FOREWORD
Special Issue on the Economics of Changing Coastal Resources: The Nexus of Food, Energy, and Water Systems.

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Viewed through the perspective of the nexus of food, energy, and water systems, improved management of coastal resources requires enhanced understanding of cross-system and cross-scale interactions and dynamics. The economics of changing coastal resources hinges on increased understanding of complex tradeoffs associated with these complex multisystem and multiscale relationships. How diverse forms of change will affect water quantity and quality as well as food and energy production in coastal areas is not well understood.

Coastal resources provide many goods and services and influence markedly the nature of many human communities. In 2010, 43 percent of the US population lived in marine coastal counties (US Census 2012), and from 1960 to 2010, the population of these counties increased by 87 percent, faster than the rest of the United States (62 percent). In addition to serving as attractive settlement locations, coastal areas provide critical ecosystem services, including critical habitat for commercially important species in some cases (Gutman 2007, Kroll et al. 2012, Hales et al. 2014). Abundant natural resource amenities also provide valuable recreation and tourism experiences (Hales et al. 2014). Further, new economic opportunities also exist in coastal areas, with many recent examples of emerging products (Barros et al. 2009), innovative seafood technologies (Ayer and Tyedmers 2009, Bugallo et al.

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2013), and potential biomedical compounds of different macroalgae (Shekhar et al. 2012) and bivalves (Newell, Ma, and Doyle 2012).

Nonetheless, the feasibility and desirability of providing different services and the interactions among different resource allocation decisions are not evident. Coastal areas are vulnerable to economic (e.g., recessions, energy prices, infrastructure), social (e.g., income inequality, gentrification) and environmental (e.g., climate change, new marine diseases, invasive species) shifts. In some instances, population and housing growth have placed increased burdens on coastal communities, including displacement of small businesses, workers, and communities focused on seafood production and lost working waterfronts (NOAA 2012a) – resources which are important to local economies (NOAA 2012b) and support local and regional food security. In other cases, economic stress induced by depletion of commercial fisheries has revealed the downside of extreme dependency on particular species or sectors.

Community threats and shocks can come in many forms, and the impacts of change will depend upon many different factors. Although there is a rich literature on the effects of climate change on marine coastal communities, almost all of these studies focus on non-US communities (e.g., Badjeck 2008, Chouinard, Plante, and Martin 2008, Crona et al. 2010, Race, Luck and Black 2010, Silver 2013, Abernethy et al. 2014, Orchard, Stringer and Quinn 2014). Transferring these results to US-based communities is problematic because community resilience and adaptability is place dependent (Storbjörk and Hedrén 2011, Johnson, Henry, and Thompson 2014, Dawley et al. 2015).

Coastal areas can play a key role in efforts to advance our nation's food, water, and energy security. The knowledge base needed to understand how diverse forms of change will affect food and energy production in coastal areas and how best to increase the resilience of these areas is relatively lower compared to other communities (Akinwale 2011, Camill et al. 2012, Switzer et al. 2012). Economic science that spurs greater understanding of changing coastal resources and communities, and inspires innovative technological and social solutions to address change and take advantage of opportunities in the face of change, offers great promise to these diverse areas (Hart and Bell 2013).

Contributions in This Special Issue

The papers in this special issue were presented at the Northeast Agricultural and Resource Economics Association (NAREA) 2016 Workshop on the *Economics of Changing Coastal Resources: The Nexus of Food, Energy, and Water Systems.* The workshop was designed to improve understanding of changing coastal resources by synthesizing insights across different lines of economics research and to support an applied economics research program focused on coastal and marine resource management issues. These systems face a variety of challenges and opportunities. Demands for, and supplies of, food, energy, and environmental amenities depend in part on human settlement patterns and development and use of new infrastructures and technologies. Allocation of coastal resources to achieve multiple objectives introduces complex and multiscale tradeoffs. Further, a changing climate influences the competitiveness of natural resource industries, the viability of longstanding cultural traditions and infrastructure, and the sustainability of human-environment systems. Increased emphasis on uncertainty and resilience challenges managers and stakeholders to consider new frameworks and approaches for understanding, assessing, and responding to changing coastal resources. By bringing together economists studying diverse aspects of those resources, this workshop strived to build a fundamental knowledge base and research network responsive to the growing calls for research at the nexus of food, energy, and water systems.

Planning and Managing Spatial Tradeoffs

Balancing new opportunities in food and energy production in an already multifunctional human-environmental system (e.g., tourism, recreation, capture fisheries, shipping, marine protected areas) introduces fascinating and important policy challenges and opportunities for economic science to make a difference. Evaluating, planning and managing the spatial tradeoffs inherent in developing ocean and coastline areas is the focus of the first two papers in this special issue. **Herrera et al.** illustrate four key conflict areas when deciding on how to navigate the tradeoffs inherent in managing common-pool natural resources (here, the ocean and coast). These conflicts are between the regulator and the regulated, affluence (the maximization of net benefits) and resource access, economic prosperity and ecological health, and present and future benefits. Using a ball-and-basin conceptual model, the authors provide an analysis of the issues and then examine how spatially explicit regulatory innovations can address these conflicts. They provide brief examples of win-win possibilities (e.g., dam removals, river restorations) before expanding on how these innovations can mitigate frictions in commercial fisheries. The results are enhanced rents, increased fish stocks, and increased participation (access) – leading to a political-bioeconomic solution.

Complementing Herrera et al.'s theoretical approach, **Bates** provides a history of coastal and marine spatial planning (CMSP) with an analysis of its uses, processes and outcomes. CMSP is a relatively new approach to managing US coastal area development and, although not mandated at the federal level, has been adopted by several coastal states to manage offshore wind development. The experience shows that, when done well, CMSP requires the collection and management of vast amounts of different types of qualitative and quantitative data as the near-ocean landscape has a variety of users, each with unique concerns (e.g., commercial and recreational fishing, shipping, tourism, naval, coastal landowners, etc.). However, difficulties arise in managing the process (e.g., CMSP requires a lot of stakeholder engagement, which is costly in terms of time and money) and in understanding how tradeoffs may change when considering the uncertainties driven by climatic changes. For example, what happens to development scenarios if whale migration routes change?

Expanding Seafood and Energy Production

Several authors (Firestone, Kempton and Krueger 2009, Haggett 2011, Firestone et al. 2012) highlight the lack of scientific research focused on understanding people's reactions to coastal wind farms; even fewer focus on tourists and tourism (e.g., Ladenburg 2010, Lilley et al. 2010, Landry et al. 2012, Westerberg, Jacobsen, and Lifran 2013). Most of the tourist studies are in the "grey literature"; i.e., manuscripts not published in peer-reviewed academic journals (e.g., Albrecht et al. 2013, Braunová 2013, Business LF 2013). Results from these studies generally show that tourists are quite mixed in their reactions to wind farms (Riddington et al. 2008, Lilley et al. 2010, Landry et al. 2012). This may not be surprising given the differences in the projects' contexts. In this issue, **Fooks et al.** use a lottery mechanism in a field setting with actual beach visitors to elicit people's willingness to pay for hotel rooms with, or without, a view of a wind turbine. As expected, most participants were willing to pay more for a higher quality hotel and for having a room without a view of the turbine. However, a significant number (12 percent) were willing to pay more for a room with a view of the turbine, suggesting turbines provide a positive externality for some.

The world's population is estimated to grow by almost 30 percent by 2050, from 7 to 9 billion people; maintaining per-capita consumption of sea-based proteins will require innovative solutions such as marine aquaculture (mariculture) to increase sustainable seafood productivity (NAP 2010, Diana et al. 2013, Béné et al. 2015). Expanding mariculture would help reduce our trade imbalance in seafood[1] and promote working waterfronts (NOAA 2012a), provide alternate local employment opportunities and diversify against the uncertainty of struggling wild-capture fisheries (Kristofersson and Anderson 2006, Tveterås and Tveterås 2010). However, mariculture is controversial (Katrin-Schlag and Ystgaard 2013) and generates conflicts with other resource users which could delay or stop mariculture expansion. Mariculture needs social acceptance to expand in communities where production is located (Barrington et al. 2010), and by consumers (Quagrainie, Hart, and Brown 2008, Davidson et al. 2012, Verbeke 2013), but information gaps persist about the social acceptance of these systems and their social and environmental impacts (Slater et al. 2013).

[1] In 2012, the U.S. trade deficit in edible fish and shellfish was $11.2 billion, with imports of $16.7 billion and exports of $5.5 billion (NMFS 2013).

Evans et al. explore the impact of mariculture on coastal homeowners. Using single-family home sales and historic spatial information on mariculture activity, they use a hedonic model to assess the effects of further mariculture development in Maine. Their results suggest spatial variation in how mariculture affects property values but that the effects are rather small. This suggests that 1) for many areas, mariculture effects on property values should not be a point of contention, and 2) centralized siting approaches may overlook effect variation (e.g., siting solely on biologic suitability). Mariculture zones or co-management may balance competing objectives and promote mariculture. Efforts to quantify the effects of siting mariculture are limited, and as far as the authors can tell no published hedonic study of mariculture exists.

The profitability of increasing food production in the coastal zone depends on adequate demand for the outputs, yet there is a lack of economic analysis of the positive (ecosystem service) spillover effects of seaweed and shellfish mariculture – information that can be used as part of a marketing strategy, or in policy analyses. For example, the National Academy (2010) finds these markets need better information about the ecosystem benefits and recommends economics research should "develop… methods of putting values on those services" (pg. 15). Further, Yip, Knowler, and Hader (2012) note that studies have provided "little evidence to indicate how consumers would perceive and value the ecosystem benefits generated by these systems" (p. 5). In fact, there are only a handful of studies (e.g., Ridler et al. 2006, Shuve et al. 2009, Kitchen 2011, Ridler 2011, Yip, Knowler, and Hader 2012) that have examined consumers' willingness to pay for these outputs.

Two related papers examine the factors that influence the demand for oysters and their associated ecosystem services; there is little yet in the academic literature. Both papers use field experiments where participants were provided an initial financial endowment, and participants chose oysters to buy; information about the oysters varied across choice scenarios and differed across the two studies. In **Li et al.,** the manipulated information was: the price of the oysters and the level of nutrients (low, moderate, high, unknown) in the water where the oysters were grown. The latter attribute reflects the ecosystem service functions of the oysters; the authors find participants were willing to pay more for oysters from waters with moderate to high nutrient loads. In **Kecinski et al.,** the manipulated information was price, brand, harvest location and growing methods (wild or maricultured). They find that most consumers did not have a brand preference, preferred products from Long Island, New York, and had a preference for wild-caught oysters. More avid oyster consumers were similar except they had brand preferences and preferred maricultured oysters.

Managing Coastal Water Quality

Coastal areas are not just places of energy and food production – they are also areas in which to relax and recreate; these recreational activities also produce economic returns. Visitors to coastal areas participate in a range of activities (e.g., beachcombing, surfing) and the quality of the experience can be contingent on the safety of the water. Two metrics of water safety that may vary due to climate change are: 1) pathogen (e.g., Vibrio, E. coli) contamination of the water, and 2) riptides, strong currents, and high surf. The safety of swimming and surfing at coastal beaches is often provided through signage, local news media and on websites. Seeing a gap in the literature, **Kaminski et al.** examine the factors that influence a beachgoer's decision to seek out beach safety information and whether those factors differ across information about water quality and surf conditions. They find swimmers seek both types of information, whereas surfers seek out surf information and do not seek water quality information. The latter is somewhat surprising, but the authors provide evidence suggesting surfers have higher risk tolerances.

Most choice scenarios in surveys present respondents with two to three choice options (one option often being the status quo) that vary in terms of the levels of a small number of choice attributes (e.g., price can be an attribute with several predetermined levels assigned to the different choices based on some experimental design). The respondent then chooses one of the options. **Noblet et al.** take a different tack; using a referendum style they asked respondents whether or not they would be willing to pay a specified fee to support a new coastal water quality program. Respondents were then asked how they would want the funds allocated to different aspects of the program (e.g., forcing respondents to make tradeoffs on how the water quality would be met). Their choice experiments also differed in other dimensions to test the effects of: 1) message framing (were the impacted resources shellfish flats used for harvesting, or beaches used for recreation; as the affected party the marine environment or public health), 2) respondents' perceptions of the management actions (i.e., adaptive or preventative), and 3) the perceived consequentiality of citizen decisions. They find that the architecture of the choice scenario affects citizens' allocation of funds to preventative water quality policy actions relative to adaptive measures.

Managing Coastal Lands

Coastal areas are under threat from sea-level rise, which poses several conservation problems. Salt marshes and beaches may migrate; this is problematic because many of these areas provide breeding (e.g., fish) and nesting (seabirds) habitat, and many of these areas are bound on the upland side by human structures (e.g., housing, roads). Conservation and land trust organizations may want to purchase coastal properties to prepare for the migration of these marshlands. However, the speed and magnitude of sea-level rise is uncertain, so these organizations have little guidance on what properties to purchase. In a unique paper, **Dissanayake and Hennessey** aim to assist these organizations by modeling optimal purchasing decisions under various budget, risk, and uncertainty scenarios, then applying those to a case study in Maine. They conclude their approach is a relatively low-cost and less computationally intensive compared to other methods, allowing smaller municipalities and NGOs to plan for climate change effects on coastal lands.

As noted by Bates, CMSP is difficult and time consuming due the large amount of various types of data needed. **Wainger et al.** expand on this issue by noting that qualitative data, though rich in detail, is often in long narratives that can be difficult to organize. As a result, this may overwhelm decision makers who then overly rely on simpler quantitative results that may mask points of conflict. Using a case study aimed at measuring stakeholder preferences for socioecological services provided by coastal marshes, Wainger et al. present and describe the use of the Q-sort method, which condenses qualitative results into metrics allowing preference comparison. They also use collaborative learning approaches in their stakeholder engagement, aimed at eliciting more well-defined preferences. They find that the two approaches allowed them to identify key differences in preferences across different stakeholder groups (community members, academics and regulators) at the beginning of the project, and find that engagement led academic preferences to convergence toward the preferences of community members. This suggests that academic researchers may be missing a piece of the puzzle if they do not engage with stakeholders.

Discussion

Coastal areas are a nexus of complex, dynamic human-environmental systems – systems that regularly face diverse forms of economic, social, and environmental change. Interconnected challenges (e.g., urbanization, climate change) affecting those systems threaten longstanding economic and cultural traditions and impose stress on the health of environmental systems. Conversely, interconnected opportunities (e.g., offshore wind and expansion of mariculture) involving those systems serve as catalysts for sustained and new economic, cultural, and environmental successes. Science that spurs innovative solutions to address threats, takes advantage of opportunities in the face of change, and communicates these results to citizens offers great promise to these diverse areas.

New production, market and governance systems, and infrastructure networks often emerge as responses to economic, environmental, and social change. Connections among land, freshwater, and coastal natural resources complicate the design, implementation, and evaluation of new systems. In addition, critical linkages among land-based and sea-based resources are often overlooked by fragmented governance systems whose design accentuates boundaries among resources and markets. Research advances in these areas are likely to follow from synergistic thinking that improves understanding of linkages among urban and rural, land and water, local and regional, and human and biophysical systems.

Finally, broader questions arise about the effectiveness and structure of prevailing governance and institutions (Ostrom 2010) for managing these coastal systems (Zhu and Chu 2013) as they scale up (Mount 2012) and join up (Barling 2002). Importantly, understanding citizen and decision-maker support for, or concerns about, these emerging opportunities is key to successful transitions. As evidenced in this issue, economists are well positioned to evaluate the opportunities, challenges, and tradeoffs required to move marine and coastal communities into a new era.

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