutional or legal arrangements (including rights; Ostrom and Nagendra 2006)—for example, treaty obligations with indigenous parties (Boyd 2003). Identify any key historical legacies (e.g., histories of colonization) and their effects on the social and political dynamics (Castillo et al. 2005, Smith 2005, Timko and Satterfield 2008).

Finally, identify the key demographic, economic, social, legal, and technological drivers underlying the decision-making process and the key phenomena such as migrations, recessions, and major shifts in industry (e.g., Sundberg 1998).

We briefly summarize information in this category to illustrate the type of information useful for this step. The major political players in the RDMW include the regional district's local government, town council members, 17 First Nation

band councils, aquaculture companies, resource-extraction industries, and federal agencies. The RDMW has an aging and shrinking population; as is the case for many rural areas across the world, many young people move to urban areas for employment. Traditional sources of revenue and jobs from forestry, fishing, and mining have declined, whereas open net pen salmon aquaculture has grown substantially. Among both the First Nations and nonaboriginal groups, some contingents adamantly oppose any type of ocean net pen salmon aquaculture, whereas others welcome the associated employment opportunities. Over the past five decades, there has been a general consolidation of processing (lumber and pulp mills, fish canneries) and ownership (Ecotrust 2001): Whereas 50 years ago, many community members participated in fisheries and fish processing and many owner–operators lived in coastal communities, few people are now employed in fisheries and fish processing, and most fish-quota owners are wealthy urbanites living outside the region (Edwards et al. 2005). The research team also investigated the historical and legal context in the region, especially First Nations and the legislation governing their relationship with natural resources.

In the RDMW study, the research team faced several related complications, largely because of its strongly enabling partnership with the nongovernmental organization: Claims of biased study design, refusal of participation, and an attempt to dissociate the governmental entity from the study (which failed). Although the team ultimately overcame these hurdles, they exemplify the complexity and sensitivity of investigations of values.

Socioecological interactions must be identified: Roughly characterize the integrated socioecological context and interactions that result in the decisionmaking processes (Ostrom 2009). This involves identifying the resource units (e.g., wild salmon and farmed salmon) and resource states at stake (e.g., wild salmon runs—some healthy and some dwindling, seascapes free of salmon farms), how the governance system links the aforementioned players (e.g., the tax revenue that the regional government obtains from salmon aquaculture compared with the revenue from wild fisheries), and the resulting interactions among these various components (e.g., possible impacts of salmon aquaculture and oil and gas development on wild fisheries and competing notions of those impacts; competition between farmed and wild salmon in seafood marketplaces; shared reliance of aquaculture and wild fisheries on fish-processing plants; shifts toward less labor-intensive salmon farming and in the number of people that live in, are highly familiar with, and directly rely on these ecosystems).

Step 4: Determine the ES, benefits, and values. Brainstorm and broadly explore the range of ES and any associated benefits and values that may be subject to change in the scenarios under consideration—ideally, with local experts and stakeholders (Klain 2010). Cultural ES fall into several categories (e.g., subsistence, outdoor recreation, education and research, artistic; Chan et al. 2011). Each of these provides a broad range of benefits (e.g., material, heritage, aesthetic, spiritual, inspirational, knowledge; Chan et al. 2011); these benefits can be of value to people for various kinds of reasons (depending on whether the benefits, e.g., are self-oriented, involve individuals or groups, are physical or metaphysical; Chan et al. 2012). The point here is not a comprehensive mapping of all beneficiaries of ES to all benefits and all kinds of values but, rather, to facilitate later stages through an exploration of the prominent ES and benefits, key connections between them, and the kinds of values at stake.

After the priority ES and benefits have been identified, the crucial next steps are to more rigorously characterize the implications of possible actions for socioecological change, the impacts of socioecological change on ES, and the importance of those possible changes, using appropriate metrics. It is at this last stage that our framework directly employs most of the core strategies described in box 1.

The US Environmental Protection Agency's Science Advisory Board extensively presented (USEPA 2009) many available methods for steps 1, 2, and 4, but here, we note several methods especially pertinent for our effort. In particular, we emphasize the utility of qualitative methods for the step of identifying priority benefits, ES, and their associated values (step 4), because these may have several important advantages (see box 2). In table 1, we also document methods of addressing the following: disentangling multiple causality, valuation of nonmaterial benefits, and evaluation of scenarios (as part of step 4). Some of these valuation methods are appropriate for representing the value of individual goods or services (the green circles in figure 3); others are parallel to decisionmaking exercises in that they represent the relative desirability of whole scenarios (the blue dotted ellipse in figure 3). As is suggested in the proposed strategies of box 1, holistic valuation and decisionmaking approaches (represented by the blue dotted and dashed ellipses in figure 3) are especially helpful under the following conditions: when benefits are interdependent or bundled (Klain 2010), when the values at stake are intangible or culturally sensitive, when the values do not conform to assumptions of economic valuation (e.g., individual, preference-based, self-oriented, market-mediated, anthropocentric, nontransformative values).

Note that our dual purposes are to enrich research and, thereby, to facilitate decisionmaking, not to mine local social data or to appropriate the intellectual property and knowledge held by local people. In some cases, decisionmaking might be best facilitated by compiling and analyzing available social data and eliciting valuations from stakeholders. In other cases, it might be facilitated best by researchers' engagement with local researchers to conduct the data gathering and valuation processes and by their obtaining from local research assistants only summary data, which leaves sensitive cultural information and values in the hands of the locals. In many cases, local cultural practitioners do not

Box 2. The advantages of an explicit use of qualitative methods of identifying priority benefits, ecosystem services, and associated values.

Methods of identifying the benefits, ecosystem services (ES), and values in a certain context might include value-identification interviews or surveys and site or stakeholder observation. Stakeholders will often benefit from the inclusion of extensive partner involvement in the design of a study. In much research on ES, it is assumed that the important benefits and values at stake can be identified by researchers without extensive contact with stakeholders (but see Shelton et al. 2001, Iceland et al. 2008). Accordingly, the qualitative methods of engaging stakeholders to identify such benefits and values have been neglected within ES research, which frequently advances immediately to quantitative valuation.

Prioritization of what matters. By engaging the relevant stakeholders to identify what matters locally, value identification avoids unsubstantiated assumptions about priority services, values, or benefits (quantitative valuation is generally restricted to a small set).

Richness, with sensitivity. The narrative approach (letting people tell their own story; see table 1) helps people express much more, especially about sensitive or controversial topics.

Understanding of influences. Answers to well-crafted open-ended questions may illuminate not just what matters (the key benefits at stake) but why it matters and how the respondents perceive these benefits to be produced or at risk (quantitative valuation frequently assumes that researchers have an a priori understanding of these aspects).

Interactions between services, activities, and benefits. Respondents' answers to semistructured questions may signal perceived interactions among services, activities, and benefits. Such interactions generally cannot be teased apart with quantitative valuation (except with a priori information, high sample sizes, and intricate survey design).

Incommensurabilities. Narrative approaches allow researchers to more directly discern the key sources of incomparability between risks and benefits.

Less dependence on framing. The discursive exchange between interviewer and interviewee lessens the problem of *framing* (in which the format of a question may dramatically alter the answers). Framing effects are less of a concern with qualitative methods because of the flexibility to tailor questions to interviewees and because interviewees' richer answers provide much more context about how the question framing directs their answers (quantitative valuation such as contingent valuation or choice experiments have a single rigid framing and allow only one-dimensional or yes–no answers). Accordingly, there is less of a need to constrain qualitative questions to particular kinds of interventions or to a particular implied causality of changes.

Kinds of values at stake. Narrative approaches to value identification can also elicit the nature of the value (whether something matters, e.g., for reasons of principle or preference, for oneself or others, at the level of the individual or the group), which informs the appropriate kinds of valuation and also gives insight into stability of the values (most quantitative valuation methods are blind to such differences).

Social and political dynamics. Such interviews help researchers understand the relationships among the key players and engaged stakeholders that are not evident from published information. Such social dynamics can be critical for framing valuation studies that will be appropriate for the research question and that will not inadvertently trigger distracting reactions to local events in responses. (Quantitative valuation thus generally benefits from such understanding, but it usually does not contribute to it.)

Rapport and local understanding of the research. In the process of effective narrative interviews, interviewees may gain understanding and appreciation of the research, which can remove many impediments and enable important further progress. (Quantitative valuation generally involves giving limited context for the research, and the less conversational format maintains the separation between researchers and interviewees.)

need researchers to represent them but need them simply to facilitate their voices' being heard.

In the RDMW, several of the authors pioneered an interview protocol whose purpose was to elicit perceptions from a range of stakeholders of the kinds of benefits that people experience in association with ecosystems and the ways in which those people experience them (Klain 2010, Satterfield et al. 2011). Our 30 interviewees frequently mentioned the ES provision of fisheries in general and of wild salmon harvests in particular. The interviewees associated fisheries with a wide range of services, benefits, and values. Fisheries continue to be important for subsistence and commercial purposes. Wild salmon was historically a staple food and is still nutritionally important for much of the local population. A majority of the interviewees valued fishing for a plethora of benefits, many of which were nonmonetary. Most of them stated that they consume the fish or shellfish. Some used them as part of their art or ceremonies. Many derived pleasure from the act of fishing (including aesthetic, activity, and spiritual benefits). Fisheries are associated with a sense of place and heritage.

These various services and benefits are strongly linked to important values. In terms of rights-based values, First Nations are working toward increasing their authority over local fisheries management and fisheries resources. Collective values are associated with food, social, and ceremonial fisheries catches (harvests allocated to First Nation communities), which are important for social cohesion. In

Table 1. Methods from values literature to aid stages 3 and 4 of the proposed framework. **Fine** ***scale methods are those providing elaborated expressions of values that are representative of small (usually local) constituencies, including a wider but small sample of representative stakeholders, as needed.*** **Coarse** ***methods are more appropriate for the representation of larger, less proximate constituencies (e.g., state, regional, or national population).***

Method	Purpose	Scale	Pros	Cons or limitations
Narrative methods	Eliciting less tangible values, benefits, and services (e.g., spiritual values)	Fine—near the scale of constituency (e.g., identifiable community group)	Best when value categories are uncertain and articulation of them is difficult	The conversion of narratives to metrics is difficult.
Mental or cultural models	Use for socioecological or cause–effect logics, including ecosystem-service production functions	Fine, possibly coarse	Best when the local worldviews (and, therefore, the relations of values, benefits, and services) are unknown	The values are often implicit across cause–effect outputs.
Paired comparisons	Elicit relative weights across benefits	Coarse (survey) and fine (interviews)	Good for ordinal rankings; provides statistical power with surveys	This method is design intensive; there are limited variables (usually fewer than 10 benefits or objects).
Norm-based preference surveys	Elicits broad values and principles	Both fine and course, usually coarse	Widely used protocols; available databases at national levels	The values are usually spatially nonspecific.
Discursive approaches and citizen juries	Best for collective choices (citizen juries or quasilegal forums)	Coarse or fine	Good for matters needing lengthy deliberation and high transparency	Labor intensive, expensive; achieving consensus is difficult
Structured decisionmaking	Identify values as statements of what matters, objectives	Fine	Flexible (uses natural, proxy, or subjective performance measures)	Labor intensive; might only be appropriate for valuation and trade-offs, not the entire decision if the application context is ecosystem services

Note: See the supplemental materials, available online at *http://dx.doi.org/10.1525/bio.2012.62.8.7*, for an expanded version of this table (e.g., including the explicit connection of these methods to the steps of the proposed framework).

contrast, salmon farming is a new industry associated with a limited range of services, benefits, and values, although this industry is important for producing a marketed commodity with material benefits. It has also provided year-round employment opportunities, whereas access to wild commercial fisheries has declined for most locals.

Step 5: Influence diagrams and scenarios. Synthesize the above information in preliminary diagrams to highlight connections among the decisionmaking process; the key components, constituents, or processes of the socioecological system; ES provision; and the wide range of intangible values potentially associated with such services. Building on other influence diagrams (e.g., Waltner-Toews et al. 2003), in this framework, we focus on ES and their benefits. In any such diagram, large numbers of bubbles can render the diagram unwieldy, so priority should be given to those benefits that are most likely to change with the decision in question and that are of the greatest importance to stakeholders (including both recognized and unrecognized benefits). Such influence diagrams, constructed with stakeholder input or on the basis of stakeholder perception, are critical for characterizing what matters to different groups and how such things might be affected by decisions and the resulting direct and indirect changes in ecosystems. A highly simplified influence diagram of some key ES and benefits from the illustrative example in the RDMW is shown in figure 3.

Using the influence diagram or diagrams, highlight potential trade-offs among services and among players associated with the decision under consideration. The diagram or diagrams can also be used to represent variation among stakeholder groups in conceptions of the system and kinds of values at stake. In the RDMW, stakeholders largely group themselves into those associated with the fish-farming industry and those not associated with it. Our interview respondents employed by the fish-farming industry did not see salmon farming as a threat to ecosystems (the impact is represented by the red arrow in figure 3 from farmed salmon to socioecological change); those respondents not associated with this industry almost invariably listed salmon farming as a threat (Klain 2010). Developing the influence diagram on the basis of this information can help identify these differences in perception within the community. Such differences can lead to several next steps. First, if the differences in perception are based on a lack of awareness of scientific information, improved education and outreach can foster shared understanding. Alternatively, such differences may be due to a lack of knowledge and can therefore point to areas of critical scientific uncertainty for further research. Second, there may be ways to reduce conflicts among stakeholders by employing fish-farming practices or siting rules that mitigate negative impacts on ecosystems. Finally, divergent stakeholder views or risk tolerances can be included explicitly in decisionmaking processes (e.g., by illustrating trade-offs in what different people care most about).

To illustrate the changes that might be anticipated to accompany the decision in question, these influences can also be depicted through contrasting scenarios. Such scenarios

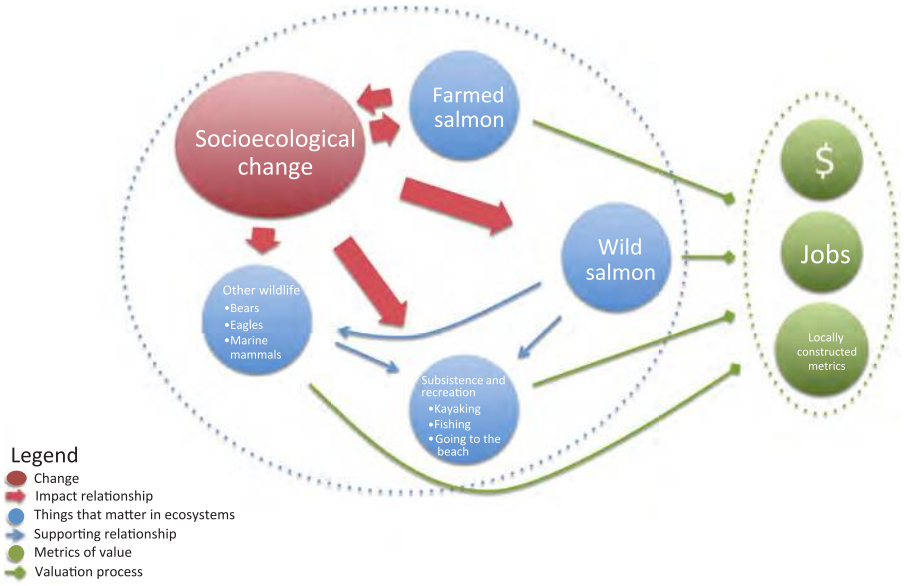

Figure 3. An example conceptual diagram of impending socioecological changes and their implications, as might be provided by a value-identification process. The one depicted is a highly simplified, unsystematic diagram for the Regional District of Mount Waddington case study. The change (the red ellipse) is expected to have a variety of impacts (the red arrows) on the things important to the stakeholders for a particular ecosystem (the blue circles; these can be decomposed into ecosystem-service benefits and other benefits); these benefits and service providers may support other benefits through supporting relationships or services (the blue arrows), and they may be of direct value to people (the green arrows), as might be measured by a variety of metrics (the green circles). Quantitative characterization of any arrow would take place in later iterations. Valuation methods include, for example, market and nonmarket monetary valuation, analyses of jobs expected, and preference surveys. Valuation or decisionmaking exercises might be focused solely on measures of benefit quantity (the blue dotted ellipse; e.g., multicriteria decisionmaking), they might be focused only on value metrics derived separately (the green dotted ellipse; e.g., a cost–benefit analysis), or they might include all manner of information and kinds of values (the entire figure; e.g., structured decisionmaking). The "Socioecological change" bubble in particular could be fleshed out considerably on the basis of details such as those provided in the framework step descriptions.

can be incorporated in decision-support tools for characterizing ecosystem change and its consequences, such as the InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) tool (Nelson et al. 2009, Kareiva et al. 2011).

Such influence diagrams should be interpreted cautiously because of their limited ability to represent ever-present complex dynamics (Norgaard 2010) and to project consequences over medium or long time periods. The simplified functional forms of stock–flow relationships between entities and ES are useful for heuristic projections of short-term consequences but not accurate predictions of long-term consequences, thresholds of system stability, or resilience.

Step 6: Iterate the previous steps. This framework is intended to be iterative, allowing a progressive deepening of understanding of key components, constituents, and processes; key services, benefits, and activities and their tangible and intangible values; and the decisionmaking processes at hand. We imagine iterations of the steps above—not in consecutive order but, rather, as determined by unfolding needs for information. Insights derived at any earlier step might inspire and enable efforts to deepen understanding at another step. Alternatively, the first pass might reveal that—although substantial scientific uncertainties remain—existing understanding is so hotly contested that further scientific understanding is unlikely to lead to meaningful progress (Pielke 2007). The latter may be the case in the RDMW in the short term, given the fundamental disagreement among stakeholders regarding the threat posed by salmon farms (Klain 2010).

In decisionmaking contexts, however, time and resources will be limited, and a first application of the steps will provide information that can assist decisionmaking without great expenditures of time or resources. Once researchers have coarse or rudimentary understandings of the decision context from the first application, subsequent applications might be designed to provide deeper understanding of the nature of the decisions at hand, who might make them, any underlying or hidden drivers of change, and the complex interactions among these drivers. Examples of activities that could be appropriate in iterations of the framework include the following (organized by elements of the framework):

In a second application of the steps, the key biophysical conditions at stake could be qualitatively characterized and mapped, and the magnitude and direction of the consequences of the decisionmaking processes on key ecosystem components and processes could be qualitatively assessed. Quantitative assessments, if needed and possible, might take place in a further iteration.

Understanding of the key players and the relationships among them can be deepened in the second application. Deeper analyses of some of these players and relationships could take place in a further iteration. The same deepening understanding can take place for the underlying drivers.

Specific components of the socioecological interactions, such as those among resource units, resource states, and

governance systems can then be further analyzed in an iteration of the process and further dissected in a further iteration.

The key benefits, their links to ES, and the reasons for their perceived importance can be assessed in a second application of the process. Their contributions to the decisionmaking processes and the complex interactions among them and among the players could be assessed in a further iteration.

More specific and clearer versions of the influence diagrams will be obtained from second and third applications of the process. The spatial context of key components, constituents, and processes and their connections to the nontangible values of ES can be drawn in a second application and further refined in a second iteration. Trade-offs among services, players, and their corresponding values could be further elicited in the iterations.

Research can inform decisionmaking at any point and in a variety of ways (figure 3). For example, an understanding of the consequences of socioecological change for ES and their benefits might inform a multicriteria decisionmaking exercise even without valuation (the blue dotted ellipse in figure 3). In contrast, researchers might use only value metrics in a cost–benefit analysis (the green dotted ellipse in figure 3). Alternatively, all available information might contribute to a deliberative approach, such as participatory structured decisionmaking (the entirety of figure 3).

Discussion of the framework

Recently, significant effort and resources have been aimed at better understanding the biophysical processes underlying ecosystem change and the implications of these changes for ES with material benefits. The importance of determining the economic value of these material benefits is gaining increasing recognition, but it is the intangible values that so often drive the success or failure of management, so the time is right to characterize the roles of those intangible values in ES valuation and natural resource decisionmaking by following and revising frameworks and methods such as the ones we propose here.

The conceptual framework we propose here is intended to help researchers, decisionmakers, practitioners, and stakeholders direct and use research to make or affect decisions. It complements existing management frameworks by elucidating the specific points of intersection with ES research—particularly the many ES associated with benefits of an intangible nature. It differs from the status quo for ES research in five principle ways: (1) It addresses the sensitive nature of intangible values (through the step of gaining the consent of the stakeholders; see figure 1); (2) it explicitly addresses the reality that ES change is a complex product of ecological and social changes ("Socioecological context" and "Influence diagrams" in figure 1); (3) it emphasizes the critical step of the participatory identification of priority ES and benefits and their connection to diverse values ("Benefits, ES, and values" in figure 1); (4) it explicitly represents a diversity of perspectives ("Influence diagram" in figure 1); and (5) it proposes a suite of valuation approaches intended to address the multiplicity of values and presents a suite of options for valuation and decisionmaking at different scales (from individual benefits or ES to whole scenarios; "Benefits, ES, and values" in figure 1).

Our framework embodies a significant step toward increased cultural sensitivity using deliberative methods in conjunction with analytic ones. That is, we propose gathering stakeholders together to discuss decision options in light of the ES and benefits at stake. Such a move toward deliberation addresses several of the core challenges in box 1 and also the critical issue of earned legitimacy. Few decisions result in true win–win situations, and those who feel losses deserve the opportunity to accept them as reasonable, both because the decisionmaking process has been a legitimate one and because the trade-offs that they face are not hidden and are ideally tolerable for as many stakeholders as possible. Although there are valuation methods that employ deliberation (e.g., deliberative pricing and willingness-to-pay studies), another worthy possibility is proceeding directly to deliberative decisionmaking, a stage in which many benefits are quantified in appropriate, meaningful terms (Satterfield et al. 2011, Chan et al. 2012). Embracing such decisionmaking methods might free ES research from the persistent and pervasive perception of being concerned only with "pricing" nature.

Applying our proposed framework in its entirety is likely to require considerable resources. With limited time and resources, researchers and practitioners can use this framework as a heuristic to guide scientific inquiry and engagement in natural resource decision processes that explicitly include cultural ES. Our main point is that conceptual models and qualitative and quantitative methodologies exist to characterize the sociocultural values associated with ecosystems and that employing such methods in real decision contexts will improve our understanding of ES and the decisionmaking associated with them.

A critical question in applying our framework is "What is the bare minimum for stakeholder participation and elicitation?" We can offer no single answer to this question, because the desire and expectations for stakeholder involvement differ greatly across cultures, regions, and particular decision contexts. In keeping with the iterative nature of the framework, we propose that researchers and practitioners start with what seems immediately feasible and only thereafter judge the necessity and appetite for further participation.

Applying this framework to ES research and practice will be enabled by several key conditions. On the research side, the framework's full application requires an engaged interdisciplinary research team interested in an applied context. On the practice side, it requires interested decisionmakers or nongovernmental organization practitioners with resources for research partnerships and a long-term planning or campaign horizon. Full realization of our framework and real policy or management change will also require a

substantial collaboration between researchers and practitioners, which itself involves additional challenges and opportunities. Perhaps most limiting, the ideal framework that we have proposed is explicitly inclusive of diverse stakeholders and values, such that the process requires insulation from or mitigation of the pressures exerted by any particular stakeholder. That said, we have discussed some promising potential uses of the outputs of this framework with EBM efforts being carried out in the RDMW (Klain 2010), the West Coast Aquatic Management Board of Vancouver Island (Guerry et al. 2012), the Puget Sound Partnership in Washington State (Puget Sound Partnership 2009), and Kamehameha Schools in Hawaii (Gould 2011). And even without the integrated partnership of researchers and decisionmakers, there is very real value in assisting stakeholders to express their concerns about elusive or intangible ES values so that—to paraphrase an interviewee (Gould 2011)—decisionmakers cannot say they were not aware of those concerns.

There is no easy way to deal with cultural values, pertaining to ecosystems or otherwise. This is sensitive territory, which is in part why it has been neglected in ES research for so long. But it is not uncharted territory, and it is not a total quagmire: We can represent these values more fully and can, in so doing, greatly improve the validity and legitimacy of ES research and decisionmaking.

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