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Communicating Research on the Economic Valuation of Coastal and Marine Ecosystem Services

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Keywords: economic valuation, marine and coastal ecosystem services, coastal and marine management, policy analysis, benefit transfer

JEL codes: Q51, Q25, Q57, Q58

Communicating research on the economic valuation of coastal and marine ecosystem services

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Abstract

Quantifying the monetary value of ecosystem services provided by coastal and marine resources can help policy makers assess the trade-offs and synergies inherent in ecosystem-based management of marine and coastal environments, thus increasing the social efficiency of decision-making processes. As shown by the valuation literature, the number of coastal and marine management settings where valuation researchers have attempted to make a contribution is rising fast. However, this rise in research activity has not been matched by the increase in the use of economic valuation (EV) in the actual management of coastal and marine resources. This raises an interesting question: is EV responding to the needs of policy makers? This paper provides a comprehensive overview of the knowledge base regarding the economic values for coastal and marine ecosystems. It then discusses how to improve the uptake of ES valuation research by focussing on two core issues which are thought to be essential for more effective communication with the policy community.

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1. Introduction

Economic valuation (EV) can provide policy makers and environmental managers and planners with information about the social benefits and costs associated with alternative coastal and marine management policies. It can help to assess the trade-offs and synergies inherent in ecosystem-based management, thus increasing the social efficiency of decision-making processes. A key question is thus why such valuation is not more widely used in actual decision-making.

As this paper shows, valuation researchers have applied their methods to an increasingly wide variety of coastal and marine ecosystems. However, the growing number of valuation studies has not been accompanied by an increase in the use of EV in the actual management of such ecosystems. As stated by Ruckelhaus et al. [1], "the pace at which the theory of ES valuation is being incorporated into real decisions has been painstakingly slow, with disapprovingly few success stories". Laurans et al. [2] argue that, despite valuation being able to demonstrate to policy makers the benefits derived from sustainable coral reef management, it has been used "in an *informative* way rather than in a *decisive* or *technical* perspective".

This situation raises an interesting question for valuation researchers: *Is EV responding to the needs of policy makers?* This question becomes even more relevant in a framework where environmental policies increasingly call for a balancing of the benefits and costs of regulations, and for regulatory impact assessments [3–6]. In a recent paper, Hanley et al. [7] wonder if EV of marine and coastal ecosystems is "currently fit for purpose" given the demands of European environmental legislation. The authors conclude that evidence that non-market values are used in policy formation is mixed, which can be explained by the "lack of scientific knowledge of key linkages in the valuation framework, a lack of relevant economic valuation studies, methodological problems in applying certain valuation methods to marine issues", and the "unfamiliarity of most people with marine ecosystems and their components".

Hanley et al. [7] mainly focus on the limitations of EV and the analysis of the extent to which the current scientific evidence base allows valuation to be conducted. The authors call for further interaction between political and social scientists on the basis there is also a need "to communicate ES research more effectively and to improve understanding of the *realities* of policy makers to economists and marine and coastal scientists". This is the motivation for the present paper, which attempts to review the current evidence base, in an attempt to guide policy makers interested in using EV in coastal and marine policy formation and management. It presents a systemic survey of the current evidence base on the values for coastal and marine resources, placing emphasis on the analysis of both the policy implications of current studies as well as existing challenges. It then discusses the scope for these kinds of studies to get used in policy implementation and environmental management as well as the main barriers to a more widespread and in-depth use of EV in coastal and marine ecosystem management. The paper extends the analysis by Hanley et al. [7] and hence also emphasizes the role of EV and the need for tackling its limitations in developing country and poor-community contexts. It also critically discusses the need for more primary and high quality valuation studies to increase the use of benefit transfer; and examines the potential of EV to complement more participatory and deliberative decision-making approaches. In this way, the paper is an attempt to start a discussion about further research needs and hence promote collaboration among political, natural and social sciences in an attempt to increase the use of the method in actual management.

The structure of the paper is as follows. Section 2 describes the methodology used to provide a comprehensive overview of the knowledge base regarding the valuation of coastal and marine ES. Section 3 presents the main conclusions from the analysis of the current evidence base and examines the scope for EV to play in the better management of coastal and marine ecosystems, while section 4

discusses the main barriers to a more influential use of the method. A "Concluding Remarks" section ends the paper.

2. Methodology

The increasing demand for non-market economic values in policy decisions has led to an increase in the use of valuation estimate databases that may be used in value transfer exercises [7]. In this paper, a systemic survey of the current evidence base on the values for coastal and marine resources was undertaken through an extensive literature review, the main source for which has been the National Ocean Economics Program/Middlebury Institute of International Studies at Monterey (NOEP) database.[1] The criteria selected to obtain the list of papers were the following: i) to guarantee the quality of the publications, only peer-reviewed papers have been considered, so technical reports, book chapters and working papers have not been taken into account, ii) published between 2000 and 2015, iii) using any valuation methodology), iv) being original or undertaking meta-analyses, v) estimating any type of non-use value, vi) valuing any type of relevant natural capital asset, and vii) focusing on any type of recreational activity.

Most of the reviewed papers have as a primary objective the valuation of goods and services provided by coastal and marine ecosystems. Further details on the review process can be found in Torres and Hanley [8].

2.1 Responding to policy makers' needs: paper classification by ecosystem type

The papers have been analysed according to their study object, the ecosystem service (ES) being valued, the types of values being estimated, their main outcomes and policy implications.[2] Additionally, the most important research needs as well as the major overcoming challenges stated by the authors have been examined. To better contribute to the analysis of the role of economic valuation in coastal and marine ecosystem decision-making, the papers have been classified relating to different ecosystem types resulting from the consideration of different management frameworks. These frameworks have been determined according to both the major management concerns among valuation researchers identified in the literature; and the classification of aquatic ecosystems made by the Water Framework Directive (WFD, 2000/60/EC) which establishes integrated river basin management as the best strategy to achieve good status of water.

On the one side, the review of the valuation literature has allowed the identification of eight broad management areas to which valuation research wants to make a contribution: wetland management, beach management, coastal area management, freshwater resource management, coastal water management, coral reef management, marine protected area policy design, and strategies to protect the deep sea/open ocean waters. On the other one, the WFD establishes a framework for the protection of inland surface, transitional, coastal and ground waters. In this context, inland waters (standing or flowing), which include rivers, streams, canals, lakes and reservoirs are freshwater ecosystems; coastal waters are marine ecosystems; and transitional waters, which include estuaries and deltas, involve a mix of freshwater and marine ecosystems.

Accordingly, and to classify the papers, eight management areas have been identified and considered as *broad ecosystem types*, as shown in Table 1. The table also depicts the *specific ecosystems* whose services have been object of valuation within each ecosystem type, and the management area which the papers within each type want to contribute to:

[1] http://www.oceaneconomics.org/nonmarket (accessed from September 7th to September 21st, 2015).

[2] Torres and Hanley [8] report this information in tables which, for each paper, also depict the Millenium Ecosystem Assessment (MEA, 2005)'s category/ies to which the ES being valued belong to (i.e. supporting, provisioning, regulating and cultural services), the estimation technique/s used and the year the monetary values refer to.

Table 1. Ecosystem types and management areas

BROAD ECOSYSTEM TYPES		SPECIFIC ECOSYSTEMS	MANAGEMENT AREAS
Coastal ecosystems	Wetlands	Wetlands, mangroves, marshes and swamps	Wetland management
	Beaches	Beaches	Beach management
	Coastal areas	Coastal protected natural areas, capes, peninsulas and barrier islands	Coastal area management
	Inland and transitional waters	Rivers, streams, canals, lakes, reservoirs, deltas, estuaries and catchments	River basin management
Marine ecosystems	Coastal waters	Bays, gulfs, sounds, fiords, inland seas and sea waters near the coast	Coastal water management
	Coral reefs	Coastal coral reefs	Coral reef management
	Deep sea/open ocean	Deep sea/open ocean (including cold-water corals)	Deep-sea waters protection
	Marine protected areas	Marine conservation zones, marine parks, marine reserves, marine sanctuaries and marine critical habitat units	MPA policy design[a]

[a] Key: MPA, marine protected area.

A ninth ecosystem type called "Coastal and marine ecosystems" has also been considered to include papers which either value ES provided by more than one of the broad ecosystem types or don't make any reference to any specific ecosystem category and just refer to 'marine and coastal ecosystems'.

3. EV of coastal and marine ecosystem services: an overview from a management perspective

In total, 196 papers have been reviewed, which can be viewed as representative of the valuation work that has been undertaken over the 21st century in marine and coastal settings.

3.1 Management interests and publication patterns

Excluding the papers classified within the ninth ecosystem type (10), the number of papers focusing on the valuation of services provided by coastal ecosystems is higher than that dealing with the valuation of marine ecosystem services (100>86), as shown in Table 2. However, this difference can be explained by the fact that coastal ecosystems include more ecosystems providing services which people are more familiar with, compared to marine ecosystems some of which providing services which are very unfamiliar to individuals (e.g. deep sea). In fact, Table 2 shows that the management of coastal ecosystems such as beaches and wetlands has captured the same attention among valuation researchers as the management of marine ecosystems such as coastal waters and MPAs.

Table 2. Number of papers reviewed by broad ecosystem type

***BROAD* ECOSYSTEM TYPES**	**# Papers**
Coastal ecosystems	***100***
Wetlands	30
Beaches	40
Coastal areas	8
Inland and transitional waters	22
Marine ecosystems	***86***
Coastal waters	37
Coral reefs	11
Deep sea	2
Marine protected areas	36
Coastal and marine ecosystems	***10***
# Papers	**186**

Over the last 16 years, valuation researchers have been particularly interested in contributing to the management of beaches, coastal waters, MPAs and wetlands. However, half of the MPA studies focus on protection of coral reefs due to their features of uniqueness and national importance [9–11]. Thus, protection of coral reefs through establishment of either MPAs or other conservation tools also seems to have attracted the attention of researchers.

In the context of coastal ecosystems, and unlike wetland valuation, the interest in undertaking valuation studies to contribute to the management of beaches and other coastal habitats has been especially high in the last years [12–14]. This publication pattern has also been found for papers valuing services provided by inland and transitional waters, as almost half of them have been published during the last five years [15–17]. It is expected that the number of studies focusing on this type of ecosystem will increase in the next years if economic valuation and environmental cost-benefit analysis are going to play a role in integrated river basin management.

The interest in valuing services provided by marine ecosystems has also been growing over the last 16 years. The majority of papers focusing on services offered by coastal waters, coral reefs and MPAs have been published during the last decade [6,18–22]. This is especially true when it comes to valuation papers around deep-sea services, which have emerged in very recent years likely, due to the lack of familiarity of most of people with these services, the relative lack of scientific evidence linking ecosystem function to ES provision, and hence the difficulty of their valuation [23,24].[3]

3.2 Coastal and marine ecosystem services and values

Researchers have mainly focused on valuing cultural services provided by coastal and marine ecosystems. This is especially true for papers focusing on beaches and other coastal areas, inland and transitional waters, coastal waters, coral reefs and MPAs, where valuation of their recreational opportunities has captured a major attention among researchers [16,25–29]. Exceptions are the papers focusing on wetlands, mostly centred on valuing their regulating functions and the provisioning services of mangroves; and the deep sea, mainly valuing its biodiversity and provisioning services for the fishing sector [23,24,30].

Studies show the high recreational benefits associated with coastal and marine ecosystems as well as the positive correlation between these benefits and the environmental quality can provide an economic justification for implementing conservation strategies [31]. This is of especial relevance in nature-based tourism destinations where the recreational opportunities offered by these ecosystems are at the core of their tourism product [32,33]. More importantly, the studies show the economic justification for protection can be sounder if the non-use values recreationists usually attach to the cultural services are also considered. In fact, the papers give evidence that non-users show a high, positive willingness-to-pay (WTP) for the conservation of coastal and marine ecosystems. Accordingly, the inclusion of option and non-use values in policy assessments is considered essential for their sustainable management [5,34,35].

3.3 Scope for EV to be used in coastal and marine ecosystem management

Many management settings can greatly benefit from the information contained in WTP estimates. The design of MPAs and marine conservation zone networks, erosion prevention and land conservation programs, biodiversity preservation strategies, and maritime and fishing heritage conservation plans as well as fisheries management and the assessment of natural resource damage and energy development projects are only some examples [14,27,36–41]. Destinations whose coastal and marine ecosystems attract a high number of visitors can also make use of the money values of ecosystem services (ES) to increase the efficiency of tourism planning processes [42]. In this context, economic valuation (EV) can

[3] See Torres and Hanley [8] for a description of the full bibliography and a classification of papers by journal and ecosystem type.

also contribute not only to examine the appropriateness of charging visitors to help finance coastal and marine ecosystem policies but also to design the proper user fee or tourist tax [43,44].

EV has also been proved to play an important role in the implementation of European legislation which increasingly calls for a balancing of benefits and costs of regulations. Studies focusing on the valuation of services provided by inland and transitional waters can contribute to design preservation strategies in the framework of the integrated river basin management plans required by the Water Framework Directive (WFD, 2000/60/EC). They can provide policy-makers with information about the benefits of achieving 'good ecological status' for the waters of the member states, thus giving guidance on the social desirability of alternative options and the potential disproportionality of some of them [45,46]. Valuation of wetland services can also contribute to design policies built on the principles of the WFD as "wetlands are considered as part of a cost-effective programme of measures in integrated river basin management plans to improve water quality" [47]. In addition, valuation of the services provided by beaches can also provide useful information for policy makers interested in further improving water quality to meet the standards required by the Bathing Waters Directive (2006/7/EC), or in deciding to de-designate sites where costs of meeting these higher standards greatly exceed benefits [3,48]. A contribution to the implementation of the Marine Strategy Framework Directive (MSFD, 2008/56/EC) and the Marine Spatial Planning Directive (2014/89/EU) can also be made by papers valuing services provided by coastal and marine ecosystems [49].

In many low income economies coastal and marine resources provide important livelihood benefits to local communities. Thus, results from valuation studies showing changes in the distribution of income from coastal and marine ES, "especially the share accruing to poor communities", can serve to show how managing sustainably coastal and marine ecosystems can contribute to reducing poverty [50]. Such studies can show the importance of cultural services compared to other direct and indirect use ES, suggesting actions involving "short-term sacrifices" to improve ecological conditions may be more acceptable to the local community than previous research suggests. Information on bequest values can help to ensure long-term ecological and socio-cultural sustainability as well as improve livelihoods through encouraging resource stewardship [51].

WTP values can also give guidance on whether local communities should continue with damaging extractive resource uses or, in contrast, should pursue their protection through different conservation practices [52]. In this context, valuation can help to design compensation mechanisms (e.g. Payment for Ecosystem Services) for local communities to contribute to a more sustainable use of their resources and/or motivate locals to attract nature-based tourists as a way to capture greater benefits from their management [53,54]. EV can also increase awareness of the value of local resources, which is crucial to ensure their sustainability [55].

Both in developing and developed country settings, EV information can facilitate the "transition to an ecosystem-based management by providing both an economic justification and a decision-making framework for prioritizing management actions" [56].

4. Barriers to more effective use of EV in coastal and marine ecosystem management

The literature review reveals that extra effort in two areas is required to increase the use of economic valuation (EV) in actual management of coastal and marine ecosystems. On the one side, there is a need for estimating non-use values which, due to their multidimensionality, are viewed as a priority area for further research for EV to better contribute to preserving coastal and marine ecosystems [57]. On the other one, more efforts in intra- and inter-disciplinary cooperation across researchers is also essential.

Indeed, there is a need to strengthen intra-disciplinary cooperation allowing for the development of more primary and high-quality valuation studies to raise the possibilities of using benefit transfer (BT) approaches and hence better respond to the growing political demand of ecosystem services (ES) values [30,47,58,59]. A larger sample of available site-specific studies would increase the accuracy and applicability of meta-analysis results and improve the reliability of welfare estimates [60]. BT can help

solve the problems of too little time and/or too little budget to perform original studies, and this is of particular interest in the context of tight time schedules imposed by the Water Framework Directive (WFD, 2000/60/EC) on member states to develop integrated river basin management plans [46,61]. This type of cooperation should go beyond a country's boundary and also involve researchers from different countries, as this can also benefit meta-analyses through provision of more precise and comparable descriptions of the valuation scenarios. In addition, it can provide incentives for "the design of supranational common environmental policies aimed at collecting damage claims" [62] via replication of studies focusing on EU-wide environmental damages.

Efforts should also be made in strengthening inter-disciplinary work with natural scientists. This work is critical to adopt the integrated natural and social science approach being necessary not only to ensure ecosystem sustainability but also to increase the acceptance among the scientific community of the role of EV in decision-making. In this sense, ecological knowledge can help economists to model the specific threats faced by coastal and marine ecosystems providing, among others, information about environmental uncertainties and biophysical factors which are essential to identify areas of protection in efficient conservation planning [30,63,64]. It can also increase the ecological understanding of the co-provision or conflicting provision of different ES, thus allowing for understanding of how ES are generated by biophysical functions and processes [47]. Collaborating with natural scientists can then contribute to a better measurement of the economic values associated with the multiple, interdependent services provided by coastal and marine ecosystems and help economists to refine their methods to reflect the ecological reality of any valuation scenario [65]. Besides, it can increase both understanding about the welfare implications of biodiversity loss [66] and public awareness regarding the benefits of deep-sea protection [5,24]. In this context, it is worth noting that economic analysis can also valuably contribute to conservation science by giving evidence of the social demand for biodiversity protection which, in turn, reinforces scientific support for conservation [41]. In addition, the integration of human patterns of activity with existing ecological information can serve to identify pressures on the marine environment by highlighting areas of high levels of activity on sensitive environments [67].

Strengthening inter-disciplinary work with political scientists is also essential to increase the validity of EV and hence its influence in decision-making. In this sense, further work should be done in exploring the potential of EV to complement rather than substitute more participatory approaches to coastal and marine ecosystem governance. Despite environmental cost-benefit analysis highlighting the nature of the benefits and costs accruing to different groups, it has been challenged in terms of concerns around rights, fairness and the need for stakeholder engagement and deliberation [68,69]. Also, despite it providing a valuable framework for interpreting biophysical findings of environmental impact assessments in economic welfare terms [70], its single-criterion approach falls short when significant environmental and social impacts cannot be assigned monetary values [71,72]. Likewise, public participation in ecosystem decision-making processes, which is viewed as crucial to ensure broad support for the implementation of management strategies [73–76], is also beyond the scope of EV.

Further work in these areas should not overlook the specificities inherent in developing country settings, where many local communities might be unfamiliar with paying for the resource usage. In this context, some studies state the importance of modifying the design and procedure of valuations to better suit the context of community relationships and kinship [77].

It is worth noting that important challenges remain for the methods used in environmental valuation. First, understanding and conserving marine biodiversity [41]. Second, the lack of information and knowledge regarding the benefits of deep-sea protection [5,24]. Network research and outreach and education campaigns can help to overcome these two challenges as they can play a role in creating a larger willingness-to-pay, thus enhancing the influence of valuation on policy assessments [66,78]. They can also contribute, together with a major participation of governments, to overcome the major challenges faced by EV in developing country settings: the lack of data and expert opinion, the low scientific understanding and education, the lack of funding and the lack of trust in institutions

[51,53,79,80].Thus, cooperation across the different actors involved in the management of coastal and marine ecosystems becomes, again, essential to overcome the major EV challenges.

5. Concluding remarks

Communicating ecosystem service (ES) valuation research can help respond to the needs of policy makers interested in applying economic valuation (EV) in coastal and marine management, thus contributing to making the most of its potential to contribute to policy formation and environmental management. This paper has provided a comprehensive overview of the knowledge base regarding the economic values for coastal and marine ecosystems. It focussed on two aspects which are thought to be essential for an effective communication and hence for better raising the possibilities of EV to get used in actual management of coastal and marine resources.

Firstly, the paper has communicated *what has been done* in EV of coastal and marine ES over the last 16 years placing emphasis on the analysis of the policy implications of the existing studies. The role EV can play in different management settings has been discussed and proved to facilitate the transition to an ecosystem-based management both in developed and developing countries. Secondly, the paper has communicated *what is needed* in valuation research to increase the influence of EV on actual decision-making and hence help to ensure ecosystem sustainability concluding that cooperation among social, natural and political scientists concerned with management of coastal and marine resources is crucial. Importantly, the paper has emphasized the need for cooperation not only to involve inter-disciplinary work but also *intra-disciplinary collaboration* across valuation researchers. The lack of correspondence between the growing number of studies focusing on valuing coastal and marine ES and their scarce use in actual management deserves a reflection within the discipline. While collaboration with other research fields is essential to improve the valuation work and increase its acceptance by the scientific community, valuation practitioners should wonder if they are sufficiently cooperating with other researchers in the field to make their work more policy relevant. Inadequate cooperation between valuation researchers can help to explain the low influence of EV on actual management as, among others, it restricts the possibilities of using benefit transfer approaches and hence makes difficult respond to the needs of policy makers which increasingly demand consistent and reliable ES values.

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