Integrated ecosystem service assessment for landscape conservation design in the Green Bay watershed, Wisconsin

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ABSTRACT

Comprehensive, partnership-driven, landscape-scale conservation planning presents challenges and opportunities to account for diverse articulations of ecosystem services. There is a need for research that engages scientists in building a body of knowledge built on technical and standardized meanings for ecosystem services, while maintaining flexibility to adapt to meanings held by communities. Herein, we share the results of an integrated ecosystem service assessment that leveraged inductive and deductive methods to identify critical services for the Fox River-Green Bay region of Wisconsin, USA according to stakeholders and experts. We found that stakeholders tended to emphasize components related to tradeoffs, management practices, and cultural benefits, while experts were instrumental in identifying ecological structures and functions, and considering the needs of stakeholders not at the table. We engaged with an expanded cascade model that included management and access concerns. This expanded cascade model helped integrate a wide range of stakeholder perspectives alongside technical knowledge and allowed us to identify several tradeoffs related to access between commercial and charter fisheries, and local farmers and agricultural tourists. By connecting services, benefits, and management and access concerns to particular stakeholder groups, we provide further evidence of ways in which what counts as a service is mediated through societal standing. This work highlights the need for integrating inductive and deductive approaches to ecosystem service assessments and outlines a path for integrated ecosystem service assessment through iterative, multi-level assessments.

1. Introduction

1.1. Ecosystem services

Ecosystem services (ES hereafter), are being incorporated into policy-making across the world including in the European Union (Schleyer et al., 2015), the United States (Schaefer et al., 2015), New Zealand (Greenhalgh and Hart, 2015), China (Liu et al., 2008), South Africa (Reyers, Nel, O’Farrell, Sitia, and Nel, 2015) and Latin America (Balvanera et al., 2012). As mainstreaming ES into policy continues, the concept of ES will be increasingly deployed as part of transdisciplinary planning spheres where ES will be both a technical term used by scientists, and a boundary object (Steger et al., 2018) which must remain pluralistic if it is to bring together multiple institutional mandates and worldviews. The very meaning of ES will be negotiated and discursively developed between multiple sectors of society (economic, political, conservation, social). Such a context requires processes for ES assessment that can navigate this nexus, allowing scientists to build up a body of knowledge built on technical and standardized meanings, while also maintaining flexibility for the meanings of ES to adapt to the framings of the society in which it is deployed.

Rather than assessing ES as a ‘view from nowhere’ (Nagel, 1989), the concept of integrated valuation moves toward understanding the unique socio-economic contexts within which each ES assessment is
founded (de Groot et al., 2010; Gómez-Baggethun et al., 2014; Irvine et al., 2016). Integrated valuation is understood as “a process of synthesizing relevant knowledge and information to elicit the various ways in which people conceptualize and appraise ecosystems services values,” (Kelemen et al., 2015, p. 6). Integrated valuation embraces the idea of value pluralism, in which people have varying degrees of intrinsic, relational, and instrumental values for ES (Díaz et al., 2015; Satz et al., 2013). Moreover, it suggests that capturing these diverse values requires bringing together multiple forms of knowledge in order to inform economic and environmental policy at multiple scales (Braat et al., 2015; Jacobs et al., 2016). This approach focuses on having a societal as well as academic impact, and being inclusive of different worldviews and value systems (Jacobs et al., 2016). At its core, integrated valuation is a solution to the partiality of knowledge and impossibility of capturing the full spectrum of values by means of any single method (Evans, 2019; Jacobs et al., 2018). Integrated valuation is a set of values and principles centered around bringing together multiple sectors of society. At current, these ideas can be applied in practice, but integrated valuation is not a consistent approach in and of itself.

1.2. Landscape conservation design

Landscape conservation design (LCD, hereafter) is a specific approach that makes use of the principles of integrated valuation. It is a process that incorporates a wide range of stakeholders in conversations about the kind, quality, and configuration of conservation needed, as well as what activities generate the greatest return on conservation investment (Brown, Mitchell, and Berestof, 2005). LCD is stakeholder driven, meaning participants come together from many institutions and set aside their institutional mandates to work together towards resilient multifunctionality (Campellone et al., 2018). In a LCD, workgroup members meet regularly to pool their knowledge and set targets and indicators for key ecological functions and services. Ideally, the iterative processes of LCD creates synergies between scientists and practitioners that result in spatially explicit products such as prioritization tools, data gap assessments, and value pluralistic conservation strategies (Campellone et al., 2018). This moves stakeholders within a broader landscape context towards managing their lands in concert under a cooperative strategy. The goal of LCD is to develop a holistic design for conservation that includes multiple objectives and strategies to sustain the social-ecological system (Bartuszevige, Taylor, Daniels, and Carter, 2016).

While LCD, as a specific approach, was developed within the United States, it draws on a long tradition of applied landscape ecology. Shared between LCD and other collaborative landscape approaches is an emphasis that planning should include shared decision-making (Termonshuizen and Opdam, 2009), consider multiple landscape functions and services across a range of stakeholders (Garcia et al., 2018; Jacobson and Haubold, 2014; McAlpine et al., 2010; Pearson and Gorman, 2010; Sayer et al., 2013), spatially integrate development and conservation (Bezák et al., 2017; Inkoom et al., 2017), and synthesize existing data to support decision-making (Gagné et al., 2015). What is perhaps unique about LCD is the entrenched processes and terminology that stem from its historical development as a project of the United States Fish and Wildlife Service. While scant peer-reviewed literature exists on LCD specifically, much grey literature has been published by the US Fish and Wildlife Service, particularly in support of its Landscape Conservation Cooperatives initiative and National Wildlife Refuges (See for example, Landscapes Conservation Cooperative, 2016; US Fish and Wildlife Service, 2013). This article shares the results of an integrated ES assessment conducted as part of an LCD known as the Blueprint for the Lower Fox River-Green Bay, Wisconsin watersheds. We also contribute a framework for incorporating the stratification of services, benefits, and values across different sectors of society and demonstrate its application to stakeholder narratives about appropriation and mobilization of resources. The processes and framework we outline could be applied in many local and regional planning contexts that seek to embed conservation planning into a larger matrix of regional planning.

We engage with the cascade model as an organizing structure to help frame complex relationships between conservation and society (Potschin-young et al., 2018). In it, ecosystem structure and function cascade into ES, benefits, and values (Berbés-Blázquez et al., 2017; de Groot et al., 2010; Haines-Young and Potschin, 2010). The cascade framework can help reduce issues related to double-counting, which occurs in instances of ecosystem interdependence leading to inputs to be counted multiple times (Fu et al., 2011). For example, pollinators are one component that can be valued, but they are also accounted for in many agricultural ES such as crop production. Depending on the overarching goals of the project, an approach is to choose one level of the cascade upon which to focus as a way to minimize, though not necessarily to avoid altogether, double counting (Boyd, 2007). This model has been proposed as a useful framework for integrated valuation because it clarifies the relationship between services and ecosystems. Levels of the cascade have been used differently by different authors. In our work, we use ecosystem services to mean “the elements of ecosystems that support human well-being without constituting benefits by themselves,” (Berbés-Blázquez et al., 2017, p. 321). In this framing, ecosystems are the physical components that have been mobilized by society, while benefits are the ways in which those components contribute to human wellbeing (de Groot et al., 2010). One service (e.g. corn) can have many benefits (e.g. nutrition, financial, aesthetics, etc.). This way of distinguishing services and benefits is useful for research centered around conservation planning (such as this manuscript), because it lends itself to identifying clear prescriptions of actions related to the retention or improvement of the ecosystem, while in this framing benefits (such as economics, aesthetics, etc.) tend to be a little further outside the center of what conservation practitioners actually do, and affecting benefits tends to require more of a multifaceted, indirect approach to affect larger structures in society.

Despite its merits, the cascade model falls short in several ways. It conceals the stratification of services and benefits in a given society. Ecosystems deliver services and benefits asymmetrically to stakeholders and often follow a gradient of socio-economic standing (Berbés-Blázquez et al., 2017; Garrido, Elbakidze, and Angelstam, 2017; Reyers et al., 2013). Each social-ecological system is unique (Braat et al., 2015; Haines-Young and Potschin, 2010) and unique interactions lead to emergent and stratified services, benefits, and values. In addition, the original formulation of the cascade model does not account for human management. People mediate the linkages between wellbeing and ecosystems, including acting through policy and management (Comberti, Thornton, de Gevereerrira, and Patterson, 2015). Spangenberg et al. (2014) propose the inclusion of resource mobilization (the work that goes into turning the materials of ecosystems into services) and appropriation (how resources are distributed). Like all frameworks, we do not expect the cascade model to mirror the world in all its complexity. However, given that our project is geared towards landscape level planning, the cascade model, as applied in planning contexts, should reflect the role of beneficiaries (Plant and Prior, 2014) and the actions of humans within the system (Fedele et al., 2017; Spangenberg et al., 2014). In this light, a revised version of the framework is presented below (Fig. 1).

1.3. Integrating inductive and deductive approaches

An ideal process for integrated valuation in regional planning allows the concept of ES to serve both as standardized terminology for scientific progress, and as a boundary object able to adapt to different meanings across society. This paper shows an approach that maximizes on the strengths of inductive and deductive approaches to achieve this goal. Before sharing our work in the Green Bay Watershed of Wisconsin
in the United States, this section will elucidate why integrating inductive and deductive approaches are necessary for ensuring resilience. Generally, inductive approaches start with observations and look for patterns to generate theory, while deductive approaches start with theory, makes hypotheses based upon that theory, and then tests whether observations fit the theory. Herein, we consider the use of standardized terminology for ES assessments to be a deductive approach, while looking for patterns in a particular context to understand ecosystem service framings to be an inductive approach. Like most dichotomies, this is a coarse division which is imperfect and could probably be thought of more as a continuum. However, the inductive-deductive dichotomy does capture an important distinction for integrated valuation: Applied ES researchers are often navigating the space between solving a problem more unique than generalizable, while also seeking to progress the science of ES through hypothesis testing and concept standardization. Inductive and deductive can help us explicitly consider how to navigate this nexus.

To elicit distinct values, integrated valuation should incorporate multiple methods (e.g. Barton et al., 2018; Langemeyer et al., 2018; Jacobs et al., 2016), which some have divided between qualitative and quantitative approaches (Schaafsma et al., 2017). Qualitative research is often conflated as inductive while quantitative research is conflated as deductive, however this is not necessarily the case. For example, consider the examples of testing hypotheses about the impact of decentralized governance on environmental resources (deductive) through a comparative case study approach (qualitative) or making use of quantitative data from a system to inductively construct an ecological model for that site. It bears noting that while the choice of method determines outcomes (Jacobs et al., 2018), the inclusion of inductive-deductive approaches matters substantially as part of choosing methods. We believe including both approaches for integrated assessment is a necessary, but not sufficient, condition for ES assessment in regional planning.

Inductive approaches have their unique strengths for mainstreaming ES. If the concept of ES is to be integrated across diverse sectors of society, then users must be able to adapt its language to the intended audience (Ainscough et al., 2019; Schleyer et al., 2015). Existing schemas may not accurately capture what matters to people because concerns tend to be framed and grounded in particular histories, and underlying differences between how people experience nature’s contributions to people (Díaz et al., 2015) and the language of ES (Stålhammar and Pedersen, 2017) suggest inductive approaches are important for developing plans that resonate with the society in which the assessment is embedded. In addition, studies have found that stakeholders are not familiar with the terminology associated with ES and may have misunderstandings based around common meanings for terms (Define Research and Insight, 2007; Greenhalgh and Hart, 2015; Vibervaara et al., 2012). For example, the technical use of common words such as ‘service’ create incorrect associations (Greenhalgh and Hart, 2015) and some technical terms such as ‘ecosystems’ and ‘biodiversity’ create a false sense of complexity surrounding the issue and can be off-putting to stakeholders (Define Research and Insight, 2007). All of these suggest the importance of open inquiry at the study site to understand local framings and concerns.

Engaging stakeholders in this way is not the same as community-led conservation, as inductive approaches to understanding stakeholder perspectives on ES still tends to be led by scientists and other experts. Therefore, an inductive ES assessment process will not necessarily yield a ‘balanced’ picture of non-expert interests. When experts are involved, they tend to reflect their institutional values (Kallis, Gómez-Baggethun, and Zografos, 2013; Lynam et al., 2007), to focus on a small subset of regulating services that relate to the scientific study of ecology and are readily measured (Bezák et al., 2017), and to reflect the value-systems of science rather than other segments of the community (Díaz et al., 2015; Lynam et al., 2007). Therefore, the key to a successful inductive assessment, is to engage in solid practices of reflexivity, where the researcher actively seeks to make her own biases explicit within the text, and uses best practices from anthropological and other ethnographic approaches. In many cases, this may mean being more impartial to the fidelity of the site than to the generalizability of the findings, such that the validity of the research is in the extent to which it captures the complexity of the site as verified through practices such as triangulation and member checks (Guba and Lincoln, 2011).

Deductive approaches to ES also have their strengths for mainstreaming ES. By relying on a standardized language, deductive approaches, such as categorization schemes identified by the Millennium Ecosystem Assessment (MEA, 2005), The Economics of Ecosystems and Biodiversity (TEEB, 2010), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Díaz et al., 2015) have the benefit of providing opportunities for comparison across studies and building on existing knowledge bases. The processes of conceptual development and the rigor of peer-review ideally lead to frameworks that are effective at capturing the range of potential ES from which assessors can draw upon when conducting assessments. In part, these schemas are useful because they allow a sense of shared understanding among scientists upon which the study of ES can be built.

Deductive ES assessments are also useful because they tend to integrate knowledge of ecological functioning with human needs, linkages which the typical stakeholder is not generally privy to. In other words, deductive approaches can they therefore compensate for a lack of community situated knowledge about ES. Critical ecological components given high value by conservation agencies are not always revealed as high priorities through participatory processes (Sayer et al., 2007), in part because stakeholders may not see the linkages between wellbeing benefits and ecological function. Stakeholder preferences are often built on incomplete understandings of the system (Ruiz-Frau et al., 2018), related to individual’s previous ecological engagement (Livingstone et al., 2018), and prioritize those aspects of nature that provide her/him with a direct benefit (Satz et al., 2013; Sayer et al., 2007). Lags between the loss of a service and its felt impacts, along with the latency of many services not under threat, means that experience-based knowledge provided by resource users may not provide tenable solutions to environmental problems (Irvine et al., 2016; Seppelt, Dormann, Eppink, Lautenbach, and Schmidt, 2011; Stedman, 2016; van Riper et al., 2017). Furthermore, it is often difficult for stakeholders to talk in abstract terms about the values of nature, as they may not see a distinction between their experiences of nature and its benefits in a way that allows for clear articulation (Stålhammar and Pedersen, 2017).

Thus, inductive assessments may put an unreasonable expectation on participants to be able to identify how ecosystems contribute to their wellbeing, while deductive assessments can help both experts and...
stakeholders to build up a vocabulary of ES. Importantly, deductive approaches also have the benefit of being able to provide targeted facts efficiently implemented into policy (Costanza et al., 1998; Gómez-Baggethun et al., 2010).

To illustrate the value of an integrated approach that makes use of the partiality of both inductive and deductive approaches for regional planning, we apply these ideas to an ES assessment in the Green Bay-Fox River region of Wisconsin in the United States. As a caveat, this article discusses an assessment process related to the identification of services to value, but not the final stage of economic, ecological, or social valuation that typically comes as part of an ES assessment. One reason for this is that we seek to highlight that societal valuation occurs, before economic or other quantitative valuation ever begins, through the very processes of identifying ES and benefits themselves. The outcomes of conservation planning are directly related to the processes that go into determining conservation priorities. These priorities can shift, both depending on the audience solicited to determine those priorities, and the approach taken to tease them out. While there is a formal valuation of services at the end of ES assessments, valuation is also something that happens throughout the entire process of ecosystem service assessments, from choosing the stakeholders to include, to the language used in the research (Vatn, 2009). Furthermore, for the sake of a manageable scope, we wish to avoid conversations about the best ways to conduct final valuations, which has been covered extensively elsewhere (e.g. Chan et al., 2012; Gómez-Baggethun and Barton, 2013; Heal, 2000).

2. Materials & methods

2.1. Research site

Green Bay is the largest freshwater estuary in the world, with a watershed area of 10.6 million acres, including the Fox and Wolf River drainages. Located in Wisconsin, United States, the region is marked by a history of industrial and agricultural-related environmental degradation as well as conservation action geared towards repair (Fig. 2). As of 1979, the lower Fox River, flowing north into the Bay, had the largest concentration of pulp and paper mills in the world (Weimer, 1979), and today is one of the most industrialized rivers in Wisconsin (WIDNR, 2017). The paper industry and its unrestricted use of the waterways for waste disposal, brought hazardous chemicals into the watershed that have had lasting impacts including contamination by polychlorinated biphenyl (PCB) (Harris et al., 2018). This project follows the boundaries of the watershed and includes parts of Door, Kewaunee, Brown, Oconto, Marinette, and Outagamie counties.

By the 1980s the lower Bay and Fox River were internationally designated as an area of concern for polychlorinated biphenyl (PCB) contamination, sediment loading, and habitat alteration (WIDNR, 2017). Users are limited in consumable fish, swimmable beaches, and drinkable water. In addition, numerous tributaries have been designated, under the Clean Water Act’s Section 303d, as impaired. Moreover, a hypoxic zone in the Bay has appeared in recent years (Klump et al., 2018). As of 2017, this region was estimated to have 162,500 milk cows (USDA, 2017) and was also a major contributor to the state’s role in producing corn. Brown County is a top dairy producer in the state, and over half of the land in the county is currently used for farming. While dairy has major economic benefits for the region, it also presents a challenge via increased nutrient (phosphorous and nitrogen) and sediment loading in the watershed.

2.2. Blueprint landscape conservation design

While many efforts have been made to improve water quality, a key challenge is related to the compartmentalization of groups involved in various conservation projects in the region and linked outcomes between conservation and development. The Blueprint LCD was initiated by a regional US Fish and Wildlife Service office. It sought to bring representatives from diverse groups working on conservation-related issues in the region together to collectively impact land and water conservation challenges through the development of regional conservation priorities (Fig. 3).

2.2.1. Ecosystem service and function knowledge assessment

During phase one, the Blueprint workgroup was convened, consisting of conservation partners from approximately fifty organizations. The group engaged in social learning activities through a series of

Fig. 2. Social-ecological history of Green Bay adapted from Harris et al., 2018. For over three centuries, Green Bay has seen a continual transformation of the landscape driven (early) by economic development and (later) by legislation. Over time, these constant changes have shaped the ecosystem services in the geography.
meetings facilitated by a third party. This led to the identification of key habitats from which ecological functions and services could be identified and prioritized. The meetings allowed participants to deliberate on conservation priorities while also arriving at some level of consensus about key habitats and indicators of ecological health. Meeting outputs were synthesized and refined iteratively in subsequent meetings, leading to the start of a framework for organizing the LCD. In the second phase, two separate panels were convened consisting of local experts. The goal was to assess and compile the current knowledge on local ES and ecological functions (EF, hereafter). A secondary goal was to creatively incorporate this knowledge into the framework developed during phase one. Experts were selected by the Blueprint workgroup to provide a variety of perspectives and were identified based on their diversity of expertise surrounding ES and EF. The ES expert panel consisted of eight individuals (many of whom are authors on this manuscript) from local universities, state agencies, and federal agencies...
with expertise in economics, strategic conservation planning and community engagement, human dimensions of natural resources. The EF panel consisted of six experts in biology and ecology.

The panels held conference calls twice a month over a three-month period. The ES experts were introduced to terminology from The Open Standards for the Practice of Conservation (Conservation Measures Partnership, 2013) and the Millennium Ecosystem Assessment (2005) and encouraged to use these documents to guide their thinking. Using the concept of ecosystem service targets as used in the Open Standards and couching the discussion in terms of the ecosystem service categories identified by the Millennium Ecosystem Assessment (supporting, regulating, provisioning, and cultural) provided a common lexicon for this work. The group thought broadly about all existing services in the geography and constructed a master list of services divided by the four Millennium Ecosystem Assessment (MEA) ES categories. It is important to note that many of the experts were also local resource users, however during the ES assessment they were generally speaking from the perspective of the institutions they represented and within the constraints of the academic vocabulary shared amongst the group, and while not entirely deductive, took primarily a deductive approach. The EF experts began by identifying a series of ecosystem components thought to have the most importance to ecosystem function. For example, wetlands were identified as a critical component due to their ability to filter toxins, provide habitat for fish and wildlife, serve as a carbon sink, etc. Once critical functions were identified, they were prioritized and a suite of quantifiable, justifiable metrics termed conservation targets and indicators to serve as a means of tracking improvement subsequent to conservation actions.

At the end of the three-month process, the ES and EF experts convened an in-person meeting to integrate their outputs. During this meeting, the group developed an approach in which ES were identified by starting with critical EFs, following a version of the cascade framework. Overall, the process was deliberative, iterative, and consisted of multiple approaches to yield what the group saw as an exhaustive.

Fig. 5. Agricultural Services, Appropriation Practices, and Benefit Cascades of Farmers and non-farmers.
representation of ES and EF vital to the Lower Fox-Green Bay region according to expert opinion and a process for incorporating these into the LCD.

2.2.2. Stakeholder research

A list of potential stakeholder groups was developed by the Blueprint workgroup using the framework of affected and affecting stakeholders (Freeman, 1984; Reed, 2008). This process generated a list of ten stakeholder groups across the following categories: agriculture (dairy and crop), rural landowners, fishing (charter and commercial), boating, hunting, trapping, water treatment, tourism, business, and planning and development.

Interview protocol was developed to assess ecosystem service salience and concerns among these groups, eliciting the links individuals saw between themselves and the environment, their ideas about healthy ecosystems, and what changes they had noticed in the region over the past decade. This interview protocol allowed stakeholders to define terms like the ‘environment’ and ‘nature’ in their own terms using narrative techniques and a semi-structured approach. We wanted to allow people to express values in their own framings and for them to direct the conversation to those areas that most concerned them. Several questions related to ecological and community health were borrowed from a qualitative ecosystem assessment conducted by Gould et al. (2015). The end result was twenty-one interviews ranging from twenty to seventy-five minutes.

Findings were validated through a process of member checking, which allows the researcher to ensure the validity of her findings. After each interview, the stakeholder was asked to comment on a one-page
summary of takeaways from their conversation broken into sense of place, future growth prospects, environmental changes, healthy ecosystems, local environmental needs, and links between them and the environment. Of the twenty-one stakeholders, approximately forty-percent engaged in this stage of the validation process: four provided written clarification and five provided written validation that the summary captured their ideas. A second stage of member checks was conducted via focus group with nine participants. During this two-hour meeting, stakeholders were invited to reflect upon key findings from the interviews about sense of place, growth scenarios, and ES using a series of discussion questions and engagement activities. Overall, some nuances were added related to trade-offs between services, but the result of the focus group largely confirmed the interview findings.

Data were transcribed and analyzed using the idea that that findings should emerge inductively from the data, as borrowed from constructivist grounded theory (Glaser and Strauss, 1967; Strauss and Corbin, 1990). During the first round of coding, all dialogue in which stakeholders discussed interactions with nature were assigned codes. These were organized into concepts during the second round. We sought, to the extent possible, to articulate nature’s contributions to people in the framing used by participants and avoided making codes fit into pre-existing ES categories. We only relied upon pre-existing ES categories where nature’s contribution to people as highlighted by participants were synonymous with pre-existing ES categories, erring on the side of participant wording when uncertainty arose. Because we wanted to consider what concepts and ideas may be missing from the current ES schemas, we did not exclude concepts if they failed to fit into traditional categories.

3. Results

Overall, the process yielded a complex array of structures, functions, services, and benefits that ranged from more general categories (e.g. agriculture, water, wildlife) to more specific components of nature (e.g. corn, water connectivity, muskrat). The full suite of outputs has been depicted using the cascade model described earlier (Fig. 4). The different processes undertaken necessarily yielded different outputs, and while comparison therefore has its limitations (namely the comparison of different groups who were given very different processes to solicit the information), a cursory view at the outputs of both processes strengthens the case for integrated valuation approaches that include both deductive and inductive approaches. Findings are presented by their position along the cascade.

3.1. Structure

Stakeholders and experts identified the importance of habitat. Over half the stakeholders we spoke with brought up the importance of open space as a basis for services and benefits they received. Farmers tended to talk about the importance of open space for spreading cattle manure and maintaining neighborly relations. Non-farmers tended to talk in terms of open space providing a clear demarcation between city and country, a sense of escape, and contributing to the sense of place. This highly important category of open space was off the radar of the expert panel, likely because its vagueness does not provide any real conservation direction and leaves open a number of deleterious land uses that could occur in land considered ‘open space.’ In this case, stakeholder values may be partially overlapped with expert values, but stakeholders were not concerned with ecological ways of dividing up the landscape and thus relied on the heuristic of open space. This case reveals a fundamental challenge for ES work, where the necessary conditions for services are often less stringent than the necessary conditions for systems health from an ecological perspective, leading to different categorical constructions in the minds of stakeholders and experts.

3.2. Function

Overall, the deductive approach brought out many ecological functions from experts that were not identified by stakeholders. This included air quality, water regulation, nutrient cycling, and nutrient regulation. Stakeholders did not tend to discuss the ecological functions except to discuss climate and pollination. Climate regulation and pollinators are likely salient due to current crises in these areas.

3.3. Services

In this case, services were understood as the tangible components of the environment that provided benefits. Stakeholders tended to highlight those components of nature closest to their experiences (e.g. hunters talked about wildlife, anglers talked about fish, etc.), meaning inductive services were quite limited by stakeholder salience. However, experts brought out many other services not linked to stakeholder groups at the table (e.g. medicinal plants, minerals, etc.), further emphasizing the value of including both groups.

3.4. Benefits

The stakeholders were of utmost value for understanding cultural wellbeing benefits. Expert processes revealed the importance of nature to larger cultural services like aesthetics and identity, however stakeholder processes revealed more specific mechanisms for how nature contributes to identity (by providing connection to nature’s cycles, opportunities for exercise, opportunities for family-oriented activities, quality of life, opportunities for shared experiences, opportunities for solitude, quality of life, and nature’s contributions to the small-town feel).

Stakeholders, however often thought in terms of social-ecological functions coming from a combination of ecological health and management activities and highlighted the importance of open land, access, and other non-ecological components as providing the structure for the ES they received. We found that the cascade framework, in its current form, does not provide a clear space for such mechanisms, but that they fit into the revised framework which includes mobilization and appropriation (Spangenberg et al., 2014).

4. Mobilization and appropriation of resources

Benefits were best understood when considering the additional categories of mobilization (the work that goes into turning the materials of ecosystems into services) and appropriation (factors that influence who benefits from services) as suggested by Spangenberg et al. (2014) For example, different stakeholders revealed divergent perspectives about the appropriation of services from agriculture (Fig. 5). Many local farmers saw agricultural tourism as a drain on their resources and as generally misaligned with the local trend towards agricultural industrialization. Conversely, economic development and tourism representatives saw agricultural tourism as a way to celebrate and share local heritage, and as a boon to the local service economy. In the first case, primarily farmers stand to benefit from agriculture through income, while in the second case, the broader community benefits through tourism and heritage. Appropriation concerns deal with who is receiving the benefits of a service, or suite of services.

In another example, commercial and charter (tour guide) fishermen debated the mobilization processes (stocking and quotas) that impact fish populations (Fig. 6). Commercial fishermen lambasted local walleye stocking practices for the harm it did to perch and whitefish. They also discussed issues of appropriation, emphasizing that perch were accessible to a broader community base. Conversely, charter fishermen mourned the current walleye stocking practices as too low. Related to appropriation, they emphasized the importance of walleye and bass for providing fishing tournaments and stimulating the local economy.
5. Discussion

The wide array of ES-related concerns among stakeholders coupled with the expert knowledge required for linking ES to ecosystem structures and functions provides evidence of the need for including inductive and deductive phases in integrated ES assessments. Studies have generally found that stakeholders place high importance on cultural services while experts tend to emphasize regulating and supporting services (Zagarola et al., 2014; Raymond et al. 2009). Our findings provide further evidence of these partialities. We capitalize on the view that ES is a technical term in need of consistent definitions (de Groot et al., 2010), but that it is also a boundary concept where its flexibility can bring together different sectors of society (Steger et al., 2018).

The process we undertook revealed how valuation emerges in the process of ES assessment before quantitative valuation ever begins. By explicitly linking services and benefits to particular stakeholder groups and their narratives regarding management practices (mobilization and appropriation), we were able to show how different the cascade became and how what counts as a service is mediated through societal standing, both in terms of occupations and interest groups. Furthermore, we brought to light several issues related to who has the right to benefit from nature in cases where tradeoffs exist, such as between commercial and charter fisheries or local farmers and agricultural tourists. We build on others who have demonstrated the importance of understanding the context-specific nature of ES (Gould et al., 2015), management mechanisms, and socially-stratified access and values (Comberti et al., 2015; Spangenberg et al., 2014).

6. Conclusions

This article outlines a process by which landscape planning can incorporate ecosystem service considerations. By engaging experts in the schema-driven identification of ES at a site and stakeholders in open-ended inquiry about ES, we develop a process for constructing a relatively exhaustive yet digestible representation of services within a broader systems framework. Such a process can be used in LCDs and other integrated conservation planning projects. We contribute to the literature on integrated valuation by extending the conversation past integration of data types (qualitative-quantitative) to integration of approaches (ductive-inductive). We have also pointed out that cultural ES and wellbeing benefits may be best elucidated via an inductive approach in which stakeholders are allowed to frame the findings in ways that make sense to them and where the cascade is expanded to incorporate mobilization and appropriation of resources. However, local knowledge, like all knowledge, is partial. Its utility can be buttressed with generalized understandings of ES built upon a broader context of scientific knowledge. The challenge for ES assessors going forward is to find the balance between generalizability and contextuality needed for their projects.

Declaration of Competing Interest

We have no competing interests.

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Disclaimer

The results and conclusions, as well as any views or opinions expressed herein, are those of the authors and do not necessarily reflect the views of the United States Fish and Wildlife Service (USFWS) or the U.S. Department of the Interior.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecoser.2019.101001.

References

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