



Applying Ecosystem Services to the Practice of Coastal Management: An Overview

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ABSTRACT

In the coastal science and management community of practice, the concept of ecosystem services (ES) is an approach to valuation that is growing and developing, through practice, to mean different things to different people. It is for these reasons that The Coastal Society, in partnership with the Coastal Management Journal editorial board, developed a special edition of the journal with the theme “Applying Ecosystem Services to the Practice of Coastal Management – Understanding Values.” This special edition sought papers on ES research and practice that examined the mix of ecological and social science research, stakeholder engagement, and communication that occurred throughout these efforts. In this introductory essay, the special edition co-editors and colleagues explore common themes across these papers, which span a range of location, practices, and experiences. Themes include the use of the ES approach, methodologies developed and deployed, connecting ES with people and society, reflections on challenges experienced, and reflections on applications for decision-making and management. This paper concludes with reflections on work that is yet to be done, in ES research, training, and application, to improve methods of measuring and communicating the values of our coasts and thus better prepare managers for the complexities of 21st-century management challenges.

KEYWORDS

coastal management;
ecosystem services;
practice; valuation

Introduction

It is more important than ever before to know, and to be able to communicate, what we value about our coasts. In the coastal science and management community of practice, the concept of ecosystem services (ES) is an approach to valuation that is growing and developing, through practice, to mean different things to different people. It is being adopted as an approach or framework and operationalized as a practice – with different processes, products and outcomes and, in some cases, wholly new vocabulary. It is due to this rapidly growing range of experiences, perspectives, and practice that The Coastal Society Board of Directors and the coeditors for this special

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issue thought the time was ripe for a collection of examples exploring how ES is being embraced across our community of practice. Therefore, in the spring of 2017, The Coastal Society, in partnership with the Coastal Management Journal editorial board, announced a special call for papers with the theme: *Applying Ecosystem Services to the Practice of Coastal Management – Understanding Values*.

ES is a framework for interdisciplinary collaboration, a suite of methods for revealing social and economic values attached to natural resources, and an approach useful in helping to make informed decisions about management challenges such as coastal protection or restoration. ES has been consistently gaining traction across U.S. federal agencies and through multiple U.S. presidential administrations as a preferred framework and approach for federal science. This culminated in the Obama Administration’s 2015 Memorandum (Executive Office of the President, United States of America 2015), “Incorporating Ecosystem Services Into Federal Decision Making.” The launch of the National Ecosystem Services Partnership, an initiative of Duke University’s Nicholas Institute for Environmental Policy Solutions (Duke University n.d.), and the development of multi-agency guidance continue to grow coordination to advance this framework. There is so much interest in ES that NOAA’s Office for Coastal Management (OCM) has begun to develop and refine trainings for coastal scientists and managers about how to approach an ES project (National Oceanic and Atmospheric Administration Office for Coastal Management 2018). These trainings, led by OCM’s Learning Services Division, focus on each of the core elements and their relationships, as illustrated in Figure 1.

Considering all of the above, the authors were asked to reflect on ES projects, with a core mix of ecological research, social science research, stakeholder engagement practices, and the communication that occurs throughout these efforts. ES examples abound, from protection and restoration investment choices in the Great Lakes or post-Superstorm Sandy in the Mid-Atlantic, to climate change-driven sea level rise adaptation scenarios for marine coastal communities and ecosystem-wide monetary value

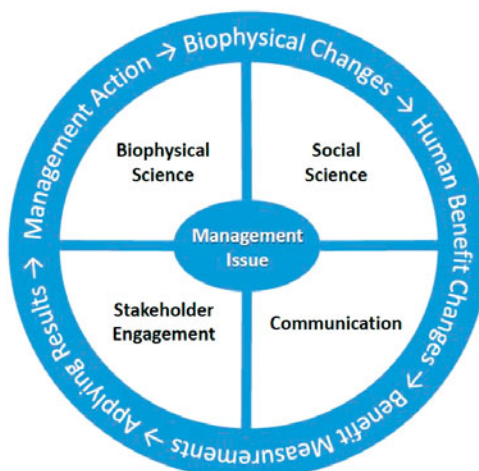


Figure 1. Ecosystem services framework used by NOAA office for coastal management for training purposes (Source: NOAA OCM).

calculations. In the hopes of detailing a range of examples, the coeditors focused on core challenges with implementing an ecosystem service approach, which include building and maintaining successful interdisciplinary teams, incorporating quantitative as well as qualitative valuations or descriptions, and determining how to visually depict the non-quantitative or non-mappable information. Instructions to authors included reflecting on the critical challenge for coastal management practitioners on how to include stakeholder engagement, coupled with effective communication among scientists, stakeholders, and managers, and how to factor end-user needs into products and processes. Ultimately, this special issue called for coastal management practitioners and scholars to either share their experiences, or analyze and critique those of others, in exploring and applying ES approaches to the challenges that they face. The ultimate goal was to use the special thematic issue to showcase different approaches to ES, the various methodologies and applications, and to highlight regional examples from the field.

The collection of papers in this issue span a range of locations, practices, experiences, and approaches. They include: a proposed resilience framework considering the ES associated with water quality on Cape Cod, Massachusetts; an evaluation of tradeoffs in ES values in the context of coastal hazard adaptation in Connecticut; a study operationalizing the ES concept of blue carbon in coastal Texas; an analysis of the linkages between social and ecological services provided through salt marsh restoration on Cape Cod, Massachusetts; and finally, an assessment of urban beach carrying capacity linked to the ES of recreational resources in Northwest Mexico. Below are reflections on each of these contributions in light of the goals for this special issue.

Reflections on using the ecosystem services approach

Merrill and coauthors present a new resilience framework for the analysis of ES related to water quality in coastal social-ecological systems and applied it to an example of degraded water quality on Cape Cod, Massachusetts, USA. This framework is offered as a way to frame future interdisciplinary research on the Cape and in other locations which can support future valuation of ES and incorporation of ES data in coastal planning and decision making. In an unrelated study, Castagno examined Cape Cod as well, applying an ES framework to examine the link between salt marsh restoration and the shellfishing industry. Castagno utilized both quantitative and qualitative valuation approaches, evaluating existing shellfish harvest data and shellfishermen opinions solicited through interviews, to examine social and ecological components of restoration and linkages between them. Moving further down the U.S. Atlantic Coast, Johnston and coauthors used an ES approach to examine the tradeoffs associated with coastal hazard adaptation measures in two Connecticut communities. The authors illustrated paired theoretical and empirical models to quantify the methods and outcomes of coastal adaptation. They then illustrated empirical application of these models through a stated preference, discrete choice experiment, in order to evaluate tradeoffs in social value associated with coastal adaptation alternatives. On the U.S. Gulf Coast, Hutchinson and coauthors operationalized the ES concept of blue carbon (carbon stored in coastal habitats) within the Mission-Aransas National Estuarine Research Reserve in Texas. The

authors examined changes in carbon sequestration, storage, and emissions associated with the expansion of mangroves into areas previously dominated by salt marsh and found that there is a lack of data on many aspects of blue carbon which presents a limitation for application of this ES approach in management. Finally, García Morales and coauthors evaluated an urban beach in Mexico, using an integrated approach incorporating ES concepts and focusing on recreational quality and visitor carrying capacity. The authors did not value specific ES *per se*, but examined a range of environmental, physical, and social attributes and used these as indicators to score the beach for recreational suitability and visitor carrying capacity.

Reflections on methodologies developed and deployed

Of note in this special edition is the broad range of methodological approaches used by the authors to frame the topic of ES. Once the domain of the natural sciences and economics, several of the ES papers included in this special edition incorporate social science approaches or social and cultural considerations more broadly. For example, Castagno addressed ecological and social linkages and incorporated interviews with shellfishermen into her research, finding that fishermen emphasized the cultural value of salt marshes above all else. Additionally, economic valuation of ES is only one component of the ES approach: only one paper, prepared by Johnston and coauthors, explicitly measured study participants' willingness to pay for different coastal hazard adaptation measures. Further, advancing the ES approach often requires developing new frameworks or approaches. For example, Merrill and coauthors outline a new framework designed to shape future interdisciplinary research in support of ES, while Hutchinson and coauthors sought to collect scientific data to operationalize a new ES approach, blue carbon. This range of methods highlights the dynamic nature of ES - scholars are still developing new approaches to framing and quantifying ES, assessing the utility of existing data to perform these types of analyses, and devising new strategies to incorporate social and cultural considerations into ES.

Reflections on connecting ecosystem services to people and society

The papers in this issue also varied in their approach to defining ES in relation to people or society. Castagno's approach was to examine the social connection to shellfish harvesting through the lens of Hopfensperger, Engelhardt, and Seagle (2006)'s framework for wetland restoration, which focuses on process, and further crafting a "social success score" to compare different restoration sites and communities engaged. Hutchinson and coauthors wrestled with the concept of blue carbon and its connection to the social and economic value of climate change mitigation. Johnston and coauthors used non-market valuation and focused on households' willingness to pay for ES, thus quantifying that relationship. Merrill and coauthors approached the definition of ES in relation to people at a conceptual level, by developing a framework focused on an overarching social-ecological system, identifying problems, resilience components, system interactions and stressors. Finally, García Morales and coauthors noted different types of ES associated with beach use, focusing on the concept of carrying capacity as an

oblique but connective link between the services provided and the people who benefit. It is worth noting that, although these papers all explore ES in relation to people and society, they do not fully address all of the social elements of ES (social science, stakeholder engagement, and communications) used in NOAA OCM's new ES training (Figure 1 above). While these papers are only a small sample of current ES research, this suggests that more may work may need to be done to enhance the social elements of ES research.

Reflections on challenges experienced

The challenges faced by the authoring teams in conducting ES research ranged from tackling data gaps to disentangling the web of social, cultural, and biophysical services upon which stakeholders reflected. Johnston and coauthors took the challenge head on of disentangling ES provided by nature and nature-based features by focusing on the values related to shoreline protection and the adaptation strategies deployed to achieve it. Castagno grappled with data gaps and inconsistencies, and more interestingly, challenges in teasing apart the effects of restoration with confounding factors that influence harvest, not to mention the time lag involved in monitoring restoration. Merrill and coauthors focused on crafting interventions that both incorporate research and relevant stakeholders. They addressed this challenge by articulating the feedback loop between social and ecological systems, which in turn enabled them to identify additional avenues for research on reducing nitrogen loads. García Morales and coauthors directly addressed the challenge of developing an ES-based valuation tool to be systematically deployed in certifying Mexican beaches for recreational use and through its application, to identify management priorities for improving beach use. Hutchison and coauthors encountered a variety of different types of data gaps and lack of relevant research elsewhere, all of which points to the challenge of operationalizing the blue carbon approach for management or decision making.

Reflections on applications for decision making and management

Reflection on these papers and their approaches to using an ES approach to inform decision making, advance science, or improve management, reveals several lessons. While many of these papers include discussion of how results *could* be used in management, none discussed how their results *had* been applied in a decision context. This is notable given that the call for papers prompted authors to discuss how their research had been used in decision making. However, embedded in these papers were key insights that could shine a light on how results could be incorporated into decision making, advance science or improve the use of ES approaches in management.

Castagno's work highlighted some critical data gaps and inconsistencies, but more interestingly with respect to management implications, found a strong cultural link between shellfish harvesters and restoration. That evidence could be used to support salt marsh restoration, inform communication and engagement with stakeholders, and build public support for restoration. Johnston and coauthors provided a framework for evaluating tradeoffs between hard armoring and nature-based methods of shoreline

protection, as well as the disentanglement of direct and indirect utility effects. These results could be of great assistance to managers evaluating management options for sea level rise. Hutchison and coauthors' findings about data gaps on mangrove carbon dynamics provide a framework to begin to address these gaps and move toward ES-informed management and decision making. The authors directly discuss the relevance to management in the Mission Aransas NERR, including using the information to communicate why coastal communities should care about protecting and/or restoring coastal habitats and how managers can effectively allocate resources. In the García Morales paper, the authors give suggestions for improved management that would lead to enhanced ES, with very specific recommendations such as the installation of restroom facilities to improve water quality and a monitoring program to inform decision making and management. These authors also suggest an immediate next step in research – the collection of information about visitor perceptions to inform decisions and improve both beach recreation and related ES.

Of all the papers, Merrill and coauthors had the most explicit focus on identifying next steps to advance their ES approach and improve its application to decision making and management. These include research on the efficacy of ecological restoration for reducing nitrogen loads, including conversion of a cranberry farm to a freshwater wetland and a home septic-scale permeable reactive barrier; and an effort to quantify the demand for ES supporting recreation at a community scale through social science and economic valuation methods. The authors' research framework is intended to move toward advancing scientific research in support of ES which will ultimately enable the integration of this information into management. Finally, they referred to engagement with local watershed managers in a degraded watershed on Cape Cod to both illustrate their approach and incorporate ES as a water quality management objective. This has very interesting potential for application in management and decision making.

Conclusion

When considered alongside the increased use of the ES approach, this collection of papers reveals that while ES research and practice is rapidly evolving, there is still much work to be done. From a research perspective, this collection of papers has raised important questions, identified gaps, needs, and challenges, and outlined frameworks that have yet to be applied in shaping future ES research. From the perspective of coastal management practice, none of these research papers included a significant stakeholder engagement and communications component. Nor had their findings been directly integrated into decision making at the point at which the authors submitted the articles. These gaps are both challenges and opportunities and are likely to be the focal areas for trainings, such as those under development by NOAA's Office for Coastal Management, which might help practitioners successfully address the stakeholder engagement elements of the ES approach while providing information to support decision-makers. Data gaps and integration issues also point to openings for the next generation of researchers and practitioners to delve into ES with a fresh perspective, and to build upon the foundation provided by these and other ES scholars by developing new methods and new solutions to operationalize the ES approach. By improving our

methods of measuring and communicating the value of our coasts, we will prepare ES science – and the managers using this approach in practice – to take on the complexities of 21st-century coastal management challenges.

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