Understanding ecosystem services adoption by natural resource managers and research ecologists

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A B S T R A C T

The ecosystem services (ES) paradigm has gained much traction as a natural resource management approach due to its comprehensive nature and ability to provide quantitative tools to improve decision-making. However, it is still uncertain whether and how practitioners have adopted the ES paradigm into their work and how this aligns with resource management information needs. To address this, we surveyed natural resource managers within the Great Lakes region about their use of ES information in decision-making. We complemented our manager survey with in-depth interviews of a related population—research ecologists at the U.S. Geological Survey Great Lakes Science Center. In this study, managers and ecologists almost unanimously agreed that ES were appropriate to consider in resource management. We also found high congruence between managers and ecologists in the ES considered most relevant to their work, with provision of habitat, recreation and tourism, biological control, and primary production being the ES ranked highly by both groups. However, a disconnect arose when research ecologists deemed the information they provide regarding ES as adequate for management needs, but managers disagreed. Furthermore, managers reported that they would use economic information about ES if they had access to that information. We believe this data deficiency could represent a gap in scientific coverage by ecologists, but it may also simply reflect an underrepresentation of ecological economists who can translate ecological knowledge of ES providers into economic information that many managers desired.

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Introduction

Ecosystem services (ES), or the benefits people obtain from ecosystems (MA, 2005), is a relatively new resource management paradigm that recognizes that society’s livelihood depends on ecosystems. Given growing global populations and rising consumption in many developing nations, many ecosystems are increasingly stressed, beyond capacity in many cases. The ES paradigm is designed to change this narrative. It takes a comprehensive approach to valuing natural resources and provides quantitative tools to inform decision-making so that benefits drawn from ecosystems can be considered as economies develop (Daily and Matson, 2008; Daily et al., 2011; Tallis and Polasky, 2011).

Much of the early ES work entailed qualitative descriptions of services from which people were benefiting (Baskin, 1997; Daily, 1997; MA, 2005) with only a few economic, spatial, or temporal estimates of the services provided by natural systems (e.g. Costanza et al., 1997 estimated the global ES value was $33 trillion/year while global gross national product was $18 trillion/year). Early work in this field was stymied by a lack of rigorous assessment tools ready for use by scientists and managers (MA, 2005; Daily and Matson, 2008).

Over the last decade, however, the ES paradigm has evolved. One aspect of this has been continual development of tools for practitioners that facilitate the incorporation of the ES paradigm into resource management. For example, the InVEST model (Integrated Valuation of Ecosystem Services and Tradeoffs) by the Natural Capital Project (Kareiva et al., 2011; naturalcapitalproject.org/InVEST/) is a spatially-explicit tool that allows practitioners to assess quantified tradeoffs (e.g. dollar values, tradeoff curves) in different management scenarios and determine locations where investment in natural capital can enhance both conservation and development. Other ES assessment tools exist including SolVES (Social Values for Ecosystem Services; https://solves.cr.usgs.gov/), ARIES (Artificial Intelligence of Ecosystem Services; www.ariesonline.org; Bagstad et al., 2011; Villa et al., 2011), and ESR (Ecosystem Services Review; www.wri.org/WRL2012); each offers a unique approach to environmental decision making (Bagstad et al., 2013). Thus far, the ES paradigm has been a largely academic discussion, but moving forward, it will likely be increasingly visible in resource management given a recent memorandum from the United States government directing agencies to incorporate ES into their planning and decision-making (Donovan et al., 2015).
It is unclear whether and how practitioners have adopted the ES paradigm into their work and how ES knowledge aligns with resource management information needs. Many viable avenues, both monetary and non-monetary, exist for incorporating ES into decision-making, and here we contribute to understanding this integration by evaluating the conceptual and monetary adoption of the ES paradigm in resource management via a survey of both resource managers and ecologists. Other studies on similar subject matter exist, but they focus on specific systems (Australian coastal zones, Marre et al., 2015; forests in developing nations, Ferraro et al., 2012) or populations (EPA wetland regulators, Arnold, 2013; private farmers and federal conservationists, Logsdon et al., 2015) that differ from this study, and they did not compare multiple populations of practitioners. To further focus our efforts on understanding ES adoption, we restricted our study area to potential users within the Laurentian Great Lakes basin.

The Great Lakes basin is unique in its watershed, regional effects of large lakes on climate and ecology, and human connectivity through transportation. Currently, this system is threatened by many stressors, and the Great Lakes Restoration Initiative is targeting the greatest threats to accelerate progress towards long term goals (Great Lakes Interagency Task Force, 2014). One goal is to remove harmful use impairments, thereby increasing the benefits people derive from the system. One example of how the ES paradigm is being considered in the Great Lakes is the biodiversity conservation strategy for Lake Erie developed by The Nature Conservancy and its partners (Pearshall et al., 2012). One chapter of their report was devoted entirely to ES. In a survey, they asked respondents, primarily resource managers, to “rate the importance of ecosystem services to the people that benefit from Lake Erie and its coastal areas.” Many respondents believed that services such as recreation, tourism, and wetlands are the most important ES in the Lake Erie area, but the study did not quantify these services in any spatial or economic sense. Another study (IJC, 2015) evaluated the effects of harmful algal blooms (HABs) to regional economic welfare. Although it estimated impacts of ES interruptions such as those in the 2011 Lake Erie HAB at over $70 million based on losses to property values, tourism, recreation, and water treatment, the authors noted that a more rigorous assessment was hindered by a lack of data and models linking HABs to user benefits.

Additional examples of ES application in the Great Lakes basin are the studies by Allan et al. (2013, 2015) in which researchers evaluated both ecosystem services and stressors to better inform restoration initiatives. Allan et al. (2013) merged environmental stressor spatial analyses with ES mapping on the Laurentian Great Lakes. By identifying areas with high cumulative stress and the associated overlap with ES provision, they provided a foundation for maximizing benefits from restoration activities. Then, Allan et al. (2015) quantified the spatial distribution of cultural ES in the form of five recreational activities. They found that local economies benefit from ecosystem conditions that support recreational services and that either human enjoyment of recreational services or ecosystem conditions are resilient to significant levels of environmental stress. These two studies are excellent examples of how the ES approach can help inform practitioners. It is still unclear, however, whether the information is being considered in practical management of the Great Lakes ecosystem. Therefore, we wanted to know whether this kind of ES information is being transmitted to resource management agencies.

The primary goal of this study was to evaluate whether ES knowledge is currently being used in natural resource management in the Great Lakes region. The project approach was to conduct a survey of natural resource managers (hereafter managers) in the Great Lakes region about their perception and use of ES in their management practices. In addition to basin-wide patterns, we explored ES integration by different manager categories such as their administrative position or the type of government agency for which they work. Through this, we developed a broader understanding of how managers currently integrate ES concepts and metrics into policy-design and decision-making, as well as elucidate changes in information provision that would further integrate ES information in accordance with federal policy (Donovan et al., 2015).

A secondary goal of this project was to evaluate whether research ecologists (hereafter ecologists) have adopted the ES paradigm. Ecosystem services concepts and models require that practitioners understand ecosystem structures and functions, and ecologists are in a unique position to contribute to ES integration by providing requisite ecological knowledge (Kremen, 2005). The U.S. Geological Survey Great Lakes Science Center (hereafter GLSC), one partner on this project, was especially interested in the extent to which their science programs incorporated the ES paradigm. Therefore, we performed in-depth interviews with their ecologists about their perception and use of ES in their research.

The final goal of this study was to compare the responses of managers and ecologists. Do managers and ecologists consider ES similarly? ES assessments are inherently interdisciplinary as they translate knowledge of ES into models describing the benefits people derive (often communicated in monetary terms; Daily and Matson, 2008; Mäler et al., 2008; Daily et al., 2011). This requires cooperation from practitioners with expertise in varying fields. Thus, we wanted to assess how managers and ecologists are adopting ES into their respective work and where impediments may exist. Although managers and ecologists were surveyed differently, there was still some overlap in their evaluations, allowing us to compare their perspectives. Additionally, we were not aware of other studies that evaluated and compared similar groups. Ultimately, we hoped this study would contribute to more responsible and comprehensive management of our finite natural resources by inspiring and providing rationale for funding ES valuations that are needed for full consideration of ES in management and decision-making.

Methods

Resource manager sampling pool

We defined natural resource managers as those who directly contribute to management or policy decisions regarding natural resources in the Great Lakes basin. Managers were selected from 29 resource management governmental agencies in the Great Lakes region representing federal, state, provincial, and tribal agencies. Agencies spanned eight U.S. states and one Canadian province that border at least one of the Great Lakes.

We anticipated a survey (Electronic Supplementary Material ESM Appendix S1) response rate of about 20%, a common rate for online surveys, and therefore determined that having at least 50 contacts from each agency would allow enough power for statistical analysis. To establish a list of potential managers, we accessed all 29 of the agencies’ websites and collected names and work email addresses of personnel (all publicly available information). If no individual contacts were provided online, we requested contact information from the agency or contacted previously known personnel within those agencies. When possible, only managers located within the Great Lakes basin were considered.

For agencies that had fewer than 50 contacts, we included every individual in our sample pool. For larger agencies, we randomly selected 50 contacts. This sample resulted in a pool of 1041 managers. In this final sample pool, 17 agencies were represented by exactly 50 managers while 12 agencies had fewer than 50 managers total. Surveys were screened for inclusion based on managers’ self-reports, and managers’ data were only included in analysis if they answered ‘yes’ to the question “In your current work, do you directly contribute to management or policy decisions regarding natural resources in the Great Lakes basin?” Subsequent examination of post-survey comments revealed one manager who stated that their jurisdiction was outside of, but adjacent to, the Great Lakes basin. We included that response because the individual contributed to decisions in the Great Lakes basin and because they work in a similar (inland lakes and rivers) and adjacent system.
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