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Economic valuation of coastal and marine ecosystem services in the 21stcentury: an overview from a management perspective

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Why this report?

The design of local and national strategies and the need for international cooperation to ensure the sustainability of coastal and marine ecosystems are of high priority. To this aim, the European Union (EU) has developed a series of Directives serving as a framework for EU water policy to give guidance to the member states on the protection of surface and ground waters, and of marine environments.

Economic valuation (EV) and environmental cost-benefit analysis (ECBA) are key tools in this regard as they can provide information about the social benefits and costs of alternative policies, thus allowing for their prioritization and hence helping increase the economic efficiency of coastal and marine decision-making processes.

The use of EV/ECBA is of especial relevance in a context in which environmental policies increasingly call for a balancing of the benefits and costs of regulations

This report aims to provide, through an extensive review of the literature, a comprehensive overview of the current (2015) knowledge base regarding the valuation of coastal and marine ecosystem services (ES), placing emphasis on the analysis of both the policy implications of current studies as well as on existing challenges.

It aims to contribute not only to the role EV/ECBA can play in the management of coastal and marine ecosystems, but also to promote discussion among social and ecological researchers about further research needs.

Serve as a basis to build a common language between social and ecological sciences

The approach used in this report is outlined below:

- ✓ **LITERATURE SOURCES/** The main source for the review has been the **NATIONAL OCEAN ECONOMICS PROGRAM/MIDDLEBURY INSTITUTE OF INTERNATIONAL STUDIES AT MONTEREY DATABASE**, from which only peer-reviewed papers published between 2000 and 2015 whose primary objective is the valuation of coastal and marine ES have been considered:

  - **196 studies have been examined.**
  - **The papers have been published in journals interested in ecological and management aspects in coastal and marine settings (155) and in natural resource and environmental issues involving the development of valuation methods and their applications to new data sets (41).**

- ✓ **PAPER CLASSIFICATION/** The papers have been classified into **EIGHT** coastal and marine ecosystem categories resulting from both the consideration of the major management concerns among valuation researchers and the classification of aquatic ecosystems made by the Water Framework Directive (2000/60/EC). The studies which either value ES provided by more than one of these ecosystem categories or do not make any reference

to any specific ecosystem type have been classified into an ecosystem category called "Coastal and marine ecosystems" (Figure I):

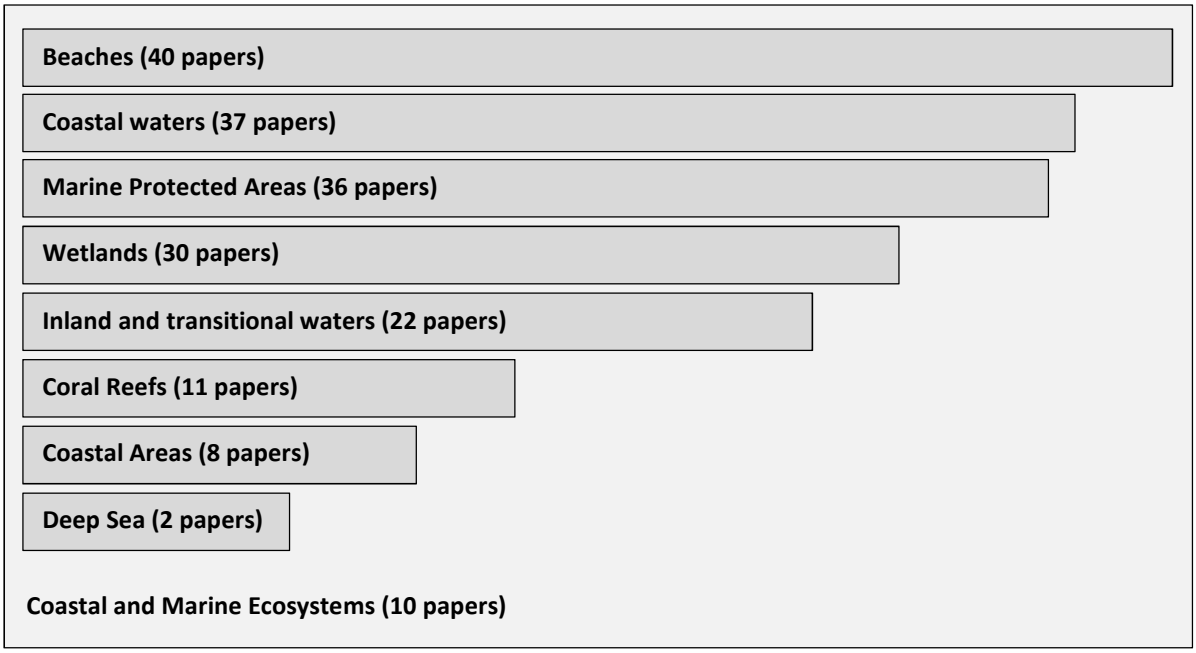

Figure I. Coastal and marine ecosystem categories considered in order to classify the papers reviewed.

- ✓ **PAPER INFORMATION/** The papers have been analysed according to their study object, the ES being valued, the types of values being estimated, their main outcomes and policy implications. The most important research needs as well as the major challenges stated by the authors have also been examined.

- ✓ **ANALYSIS LAYOUT/** For each ecosystem category, a table reports the list of reviewed papers depicting the above-mentioned information together with the Millenium Ecosystem Assessment category/ies to which the ES being valued belong to, the estimation technique/s used and the year the monetary values refer to. Figure II shows, for the case of wetlands, how the analysis of the papers is laid out:

Figure II. Layout of the analysis of wetland valuation papers.

What are the main conclusions in the report?

- ✓ **MANAGEMENT INTERESTS/** Valuation researchers have been especially interested in contributing to the management of beaches, coastal waters, marine protected areas (MPA), and wetlands. The interest in contributing to reef management has also been considerable (half of MPA papers focus on protected coral reefs areas).

- ✓ **PUBLICATION PATTERNS/** Unlike wetland valuation, the interest in contributing to the management of coastal and marine ecosystems has been especially high in recent years (the majority of papers have been published during the last decade). This is especially true for studies focusing on the valuation of services provided by inland and transitional waters, and the Deep Sea.

- ✓ **DEVELOPING COUNTRIES/** A considerable number of papers have focused on valuing services provided by wetlands, coral reefs and MPAs in developing country settings.

- ✓ **METHODS/** Very few, and mostly recent, studies have applied meta-analysis and/or benefit transfer (BT) approaches, especially in the context of wetland valuation. The methods commonly used to value the services provided by coastal and marine ecosystems are:

  - **Direct market approaches**
    (indirect and direct use values attached to regulating and provisioning ES, respectively).
  - **Revealed preference methods**
    (direct use values attached to cultural ES).
  - **Stated preference methods**
    (direct use values attached to provisioning and cultural ES; non-use values assigned to provisioning, regulating, and cultural ES as well as to biodiversity; indirect use values associated with supporting ES; and option values linked to provisioning and cultural ES).

- ✓ **ECOSYSTEM SERVICES**/ Researchers have mainly focused on valuing cultural ecosystem services, especially in the context of beaches and other coastal areas, inland, transitional and coastal waters, coral reefs and MPAs, placing emphasis on the recreational opportunities offered by these ecosystems. Exceptions are papers around valuation of both wetland and deep-sea services, which have mostly focused on regulating and provisioning ES, and provisioning and supporting ES, respectively.

- ✓ **USE VALUES**/ Most of papers have estimated direct use values, especially non-consumptive direct use values. Few studies (< 15%) have inferred option values, especially in the context of MPAs (almost 50%) and inland and transitional waters (20%).

- ✓ **NON-USE VALUES/** Many papers have estimated non-use values, especially in the framework of wetlands and coastal areas other than beaches, inland, transitional and coastal waters, Deep Sea, and MPAs. Existence and bequest values have been the non-use motivations capturing major attention among researchers, although cultural and cognitive values linked to both marine biodiversity and freshwater ecosystems, as well as altruistic values, have also been object of study in some papers.

- ✓ **OUTCOMES**/ Studies show both high recreational benefits associated with coastal and marine ecosystems and a positive correlation between these benefits and the ecosystem environmental quality, and high, positive willingness-to-pay (WTP) for coastal and marine ecosystem protection:

  - ➢ Resource users assign a mix of use and non-use values to coastal and marine ES.
  - ➢ **I**mportant non-use values are attached to coastal and marine ES, especially cultural services and biodiversity.

- ✓ **ECONOMIC JUSTIFICATION FOR CONSERVATION/** The high recreational benefits and their positive correlation with environmental quality provide an economic justification for implementing conservation strategies, which can be sounder if the non-use values users and non-users attach to cultural services and biodiversity are also considered.

- ✓ **EV/ECBA ROLE IN COASTAL AND MARINE MANAGEMENT/** Many management settings can benefit from the information contained in WTP estimates. Additionally, EV/ECBA provides useful information for policy makers in developing country settings (Table I):

Table I. Coastal and marine management settings benefiting from WTP estimates

MANAGEMENT SETTINGS
• Design of MPAs and marine conservation zone networks. • Design of erosion prevention and land conservation programs. • Design of biodiversity preservation strategies. • Design of maritime and fishing heritage conservation plans. • Fisheries management. • Natural resource damage assessment • Evaluation of energy development projects. • Assessment of beach nourishment policies. • Evaluation of wetland mitigation strategies. • Tourism planning processes. • Analysis of establishment of fee/tax mechanisms (appropriateness, design of fees/taxes, etc.) • Implementation of EU legislation (Water Framework Directive, Bathing Waters Directive, Marine Spatial Framework Directive, Marine Spatial Planning Directive).
EV/ECBA ROLE IN DEVELOPING COUNTRY SETTINGS:
• Show the role of sustainable marine ecosystem management in achieving poverty reduction goals. • Ensure long-term ecological and socio-cultural sustainability as well as improve livelihoods. • Give guidance on whether local communities should continue with damaging extractive resource uses or, in contrast, should pursue their protection. • Design compensation mechanisms for local communities to contribute to a more sustainable use of coastal and marine resources. • Motivate locals to attract nature-based tourists to capture greater benefits from the management of their resources. • Increase public awareness of the value of local resources.

What else do we learn from this report?

- ✓ **TRANSITION TOWARDS ECOSYSTEM-BASED MANAGEMENT**/ Both in developing and developed countries, valuation information can facilitate the transition towards a more ecosystem-based management by providing an economic justification of conservation policies and a decision-making framework for prioritizing management actions.

- ✓ **FURTHER RESEARCH NEEDS**/ Further research is needed on some areas for EV/ECBA to better contribute to preserve coastal and marine ecosystems. Table II shows the main areas for future work identified in the literature and explains why they are relevant to increase the use and influence of the method in ecosystem management:

Table II. Main research needs and their relevance from a management perspective.

RESEARCH NEEDS
i. Conducting more studies estimating non-use values.
Policy relevance • Multidimensionality of non-use values. • Importance of non-use values for the sustainable management of coastal and marine resources.
ii. Undertaking more primary and high quality valuation studies.
Policy relevance • Extend the possibilities of using BT and better respond to the growing political demand of ES values. • BT allows overcoming time and/or budget problems to perform original studies, which is relevant in the context of tight time schedules imposed by the Water Framework Directive on member states to develop integrated river basin management plans.
iii. Increasing intra-disciplinary cooperation across countries.
Policy relevance • Benefits meta-analyses through more precise and comparable descriptions of the valuation scenarios. • Enhances the role of EV/ECBA in the management of EU-wide environmental damages through replication of studies focusing on them, which can incentivize institutional innovations in the EU governance based on designing supranational common policies aimed at enabling damage claims.
iv. Promoting network research and inter-disciplinary work with natural scientists.
Policy relevance • Contributes to model threats faced by coastal and marine ecosystems and provides information about biophysical factors, essential to identify areas of protection. • Increases the ecological understanding of the co-provision or trade-offs of different ES, essential to understand how ES are generated by biophysical functions and processes. • Gives information about existing environmental uncertainties, essential to examine how this information can affect values of coastal and marine ecosystem protection. • Allows a better measurement of the values associated with the multiple, interdependent services provided by coastal and marine ecosystems. • Helps economists refine their methods to reflect the ecological reality of any valuation scenario. • Helps to define feasible approaches to estimate the value of marine biodiversity. • Increases public awareness regarding the benefits of biodiversity and deep-sea protection. • Is critical to adopt an integrated natural and social science approach, which can increase the acceptance among the scientific community of the role of economic valuation in decision-making.
v. Examining the potential of EV/ECBA to complement more participatory approaches.
Policy relevance • Increases the validity of EV/ECBA and hence its influence in decision-making as public is crucial to ensure broad support for management strategies and hence their success.
vi. Modifying the design and procedure of valuations in poor-community settings.
Policy relevance • Suits the context of community relationships and kinship, thus helping increase the EV/ECBA use.

- ✓ **CHALLENGES**/ Important challenges still remain for EV/ECBA, from which the following ones are of special concern:

  - **Understanding and valuing marine biodiversity.**
  - **The lack of information and knowledge regarding deep-sea protection benefits.**
  - **In a developing country setting, the lack of data/expert opinion, low scientific understanding/education, lack of funding and lack of trust in institutions.**

- ✓ **WHAT'S NEXT/** Network research and outreach and education campaigns, together with a major participation of governments, especially in developing countries, can serve to overcome the existing challenges. In other words, **COOPERATION** across the different actors involved in the management of coastal and marine ecosystems represents a key issue to both increase the use and influence of valuation in decision-making and overcome the major economic valuation challenges.

Cooperation, and claim for poverty elimination and legal recognition of the rights of local communities should be of high priority for the scientific community if coastal and marine ecosystems are to be sustainably managed in the future.

1. INTRODUCTION

Coastal and marine ecosystems provide many important services to society. Yet they are also subject to continuous anthropogenic impacts which are likely to be intensified by climate change (Waycott et al., 2009). Thus, as long claimed by the scientific community, both the design of local and national strategies and the need for international cooperation aimed at preserving these ecosystems are of high priority.

The European Union (EU) water policy serves as a basis for the development of such strategies. Indeed, the EU has developed a series of Directives serving as a framework for the EU water policy which aim to give guidance to the member states on the protection of inland, transitional, coastal and ground waters, and of marine environments. In this sense, the Water Framework Directive (WFD, 2000/60/EC) introduced a new legislative approach to managing and protecting water based on river basins, that is, one based on natural geographical and hydrological formations instead of on national or political boundaries. The WFD establishes integrated river basin management as the best strategy to achieve good status of water, and provides a framework for the protection of surface waters and groundwaters. The WFD is complemented by other legislation regulating specific aspects of water use, such as the Groundwater Directive (2006/118/EC), the Environmental Quality Standards Directive (2008/105/EC) and the new Bathing Water Directive (2006/7/EC), as well as by legislation expanding the scope of integrated water management such as the Floods Directive (2007/60/EC) and the Marine Strategy Framework Directive (2008/56/EC).[1]

In this context, the development of decision-making tools which can help to assess the trade-offs and synergies inherent in ecosystem-based management of marine and coastal environments can play an important role. Economic valuation (EV) and Environmental Cost-Benefit Analysis (ECBA) are key methods in this regard. They can provide decision makers with information about the social benefits and costs associated with alternative management practices, thus contributing to measurement of social profitability.

Consequently, they allow policy makers to prioritize policies, thus helping to make the decision-making process more economically efficient. This is of special relevance in a framework where environmental policies increasingly call for a balancing of benefits and costs of regulations, as required by regulatory impact assessments. In fact, as shown in this report, there is recent experience in the UK of using EV/ECBA to assess the value of potential marine protected areas (MPA). Likewise, consideration of EV issues has been important in the implementation of EU directives such as the EU Marine Strategy Framework Directive and the EU Marine Spatial Planning Directive.

[1] http://ec.europa.eu/environment/pubs/pdf/factsheets/water-framework-directive.pdf

This report aims to provide, through an extensive review of the literature, a comprehensive overview of the knowledge base regarding the valuation of coastal and marine ecosystem services (ES), placing emphasis on the analysis of both the policy implications of current studies as well as existing challenges. We aim to contribute not only to the role that economic valuation can play in the management of these ecosystems, but also to promote discussion among social and ecological researchers about further research needs. The report aims to serve as a basis to build a common language which is crucial to improve the sustainability of natural resources.

The report is structured as follows. In the next section, the methodology followed to provide the overview of the knowledge base regarding valuation of coastal and marine ES is explained. So the literature sources employed and the process followed to classify and analyze the papers are described in detail. Section 3 examines the existing studies by ecosystem type. A conclusion section ends the report.

2. METHODOLOGY

To provide a comprehensive overview of the knowledge base regarding valuation of coastal and marine ecosystem services (ES), an extensive literature review has been undertaken. The literature sources employed, the criteria followed to classify the papers and the issues analyzed from each paper are detailed in the following sections.

2.1 Literature sources

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 (Hanley et al., 2015). This report uses the National Ocean Economics Program/Middlebury Institute of International Studies at Monterey (NOEP) database[2] as the main source for the literature review. The criteria selected to obtain the list of papers have been 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 (avoided cost method, benefit transfer method, calibrated models and conjoint analysis , choice experiments , contingent valuation menthod , damage assessment model, discrete choice, expenditure analysis, productivity method, random utility model , referendum method, and travel cost method), iv) being original or undertaking meta-analyses, v) estimating any type of non-use value (option, existence, bequest), vi) valuing any type of relevant natural capital asset (bay/gulf/sound, beaches, biodiversity, climate change, coastal land values, coastal wetlands, ecosystem and environmental services, estuaries, fisheries, lakes, mangroves, marine protected areas, non-use values, reefs, rivers, water quality, watershed, and wildlife), and vii) focusing on any type of recreational activity (boating, general beach recreation, hunting, recreational fishing, scuba diving, snorkeling, surfing, swimming, and wildlife viewing).

From the resulting list of papers, two types of journals where these have been published have been identified. The first type of journals relates to journals which are interested in publishing work related to specific natural resource and environmental issues, for which further development of valuation methods and their novel applications to new data sets is one of the issues of concern. These journals are “Agricultural and Resource Economics Review”, “Australian Journal of Agricultural and Resource Economics”, “Environment and Development Economics”, “Environmental and Resource Economics”, “Journal of Environmental Economics and Management”, “Land Economics” and “Resource and Energy Economics”. As the NOEP database didn’t display papers published during the last years by

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

some of these journals at the time the database was used, these journals were accessed directly to complete the review until 2015. This led to add some more papers to the list displayed by the NOEP database. Additionally, the articles published between 2000 and 2015 in journals which are also considered relevant within this type of journals were also reviewed and added to the list if they focused on valuing coastal and marine ES. These journals are "American Journal of Agricultural Economics", "European Review of Agricultural Economics" and "Journal of Agricultural Economics".

The second type corresponds to journals interested in publishing work around both ecological and management issues in coastal and marine settings. These journals are "AMBIO", "Biological Conservation", "Bioscience", "Coastal Management", "Contemporary Economic Policy", "Conservation Biology", "Ecological Economics", "Ecological Engineering", "Ecosystem Services", "Environmental Management", "Estuarine, Coastal and Shelf Science", "Fisheries Management and Ecology", "Fisheries Research", "Journal of Coastal Research", "Journal of Environmental Management", "Journal of Marine Systems", "Landscape and Urban Planning", "Marine Policy", "Marine Pollution Bulletin", "Marine Resource Economics", "Ocean and Coastal Management", "Water Resources Research".

Most of the reviewed papers have as a primary objective the valuation of goods and services provided by coastal and marine ecosystems. Valuation papers whose major concern is to test methodological hypotheses through case studies framed in coastal and marine settings have been excluded with the exception of some methodological articles which have been thought to have interesting policy implications in coastal and marine contexts.

2.2 Paper classification: ecosystem types

To better contribute to the analysis of the role of economic valuation in coastal and marine ecosystem decision-making, and to build a bridge between the economic and ecological research fields, 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) which establishes integrated river basin management as the best strategy to achieve good status of water.

On the one side, a review of the valuation literature has allowed us to identify eight broad management areas to which valuation research makes a contribution. These areas are wetland management, beach management, coastal area management, freshwater resource management, coastal water management, coral reef management, marine protected area (MPA) policy design, and strategies to protect the Deep Sea/Open Ocean. Alternatively, the

WFD establishes a framework for the protection of inland surface, transitional, coastal and ground waters. In other words, it states that "an effective and coherent water policy must take account of the vulnerability of aquatic ecosystems located near the coast and estuaries or in gulfs or relatively closed seas, as their equilibrium is strongly influenced by the quality of inland waters flowing into them" (Directive 2000/60/EC). In this sense, surface waters can be classified into two different types of aquatic ecosystems: freshwater and marine ecosystems. In particular, inland waters (standing or flowing), which include rivers, streams, canals, lakes and reservoirs are freshwater ecosystems, while coastal waters are marine ecosystems. Transitional waters, which include estuaries and deltas, involve a mix of freshwater and marine ecosystems as they "are bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but which are substantially influenced by freshwater flows" (Directive 2000/60/EC).

According to this, **eight** management areas have been considered: wetland management, beach management, coastal area management, inland and transitional water management, coastal water management, coral reef management, MPA policy design, and strategies to protect the Deep Sea/Open Ocean. These areas have led us to take into account the following ecosystem types to classify the valuation papers:

1) "**Wetlands**" (coastal ecosystems), which includes papers dealing with the valuation of ES provided by wetlands, mangroves, marshes and swamps, and its contribution to wetland management.
2) "**Beaches**" (coastal ecosystems), which includes papers dealing with the valuation of ES provided by beaches, and its contribution to beach management.
3) "**Coastal areas**" (coastal ecoystems), which includes papers dealing with the valuation of ES provided by coastal habitats different from wetlands and beaches, such as coastal protected natural areas, capes, peninsulas and barrier islands , and its contribution to coastal area management.
4) "**Inland and transitional waters**" (coastal ecoystems), which includes papers valuing ES provided by rivers, streams, canals, lakes, reservoirs, deltas, estuaries and catchments, and its contribution to river basin management.
5) "**Coastal waters**" (marine ecosystems), which includes papers dealing with the valuation of ES provided by bays, gulfs, sounds, fiords, inland seas and sea waters near the coast, and its contribution to coastal water management.
6) "**Coral reefs**" (marine ecosystems), which includes papers dealing with the valuation of ES provided by coastal coastal coral reefs, and its contribution to coral reef management.

7) "**Deep Sea/Open Ocean**" (marine ecosystems), which includes papers dealing with the valuation of ES provided by the Deep Sea/ Open Ocean, and its contribution to the design of strategies aimed at protecting deep-sea waters.

8) "**Marine protected areas**" (marine ecosystems), which includes papers dealing with the valuation of ES provided by marine conservation zones (MCZ), marine parks, marine reserves, marine sanctuaries, marine critical habitat units (CHU), and its contribution to MPA policy design.

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

2.3 Paper information: issues of interest

For each type of ecosystem, the papers have been analyzed according to their study object, the ecosystem service (ES) being valued, the types of values being estimated, their main outcomes and policy implications. Additionally, the most important research needs as well as the major overcoming challenges stated by the authors have been examined. This information is reported in a table which, for each paper, also depicts, in parenthesis, the Millenium Ecosystem Assessment (MEA) category/ies to which the ES being valued belong to, the estimation technique/s used and the year the monetary values refer to.

As the widely accepted framework proposed by the MEA report is followed to classify the ES, four ES categories have been considered: provisioning services, involving the products obtained from ecosystems (e.g. food, water); regulating services, which are the benefits obtained from regulation functions of ecosystems (e.g. climate regulation, water purification); cultural services, which are non-material benefits obtained from ecosystems (e.g. recreational benefits, cultural heritage); and supporting services, which are intermediate ES acting as inputs to the production of the three final ES (MEA, 2005).

Most of the papers published after 2005 do not indicate whether the ES being valued are provisioning, regulating or cultural services, and very few studies indicate they value supporting services. This is reasonable since it is difficult to determine whether individuals really express a value for supporting services when they are asked for their willingness-to-pay (WTP) to preserve them. In fact, supporting services are usually valued through the other ES categories. Accordingly, the ES category/ies reported in the tables for most of the papers, which do not indicate the type of MEA ES being valued, has/have been assumed to be provisioning, regulating and/or cultural unless the papers clearly indicate they value some intermediate ES, in which case it has been assumed supporting services have also been

object of valuation. Indeed, the ES category/ies has/have been determined according to the information provided about the study object, the specific ES being valued, the technique/s used to estimate the values, and the sample of surveyed individuals (recreational visitors, tourists, residents, etc.).

Regarding the type of values being estimated, these can be values of both current and future use of the resource as well as non-use values (e.g. existence, bequest, altruistic values). In particular, consumptive direct use values are attached to provisioning services; indirect use values to regulating; and non-consumptive direct use values to cultural services. Given they are intermediate ES which affect the provision of final ES, supporting services are usually assigned indirect use values. Option values, which are the values attached to having the option of using the resource in the future, are normally related to cultural services, although they can also be assigned to provisioning services. Non-use (or passive use) values refer to the satisfaction of knowing that either a species/ecosystem exists (existence value) or other people or future generations will have access to nature's benefit (altruistic and bequest value, respectively). These values are usually attached to cultural services, to which individuals tend to assign a mix of use and non-use values, although they can be considered for provisioning and regulating services too. It is also common to express non-use values for biodiversity/habitat, which helps to explain why some authors attach non-use values to supporting services. In fact, some authors have demonstrated it is not easy to disentangle the values people attach to specific organisms (e.g. cold-water coral) due to its role as habitat for other species (e.g. fish), compared to any pure existence motivation for value (Aanesen et al., 2015).

Many of the reviewed studies do not indicate the type of values that have been estimated. In these cases, information about the study object, the ES being valued, the technique/s used to estimate the values, the sample of surveyed individuals, the attributes used in the valuation exercise and/or the follow-up questions/analyses pursuing to explain the WTP of individuals has been used to classify the type of values being estimated. In particular, and to determine if non-use values have been estimated, two criteria have been considered simultaneously: 1) look if the authors use a stated preference (SP) technique, as SP methods allow for estimation of non-use values; and, if so, 2) examine if biodiversity/habitat has also been valued through one or more attributes and/or if the follow-up questions show that the WTP is driven by non-use value motivations (e.g. environmental awareness/attitudes, altruism, ethics). Using habitat/biodiversity attributes to elicit the value of final ES might indicate individuals assign a mix of use and non-use values to these services as a focus on habitat/biodiversity issues implicitly suggests protection values, of which non-use values are a core element, are at stake (Marre et al., 2015; Rolfe and Windle, 2012a). Thus, users of ES can also assign non-use values to them provided a SP method has been used for estimation

purposes. In case of papers which only estimate non-use values, no ES category has been reported in the tables.

Only some monetary outcomes have been presented for those papers reviewed to give an idea of the economic importance attached to the object of valuation. It is recommended to access each paper for details regarding the different monetary values that have been estimated and the techniques used for estimation purposes. Currencies are reported in parenthesis when indicated in the studies. However, when this information is not given in the studies, some assumptions could be made. Indeed, for the papers applying both stated and revealed preference methods but hedonic analysis, it could be assumed the monetary values correspond to prices of the year in which the valuation study has been undertaken. In these cases, the year of the data collection is reported in parenthesis. If the survey has been undertaken within a period involving more than one year, this period is indicated. For the papers applying both hedonic analysis and direct market approaches such as cost-based and production function approaches, information about the years which the data used have been published in is also reported in parenthesis.

3. ANALYSIS OF VALUATION STUDIES

This section shows a classification of the papers by journal and ecosystem type and analyzes the existing studies within each ecosystem category.

3.1 Classification by journal and ecosystem type

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. Table 1 classifies the reviewed papers by journal and ecosystem type.

Table 1. Reviewed papers by journal and ecosystem type[a]

JOURNALS	ECOSYSTEM TYPES									
	T1	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**# Papers**
First type of journals										
Agricultural and Resource Economics Review	1				1					**2**
American Journal of Agricultural Economics		1								**1**
Australian Journal of Agricultural and Resource Economics				2	2			1		**5**
Environment and Development Economics	2							1		**3**
Environmental and Resource Economics	4	3		2	2			1		**12**
European Review of Agricultural Economics				1						**1**
Journal of Agricultural Economics		1						1		**2**
Journal of Environmental Economics and Management		1	1		1					**3**
Land Economics		2	1	1	3			1	1	**9**
Resource and Energy Economics				3						**3**
	7	***8***	***2***	***9***	***9***	***0***	***1***	***5***	***1***	***41***
Second type of journals										
AMBIO						1		1		**2**
Biological Conservation	1		1		1					**3**
Bioscience						1				**1**
Coastal Management		6		2	1			3		**12**
Contemporary Economic Policy	1	2		1						**4**
Conservation Biology	1									**1**
Ecological Economics	8	2		5	5	3	1	8	3	**35**
Ecological Engineering	1									**1**
Ecosystem Services	1	2						1	1	**5**
Environmental Management	2			1				1		**4**
Estuarine, Coastal and Shelf Science	1		1						1	**3**
Fisheries Management and Ecology					1					**1**
Fisheries Research					2			1		**3**
Journal of Coastal Research		1								**1**
Journal of Environmental Management	2	1	1	2	1	1		3		**11**
Journal of Marine Systems	1									**1**
Landscape and Urban Planning					1					**1**
Marine Policy		2	1		3		1	6	1	**14**
Marine Pollution Bulletin				1	1				2	**4**
Marine Resource Economics	1	8	1		12	2		1		**25**
Ocean and Coastal Management	3	7	1	1		3		6		**21**
Water Resources Research		1							1	**2**
	23	***32***	***6***	***13***	***28***	***11***	***2***	***31***	***9***	***155***
# Papers	**30**	**40**	**8**	**22**	**37**	**11**	**2**	**36**	**10**	**196**

[a] Key: T1, Wetlands; T2, Beaches; T3, Coastal areas; T4, Inland and transitional waters; T5, Coastal waters; T6, Coral reefs; T7, Deep Sea/Open Ocean; T8, Marine Protected Areas; T9, Coastal and marine ecosystems.

Looking at the ecosystem types, and excluding those papers classified within the ninth ecosystem category (T9), Table 1 shows that the number of papers focusing on the valuation of ecosystem services (ES) provided by coastal ecosystems is higher than that dealing with the valuation of marine ES. Indeed, there are more publications estimating the willingness-to-pay (WTP) for ES provided by wetlands, beaches, coastal areas and inland and transitional waters than those around ES provided by coastal waters, coral reefs, marine protected areas (MPA) and Deep Sea/Open Ocean (100>86). However, this difference is mainly driven by the fact that coastal ecosystems include more ecosystems providing services which people are more familiar with, compared to marine ecosystems where deep-sea services are, for instance, very unfamiliar to individuals. Indeed, if one looks at each ecosystem type, it can be observed that the management of some coastal ecosystems (beaches and wetlands) has captured the same attention among valuation researchers as the management of some marine ecosystems (coastal waters and MPAs).

From a journals perspective, it can be seen that most of the valuation papers (79%) have been published in the second type of journals, that is, in journals which are interested in publishing work around both ecological and management issues in coastal and marine settings rather than work related to further development of valuation methods and their applications to new data sets. In this sense, “Ecological Economics” (35), “Marine Resource Economics” (25) and “Ocean and Coastal Management” (21) are the journals which have published more work on valuation of coastal and marine ES over the last 16 years, followed by “Marine Policy” (14) and “Coastal Management” (12). In particular, almost half of the papers published in “Ecological Economics” revolve around wetland and MPA policy design issues (8 papers for each topic), while “Marine Resource Economics” has mainly published studies around coastal water and beach management issues (12 and 8 papers, respectively). Concerns about beach management have also been the focus of most papers published in “Ocean and Coastal Management” (7) and “Coastal Management” (6). In contrast, almost half of the “Marine Policy” papers deal with ES provided by MPAs (6), a topic which has also been of interest for “Ocean and Coastal Management” (6).

3.2 Wetlands

Economic valuation of the services provided by wetlands can contribute to a more efficient wetland management. In this context, a large number of studies (30) valuing services provided by wetlands have been published over the last 16 years. Wetlands play an important role in the implementation of European legislation such as the Water Framework Directive (WFD), where they “are considered as part of a cost-effective programme of measures in integrated river basin management plans to improve water quality” (Brander et al., 2013). In a developing country setting, economic valuation can also serve to give

guidance to policy makers to ensure sustainability of inland wetlands and coastal mangroves.

Table 2 reports a list of papers dealing with the valuation of services provided by wetlands, mangroves, marshes and swamps. Two papers valuing services provided by the Lagoon of Venice have also been included as this Lagoon is a "complex wetland coastal zone characterized by the presence of dynamic and open systems, involving terrestrial and aquatic, freshwater and marine ecosystems" (Nunes et al., 2008, 2004). The table presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As shown in Table 2, the interest in valuing services provided by wetlands has been constant over the last 16 years, although the use of meta-analyses has been quite recent. Indeed the majority of meta-analyses (4 out of 6) have been carried out since 2012 and mostly by the same author (Brander et al., 2013, 2012a, 2012b; Camacho-Valdez et al., 2013). Looking at primary valuation studies, the use of production function approaches is also considerable due to the interest in valuing the regulating services provided by wetlands (Barbier et al., 2002; Byström, 2000; Grossmann, 2012; Gunawardena and Rowan, 2005; Sathirithai and Barbier, 2001), although they can also be valued through stated preference (SP) methods. More than half of the studies estimate non-use values. Interestingly, among the primary valuation papers, a high number (11) have focused on valuing services provided by wetlands located in developing countries.

3.2.1 Ecosystem services and values

Looking at primary valuation studies (i.e. excluding meta-analyses) both regulating and cultural services have been valued in half of the papers (in 12 papers each), followed by provisioning services, which have been valued in 8 studies. Although this ES prioritization is kept when valuing goods and services provided by wetlands located in developed countries (regulating and cultural services valued in 7 papers each, and provisioning services valued in 3 studies), it changes when the study area is a developing country. In this latter case, regulating services appear as the services valued with a higher frequency (in 6 papers), followed by provisioning and supporting services (valued in 5 and 2 papers, respectively). This is reasonable since wetlands and mangroves in developing countries are an important source of resources for many local communities. In this context, cultural services have been valued a lower number of times (5). Despite the difference between the studies undertaken in both types of countries, it can be said that, on average, regulating and provisioning

services are the services provided by wetlands which have been mostly valued by researchers likely because they are the most important ones.

In this sense, the regulating services which have been valued in more papers have been the role of wetlands for nitrogen mitigation and their role for coastal protection and stabilization. Regarding provisioning services, those capturing major attention among researchers have been fisheries and the direct use of mangroves' forest resources by local communities. This latter service has only been valued in studies undertaken in less developed countries as they are usually found in tropical and sub-tropical regions. Bird watching represents the cultural service provided by wetlands which has been valued in more papers, followed by recreational fishing. The role of mangroves as a breeding ground or nursery for off-shore fisheries is the supporting service valued in the reviewed studies (Barbier et al., 2002; Sathirithai and Barbier, 2001).

In this context, more than half of the papers estimate non-use values, besides the direct and/or indirect use values associated to the final ES object of valuation (consumptive and non-consumptive direct use values in the case of provisioning and cultural services, respectively, and indirect use values in the case of regulating services). Note that indirect use values have also been estimated for the supporting service related to the role of mangroves in serving as a breeding ground or nursery for off-shore fisheries (Barbier et al., 2002; Sathirithai and Barbier, 2001).

Most of the papers estimating non-use values focus either on cultural services or on cultural services together with regulating and/or provisioning services. This is reasonable since non-use values are usually attached to cultural services. However, some papers dealing with provisioning and regulating services also estimate non-use values, as shown by Gunawardena and Rowan (2005) and Petrolia et al. (2014). As these latter use a wildlife habitat attribute, it is expected individuals also attach non-use values to these services. Similarly, Milon and Scrogin (2006) elicit non-use values for regulating services. They evaluate the effects of alternative ecological characterizations of wetland functions and services on individual preferences, where a functional characterization focuses "on spatial and temporal variations in water levels that influence the diversity of micro- and meso-habitats" and a structural description of restoration bases on "changes in population levels for groups of native fauna". So it has been assumed that non-use values have also been estimated as the ecological characterizations involve habitat components. Note that the authors do not indicate if they value supporting services, which explains why only regulating services have been reported in Table 2 for this paper. It has also been assumed that Nunes et al. (2008), who uses a choice experiment (CE) to value provisioning services, also estimate non-use values as they state, in the motivation analysis, that "fishermen who feel a stronger

responsibility for the weak environmental conditions in the lagoon of Venice are willing to pay less for fishing during the day rather than the average respondent".

Particular cases are Do and Bennett (2008) and Othman et al. (2004), who apply choice modelling to estimate only non-use values attached to biodiversity and to regulating and cultural services, respectively. Indeed, in the latter study, the survey is restricted to respondents who have "knowledge of the existence of the mangroves, but had no direct consumptive relationship with the resource".

3.2.2 Outcomes and policy implications

In general, the studies show support for protection of wetlands and mangroves. In this sense, the meta-analysis studies show some evidence that the method employed affects wetland values, although it does not seem to be the primary determinant (Woodward and Wui, 2001). Additionally, these papers also show that socio-economic variables, such as income and population density, and the bio-physical characteristics of the site, such as wetland type, size, the scarcity or abundance of other wetlands in the surrounding landscape, are important in explaining wetland values (Brander et al., 2013, 2006, 2012b; Camacho-Valdez et al., 2013).

In terms of policy implications, the studies argue that the economic value of wetlands can contribute to a more efficient wetland management and add to the debate of whether wetlands should be preserved or not compared to alternative uses. In this sense, the estimated values can be used for the appraisal of integrated water resource management projects (Grossmann, 2012). Public support for wetland mitigation strategies (preservation of existing wetlands, restoration of degraded ones and construction of new wetlands) is essential because the public pays for many mitigation projects in the form of higher taxes. In this sense, it has been argued that, if biodiversity protection is a policy priority, it can be useful to undertake public awareness raising campaigns (Westerberg et al., 2010). Decision makers should also consider local demographics when determining appropriate projects as it plays a role in the type of mitigation preferred. Additionally, an spatial ES valuation framework can assist policy makers in the private and public sectors to identify areas which are critical in the delivery of ES (Brander et al., 2012b).

Recent studies have shown the usefulness of using benefit transfers in response to a growing political demand. Indeed, as stated by Brander et al. (2012b), "the Convention on Biodiversity New Strategic Plan for 2020 requests that values for biodiversity be integrated into national development strategies and national accounts. Similarly, the EU Biodiversity Strategy for 2020 (Target 2, Action 5) requires Member States to assess the economic value of ecosystem services and integrate them into accounting systems at the national level".

However, it has also been said that caution is needed when using results of meta-analyses in cases in which the ´previous' valuation studies do not represent well the characteristics of the policy sites (Brander et al., 2006).

Some authors also state that there is a need for an integrated natural and social science approach to measure the economic value of wetland services for policy purposes, as wetlands are complex ecological ecosystems. Besides, results from studies "should be compared to subsequent survey results as part of the ongoing adaptive assessment process to understand how public preferences respond to new information" (Milon and Scrogin, 2006).

In this context, it has been argued that environmental cost-benefit analysis (ECBA) becomes an important decision-making tool as it allows one to highlight the nature of the benefits and costs accruing to different groups, so providing with more information to decision-makers concerned with equity issues. According to Gunawardena and Rowan (2005), ECBA allows the interpretation of biophysical findings of environmental impact assessments in economic welfare terms, thus contributing to present results in a more familiar language to decision-makers. These authors state that "ECBA should be promoted to enable decision-makers to be more fully cognizant of a project's environmental and socioeconomic implication".

Concerning developing countries, some policy implications of economic valuation deserve attention. First, the value of wetlands seems to be often high enough to provide incentives for local communities to participate in their protection. In this sense, it has been argued that establishing compensating mechanisms in order for farmers to maintain wetlands and mangroves would be an important policy option (Gürlük and Rehber, 2008; Jenkins et al., 2010). Second, increasing public awareness of the value of wetlands in developing countries also seems to be important to ensure the sustainability of these resources (Kaffashi et al., 2012). Third, working to attract more nature-based tourists can be an interesting way for local people to capture greater benefits from management of their local resources (Shrestha et al., 2002). Fourth, and even most importantly, decisions about wetland and mangrove management must involve all stakeholders including policy makers, wetland authorities and community (Kaffashi et al., 2012). Gürlük and Rehber (2008) state that "an Integrated Basin Management Plan should be planned including local authorities, NGOs, farmers, fishermen, local community, representatives of private firms, universities and other scientific institutions and all those stakeholders who will likely act together to determine the needs and find solutions". In this sense, Stone et al. (2008) state that the value of the restoration would be much greater if restoration plans explicitly consider species that serve specific consumptive and non-consumptive needs of the user groups and recognize that these needs vary across community sub-groups. The authors argue that the government should also

assure that “approved reforestation sites should be given long-term protections from future government acquisitions for government approved industry, power plants, government facilities and other such uses”. They state that “a contract between Federal and State governments and village communities which gives access to and control over reforestation sites, as managed by community run mangrove management committees may increase trust in such projects”.

3.2.3 Research needs and challenges

Further research is needed to overcome the major challenges identified in the literature. On the one side, and regarding benefit transfer (BT), there is a large need for primary valuation studies as the prediction of a wetland’s value based on previous research remains highly uncertain (Woodward and Wui, 2001). This is particularly important in developing countries, where the need for more and higher-quality primary valuation studies is even more remarkable (Brander et al., 2013, 2006, 2012a). Additionally, and given there are very few valuation studies that explicitly estimate only non-use values, this seems to be an area for further research (Brander et al., 2012a). Researchers should also provide more information about their studies and centralize the supporting documentation. One of the major problems to apply BT is the lack of uniformity across studies (Woodward and Wui, 2001). It has also been suggested that future valuation meta-analyses should include comprehensive socio-economic information from other sources to better represent determinants of value (Brander et al., 2006) as well as other spatially defined context variables as it would offer a “potentially important avenue to further account for variation in values” (Brander et al., 2012b).

In their proposal of a methodology for scaling up values for changes in the stock of ecosystems at large geographic scales using a meta-analytic value function combined with spatial data derived from a Geographic Information System (GIS), Brander et al. (2012a) state that an important area for improvement in their methodology would be the treatment of ecosystem quality as their method deals primarily with the quantity (area) of ecosystems rather than with quality changes. The authors state that incorporating “ecosystem quality […] would require the definition and inclusion of quality variables in both the valuation data underlying the meta-analysis and in the data on ecosystem networks to which values are transferred”. Implicitly, this can be interpreted as a need for collaboration between ecology and economic sciences.

In fact, the need for collaborative work underlies the statement that further research is needed concerning the combination of mangrove dynamics and economics to jointly model the provision and value of mangrove ES. In this sense, some authors state that considering potential non-linearities in ES provision when modelling mangrove ecology would be

preferable. Accordingly, the value transfer analysis should be "revisited when (modelled) data on the provision of services from mangroves becomes available" (Brander et al., 2012b). These authors also state that modelling the specific threats faced by mangroves would benefit the estimation of changes in mangrove stock over time.

Collaborative research between economic and ecological sciences will allow including ecological knowledge of the co-provision or trade-offs of different ES in future analyses (Brander et al., 2013). This can help to measure the economic values associated with the multiple, interdependent services provided by wetland ecosystems for which it has also been stated that further research is needed (Milon and Scrogin, 2006). To date, there is considerable uncertainty regarding the range of services provided by mangrove and wetland ecosystems and how these interact with other ecosystems that also produce valuable services to society (Gunawardena and Rowan, 2005). According to Bauer et al. (2004), "future research should more directly address the details of the scientific discussions and uncertainties over service differences that may or may not arise, on a per-acre basis, between relatively natural wetlands and restored, or even human-created, wetlands". For instance, Grossmann (2012) states there is still large uncertainty over the nutrient retention capacity of restored floodplains. In a context of more scientific evidence on the ecological benefits of restoring wetlands and corresponding emergence of new ES markets, Jenkins et al. (2010) state that the value of wetland restoration "will likely grow as currently non-market services, such as floodwater storage, gain their own price tags".

Interestingly, Faccioli et al. (2015) deal with valuation of climate change impacts on wetland's biodiversity and suggest it would be of relevance to incorporate uncertainty over these impacts into the valuation analyses. Further ecological research on CC impacts on wetlands and the analysis of how uncertainty can affect their valuation can help to make a better contribution to wetland management adaptation to CC, as the authors argue. The same authors also state that it would be interesting to explore the potential of applying Multicriteria Analysis (MCA) to wetland contexts as it would allow including aspects which are difficult to quantify in monetary terms into the policy assessment.

Some authors state more research is needed on how to better explain preferences in wetland contexts. In this sense, Milon and Scrogin (2006) state that it may be necessary to combine stated and revealed preference methods. Additionally, psychometric measures that include a broader array of environmental attitudes than the New Environmental Paradigm (NEP) index introduced by Dunlap et al., (2000), such as the Environmental Response Inventory, and ethical motives may also allow choice models to better explain diffferences between groups within the population. The authors state that "the practical difficulty for researchers will be to reconcile the time requirements that accompany more extensive

psychometric inventories with the cognitive complexity that accompanies experimental designs using multiple ecosystem attributes". On the other side, Petrolia and Kim (2011) state that future work should consider the preferences of non-residents, which are mostly driven by non-use value motivations, for wetland restoration to have a better picture of the welfare estimates.

When it comes to wetland valuation in developing countries, two major challenges have been identified. First, the lack of data (Barbier et al., 2002). Second, the need for legal recognition of the rights of local communities to ensure wetland sustainability. As stated by Sathirithai and Barbier (2001), "the long-term success of any local initiative will depend on how well organized and effective are the resulting institutions for common property management", which will depend, in turn, on "whether the national legal system recognizes the rights of the local people to protect and manage mangrove forests".

Table 2. Papers concerning the valuation of services provided by wetlands[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Byström (2000)	Estimation of the value of using wetlands for abatement of agricultural nitrogen load in the Baltic Sea.	• Abatement of agricultural nitrogen (regulating)	• Indirect use value (replacement value)	• Total abatement costs for nitrogen reduction through use of wetlands for nitrogen abatement are 540 MSEK/year. • Total abatement costs for nitrogen reduction without using wetlands for nitrogen abatement are 753 MSEK/year. • The value of wetlands equals 213 MSEK/year. (1992MSEK)
Policy implications: • The use of wetlands as nitrogen sinks can reduce the total abatement costs of nitrogen emissions by 30% for Swedish agricultural sources of nitrogen pollution. • Contribution to wetland abatement technology and guidance on wetland policy. • To provide incentives for farmers to construct wetlands a subsidy would need to be higher than the current level in some regions.				
Sathirithai and Barbier (2001)	Assessment of the benefits of mangroves compared to the net returns from converting the areas into shrimp farms (which cause mangrove losses and water pollution) in a case study area of southern Thailand.	• Habitat-fish linkages • Local direct use of forest resources • Off-shore fisheries • Coastal protection and stabilization (supporting, provisioning and regulating)	• Consumptive direct use value • Indirect use value (production function approach)	• The net income derived by the local community from the use of forest resources is $88/ha. • The value of mangroves is $21-$69/ha. • The value of coastal protection and stabilization is $3,679/ha. • The net present value for a 20-year period of all three values, depending on the discount rate, ranges from of $27,264 and $35,921/ha. (local direct use value: 1996/off-shore fishery-linkages: 1983-1993)
Policy implications: • Valuation allows comparing the economic benefits of mangroves to local communities with the returns to shrimp aquaculture or to determine whether there are sufficient benefits from conserving the mangrove systems to provide the incentives for local communities to participate in their protection. • Although shrimp farming creates huge private benefits, it is not so economically viable once the externalities generated by mangrove destruction and water pollution are included.				
Woodward and Wui (2001)	Assessment of the relative value of different wetland services, the sources of bias in wetland	• Habitat of aquatic species/improvements in commercial and/or recreational fisheries • Biomass production and export	• Consumptive direct use value • Indirect use value	• The means of wetland values varies from a low US$198 from the travel cost method to a high US$1555 for the replacement cost method (bivariate

	valuation and the returns to scale exhibited in wetland values.	• Recharge/discharge of groundwater • Water quality control • Retention/removal/transformation of nutrients • Flood control and storm buffering • Sediment stabilization • Recreational observation and hunting of wildlife • Amenity values • Habitat of terrestrial and avian species (supporting, provisioning, regulating and cultural)	• Non-consumptive direct use value • Non-use value (meta-analysis)	meta-analysis). • The method employed and econometric quality can affect wetland values. (1990US$)
Policy implications: • Quantifying the value of wetland services contribute to know whether particular areas are in their highest economic use as wetlands, and to what extent public and private resources should be used for their protection and restoration.				
Barbier et al. (2002)	Development of a dynamic production function approach to analyse the influence of habitat changes on an open access fishery that faces a finite elasticity demand in Thailand.	• Role of mangroves in serving as a breeding ground or nursery for off-shore fisheries (supporting)	• Indirect use value (production function approach)	• Under pure open access conditions, the welfare losses for mangrove deforestation range from $12,000 to $408,000. • Inelastic demand exacerbates the welfare losses from degradation. (data collection: 1993)
Policy implications: • Open access conditions affect the value attributed to habitat-fishery linkages. • The widespread illegal fishing that usually accompanies open access conditions in developing countries makes it difficult to estimate the value with accuracy. However, it can be stated the welfare losses are expected to increase if illegal fishing is accounted for.				
Shrestha et al. (2002)	Measurement of the recreational fishing value of the Brazilian Pantanal.	• Recreational fishing (cultural)	• Non-consumptive direct use value (TCM)	• The average CS per day of recreational anglers ranges from $86.35 to $138.91. • Recreational fishing trips might be also influenced by the proximity of alternative sites, the opportunity to fish a rich variety of species, and anglers' non-use values for outdoor recreation in experiencing one of the world's most unique and varied ecosystems. (1994$)

Policy implications: • Contribution to resource management decisions in the Pantanal. • Results can serve as a reference in valuing similar resources in other ecosystems around the world. • Management of the industry towards recreational fishing may help local people to capture greater benefits from the management of their resources. • There is a need for working to attract more nature-oriented tourists and maximize revenues from recreational tourism through policies to enhance tourists 'experience.				
Bauer et al. (2004)	Identification of factors affecting public support for different types of compensatory wetland mitigation programs in Rhode Island.	• Compensatory wetland mitigation strategies described through cost, size, public access, and presence of endangered species (cultural)	• Non-consumptive direct use value • Non-use value (contingent choice)	• Households are willing to pay $54.31 for the addition of a boardwalk, $25.35 for the addition of the presence of an endangered species, and $43.38 for a viewing tower. • One acre of preserved or restored salt marsh is valued at $0.48. (1997$)
Policy implications: • Support for increasing taxes and fees for most mitigation projects. The larger the mitigation project and the lower the cost, the more likely it is to gain public support. • Public access can be critical to public support, particularly if the size of the wetland is small or the cost is high. If the cost of providing public access is relatively small, the gain in public support for mitigation expenditures may well allow a substantial expansion of the area involved in mitigation projects and thus a greater increase in the amount of habitat conservation. • As demographics play a role in the type of mitigation (creation, restoration, or preservation) the public is willing to support, decision makers should consider local demographics when determining appropriate mitigation for specific projects. • As public support for wetland mitigation is essential as the public pays for many mitigation projects in the form of higher taxes, public preferences should be considered when it comes to the assessment of wetland mitigation options.				
Nunes et al. (2004)	Economic valuation of alternative clam management practices in the Venice Lagoon, with a focus on the economic valuation of the environmental damages associated with the introduction of the exotic clam species *Tapes philippinarum.*	• Clam fishing area • Clam fishing system (provisioning)	• Consumptive direct use value (CE)	• Commercial fishermen's WTP for a larger clam fishing area ranges between €568 and €811/year. • An individual's WTP for a fishing practice exclusively based on the vibrant rake system ranges between €1,005 and €2,456. • The adoption of a clam fish management practice exclusively based on the use of manual rakes (associated with the lowest damage to the lagoon ecosystem) represents a welfare loss of €5,904/fisherman/year. • The welfare loss associated with the adoption of the above-mentioned type of clam management amounts to €11.8 million/year. (data collection: 2001)

Policy implications: • Monetary information can serve to identify the benefits and costs involved with alternative clam management practices or clam regulation scenarios. • Any environmental policy protection measure is justified if the associated benefits, in terms of forgone environmental damages, amounts too €11.8 million or higher per year.				
Othman et al. (2004)	Estimation of the non-market values provided under different management options in the Matang Mangrove Wetlands in Perak State, Malaysia.	• Environmental forest area and fish breeding, storm protection, etc. • Sport fishing, rivering boating, visitation of archeological sites and bird watching • Number of migratory bird species • Local employment opportunities (regulating and cultural)	• Non-use value (choice modelling)	• Respondents value increases in visitation rates and dislike decreases in the number of local employed people. • Non-user households are, on average, willing to pay RM0.81 for an additional 1% of environmental forest area and RM1.36 for an additional 1% of migratory bird species, ceteris paribus. (data collection: 2000)
Policy implications: • Contribution to identification of the management plan that yields the greatest net benefit to society.				
Gunawardena and Rowan (2005)	Identification and valuation of the wider range of environmental services offered by a relatively pristine mangrove ecosystem in the south of Sri Lanka, in the framework of an extended ECBA of a moderately large shrimp aquaculture project.	• Firewood harvest • Fisheries • Shore zone stability (provisioning and regulating)	• Consumptive direct use value • Indirect use value • Option value • Existence value • Bequest value (net value of fisheries/replacement method/CVM)	• The annual value to the firewood harvest is US$24/ ha/year. • The annual net value of the mangrove–lagoon fisheries is US$268/ha/year and that of the coastal fisheries, US$493/ha/year. • The value of the shore zone stability (value of the mangrove buffer) is US$300/ha/year. • The option, existence and bequest values are equivalent to US$ 2.6/ha/year. (data collection: 1998)
Policy implications: • An ecologically rich ecosystem supporting low-intensity, but sustainable, harvesting is far more valuable to the local and wider community than a large shrimp culture project, which is associated with significant socioeconomic impact and loss of traditional livelihoods. • By highlighting the nature of the benefits and costs accruing to each local group, more information can be made available to decision-makers concerned with the promotion of equity issues. • The ecological and cultural dimensions of the proposal also have consequences for regional, national, and international stakeholders (e.g., eco-tourism).				
Birol et al. (2006)	Valuation of the Cheimaditida wetland in Greece.	• Biodiversity • Open water surface area • Research and education	• Non-consumptive direct use value	• The mean household WTP for the low impact management scenario is €107.56, whereas greater improvements in ecological, social and economic conditions in the wetland under the medium impact scenario increase the mean WTP to €116.49, and

		opportunities • Retraining of local farmers in environmentally friendly employment (cultural)	• Non-use value (CE)	under the high impact scenario, to €134.46. • There is preference heterogeneity across individuals which, on average, show support for sustainable management of the wetland. (2005€)
Policy implications: • The economic benefits of sustainable wetland management can be compared against the costs of alternative wetland management scenarios. • Results can help design socially optimal policies for sustainable management of the Cheimaditida wetland in accordance with the Ramsar Convention and the EU Water Framework Directive (2000/60/EC), with possible implications for other similar wetlands in Greece and the rest of Europe.				
Brander et al. (2006)	Comprehensive meta-analysis of the valuation literature that includes tropical wetlands, estimates from diverse valuation methodologies, and a broader range of wetland services.	• Biodiversity • Habitat and nursery service • Materials • Fuel wood • Flood control and storm buffering • Recharge/discharge of groundwater • Water quality maintenance/nutrient retention • Recreational hunting • Recreational fishing • Amenity and other recreational uses (supporting, provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Non-use value (meta-analysis)	• The average wetland values are highest in Europe, followed by North America, Australasia, Africa, Asia, and, finally, South America. • The biodiversity service of wetlands has an average value of 17,000 US$/ha/year), while the use of wetlands for collecting fuel wood and other raw materials has values of 73 and 300 US$/ ha/year, respectively. • Socio-economic variables, such as income and population density, help explain wetland values. • The assessment of the prospects for using the analysis for value transfer show average transfer errors of 74%, with just under one-fifth of the transfers showing errors of 10% or less. (1995US$)
Policy implications: • Urge caution in using the results of such a meta-analysis for value transfer, particularly to policy sites for which their characteristics are not well represented in the underlying valuation studies.				
Milon and Scrogin (2006)	Evaluation of the effects of alternative ecological characterizations (functional and structural attributes) of wetland functions and services on individual preferences, and analysis of whether socioeconomic factors and psychometric measures of environmental attitudes can	• Functional and structural ecosystem attributes describing restoration programs (regulating)	• Indirect use value • Non-use value (choice model)	• The MNL estimate of household WTP for full restoration with the structural attribute subsample is approximately twice the WTP for full restoration with the functional attribute subsample ($59.26 vs. $29.33). • The latent class analysis reveals socioeconomic and attitudinal factors explaining some of the heterogeneity in preferences and WTP within each subsample regardless of the description used for

	explain differences in preferences and values for restoration of the Greater Everglades ecosystem.			wetland functions and services. (data collection: not indicated)[b]
Policy implications: • Emphasis should be put on structural rather than functional restoration endpoints. • Social science research and stated choice methods in particular, can provide useful information for complex environmental policy problems such as the restoration of wetland ecosystems. • Given the diversity of wetlands and the services they provide, preference analysis is needed that account for differences in individual preferences for ecosystem services. • An ongoing adaptive assessment process should be conducted to understand how public preferences respond to new information.				
Do and Bennett (2008)	Estimatation of the biodiversity protection values of Tram Chim National Park, a typical wetland ecosystem of the Mekong River Delta.	• Biodiversity	• Non-use value (choice modelling)	• The estimated net social benefit for households of a proposed protection program ranges from US$ 0.52 million to US$ 1.84 million. (data collection: 2007)
Policy implications: • The values can be used to justify wetland conservation in Vietnam but also other decision making processes involving sustainable development.				
Gürlük and Rehber (2008)	Estimation of the recreational economic value of bird watching in the Kuscenneti National Park (KNP) at Lake Manyas, Turkey.	• Recreational bird watching (cultural)	• Consumptive direct use value (TCM)	• The annual value assigned by visitors to the KNP is US$ 103,320,074. (data collection: 2004)
Policy implications: • The required new investment and improvement of lake characteristics would be socially profitable if social benefits exceed social costs. • Necessary funding may be created by increasing the entrance fees. • As urban users value more the lake, compensating the farmers for the sustainability of important species around the site is an interesting policy option as it can incentivize them to allow proper water levels for the KNP.				
Nunes et al. (2008)	Evaluation of the social and cultural profile of fishermen, and estimation of their preferences for different alternative policy options that may characterize a future fishing regulation.	• Period of fishing • Certification of the fishing product • Distance between the harbor and the fishing ground • Net monthly income (provisioning)	• Consumptive direct use value • Non-use value (CE).	• On average, an individual fisherman is willing to pay €495 to go from a situation where fishing is during the day rather than during the night. • He is willing to pay €455€ for a change from today's fishing situation to a fishing practice in which the concession of the fishing ground is located near the harbor where the boat is located. • He is willing to pay €245 for the introduction of such a regulatory mechanism. (data collection: 2002)

Policy implications: • Results are of particular significance to design an efficient, widely supported fishing regulation policy such as product certification. • Any direct governmental intervention may fail if the local institutions do not engage in a set of activities so as to re-obtain the trust from fishermen.				
Stone et al. (2008)	Analysis of the factors that influence households' willingness to contribute toward mangrove restoration among three subsistence user groups (fishermen, fisherwomen and rice farmers) in west coast of India.	• Mangrove forest product use • Contribution of mangrove to fish nursery • Erosion control • Crop pests control • Protect rice plants (provisioning and regulating)	• Consumptive direct use value • Indirect use value (CVM)	• About 70% of the fisherwomen and 55% of the fishermen are willing to work some hours for mangrove reforestation, while only 33% of rice farmers are willing to contribute some rupees for it. • The willingness to participate of rice farmers is the highest one, at Rs 626/year. • The median rupees equivalent to the number of days of labor that fishermen and fisherwomen are willing to contribute are Rs 342 and Rs 395/year, respectively. • Contribution of mangrove to fish nursery is the main reason stated by fishermen to take part in restoration. • Role of mangrove as an alternative source of income for the whole community influences fisherwomen's decision to participate. • Only a minority of rice farmers are willing to contribute to mangrove restoration due to its role to control erosion and crop pests. (data collection: 2005)[c]
Policy implications: • Restoration manager must carefully consider users' needs and perceived mangrove benefits while selecting mangrove species for restoration in order to enhance community participation.				
Yang et al. (2008)	Estimation of the ecological economic value of constructed wetland ecosystems for treating eutrophic water in Hangzhou, China.	• Water suppy • Eutrophication abatement • Aesthetics and scientific values (provisioning, regulating and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Indirect use value (qualitative analysis) • Option value • Existence value • Bequest value (CVM and Shadow Project Approach)	• The total economic value of the constructed wetland in a 20-year period is yuan800,000. The Shadow Project Approach (which excludes non-use values) provides a value of yuan23.04 million. • The direct use value is yuan1.40 million • The option value is yuan307,000 • The existence value is yuan278,000. • The bequest value is yuan135,000. (2007yuan)

Policy implications: • The study provides a benchmark when evaluating constructed ecosystem services and help policy makers to promote the development of constructed wetlands in China.				
Tuan et al. (2009)	Estimation of the direct use values of resource-based economic activities occurring on Tam Giang lagoon wetland, Vietnam.	• Aquaculture • Capture fisheries • Rice cultivation • Agricultural production • Sea-grass collections (provisioning)	• Consumptive direct use value (market price method)	• Capture fisheries provide the highest net benefit (VND16.3 billion/year), followed by agriculture (about VND6.9 billion/year), sea-grass collection (VND2.7 billion/year), and aquaculture (a negative net benefit of VND7.8 billion/year). • The aggregation of net benefits for the whole Tam Giang lagoon is estimated at VND18.9 billion, and the average value is VND4.4 million/ha/year. (2005VND)
Policy implications: • The use value would increase if other activities in the lagoon such as tourism, transportations, and titanic mining would have been taken into account. • Information about the economic values of different uses of the lagoon wetland is useful for policy making. • Results are useful for policies and decisions in making trade-offs among alternative management and use options of the lagoon wetland. • It seems more profitable for society to maintain the current resources in the wetlands rather than growing rice all over the wetlands. • The total value estimated can be compared with the provincial gross domestic product (GDP) to see the contribution of the Tam Giang lagoon in the regional GDP.				
Jenkins et al. (2010)	Assessesment of the value of restoring forested wetlands via the US government's Wetlands Reserve Program (WRP) in the Mississippi Alluvial Valley by quantifying and monetizing ES.	• Nitrogen mitigation • GHG mitigation • Waterfowl recreation (regulating and cultural)	• Indirect use value • Non-consumptive direct use value (ecosystem market prices/valuation literature)	• The market value of ES is approximately $70/ha/year. • The social value of ES ranges from $1,435 to $1,486/ha/year. • The gap between the market and social value closes to a large degree when potential markets for ES are considered: the potential market value is about 70% of the social value and nearly 15 times the market value under existing markets ($1,035/ha/year). • Nitrogen mitigation is clearly the driver for both of the larger values, comprising 60% of the potential market value and around 85% of the social value. (2008US$)
Policy implications: • The estimated social value surpasses the public expenditure or social cost of wetlands restoration in only 1 year, indicating that the return on public investment is very attractive for the WRP. • The potential market value is substantially greater than landowner opportunity costs, showing that payments to private landowners to restore wetlands could also be profitable for them.				
Westerberg et al. (2010)	Valuation of preferences for land use and activity changes of the	• Wetland restoration size	• Indirect use value	• Tree hedge restoration allowing a view of the Alpilles is valued, on average, at €24.7/person/year.

	Marais des Baux Wetland, France.	• Mosquito control • Extent of tree hedges • Recreational opportunities • Biodiversity (regulating and cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The value of large-scale wetland restoration when coupled with natural mosquito control or when respondents have an attachment to the area is €20.6 and €25.6, respectively • Active and passive recreation has a value of €19.4 and €20, respectively. • Natural mosquito control independent of wetland restoration has a value, on average, of €20.7. (data collection: 2008)
Policy implications: • Results can guide policy makers and landowners in decision-making. • It is recommended to restore the wetland to one third of its original size in conjunction with biological control of mosquitoes, more tree hedge rows and recreational facilities, while increasing efforts to induce higher levels of biodiversity.				
Petrolia and Kim (2011)	Estimation of the compensating surplus and the equivalent surplus welfare measures for the prevention of future land losses in coastal Louisiana.	• Storm protection • Ecosystem protection • Recreational opportunities (regulating and cultural)	• Indirect use value • Non-consumptive direct use value • Non-use value (CVM)	• Mean WTP is $825/household/year and mean WTA is estimated at $4,444/household/year (probit model using Box-Cox specification on income). • Major factors positively influencing support for land-loss prevention are income (WTP model only), perceived hurricane protection benefits, environmental and recreation protection, age (WTA model only), and race (for whites), while distrust of government affects it negatively. • At least half of respondents cite protection from hurricanes as their primary motivation. (2009US$)
Policy implications: • The estimates reflect support for a unified large-scale approach to land-loss prevention that spans the entire Louisiana coast.				
Brander et al. (2012a)	Proposal of a methodology for scaling up values for changes in the stock of ecosystems at large geographic scales using a meta-analytic value function combined with spatial data derived from a GIS, and its application to value	• Natural habitat and biodiversity • Commercial fishing and hunting • Harvesting of natural materials • Fuel wood • Flood control and storm buffering • Surface and ground water supply • Water quality improvement • Recreational hunting • Recreational fishing	• Consumptive direct use value • Indirect use value • Consumptive direct use value	• The annual value in 2050 of lost ecosystem services in Europe resulting from wetland change due to climate change is estimated to be approximately US$1 billion. (2003US$).

	the impact of climate change on European wetlands for the period 2000–2050.	• Recreation • Amenity and aesthetics (supporting, provisioning, regulating and cultural)	• Non-use value (meta-analysis)	
Policy implications: • Economic valuation can better inform decision makers about consequences of their decisions.				
Brander et al. (2012b)	Analysis of the value of ES provided by mangroves through meta-analysis and application of the estimated value function to assess the value of mangrove ES in Southeast Asia under a baseline scenario of mangrove loss for the period 2000-2050.	• Fish • Fuel wood • Materials • Coastal protection • Flood prevention • Water quality (provisioning and regulating)	• Consumptive direct use value • Indirect use value (meta-analysis)	• The values of mangrove ES are highly variable across study sites due to, amongst other factors, the site's bio-physical features and the socio-economic characteristics of the beneficiaries of ES. • The inclusion of spatial variables describing the context of individual mangrove patches is important in accounting for variation in ES values. • The estimated foregone annual benefits in 2050 are US$2.2 billion (prediction interval of US$ 1.6–2.8 billion). (2007$)
Policy implications: • Increasing the accessibility of mangrove areas appears to degrade the services they provide. • Mangrove conservation efforts should aim to mitigate the impacts of fragmentation by transport infrastructure. • The value transfer analysis should be revisited when (modelled) data on the provision of services from mangroves becomes available. • The estimation of changes in the stock of mangroves over time could be greatly improved by explicitly modelling the specific threats faced by mangroves.				
Grossmann (2012)	Estimation of the economic value of nutrient retention function of restored floodplain wetlands in the Elbe River basin and presentation of an empirical cost function for the costs of floodplain restoration measures.	• Nutrient retention (regulating)	• Indirect use value (replacement cost)	• The marginal costs for load reductions without the floodplain programme rise from €5.3 to €137/Kg for phosphorous and from €3.8 to €125/Kg for nitrogen. • These costs are lower when including the nutrient retention generated by the floodplain restoration programme: they rise from €4.4 to €29.7/Kg for phosphorous and from €3.5 to €121/Kg for nitrogen. • The nutrient retention benefit of restored floodplain area increases with increasing nutrient load reduction targets. (data collection: 2000-2005)

Policy implications: • Results give vidence of the value of restoring wetland ES. • The estimated values can be used for economic appraisal of floodplain and integrated water resource management projects in the Elbe River basin.				
Kaffashi et al. (2012)	Estimation of the economic benefits of Shadegan International Wetland in Iran.	• Water quality • Biodiversity • Ecological functions (nutrient cycling, flood flow alteration, sediment stabilization and pollution retention) • Natural scenery (regulating and cultural)	• Indirect use value • Non-consumptive direct use value • Option value • Existence value (CE)	• The marginal value assigned by households to pass from an unacceptable water quality level to a moderately acceptable one is Rials30,028.15. • The marginal value to pass from a moderately acceptable water quality level to an acceptable one is Rials45,728.8. • Positive preferences for water quality, biodiversity, natural scenery and ecological functions, being water quality the highest valued attribute. (data collection: 2010)
Policy implications: • Results show support for wetland conservation in developing countries. • Increase public awareness of the values is needed. • Decisions must involve all stakeholders including policy makers, wetland authorities and community.				
Brander et al. (2013)	Identification and quantification of the factors that influence the value of wetland regulating services in agricultural landscapes and analysis of the potential for using the resulting value function to transfer values to currently unvalued wetland sites in an agricultural setting.	• Flood control • Nutrient recycling • Water supply (regulating)	• Indirect use value (meta-analysis with use of GIS)	• From the database used, containing 66 value estimates, mainly for wetlands in the US and Europe but also a huge number in developing countries, the mean value for flood control is 6,923US$/ha/year; the mean value for water supply is 3,389 US$/ha/year; and the mean value for nutrient recycling is 5,788 US$/ha/year. • The values of these services vary across individual wetland sites due to, amongst other factors, differences in wetland type, size, the scarcity or abundance of other wetlands in the surrounding landscape, and the socio-economic characteristics of the beneficiaries of these services. (2007US$)
Policy implications: • It is important to make explicit the value of the multiple functions provided by wetland. • The value of the functions provided by wetlands should be assessed within a framework allowing for comparison of the gains to be made from activities that might threaten wetlands. • This should serve not only to better protect these threatened ecosystems, but also to improve decision-making for the benefit of society.				

• As transferring values using the estimated meta-analytic value function results in considerable estimation error, results have to be interpreted with caution.				
Camacho-Valdez et al. (2013)	Implementation of a method to generate baseline estimates for ES values provided by coastal wetlands by using and modifying recent developments in combining value transfer with GIS tools.	• Biodiversity • Water supply • Commercial fishing and hunting • Harvesting of natural materials • Fuel wood • Flood control and storm buffering • Water quality • Recreational fishing • Recreational hunting • Non-consumptive recreation • Amenity and aesthetic • Natural habitat (supporting, provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Non-use value (meta-analysis)	• Saltmarshes are the most important wetland in terms of covered area. • Socio-economic variables, such as income, are important in explaining wetland values. • A value of US$1 billion/year is delivered to the local citizens by the surrounding wetlands. (2003US$)
Policy implications: • As wetlands have suffered some loss and substantial habitat alteration, their conservation should be a priority from both an ecological and an economic perspective. • Inventories are required to identify wetlands and define and value their services to obtain appropriate information relevant to conservation strategies. • Spatial ES valuation framework can assist decision makers in the private and public sectors to identify critical areas in the ES delivery. • The use of ECBA for large scale projects that can impact large land areas is recommendable as tourism developments are projected to be undertaken in the near future in many coastal regions.				
Frey et al. (2013)	Measurement of the economic value of living near a urban multi-use wetland in Long Beach, California.	• Amenity value/Distance to the lagoon (cultural)	• Non-consumptive direct use value (HA)	• A home 10% closer to the lagoon (approx. 300 feet) has a sale price 0.6% higher all else being equal. • At the mean home value of $578,608, the above-mentioned change in distance amounts to an expected $3,471 increase in sale price. (data on sales for 2000 through to 2011)
Policy implications: • Although the results should be interpreted with caution since they need to be tested in a broader setting in other areas, the similarity in results for the estimated value and sale price models is a promising first step. • Results can be used to justify ongoing restoration projects and prevent further degradation of urbanized natural resources.				
Petrolia et al. (2014)	Measurement of the value assigned by US households for a large-scale restoration of	• Commercial fisheries • Storm surge protection • Wildlife habitat	• Consumptive direct use value • Indirect use value	• Respondents are willing topay an average of $189 for an increase in fisheries productivity from the low level to the intermediate level and $204 for an increase from low to high level, all else equal. • The WTP for an increase in storm surge protection to

	Lousiana's coastal wetlands.	(provisioning and regulating)	• Non-use value (CVM, CE)	the intermediate level is $149, and the WTP for a further increase is just $2. • The WTP for an increase in wildlife habitat to the intermediate level is $109 and an additional $30 for a further increase to the high level (data collection: 2011)
Policy implications: • Results can be used to justify coastal wetland restoration program.				
Faccioli et al. (2015)	Valuation of the recreational benefits of climate change adaptation options concerning species' abundance and diversity in s'Albufera wetland, Mallorca.	• Watching of 'specialis't and 'generalist' migratory bird species (cultural)	• Non-consumptive direct use value • Existence value • Bequest value (CE)	• The mean marginal value visitors assign to a unit increase in the number of 'specialist' bird species is €1.31. • The mean marginal value visitors assigned to a unit increase in the number of 'generalist' migratory bird species is €1.00. (data collection: 2013)
Policy implications: • Results show support for climate change adaptation policies in wetland context. • Results can also contribute to a more efficient tourism planning if wetlands are located in tourism regions.				

[a]Key: CE, choice experiment; CS, consumer surplus; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; GIS, geographic information system; HA, hedonic analysis; MNL, multinomial logit; TCM, travel cost method; WTP, willingness-to-pay.
[b] Complete details on the survey are reported in Milon et al. (1999).
[c] The year of data collection could be 2005 as the study has been funded through the US Department of Agriculture CREES Grants (award # 2005-38422-5940).

3.3 Beaches

As shown in Table 1, the number of papers valuing services provided by beaches from 2000 onwards is considerable (40), showing that beach management has been an issue of great concern among researchers focusing on the valuation of services provided by coastal ecosystems.

Economic valuation of the services provided by beaches can provide useful information for policy makers interested in either further improving water quality to meet the standards required by the Bathing Waters Directive (2006/7/EC) or in preserving beaches from erosion phenomena. Additionally, valuing services provided by beaches can also contribute to design more efficient tourism strategies in destinations which attract a high number of tourists as well as to examine the appropriateness of charging visitors to contribute to finance coastal ecosystem policies.

Table 3 reports a list of papers dealing with the valuation of services provided by beaches. It presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As shown in Table 3, it seems there has been a growing interest in contributing to beach management as 40% of the papers have been published during the last five years (16). Only one study has applied a benefit transfer (BT) approach. In particular, Van Houtven and Poulos (2009) demonstrate and evaluate how an structural BT function can be developed to assess the welfare impacts on beach users of changes in saltwater beach width. Excluding the papers applying hedonic analysis (7), which use data related to housing markets, and Van Houtven and Poulos (2009), a slight majority of studies focus on estimating preferences for beach use of locals and/or residents. In other words, almost half of the studies have been undertaken in tourist areas and hence their samples consist of beach visitors which include both tourists and locals/residents (Beharry-Borg and Scarpa, 2010; Hess and Beharry-Borg, 2012; Nunes and Van Den Bergh, 2004; Parsons et al., 2013; Shivlani et al., 2003; Zhang et al., 2015) or only tourists or 'non-residents visitors' (Blakemore and Williams, 2008; Castaño-Isaza et al., 2015; Jones et al., 2011; Kontogianni et al., 2014; Oh et al., 2008, 2009). Most of studies only estimate use values. Only four studies value services provided by beaches located in developing countries.[3]

[3] Among the papers framing the analysis in developing countries, Beharry-Borg and Scarpa (2010) and Hess and Beharry-Borg (2012) have been considered independent studies. Indeed, despite Hess and Beharry-Borg (2012) uses the sample of sknorkellers used in Beharry-Borg and Scarpa (2010), both studies use different data as

3.3.1 Ecosystem services and values

Excluding Van Houtven and Poulos (2009), all the papers (39) value cultural services.[4] This is reasonable since the most important services provided by beaches are recreational and amenity services. Landry et al. (2003) and Landry and Hindsley (2011) are exceptions as they also consider some regulating services provided by these ecosystems. Indeed, they also examine, through a hedonic analysis (HA) approach, the impact of benefits of storm and erosion protection on coastal property values. Thus they estimate the willingness-to-pay (WTP) for environmental amenities that also reduce risk.

In this context, Landry et al. (2003) and Landry and Hindsley (2011) consider that beach width is a key determinant to provide recreation potential and storm/erosion protection benefits. In fact, describing beach quality through beach and dune width has been common among researchers applying HAs (Alexandrakis et al., 2015; Gopalakrishnan et al., 2011; Parsons and Powell, 2001). Measuring the value of beach access or proximity has been the second issue of concern among researchers applying HA (Parsons and Noailly, 2004; Taylor and Smith, 2000). This shows how the value of these attributes can be capitalized into the housing markets.

Beach width and beach access can also enter the utility function of individuals, as shown by researchers applying other revealed preference (RP) methods as well as stated preference (SP) techniques. Pendleton et al. (2012) apply a travel cost method (TCM) and Parsons et al. (2013) combine it with both a contingent behavior and a visitor count model to estimate the value of beach width, while Van Houtven and Poulos (2009) measure this value through an structured BT. On the other hand, Oh et al. (2008) and Oh et al. (2009) infer the value of beach access through a contingent valuation method (CVM) and a choice experiment (CE), respectively, while Barry et al. (2011) estimate the value of access to an additional beach area and the development of a coastal trail connecting the two beach areas through a contingent behavior (CB) approach. Whitehead et al. (2008) focus on measuring the WTP for beach width and beach access through a TCM using SP and RP data. The use of SP methods is then considerable in this context, which implicitly emphasizes that, in the face of beach erosion problems, there is a need to measure the welfare effects that can be derived from expected erosion impacts if no action is taken today.

Understanding how variations in water quality affect values has also been an issue of interest among researchers concerned with the recreational benefits provided by beaches. A

Beharry-Borg and Scarpa (2010) also use a sample of non-snorkellers. Besides, both articles employ different methodologies.

[4] Despite Lew and Larson (2005) and Lew and Larson (2008) use the same sample, both studies employ different estimation methods. So they have been considered independent studies.

considerable number of papers focus on estimating the value of water quality together with other recreational and amenity services provided by these ecosystems. Again, the use of SP methods dominates ex-ante valuations. Machado and Mourato (2002), Hanley et al. (2003), Beharry-Borg and Scarpa (2010), Hess and Beharry-Borg, (2012), Hynes et al. (2013) are examples in the SP field, applying a CVM the former and a CB and a CE the three latter, while Murray et al. (2001) use a TCM. In contrast, Nunes and Van Den Bergh, (2004) and Awondo et al. (2011) employ a joint TCM and CVM, and a TCM and a CB, respectively.

Valuing beaches as open access resources has also been of interest for some authors. This is the case of Fleischer and Tsur (2003), who, through an integrated participation and allocation approach using travel costs, develop an aggregate measure of the recreational value of beaches as open access and compare it to the value of urban and national parks. Other authors have been interested in measuring, together with other beach features, the value of both beach access and water quality, as done by Huang et al. (2007) through conjoint analysis, and water quality and open access, as done by Blakemore and Williams (2008) by means of both a TCM and a CVM.

Interestingly, only one study has shown concerns about congestion and noise issues (Oh et al., 2009). However, as stated by Oh et al., (2008), considering these issues is of high relevance as they could affect local residents' interest in development and maintenance of beach access and other management measures. They state that having omitted local residents in their data collection represents a limitation of their study.

Apart from water quality, some studies have focused on valuing other environmental quality attributes associated to beaches. This is the case of Shivlani et al. (2003) and Jones et al. (2011), who examine whether non-recreational issues such as sea turtle habitats might also influence visitors' preferences for beach protection and management; Huang et al. (2007), who also consider alteration of wildlife habitats when estimating preferences for beach erosion control programs; and Nunes and Van Den Bergh (2004), who take into account the impacts on marine ecosystem of harmful algal-bloom species when valuing marine protection programs. Consideration of such environmental attributes helps to explain why the values assigned by individuals to the recreational services in these SP studies are a mix of use and non-use values. In this context, it has been assumed that Castaño-Isaza et al. (2015) also estimate non-use values. Indeed, they estimate, through a CVM, the value placed by visitors to San Andres Island beaches, which are located in the Seaflower marine protected area (MPA), the seventh largest MPA in the world and the largest one in the Caribbean, and find that the majority categorize beaches and environmental features as very important factors in their decision to choose SAI as a destination.

As earlier said, non-use values are commonly expressed for biodiversity/habitat. Despite this, however, it has not been assumed that Beharry-Borg and Scarpa (2010) and Hess and Beharry-Borg (2012) estimate non-use values in their CEs designed to estimate the WTP for water quality improvements although some of the attributes they value are environmental ones ('presence of MPA', 'fish abundance' and 'coral cover'). While the use of such attributes could suggest that visitors attach a mix of use and non-use values to the recreational benefits, their description in the survey makes a clear reference to the contribution of such attributes to the enjoyment of the recreational activity. In fact, Beharry-Borg and Scarpa (2010) state that one possible explanation that MPAs which do not allow fishing elicit higher WTP values than those which do can be that "recreationists perceive that no-take zones may increase the probability of seeing more coral cover and a greater fish abundance".

However, non-use values can also be attached to cultural services, as shown by Kriesel et al. (2004), who examine, through a CVM, how the pro-environmental attitudes of respondents can help to explain the benefits from beach amenities associated with erosion management alternatives; and Saengsupavanich et al. (2008), who also estimate non-use and option values when valuing, by using the same method, the recreational benefits provided by a local beach affected by port-induced erosion.

In this context, it is worth noting the paper by Kontogianni et al. (2014), who explore beach users' perceptions regarding the impacts of beachrocks on their recreational experiences and their WTP to preserve beaches from further deterioration due to this phenomenon. They state that respondents who are married or live together seem to favor supporting scientific research in order to avoid further deterioration. As they suggest this could probably be attributed to paternalistic altruism towards children, it has been assumed bequest values have also been estimated in their study.

Nevertheless, the majority of papers only estimate non-consumptive direct use values, with the exception of Landry et al., (2003) and Landry and Hindsley (2011), who also estimate indirect use values associated to regulating services provided by beaches.

3.3.2 Outcomes and policy implications

Beaches provide not only important recreational and amenity services to society but also benefits of storm and erosion protection to owners of coastal properies. Accordingly, the reviewed studies give evidence of the social support for beach protection strategies.

In this sense, the studies show people assign economic value to beach width which implicitly suggests public support for beach erosion management programs (Parsons et al., 2013; Whitehead et al., 2008). Parsons and Powell (2001) show a high net present value for the

costs of retreat ($291 million in 2000$), which they use to justify beach nourishment as a good policy strategy. Likewise, after having examined the economic efficiency of beach nourishment with shoreline armoring, beach nourisment without armoring and shoreline retreat, Landry et al. (2003) show that a beach nourishment strategy provides for higher recreational benefits compared to shoreline retreat, which leads to slightly lower benefits. However, they also show that both strategies receive "higher evaluations for the same resulting general beach conditions than when no management strategy is specified", which suggests "people value information on the management of natural resources substantially". Interestingly, Landry et al. (2003) find that beach nourishment with shoreline armoring is the least preferred option and, when the management costs rise substantially, shoreline retreat becomes more preferable over beach nourishment. In fact, they argue that the relative desirability of the three measures depends on the rate of beach erosion and how management costs change over time.

Other papers show positive preferences for beach nourishment options by demonstrating that the value of policy interventions via beach nourishment are capitalized into the housing market (Gopalakrishnan et al., 2011). Alexandrakis et al. (2015) show that "the value of beach width is also, at least partially, capitalized in the tourism market". In this context, Landry and Hindsley (2011) demonstrate that beach and dune widths increase the property value only for houses within 300m from the shore, while Pendleton et al. (2012) show that the value of increasing beach width depends on initial beach width and it is different for different types of users.

The positive value visitors assign to additional, or improvements in, beach access has led some authors to propose a value capture property tax for financing beach nourishment projects which is in proportion to the benefits homeowners receive from these projects (Parsons and Noailly, 2004). Other authors propose charging beach recreationists as a way to fund such projects given beach nourishment relates to additional recreational opportunities and resource protection. Indeed, Shivlani et al. (2003) state that, "with a site-specific approach, decision makers can utilize a user fee that will shift the burden of paying for beach nourishment from governmental sources to the users themselves". In this sense, they suggest that any user fee should be implemented differently for local beaches versus beaches attracting more non-local visitors. In contrast, Kriesel et al. (2004) state that user fees would be a second best compared to general revenue funding as user fees can result in fewer users and hence lower levels of benefits. Interestingly, they find that both nourishment and retreat policies will benefit society, although the latter "has a slight lead". However, as the retreat option "would involve the taking of property to which some people may have a very strong attachment that compensation cannot overcome", they say that nourishment might be the only politically feasible option.

Nevertheless, beach erosion control programs can also have negative effects on the beach environment as shown by Huang et al. (2007), who show that the economic benefits of these programs can be exagerated if derived potential negative impacts on the coastal environment are not considered.

Beach and foreshore protection projects are also crucial to ensure tourists continue to be attracted to tourists destinations and hence to ensure tourism revenues (Zhang et al., 2015). In this context, knowing coastal tourists' concerns about current beach management programs and support for prospective management actions is of relevance for policy makers in tourism destinations. Oh et al. (2008) and Oh et al. (2009) show that identifying tourists' preferences for management options is important for management agencies to better serve coastal tourists. In this sense, they find that beach visitors have a higher preference for more beach access points and Oh et al. (2009) also find tourists prefer less crowding and noise on the beach and are willing to support certain management actions such as the introduction of some rules and regulations on beach use.

In this context, the possibility that tourists can help to fund management policies has been considered in the majority of studies investigating tourists' preferences. Indeed, Jones et al. (2011) have focused on the level of environmental awareness of tourists and their perceptions of two proposed policy tools to ensure funding for the improvement of the management of beach areas with high biodiversity values. They analyze an entrance fee to the beach and a tax to be levied on local accommodation costs and find that the accommodation tax is viewed as a more effective policy when compared to the entrance fee. They also find that social and institutional trust significantly influences both the perceived level of policy effectiveness and the stated WTP. With a focus on mass tourism Mediterranean regions, Kontogianni et al. (2014) show that tourists believe that the administration should undertake precautionary measures and that the EU should increase research funding to avoid further beachrock expansion. Almost half of them are shown to be willing to pay an annual tax to contribute to this effort. Additionally, Blakemore and Williams (2008) state that understanding and considering tourists' values may be important for the successful introduction of tourist ecotaxes.

Economic valuation of recreational services provided by beaches can also inform policy makers about the benefits derived from water quality improvements which, in turn, can provide information about the benefits of implementing the Bathing Water Directive (2006/07/EC) (Hanley et al., 2003). Some studies show that the economic benefits of implementing the Directive would clearly be substantial (Hynes et al., 2013). In fact, most of the papers show that people are willing to pay for improvements in water quality (Awondo et al., 2011; Murray et al., 2001). In this context, Machado and Mourato (2002) state that

future policy and legislation aimed at enhancing beach water quality should not only be focused on health risks but also pursue to promote amenity values..

Interestingly, Lew and Larson (2005) find that, although beach users indicate that water quality highly affects their beach experience, it does not appear to be a strong determinant of their beach choice. In contrast, several types of beach amenities contribute significantly to the value of a beach day and to attracting beach visitors to specific beaches, (e.g. the availability of free parking and life-guards).

In general, a review of studies focusing on valuing the recreational benefits provided by beaches gives evidence of the potential usefulness of environmental cost-benefit analysis (ECBA) as it can help to prioritize among alternative options thus contributing to make beach management more socially efficient. This is especially true in a small-island developing country context where there is a need to prioritise alternative policies due to limited financial resources and conflicting objectives for natural resource management (Beharry-Borg and Scarpa, 2010). Valuation can also inform about how much to spend on beach protection programs (Bin et al., 2005). In this context, it has been argued the importance of considering non-use values for beach protection as there is the risk that if only use values are taken into account, beach protection strategies are not socially profitable and hence not considered by policy makers (Saengsupavanich et al., 2008). Beharry-Borg and Scarpa (2010) also state that it is important to account for taste heterogeneity to better inform policy making. Indeed, if there is variation in preferences across different recreational types of users, recreation site managers and policy makers should develop site-specific management plans (Hynes et al., 2013). For the context of well-known tourism destinations, it has also been stated examining preferences of local residents should not be overlooked (Rolfe and Gregg, 2012; Windle and Rolfe, 2013). In this framework, Beharry-Borg and Scarpa (2010) state that “policy options should be further analyzed through economic evaluation tools such as cost–benefit multicriteria studies”. The need for going beyond the single-criterion approach followed by ECBA has also been suggested by authors who attempt to provide more realistic cost-benefit scenarios for the involved stakeholders and policy makers so as to prioritize and allocate costs and benefits from an Integrated Coastal Zone Management (ICZM) viewpoint. Alexandrakis et al. (2015) is one example.

Other papers state the usefulness of valuing recreational services provided by beaches in natural resource damage assessment as it can help to determine compensatory restoration equivalents (Parsons and Kang, 2010; Parsons et al., 2009). It has also been argued that understanding the values visitors place on coastal recreational access can contribute to designing new regulations such as MPAs and hence manage resources more sustainably (Barry et al., 2011). Additionally, it has been stated that valuation studies can also be useful

to develop novel funding mechanisms such as Payment for Ecosystem Services to ensure financial sustainability for MPA networks. Indeed, Castaño-Isaza et al. (2015) state, in the context of San Andres Island beaches, that the importance of these ecosystems and the potential revenue loss due to beach erosion can serve to provide the private sector with incentives to invest in environmental policies aimed at maintaining and protecting beaches.

3.3.3 Research needs and challenges

Some needs for further research and challenges have been identified during the review of papers valuing recreational services provided by beaches.

When it comes to valuing different beach erosion management strategies, Landry et al. (2003) suggest that distributional consequences of the management strategies should be taken into account. In this sense, they state that retreat policies would have a negative impact on "small, concentrated groups of users" and hence it would be interesting to explore the possibilities for compensation mechanisms if they are necessary to make a transition to a policy of retreat. Investigating on "government-sponsored erosion insurance and other financing mechanisms" could also be interesting for further research according to them. In this context, Kriesel et al. (2004) suggest that a retreat policy might not be feasible in beach areas which arehighly developed with higher value properties as it would involve a high level of property owner compensation. So, these authors propose, as a task for future research, identifying the "threshold level of property development" and using it to "identify potential candidate communities where a retreat policy could be preferred to nourishment". In this context, it should also be taken into account, as suggested by Parsons and Powell (2001), that retreat losses will depend on the density of housing and the specifics of the housing market, the erosion rate and the fact that coastal regions might have losses concentrated over commercial structures, public infrastructure, or wetlands.

In terms of funding coastal management strategies, two main needs for further research have been identified. On the one side, and concerning the application of a value capture property tax for financing beach nourishment projects, Parsons and Noailly (2004) state that "the tax could be set per square foot instead of per house". Consequently, "larger lots would be taxed more and vacant lots could be included in the rate schedule". They also suggest that "separate analyses could be done for vacant lots, condos, and commercial property". On the other one, and regarding funding of coastal management options by visitors, Jones et al. (2011) argue that "further research should be conducted investigating firstly, citizens' preferences for different policies involving the same institutions and also of identical policy instruments but with different management actors". This would allow determining whether the level of institutional trust is a strong determinant of visitors' choice of a given policy instrument. They also suggest it is important to increase the level of trust toward the

responsible institutions if the accommodation tax has to be accepted by visitors as an effective policy tool. An increase of information through formal networks with information campaigns together with the implementation of more deliberative decision-making techniques can help to increase the trust level. With a focus on property owners, Alexandrakis et al. (2015) argue that increasing the beach rental prices to fund mitigation actions or adding additional taxes to businesses that use the beach should be considered in order to protect this type of ecosystem and hence facilitate its enjoyment by beach users. This would also increase the attractiveness of business with high added value.

In the context of BT, Van Houtven and Poulos (2009) state that, while the functions calibrated using WTP estimates "produce plausible benefit estimates for alternative beach width scenarios […] the trip demand estimates implied by the calibrations are implausibly small". Consequently, further research on this issue is needed "as it may reflect a limitation of the assumed preference structure". Additionally, they argue that another area for further work is to evaluate whether their structural BT function outperforms other BT methods. They also argue the multisite framework they describe could be assessed by considering other policy areas. In Van Houtven and Poulos (2009)'words, "nonmarket valuation studies of beach closures rather than beach width may offer more data and thus more opportunities for econometric estimation of preference parameters rather than just calibration".

Huang et al. (2007) argue that, since the BT results depend on the quality of the primary valuation studies, the similarity between the existing and new studies and the value transfer method, further research is needed to validate and ensure the transferability of values. . When examining the suitability of the value estimates for BT, Windle and Rolfe (2013) state that variations in these estimates accross regions indicate that there are differences in the determinants of beach choice between daytrips and overnight trips which should be considered if value estimates have to be transferred to other contexts.

To better inform policy making, other authors have also advocated the need for further research in different settings. First, some researchers state that substitution effects among beaches which can occur if beach quality conditions change should be considered in the models (Machado and Mourato, 2002; Rolfe and Gregg, 2012). Second, others argue that since the level of congestion can be affected by different policies such as beach nourishment or changes in beach access, this is an area for further research (Bin et al., 2005). In this context, Oh et al. (2008) point out that preferences of residents in tourist areas should also be considered as "local residents are possibly less interested in development and maintenance of beach access and other management measures due to concerns about crowding and congestion as a result of tourism development". Third, the need for more accurate beach trip data to better contribute to decision-making has also been pointed out

by other researchers (Lew and Larson, 2005). Fourth, Lew and Larson (2008) suggest that, "while their work shows how measurement error in the latent shadow value of leisure time generates the more flexible random parameters version of the multinomial logit model, it should be possible to allow more key economic parameters such as the marginal utility of income to be random as well". Fifth, in their proposal of an Integrated Choice and Latent Variable model in the context of beach visitors' WTP for improvements in water quality, Hess and Beharry-Borg (2012) suggest the use of latent attitudes to allow for additional random heterogeneity not linked to the latent attitude.

Hynes et al. (2013) identify some interesting challenges when it comes to valuing water quality improvements in the framework of the Bathing Water Directive (2006/7/EC). Indeed, they point out that their per-trip estimates could be combined with national participation data if these were available which would allow to obtain national WTP estimates for improved beach quality. They also highlight the need for estimating "non-use and informal recreational use values" for these improvements. Working on these areas would allow comparing national benefit estimates to national cost figures which would contribute to more informed policy making. In this context, they also point out that beach specific benefit estimates could help determine which "beaches should be targeted for improvements, and which should be no longer designated as bathing waters" (which would happen if the economic costs of improvements outweigh the benefits). The authors state that, in case national aggregate benefits are substantially lower than national costs, policy makers should pay more attention to finding more cost-effective ways of achieving target water quality improvements. They also suggest the need for collaboration between social and ecological researchers when stating that the evaluation of ES from both economic and ecological perspectives is a necessary ingredient in practical policy.

Finally, despite not being stated by many authors, it is worth noting that policy makers will face challenges related to the emergence of potential conflicts between different types of coastal users, especially in regions which are less developed in tourist terms. An example is pointed out by Barry et al. (2011) in the case of Ireland. They argue that, "while farmers face external costs by allowing recreational access through their land such as nuisance effects that can interfere with the business of farming, it should also be recognised that, as a community, they have got significant public transfers and further agricultural policy support should not be given for providing recreational access". In this sense, they point out the need both to persuade farmers of the economic benefits of rural tourism as a whole and to invest in coastal recreation and other necessary infrastructure due to its potential for tourism and employment.

Table 3. Papers concerning the valuation of services provided by beaches[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Taylor and Smith (2000)	Analysis of firm-specific estimates of price markups as measures of market power and use of these markups to estimate the implied marginal value for access to coastal beaches in North Caroline coastline.	• Amenity services/beach access (cultural)	• Non-consumptive direct use value (HA and residual demand models)	• The mean price of ocean-front conditional on composite price markups for the peak season ranges from $784 to $1430. • The mean price of ocean-side ranges from $656 to $915. (1992)
Policy implications • Site-specific environmental amenities contribute to product differentiating market power. • Environmental policies offer opportunities to realize differential market power through providing enhanced access to environmental amenities as a product-differentiating characteristic.				
Murray et al. (2001)	Estimaton of the value of reducing beach advisories in Great Lakes beaches located along Lake Erie's shoreline in Ohio.	• Amenity services/water quality (cultural)	• Non-consumptive direct use value (TCM)	• The average seasonal benefit of reducing one advisory is approximately $28 per visitor. • Individuals who use the media in advance of trips gain approximately $24/year, while those who use only signs posted at the beach would gain $38/year. (data collection: 1998)
Policy implications • Results provide useful information for policy makers interested in further improving water quality in Lake Erie or other Great Lakes. • As the presence of pathogens in the water may arise from human waste entering surface water through sewage outlets or from animal waste entering through agricultural runoff, it may be possible to reduce beach advisories by altering sewage treatment methods, eliminating combined sewer overflows, or altering land management. • As other beach characteristics are also important for users, beach managers could undertake other activities helping to increase the value of the trip at individual beaches.				
Parsons and Powell (2001)	Estimation of the value of capital and structure losses over the next 50 years of allowing Delaware's ocean beaches to retreat inland.	• Amenity services/land and capital loss due erosion (cultural)	• Non-consumptive direct use value (HA)	• If erosion rates remain at historic levels, the present value of the cost of retreat is about $291 million. • The cost of retreat rises with erosion rates. • The loss is very sensitive to the erosion rate. (2000$)
Policy implications • When comparing the estimates to the current costs of nourishing beaches, it can be concluded that nourishment makes economic sense, at least over the next 50 years.				
Machado and Mourato (2002)	Evaluation of the multiple benefits of	• Recreational and amenity	• Non-consumptive	• The WTP of Lisbon residents for water quality improvements from bad to average is 1,924 PTE (US$ 10.97)/visit.

	improving the quality of marine recreational waters at the Estoril coast in Lisbon, Portugal.	services/water quality and human health (cultural)	direct use value (CVM and contingent ranking)	• Unimportance of risk reduction considerations when valuing water quality improvements. • Perceived health risks appear to be lower than actual risks. (data collection: 1997)
Policy implications • Future policy and legislative efforts to enhance beach water quality should assign increased weight to promote amenity values rather than concentrating on health risk alone.				
Fleischer and Tsur (2003)	Estimation of the recreational value of beaches, urban parks and national parks in Israel when data on individual site visitation are not available. The procedure accounts for both the allocation between the three types of open space and participation decisions.	• Recreational services (cultural)	• Non-consumptive direct use value (integrated participation and allocation approach using travel costs)	• The average CS for beaches is NIS670.66/season and NIS34.70/trip (MNL), or NIS810.92/season and NIS41.94/trip (NMNL). • The average CS for urban parks is NIS161.42/season and NIS9.23/trip (MNL), or NIS142.26/season and NIS8.15/trip (NMNL). • The average CS for national parks is NIS47.77/season and NIS3.06/trip (MNL), or NIS39.57/season and NIS2.60/trip (NMNL). (1997NIS)
Policy implications • Conflicting trends underlining the allocation of open space in developed countries raise the need for open-space allocation, which in turn requires estimates of the recreational value of the different types of open space. • Beaches generate the greatest economic value and thus should be preserved with the utmost care. • National and urban parks are substitutable to some degree, implying some flexibility in preserving and managing them. • The procedure developed is particularly useful for land use planning at the regional or country level where types of open space rather than individual sites are of main concern.				
Hanley et al. (2003)	Valuation of benefits from water quality improvements with a focus on a Scottish area which has consistently failed to meet the standards under the Bathing Waters Directive.	• Recreational services/water quality (cultural)	• Non-consumptive direct use value (contingent and real behavior)	• Hypothetical improvements of water quality yield only a 1.3% increase in predicted trip frequency. • The surplus associated with enhanced water quality is £0.48/trip or £0.58/person. (data collection: 1999)
Policy implications • It is interesting for policy makers to know the water quality improvements benefits especially given the costs of the measures aimed at meeting the standards set by the Bathing Waters Directive.				
Landry et al. (2003)	Examination of the relative economic efficiency of beach nourishment with shoreline armoring, beach	• Erosion protection/beach width	• Indirect use value • Non-consumptive direct use value	• A one-meter increase in beach width implies an additional $233 in property value (HA). • Ocean-front and inlet-front status imply an increase in value of $34,068 for ocean-front properties and $87,620 for inlet-home properties (HA).

	nourisment without armoring and shoreline retreat for Tybee Island beaches, Georgia.	• Recreational and amenity services/beach width (regulating and cultural)	(HA and contingent choice)	• The weighted average daily marginal WTP for a one-meter increase in the average width with shoreline armoring similar to the status quo is $6.75 per household (contingent choice). • A 2.5-meter increase in the average beach width with minimal shoreline armoring leads to an increase of $1.70 of the daily marginal WTP. (data on property sales between 1990 and 1997/data collection for contingent choice analysis: 1996)
Policy implications • The potential benefits from maintaining wide beaches without shoreline armoring are substantial. • As assuming the removal of shoreline armoring improves overall beach quality, beach nourishment with shoreline armoring is the least preferred option. • If cost rise substantially, shoreline retreat is preferable over beach nourishment. • As the relative desirability of the measures depends on the beach erosion rate and how management costs change over time, understanding the relationship between coastal management, recreational and property benefits and the housing market is critical.				
Shivlani et al. (2003)	Examination of how variations in amenities and visitor types across beaches influence visitors' WTP for beach protection and analysis of whether non-recreational issues such as sea turtle habitat might also influence visitors' preferences in South Florida.	• Recreational and amenity services/sea turtle habitat (cultural)	• • Non-consumptive direct use value • Non-use value (CVM)	• At all beaches and among all visitor types, the WTP for turtle nesting habitat as improved by beach nourishment is $2.12/visit. • At all beaches and among all visitor types, the WTP for beach recreational activities as improved by beach nourishment is $1.69/visit. • Important differences among beach visitors and preferences at sites within short distances of each other. • Visitors are willing to pay for beach nourishment as it relates to additional recreational opportunities and resource protection. (data collection: 1999)
Policy implications • The turtle habitat WTP estimates should be interpreted with caution since WTP totals may be related both to the amount of information provided to the respondents and to their actual understanding of the resource in question. • As governmental agencies reduce their share and require more local funding, beach nourishment must rely on other funding sources, including beach recreationists. • With a site-specific approach, decision makers can use a user fee that will shift the burden of paying for beach nourishment from governmental sources to the users themselves. • Differences in visitor types suggest that any user fee imposed on beach goers should be implemented differently for local beaches versus beaches attracting more non-local visitors. • The differences in visitors and amenities across the beach sites should influence resource managers' decisions of where to nourish and who should pay.				
Kriesel et al. (2004)	Estimation of the benefits and revenues from beach amenities	• Amenity and	• Non-consumptive	• The median annual WTP for beach improvements among all users is $6.06/day for improvements through beach

	associated with erosion management alternatives in Jekyll Island, Georgia (beach visitors and local residents); the different effects resulting from a retreat versus a nourishment policy; and the seasonal variation in visitation and benefits.	recreational services (cultural)	direct use value • Non-use value (CVM)	nourishment and $7.71/day for improvements through a retreat policy. • People with a higher education level have a higher propensity to prefer the beach improvement project, as do people with pro-government attitudes. (1998$)
Policy implications				
• Data can be used in financial decision making, including benefit-cost analysis. • Beach improvement is an effective policy within the considered time frame. • A nourishment policy may be the only politically feasible option as the retreat policy would involve the taking of property to which some people may have a very strong attachment that compensation cannot overcome. • However, if the island's decision makers want to maximize social welfare when managing a public resource, they would use the retreat policy funded by general revenues. • As using user fees to fund beach improvement projects can result in less users and hence lower levels of benefits, this would be a second best compared to general revenue funding.				
Nunes and Van Den Bergh (2004)	Valuation of a marine protection program focusing on the prevention of harmful algal-blooms along the coastline of the Netherlands.	• Recreational services/water quality, human health, marine ecosystem impacts (cultural)	• Non-consumptive use value • Non-use value (TCM, CVM)	• The gross recreational benefits per individual are €55/year (total recreational loss if the beach area of Zandvoort is closed for a year) (TCM). • The annual mean WTP estimate is €76.2 (CVM). (data collection: 2001)
Policy implications				
• Respondents with relatively high travel costs have a relatively low WTP for the marine protection program, which suggests that some budget constraint is active and that TCM and CVM estimates are to some extent complementary in terms of achieving a complet picture of the overall monetary value. • The program makes sense from an economic viewpoint provided its cost is in any case less than €225 million and possibly less than €326 million depending on how survey refusals are dealt with. • The welfare losses caused by harmful algal-blooms can be interpreted as financial costs of implementatoin of an efficient marine protection program.				
Parsons and Noailly (2004)	Proposal and application of a value capture property tax for financing beach nourishment projects in Delaware.	• Amenity services/beach proximity (cultural)	• Non-consumptive direct use value (HA)	• The results applied to a nourishment project in 1998 give a property tax-rate of about $2,300/house for ocean-front property (assuming property taxes are used to finance the entire project). • For houses near the coast but without ocean frontage, the tax is about $900. Moving inland by zone, each zone being 550 ft wide, the tax drops to $540, $250, $230, and, finally, $120. (housing transaction data from 1992)
Policy implications				
• As the property tax schedule taxes homeowners in proportion to the benefits they receive from the projects, the tax is equitable in the sense that tax burden and project benefits are aligned.				

• The tax is also efficient in the sense that homeowners face the real cost of maintaining beaches that protect and improve their property. • With value capture property taxes individuals pay taxes in proportion to the benefits received and face something closer the real cost of living near the beach.				
Bin et al. (2005)	Estimation of the CS of a beach day in North Caroline.	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• Depending upon on the site, the net benefits of a day at the beach in North Caroline range from US$11 toUS$80 for those users making day trips, and US$11 and US$41 for those users that stay overnight at the beach. (2003US$)
Policy implications • How much to spend to preserve beaches via nourishment projects depends on use and non-use values assigned to these resources.				
Lew and Larson (2005)	Estimation of the economic values associated with beach recreation in San Diego County.	• Recreational services (cultural)	• Non-consumptive direct use (TCM)	• The reduction in the value of a beach day from being precluded from visiting any single beach only ranges from $0 to $1 (depending upon the beach). • The value of a day at the beach is about $28/beach trip. • Water quality is not a significant determinant of beach choice. • Beach amenities such as the availability of free parking and life-guards have a signficant effect on behavior. • Beach users are less likely to visit beaches that suffer from “cobblestoning” than those that do not. (data collection: 2000-2001)
Policy implications • Policy makers and analysts concerned with coastal issues often need economic value information to evaluate policies that affect beach recreation. • This valuation information can be applied to a number of settings such as evaluating beach renourishment projects and land use decisions. • Valuation can contribute to natural resource damage assessments resulting from oil spills that damage coastal beaches.				
Huang et al. (2007)	Elicitation of individual choices of beach erosion control programs than can potentially cause multiple effects on beach environment in New Hampshire and Maine.	• Amenity and recreational services/ beach preservation, restricted beach access, hazards for swimmers, alteration of wildlife habitat, water quality deterioration, etc. (cultural)	• Non-consumptive direct use value • Non-use value (conjoint analysis)	• An erosion control program designed to preserve 5 miles of beach but which will cause erosion on the neighboring beach and deterioration of water quality has an annual value of $4.45/household. (data collection: 2000)

Policy implications • The economic benefits of an erosion control program to preserve a strecht of sand beach can be grossly exagerated if potential negative impacts on the coastal environment from the same program are not considered. • The choice-based conjoint analysis can be used to evaluate any program or policy with multiple positive and negative effects on different stakeholders.				
Blakemore and Williams (2008)	Valuation of a Turkish beach by British tourists.	• Amenity and recreational services/scenery, open access, water quality (cultural)	• Non-consumptive direct use value (CVM, TCM)	• The weigthed average CS for enjoying the beach is £1.11/adult/visit (TCM). • The value of enjoying the beach is £0.90/adult/visit (CVM). • The majority of tourists uses the beach for recreation activity and enjoy open space and scenery, being the major dislikes litter, water quality and dogs' faeces. • Marginal WTP diminishes with increased use of the beach. (data collection: 1998, 1999, 2002, 2004)[b]
Policy implications • Preference analysis helps coastal and tourism managers to understand their customers. • Understanding tourists' values and acting in accordance with them may be important for the successful introduction of tourist ecotaxes. • As the reduction of visitors to the Balearic Islands following the introduction of a tourist ecotax of circa €1/person/day is similar to the proportion of respondents who are not willing to pay to maintain or improve the beach, this demand reduction may reflect a refusal to pay tourist ecotax or a reaction to an increased price or charge.				
Lew and Larson (2008)	Analysis of individuals' decision about whether or not to visit a beach and which beach to visit in Southern California.	• Recreational services (cultural)	• Non-consumptive direct use value (joint model consisting of a labor supply model and a recreation demand model)	• The value of having access to the beach in San Diego County is estimated to be between $21 and $23/day. • The value of a beach day in San Diego County falls within the (rather broad) range of beach values for California. (data collection: 2000-2001)
Policy implications • Beach recreation values are often needed by policy makers and resource managers to efficiently manage coastal resources.				
Oh et al. (2008)	Estimation of the economic value assigned by non-resident visitors to public access to South Carolina beaches.	• Recreational services/beach access (cultural)	• Non-consumptive direct use value (CVM)	• Visitors are willing to pay an extra $6.60/day for additional beach access points and parking. (data collection: 2006)

Policy implications • The value of public beach access allows decision-makers to better compare management policies in their efforts to provide sufficient public beach access through a target effective strategy. • Because the acquisition of new beach access points is very costly, estimation of visitors' benefits accrued from provision of such beach access points is crucial to effective management decisions. • Relevant economic information and concerns for public beach access should be taken into account in the development of comprehensive management plans, as it is essential for efficient government spending on maintenance and provision of public access to beaches. • Cost–benefit analysis is a valuable means to make better decisions regarding program size and available alternatives.				
Saengsupavanich et al. (2008)	Integration of environmental economics and coastal engineering in managing port-induced coastal erosion occurring at a local recreational beach called Nam Rin by using Map Ta Phut port in Thailand as a case study.	• Recreational services (cultural)	• Non-consumptive direct use value • Option value • Non-use value (CVM)	• Individual WTP for the beach is ThaiBaht867.5 (approx. US$ 24.8)/year. • If only the use value of the beach is considered in a B/C ratio analysis, Nam Rin beach may not be protected since the ratio is lower than one (63,000/114,000=0.55). • Including the non-use value of the beach leads to a B/C ratio equal to 18.5 (2,110,000/114,000), which is large enough to initiate the beach protection program. (data collection: 2006)
Policy implications • By multiplying the individual WTP with the appropriate number of population benefiting from the beach protection benefit and dividing such benefit by the construction and maintenance costs of a particular beach protection measure, the polluters can select a proper beach protection approach that fulfills their B/C requirement.				
Whitehead et al. (2008)	Estimation of the changes in recreation demand that might occur with beach nourishment and parking improvements in North Carolina which are necessary to satisfy the requirements for US Army Corps of Engineers cost-share.	• Recreational and amenity services /beach access, beach width (cultural)	• Non-consumptive direct use value (TCM using SP and RP data)	• Considering a baseline CS/trip of about $90, the increase in CS/trip with the improvement of beach access is about $25, while the increase in CS/trip with the increase in beach width is about $7. • Hypothetical bias affects estimates of the number of trips and slope coefficients but does not affect elasticity or CS/trip estimates). (data collection: 2003/RP data, 2004/SP data)
Policy implications • When the product of trip and CS/trip is taken as an estimate of CS/season, hypothetical bias leads to upwardly biased seasonal CS estimates. Thus, SP recreational demand data, in isolation from RP data, may be suitable for estimation of CS/trip but not CS/season. • The benefit estimates can be compared to cost estimates to determine the economic efficiency of coastal management policies.				
Oh et al. (2009)	Analysis of tourists' preferences for management options and policies related to public beach access in South Carolina beaches.	• Recreational and amenity services/beach access, crowding and	• Non-consumptive direct use value (CE)	• Visitors are willing to pay approximately $13 and $16 to acquire one more main beach access point and two more main access points, respectively, in their beach destination. • Visitors require a compensation of $9–10 when considering a moderately crowded beach, and a compensation of $31–35 to

		noise levels, among others (cultural)		accept a highly crowded beach sites. • Visitors are also willing to support certain management actions such as the introduction of some rules and regulations on beach use. (data collection: 2006)
Policy implications • Under limited development opportunities and budget constraints, identifying tourists' preferences for management options is highly important for management agencies to better serve coastal tourists. • As beach sites with attractions, such as boardwalks and amusements, have more appeal to many visitors, some development is necessary to provide required facilities for visitors such as hotels/lodging, dining, entertainment, and retail. • When coastal destinations create their development plans, management agencies should consider policies and strategies that minimize the appearance of too much commercial development, especially in already moderately to highly developed destinations. • When the potential for conflict increases, tourists are more accepting of management rules and regulations that will reduce potential conflict with others.				
Parsons et al. (2009)	Estimation of the economic loss due to hypothetical beach closure on the Padre Island National Seashore of Gulf Coast of Texas.	• Recreational services (cultural)	• Non-consumptive direct use value (linked model)	• The mean per trip loss for the closure of all Padre beaches (in the event of a major incident such as an oil spill) is about $20. • The loss-to-trip ratio is about $180, and the aggregate loss for a season (May-Sept) is about $73million. • Actual losses should be larger as these values just involve recreation. (2008$)
Policy implications • Results should be useful in damage assessment and ECBA applied to the Texas Guld Coast and through transfer to other coastal areas.				
Van Houtven and Poulos (2009)	Demonstration and evaluation of how a Structural BT function can be developed to assess the welfare impacts on beach users of changes in saltwater beach width in North Carolina.	• Amenity and recreational services/beach width (cultural)	• Non-consumptive direct use value (structural BT)	• Nourishing 5 or 15 miles of beach in southern North Carolina is predicted to yield $20–30 and $60–80 worth of benefits, respectively. (2008$)
Policy implications • Coastal management policies that reduce erosion can significantly increase the quality and demand for beach visits. • Results from the beach valuation literature can be combined to specify an SBT function, which can be used to predict WTP for specific erosion management or beach nourishment programs. • BT approaches can contribute to decision-making as they adapt and apply preexisting benefit measures to address project-specific benefit assessment needs in a context in which analysts frequently need to estimate project-specific benefits to support public decisions regarding environmental protection but have limited resources to develop them.				

Beharry-Borg and Scarpa (2010)	Estimation of the WTP of snorkellers and non-snorkellers for an improvement in coastal water quality in Tobago's beaches.	• Recreational services/water quality (cultural)	• Non-consumptive direct use value (CE)	• Snorkellers of class 1 are willing to pay an average amount 4 times as much than class 2 for attributes linked to snorkelling. • For snorkellers of class 1, the individual-specific WTP estimates are TT$35 for up to 60 fishes, TT$50 for up to 45% of coral cover, TT$40 for up to 10m of vertical visibility, TT$33 for an MPA which allows fishing, TT$34 for an MPA which does not allow fishing, TT$15 for up to 5 pieces of plastics, TT$22 for a low chance of ear infection and TT$15 for a low level of development. • Both snorkellers and non-snorkellers have higher WTP for an MPA which does not allow fishing compared to one that allows fishing and a higher WTP for greater fish abundance and higher coral cover compared to lower levels. • Non-snorkellers are more willing to pay for attributes representing a lower level of environmental quality. (data collection: 2005)
Policy implications • Valuation provides useful information for policy makers and managers to manage the coastal environment, which is especially of relevance in the context of a small-island developing country where there is a need to prioritise policy recommendations due to limited financial resources and conflicting objectives for natural resource management. • Environmental policy decisions should allow for any taste heterogeneity. • On small-island states, it may be better to focus on policies delivering benefits to the largest cross-section of beach recreationists and then focus on policies delivering benefits to subgroups. • Although it is possible to consider a pricing policy that differentiates between the activities engaged by the beach recreationists, it would not be feasible to charge different rates for beach access. Thus, an alternative could be to charge different rates for access to different snorkelling sites depending on reef health (e.g. coral cover and fish abundance). • Policy makers should first focus on reducing the health risks of the coastal waters; ensuring that there is proper planning and development control on coastal areas close to beaches; aiding in the creation of more MPAs; and actively implementing and enhancing solid waste collection programs along the beaches. • The above-mentioned improvements would have spillover effects on other environmental aspects such as improvement of vertical visibility and an increase in coral cover and fish abundance. • Policy makers could also implement strategies and programs which help to further reduce the adverse impacts of recreational use such as provision of adequate facilities for boaters and managing the behaviour of reef users. • Education programs can also help with the effective implementation of any management program.			
Parsons and Kang (2010)	Determination of compensatory restoration equivalents for day-trip users for hypothetical closures of beaches on the Padre Island National Seashore in the Gulf Coast of Texas.	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• Five of the project groups[c] require less than 4 years before compensation is complete. • All these have a mean absolute difference (between compensation and loss) of about $6 (where the annual loss is estimated at $30), with the exception of Clean C where the mean difference is under $4. (2001$)
Policy implications				

• The restoration projects that compensate for beach closures have good alignment in terms of compensating those who actually suffer from the closures. • The projects that work best seem to be machine cleaning and providing vehicle-free access on beaches. • Valuation can contribute to Natural Resource Damage Assessment as it often calls for compensation in non-monetary or restoration equivalent terms.				
Awondo et al. (2011)	Estimation of the monetary value of restoring wetlands in Maumee State Bay Park on Lake Erie focusing only on the resulting beach recreation benefits due to the ability of restored wetlands to eliminate high levels of bacteria and thus eliminate the need for posting swimming advisories.	• Recreational services/water quality (cultural)	• Non-consumptive direct use value (TCM, CB)	• The mean annual WTP for water quality improvement (average per person CS) is $166. • Considering an estimated current 37,300 annual beach visitors, the aggregate WTP for wetland restoration is $6.19 million annually. (data collection: 2006-2007)
Policy implications • Based on the partial estimates of the benefits from restoring additional wetlands at Maumee State Bay Park and ECBA, it is efficient for policy makers to incur costs up to aproximately $6.2 million annually to ensure the elimination of high bacteria levels at park's beach and thus eliminate advisories.				
Barry et al. (2011)	Measurement of the WTP for public access to additional beach area and trail improvements to a coastal recreational site in the west of Ireland.	• Recreational and amenity services/ access to additional beach area and development of a coastal trail connecting two beach areas (cultural)	• Non-consumptive direct use value (CB)	• The mean WTP of the average recreationist using Silverstrand beach is €22/trip. • The increase in CS associated with the introduction of the trail is estimated at €111.15/person/year. (data collection: 2009)
Policy implications • Despite the benefits associated with improved coastal access and coastal amenities, rational public decision-making on financing improvements to coastal recreational amenities requires that these economic benefits are clearly identified and valued. • In designing new regulation such as MPAs for the management of Ireland's coastline, an understanding of the values the Irish public place on coastal recreational access is important to manage the resource in a sustainable manner. • Coastal policy in Ireland needs to recognise the demand for outdoor recreation along Ireland's coast while at the same time encouraging farmers and other coastal landowners to develop business opportunities and add value to farm activity by harvesting the potential offered by recreational activities along the coast. • Recognition of the demand for non-market goods is vital and requires action to maximise the utility associated with the resource.				
Gopalakrishnan et al. (2011)	Development of an approach which bridges the gap between static, empirical non-market valuation studies and dynamic resource models	• Recreational and amenity services/beach width	• Non-consumptive direct use value	• Compared to a baseline scenario where the property value is $39,000, the cumulative value at the optimal rotation decreases by 52% when the erosion rate triples (from 2 to 6 ft/year) and the cost of nourishment quadruples (from $300

	of beach nourishment decisions (which consider the dynamic features of beaches and the feedback of nourishment on shoreline retreat) in North Carolina.	(cultural)	(HA)	to $1200 per cross-shore ft of beach build-out). • Beach width contributes to the value of coastal property to a greater extent than previously believed. (sales data and sales prices for transactions occurring between 2004 and 2007)
Policy implications • The conventional policy of building hard structures, such as seawalls and jetties, to obstruct the waves and reduce the velocity of ocean currents has fallen out of favor in recent years. • Results give evidence of the importance of sand availability in maintaining coastal property values and sustaining beach nourishment as a viable option over time. • While the results may not change the outcome of a static evaluation of coastal policy options, it could have a significant impact on the long-run policy decisions.				
Jones et al. (2011)	Analysis of visitors' perceptions of an important nesting ground for loggerhead sea turtles located in the highly touristic area of Rethymno, Crete, registered in the Natura 2000 network. The paper focuses on visitors' perceptions of both an entrance fee and an accomodation tax aimed at securing funding for an environmental improvement.	• Recreational services/ nesting ground for loggerhead sea turtles (cultural)	• Non-consumptive direct use value • Non-use value (Linear Regression models, Exploratory Factor Analysis, open-ended format question)	• When including all responses, an average WTP of €1.59 is stated for the entrance fee and an average WTP of €1.13 is stated for the accommodation tax. • By excluding protest responses, an average amount of €2.81 emerges for the entrance fee whereas the respective amount for the accommodation tax is €1.92. • Awareness of the existence of the Natura 2000 site is low. • The accommodation tax is regarded as a more effective policy when compared to the entrance fee. • Visitors who tend to trust other individuals and institutions responsible for environmental and financial management are willing to pay more for the entrance fee. (data collection: not indicated)
Policy implications • As tourism has important, positive and negative, impacts on the management of coastal areas with high biodiversity value, it is important to investigate visitors' perceptions concerning environmental policy alternatives for these areas along with the factors influencing these perceptions. • The accommodation tax would be a more appropriate policy for the management of Rethymno beach taking into consideration visitors' perceptions and the current level of trust.				
Landry and Hindsley (2011)	Analysis of the influence of beach quality on coastal property values in Tybee Island, the northernmost barrier island on the Georgia coast.	• Recreational and amenity services/beach and dune width • Storm/erosion protection	• Indirect use value • Non-consumptive direct use value (HA)	• The marginal WTP for houses close to the beach ranges from $421 to $487 for an additional meter of high-tide beach, or $272 to $465 for an additional meter of low-tide beach. • The marginal WTP for increases in dune width ranges from $212 to $383/meter. • Beach quality is not significant beyond 300m from the shore. • For houses within 300m from the shore, beach and dune widths increase property value. • Interpretation of marginal WTP for beach quality depends upon individual understanding of coastal processes and

		(regulating and cultural)		expectations of management intervention. (1999$)
Policy implications				
• Estimates are insightful in gaining an understanding of property owners' preferences for environmental quality and are informative for policy analysis of coastal erosion management options.				
Pendleton et al. (2012)	Development of a model that quantifies recreational benefits as a function of beach width and other attributes for beaches in Los Angeles and Orange County, California.	• Recreational services/beach width (cultural)	• Non-consumptive direct use value (TCM)	• Although the different counterfactual scenarios result in a different number of lost or gained trips (and hence a different change in economic welfare), the value of a lost trip is stable at just over $100/trip. • The value of beach width varies for different types of beach uses (water contact, sand-, and pavement-based activities). • The marginal value of beach width depends on initial width. (2000$)
Policy implications				
• Determining how beach management policies affect beachgoers and their economic well-being is an important element in determining the beach policy, especially in a context in which beach nourishment is a costly process and beach armoring is controversial and in many cases can result in a loss of beach sand. • Beach managers should carefully consider the activities undertaken by beachgoers at a particular beach when weighing the potential benefits and costs of beach nourishment or beach erosion. • As natural sources of beach sand become more scarce, sand from extremely large beaches, especially accreting beaches, can be considered as a source of sediments for beach nourishment.				
Hess and Beharry-Borg (2012)	Illustration of the use of an Integrated Choice and Latent Variable (ICLV) model in the context of beach visitors' WTP for improvements in water quality in Tobago and discussion of the role that underlying (and unobserved) attitudes may have in driving preference heterogeneity.	• Recreational services/ water quality (cultural)	• Non-consumptive direct use value (CE)	• The median WTP is TT$8.3 for an MPA which allows fishing and TT$12.03 for an MPA which does not allow fishing. • The median WTP for an increased chance of contracting ear infenction from swimmimg in polluted water is TT$-16.93 and for a reduced chance, TT$15.86. • The incorporation of the latent variable leads to very significant gains in statistical fit and provides further insights into behaviour, leads to changes in the WTP measures, and shows the variation in these measures across respondents as a function of their underlying attitudes. (data collection: 2005)
Policy implications				
• The fact that different respondents are willing to pay different amounts for attributes associated with higher environmental quality as well as for avoiding undesirable effects has important implications for the calculation of aggregate benefits and their consequent use in ECBA for coastal water quality improvement programs.				
Rolfe and Gregg (2012)	Estimation of the recreational values for beaches over approximately	• Recreational services	• Non-consumptive direct use value	• The value of a single beach visit/person is $35.09 and beach recreation values are $587.3 million/annum. • The marginal value/recreation trip to avoid a 1% decline in

	1,400Km of coastline along the Queensland coast.	(cultural)	(TCM, CB)	water quality is $1.30. This value ranges between $1.11 and $1.69 for a 1% change across different regional communities. • These values are likely to be conservative because opportunity costs incurred to live closer to the beach (e.g. housing premiums) have not been assessed. • Populations with more respondents choosing to live closer to the beach have lower trip values. (data collection: not indicated)
Policy implications • Economic valuation allows policy makers to assess the values of changes in beach access or beach condition which is of particular relevance in areas where beach recreation is a core activity. • Recreation experiences depend on a number of beach characteristics, and visit rates decline if beaches have poorer environmental standards or other problems.				
Hynes et al. (2013)	Estimation of the economic benefits from water quality improvements in Irish beaches and analysis about how they vary according to the extent of risk exposure.	• Recreational services/water quality (cultural)	• Non-consumptive direct use value (CE)	• The mean WTP for a programme that improves benthic health from 'no improvement' to a 'large improvement', reduces health risks from 5% to virtually 0%, and changes beach debris management from 'prevention only' to 'prevention and collection' is €6.78/beach visit (RPL). • Improvements in all bathing water related attributes result in positive WTP and there is evidence of scope effects. • Heterogeneity in preferences is present to a significant degree and can be explained by the degree of exposure of individuals to health risks relating to water quality, proxied by the type of recreational activity they undertake. (data collection: 2011)
Policy implications • Whilst it is not possible at present to aggregate the estimates to a national benefits figure (due to a lack of reliable national data on participation in coastal water-based recreation), the economic benefits of implementing the Bathing Water Directive would clearly be substantial. • Economic valuation helps build a picture of the economic values of protecting and enhancing ES, thus contributing to the evidence base for better management of marine resources, and for improved policy-making and regulation.				
Loomis and Santiago (2013)	Estimation of beach recreation from the visitor's perspective in Puerto Rico by implementing a bottom-up approach in the selection of key beach quality characteristics identified by visitors.	• Recreational services (cultural)	• Non-consumptive direct use value (CVM, CE)	• The increased economic value/visitor day for increasing beach water clarity is $54 (CVM), and $51 (CE). • The value/visitor day of eliminating trash on beaches is $103 (CVM), and $98 (CE). • CE and CVM lead to statistically equivalent values. (data collection: 2010-2011)

Policy implications • Valuation can demonstrate that water quality regulations and shoreline maintenance are "economical". • The visitors' identification of key beach features and their subsequent valuation allows providing information that assists government agencies and non-profit organizations responsible for beach and coastal resources in making current management objectives and practices more responsive to users' needs. • Results provide both non-governmental organizations and the public sector with information on those beach features being most valuable to visitors, which can ensure visitors' needs are considered in resource allocation.				
Parsons et al. (2013)	Development of a travel cost model combining RP and SP data on beach use in Delaware to value changes in beach width.	• Recreational services/beach width (cultural)	• Non-consumptive direct use value (visitor count model, TCM, CB)	• The per-trip values for day-trippers are –$4.72 for a narrowing to one-quarter current width and $2.60 for doubling current width. • These values are, for overnighters, –$11.58 and $6.38, respectively. (data collection: 2010-2011)
Policy implications • The welfare measures have direct application for management as they help assess retreat and nourishment policies that have different implications for beach width. • These results are currently used in an ECBA to help guide the state's long-run decision making. • The application of results brings in the value of storm protection, housing loss (in the event of retreat), environmental effects, and cost of various management strategies along with the reported recreation values to arrive at net benefits.				
Windle and Rolfe (2013)	Estimation of the value of beach recreation by residents in Brisbane, Queensland. Negative binomial models were used to estimate values associated with both daytrips and overnight trips to beaches in different regional areas	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• The total value of an overnight beach trip is $229.64, $234.14 and $212.63 for Gold Coast, Moreton Bay and the Sunshine Coast, respectively. • The total value of a daytrip beach trip is $40.05 and $89.60 for the Gold Coast and the Sunshine Coast, respectively. • The total annual recreational value of Brisbane residents for Gold Coast and Sunshine Coast beaches are $459 million and $450 million, respectively. • The similarity in estimates overlooks the considerable differences in value composition between daytrips and overnight trips. • The total annual recreational value of southeast Queensland beaches is estimated at $1,039 million (ranging from $839 million to $1,416 million). (data collection: 2012)
Policy implications				

• Brisbane residents make an important contribution to the value of beach recreation in central and northern parts of the State, with households making approximately 0.27 million overnight trips per year (although there has not been possible to apply TCMs for beaches in these regions due to the low visitation rates and insufficient differentiation in visitation rates). • As the activity of local residents, who use the beaches most frequently, is generally not recorded in official records, but has significant economic value, it should be taken into account. • Providing policy makers with economic values can help make budgetary assessments about the benefits and costs of different coastal/beach management programs.				
Kontogianni et al. (2014)	Analysis of European tourists' perceptions regarding beachrocks impacts on their recreational activities and their WTP to preserve beaches from further deterioration due to this phenomenon in the island of Lesvos, Greece.	• Recreational services (cultural)	• Non-consumptive direct use value • Bequest value (CVM)	• Tourists believe that the authorities should undertake precautionary measures and that EU should increase research funding in order to avoid further beachrock expansion. • Almost half of the respondents are willing to pay an annual tax in the range of €13.2 to €16.4/household in order to contribute to this effort. (data collection: 2005)
Policy implications • It is crucial to quantify the social cost of beachrock in order to plan and adopt efficient policies and measures for the effective protection of coasts through the implementation of ECBAs as beachrock occurrence requires immediate attention, especially for Mediterranean countries receiving millions of coastal tourists annually. • As research on beachrock occurrence is very limited, transfer errors from the "upscaling" procedure can be very large, even under best practice conditions (e.g. combining several 'point' estimates with spatial variables by means of GIS).				
Alexandrakis et al. (2015)	Application of a combined environmental and economic approach along the geographical space to estimate the value of an eroded beach determined by its width and the tourism business located in there in the highly touristic coastal city of Rethymnon, Crete.	• Recreational services/beach width, accomodation facilities and coastal businesses, among others. (cultural)	• Non-consumptive direct use value (HA)	• The highest value/m^2 of the beach is 60.5 €/m^2/day and corresponds to a sector where six 5-star hotels are located, with 559 rooms and average room price €180. • The lowest value/m^2 is 1.6€/m^2/day and corresponds to a sector where two rent-rooms establishments are located, with 45 rooms and average price €45. • The average beach value/m^2, considering all sectors, is estimated at 18.5 €/m^2/day. • As the shoreline retreat reduces the beach width, it also reduces the value of the beach. (municipality records of renting values 2013)
Policy implications • The expansion of the shoreline retreat reduces the available beach space and hence increases the value of the remaining beach and the respective rental rates, which is more intense in sectors near the city, where rental prices are higher. This will result in reducing the relevant corporate and socioeconomic development potential. • This research is placed within the ICZM framework for the control of beach erosion and suggests cost-benefit scenarios for planning sustainable protection measures in order to mitigate the negative economic impact of beach erosion.				
Castaño-Isaza et al. (2015)	Analysis of information about tourists' experience and the value they place on beaches located in San	• Recreational services	• Non-consumptive direct use value	• Based on the party size, the WTP for SAI beaches is US$ 13,414. • The WTP for all tourists to SAI is US$ 997,468/year.

	Andres Island (SAI) where there is the Seaflower MPA.	(cultural)	• Non-use values (CVM)	• Tourists consider beaches as the main reason for choosing SAI as a destination and express they would be willing to pay additional money, US$ 997,468 annually, on top of what they have already paid for their vacation to protect SAI's beaches. (2011$)
Policy implications				
• Beach erosion can have negative economic impacts on the tourism sector (nearly US$73 million/year), based on a hypothetical situation not expected to occur for another decade (2025). • The beach importance for SAI and the potential revenue loss due to erosion can serve to incentivize the private sector to invest in natural infrastructure that maintains and protects beaches. • Valuation can serve for the development of PES to achieve financial sustainability for the MPA network in Colombia, which is of special importance due to the vast area of the Seaflower MPA and the limited budget allocated by the national government. • A conservation plan for beaches should necessarily extend and encompass coral reefs, mangroves and seagrasses to ensure coastal stability and secure local livelihoods. • Economic valuation can inform the national government about the contribution of ES to national income.				
Zhang et al. (2015)	Estimation of the recreational value assigned by local beach visitors, domestic tourists and international tourists to Gold Coast beaches, Australia and analysis of the efficiency of the value transfer method.	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• The estimated CS from a single beach visit trip ranges from A$10.05 to A$14.32/person for local residents and from A$16.to A$19.98/person for visitors. • The transfer error from the available studies to Gold Coast beaches ranges from 11.4% to 85.3%. • Transferring the CS estimated from the study conducted at the same/close location but at a different time leads to the smallest error, while transferring the CS estimated for much less well known beaches causes the largest error. (A$2011)
Policy implications				
• Beach and foreshore protection projects are critical to both ensuring that tourists continue to be attracted to the Gold Coast and increasing income from tourism for Queensland. • A good understanding of the characteristics of beach users and their recreational use values is of high importance to formulate effective beach management policy. • The total recreational value of Gold Coast beaches for a large number of beach visits could be more than $500 million/year, a value which could be even higher if non-use values are considered. • Beach and foreshore protect projects, which cost less than $500 million per year, are therefore economic feasible.				

[a] Key: B/C, benefit/cost; BT, benefit transfer; CB, contingent behavior; CE, choice experiment; CS, consumer surplus; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; GIS, geographic information system; HA, hedonic analysis; ICZM, integrated coastal zone management; MNL, multinomial logit; MPA, marine protected area; NMNL, nested multinomial logit; PES, payment for ecosystem services; RP, revealed preference; RPL, random parameter logit; SP, stated preference; TCM, travel cost method; WTP, willingness-to-pay.

[b] Use of unadjusted prices supported by the analysis of time effects that finds all four survey-phases are statistically similar with regard to mean vacation costs.

[c] Padre A [machine cleaning on North, Malaquite & South Padre Beaches and Lifeguards on North & Malaquite Padre beaches]; Padre B [Padre A+no entrance fee on Malaquite & South Padre beaches]; Padre C [Padre B+ vehicle free on North & South Padre beaches]; Clean C [Clean A+Clean B, with Clean A involving machine cleaning on Corpus Christi & Magee beaches and Clean B involving machine cleaning on North, Malaquite & South Padre beaches]; Vehicle C [Vehicle A+Vehicle B, with Vehicle A involving vehicle free on Port Aransas Park & JP Luby Park beaches and Vehicle B involving vehicle free on North & South Padre beaches].

3.4 Coastal areas

Only 8 papers have been classified within the ecosystem type 'coastal areas'. In fact, most of studies concerned with the valuation of services provided by coastal habitats have mainly focused on beaches and wetlands. Table 4 reports a list of papers dealing with the valuation of services provided by this ecosystem type. It presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As shown in the table, half of the papers have been published from 2012 onwards. The papers analyzed in this section attempt to contribute to coastal areas management by measuring the willingness-to-pay (WTP) for coastal land conservation in different contexts. The analyses revolve around the valuation of services provided by habitats such as coastal protected natural areas (Font, 2000), capes (Turpie et al., 2003), barrier islands (Petrolia and Kim, 2009), peninsulas (Voke et al., 2013), coastal margin habitats of saltamarsh, sand dune and machair dune grassland (Beaumont et al., 2014), and other types of coastal areas different from wetlands and beaches (Durán et al., 2015; McGonagle and Swallow, 2005; Östberg et al., 2012). One study frames the analysis in a developing country context (Turpie et al., 2003).

3.4.1 Ecosystem services and values

Cultural services are the ES type which has captured the most attention of researchers concerned with the valuation of services provided by coastal habitats different from beaches and wetlands. In fact, all the papers but one (Beaumont et al., 2014) value cultural services. In particular, this is the only type of service valued by Font (2000), McGonagle and Swallow (2005), Östberg et al. (2012), Voke et al. (2013) and Durán et al. (2015), while Petrolia and Kim (2009) also value regulating services and Turpie et al. (2003), provisioning and regulating services together with cultural services. Beaumont et al. (2014) only deal with regulating services. Thus, regulating services are the second ES type valued in a higher number of papers after cultural services.

In this context, recreational services are the cultural services which have been valued with a higher frequency by researchers focusing on coastal areas. In this sense, some authors have focused on valuing tourists' preferences for the recreational services provided by coastal areas of high ecological importance. This is the case of Font (2000), who estimates the recreational value attached to coastal protected natural areas in Mallorca, and Turpie et al. (2003), who measure, among others, the recreational value derived from the terrestrial and marine biodiversity of the Cape Floristic Region in South Africa. Estimating the preferences

of residents for the recreational opportunities offered by coastal habitats different from beaches and wetlands has captured the attention of most of the remaining papers. This is the goal of Östberg et al. (2012), who focus on valuing the possibilities for hiking, bathing, fishing and boating in two Swedish coastal areas with emphasis on water quality, noise and littering as site attributes; Petrolia and Kim (2009), who estimate, among others, the WTP for three restoration options for the Mississippi's barrier islands where recreational opportinities provided by these ecosystems are also considered; and Voke et al. (2013), who assess the recreational value of the marine environment in West Wales in a context in which a tidal stream turbine demonstration project is underway and larger array developments, both wave and tidal, are planned for the next few years. McGonagle and Swallow (2005) examine the role of public access in the WTP of residents for coastal land as open space in Rhode Island by considering a series of physical features of coastal parcels as well as some management attributes for their conservation. Interestingly, Durán et al. (2015) evaluate the social benefits of a maritime and fishing cultural heritage public conservation plan in Galicia, by defining fishing architecture and traditional boats as tangible cultural heritage, and fishermen's knowledge, folklore and other traditional knowledge relating to fishing activity as intangible cultural heritage. They state that the former can be enjoyed by viewing, scenery, among others.

Regarding the type of regulating services which have been valued, Petrolia and Kim (2009) focus on the hurrican protection service provided by the Mississipi's barrier islands, while Turpie et al. (2003) consider the beekeeping service of the Cape Floristic Region biodiversity. Beaumont et al. (2014) value blue carbon sequestration of the principal UK coastal margin habitats of saltamarsh, sand dune and machair duen grassland. When focusing on the provisioning services provided by coastal ecosystems, Turpie et al. (2003) measure the value of different coastal marine and terrestrial resources, such as seaweed, fish, rocklobster, abalone, other marine organisms, and fynbos and forest products.

Apart from the consumptive and non-consumptive direct use values assigned to provisioning and cultural services, respectively, and the indirect use value attached to the regulating services, two papers indicate they also estimate option values (Östberg et al., 2012; Turpie et al., 2003). Most of them (6 out of 8) also estimate non-use values through different stated preference (SP) methods. This is reasonable since some of them value biodiversity (Turpie et al., 2003), analyze attitudes towards environmental protection or respondents' environmental concerns that help to explain the WTP and/or value environmental attributes/impacts (McGonagle and Swallow, 2005; Petrolia and Kim, 2009). Voke et al. (2013) state they attempt to evaluate how the travel cost method and the contingent valuation method can be adapted to indicate the non-use values of a particular marine

habitat in West Wales. Durán et al. (2015) state that when it comes to cultural heritage, non-use values exceed use values, and Östberg et al. (2012) estimate bequest values.

3.4.2 Outcomes and policy implications

Results show support for coastal areas conservation. In particular, evidence is given that both tourists and residents value highly the ecological features of coastal areas, as well as their biodiversity. Indeed, McGonagle and Swallow (2005) show support for programs that favour certain water types and ecologically or scenically unique sites. They also find that provision of public access may not unambiguously increase the WTP to support conservation as individuals might view public access only as partially compatible with ecological quality. Similarly, when valuing marine and terrestrial biodiversity of the Cape Floristic Region (CFR), Turpie et al. (2003) show that the total economic value of the CFR is equivalent to over 10% of the regional Gross Geographic Product (at least R10,000 million per year), thus clearly outweighing the opportunity costs of protection at a national level. On the other side, Font (2000) finds that protection of coastal natural areas plays an important role in promoting the tourist product, while, when valuing restoration options for the Mississippi's barrier islands, Petrolia and Kim (2009) find that the primary concerns are hurrican protection, followed by the environmental impacts.

An interesting result is also given by Beaumont et al. (2014) who demonstrate that, "if current trends of habitat loss continue, the capacity of the coastal habitats to sequester and store CO_2 will be significantly reduced, with a reduction in value of around £0.25 billion UK sterling" over the period 2000-2060 (3.5% discount rate).

Economic valuation can contribute to decision-making in different settings. Valuation techniques can make discussions of trade-offs between different ES and associated beneficiaries more transparent when alternative development options are at stake (Beaumont et al., 2014). In this framework, five policy contexts have been identified where economic valuation can play an important role.

Firstly, as stated by Font (2000), it can contribute to the development of territorial, urban and environmental planning in areas where the tourist industry faces great structural problems. Secondly, it can also contribute to conservation of biodiversity patterns and processes and hence to successful conservation planning, which is of special concern for countries being signatories to the Convention on Biological Diversity. Turpie et al. (2003) state that conservation planning has to consider welfare maximization goals together with biophysical factors such as representativeness and connectivity when identifying areas for protection. Interestingly, they also state that, despite subsidies could play a role to persuade farmers to conserve natural vegetation or to enter into agreements to do so, "the only sure

protection against the plough is inclusion in strict protected areas or finding ways to make natural vegetation more valuable to landowners, such as through ecotourism ventures" with the help of government-funded marketing. They say that "incentives that work in the absence of agreements will have much more far reaching conservation benefits". Thirdly, economic valuation can also contribute to measuring the costs and benefits of policies aimed at achieving a good ecological status of surface and groundwaters, as required by the Water Framework Directive, and to undertake the economic analyses required by the EU Marine Strategy Framework Directive (Östberg et al., 2012). Fourthly, economic valuation can better inform policy makers when it comes to the assessment of energy development projects. Fifthly, and given the provision of cultural goods has been shown to positively affect the social welfare, economic valuation can also contribute to better design of maritime and fishing heritage conservation plans (Durán et al., 2015).

3.4.3 Research needs and challenges

According to the importance of biodiversity and ecological values, four major research needs have been identified. Firstly, the need for detailed spatial analysis of costs and benefits to estimate the optimum area of coastal land protection in a context in which the cumulative benefits of conservation usually increase at a decreasing rate, while the cumulative costs can be expected to increase at an increasing rate and hence the net benefit of an extra hectare under protection is expected to become negative beyond some point (Turpie et al., 2003). Secondly, and taking into account the ambiguous role of public access in the WTP for coastal land conservation, further research could assess whether individuals who prefer no access may be willing to accept some access if management succefully mitigates human-induced ecological impacts (McGonagle and Swallow, 2005). Thirdly, in a context of ES provided by barrier islands, Petrolia and Kim (2009) state that their work only addresses the question whether support for restoration exists and if so what scale of restoration would likely be supported. However, examining how the islands have to be restored and what type of restoration would be preferred would also be policy-relevant.

The fourth research need has been pointed out by Beaumont et al. (2014) and has to do with the need for addressing the existing uncertainty over the value of blue carbon sequestration if this value is to be incorporated into local, national and global policies as well as regulations. They believe "there is potential for considerable uncertainty in valuation estimates, arising from uncertainty in the C sequestration rate and the CO_2 price". Thus, on the one hand, they state there remains a need to more widely assess carbon stocks and organic sediment depths on the north and west UK coasts, which implicitly suggests the need for collaborative work between social and ecological sciences. Further information is needed to show "how the carbon sequestration rates vary with factors such as temperature, CO_2 concentrations, water table depth and UK location". On the other hand, and given

“carbon prices are increasingly applied to natural environments often with little consideration of what this price means”, they recommend developing robust values which are specific to the natural environment.

In terms of challenges, it is worth noting that, although Östberg et al. (2012) advocate for the use of their holistic political-ecological approach for the non-market valuation of the coastal environment, they recognize that whether people really understand and value what policies want to achieve as a whole is an issue of concern.

Another challenge is pointed out by Beaumont et al. (2014) regarding carbon sequestration and has to do with the difficulty of determining the overall net change of C sequestered resulting from conversion of coastal areas to urban or insfrastructure expansion or agricultural land claim. Indeed, although some of the sequestration rates are available, the authors state that the areas that might be converted are not. Another challenge has to do with the potential variability and uncertainty in the value of blue carbon sequestration depending on the discount rate.

In the context of developing countries, one challenge also emeges. As stated by Turpie et al. (2003), “although the existence value of coastal resources is high relative to terrestrial resources, the perceived societal value of coastal marine conservation lies mainly in securing local incomes related to tourism”. This, together with open-access to resources, leads to high incentives to mine marine resource stocks. In this setting, the authors state that “only under well-defined ownership, and in the absence of poverty, will resources be managed sustainably”. Despite limiting access to coastal areas either through MPAs or the limitation of access pointscould be a feasible option, they argue that for highly immobile resources, “local-level community or individual ownership is probably the only solution”.

Table 4. Papers concerning the valuation of services provided by coastal areas[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Font (2000)	Estimation of the value assigned by tourists to the recreational services provided by protected coastal natural areas in Mallorca.	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• The compensating variation is greater for the sites with a greater probability of being chosen. • The average of the site-specific compensating variations for the elimination of one of the areas is €52.27/tourist/choice period, and the population median for a 95% confidence interval falls between €29.65 and €33.68. • The natural areas play an important role in promoting the tourist product. (data collection: 1997)
Policy implications • There is a clear necessity for creating manageable and profitable strategies for natural areas. • Economic valuation can contribute to the development of territorial, urban, and environmental planning in a context where the tourist industry faces important structural problems.				
Turpie et al. (2003)	Estimation of the economic value of the terrestrial and marine biodiversity of the Cape Floristic Region (CFR), South Africa, and analysis of how the main agents of biodiversity loss impact on this value.	• Coastal marine resources (seaweed, fish, rocklobster, abalone, other marine organisms) • Fynbos products (food, medicines) • Forest products (timber) • Beekeeping • Tourism (beauty and floral diversity, whale watching, angling) (provisioning, regulating, and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Existence value (published and unpublished data, questionnaires, quantitative information, total net income, market prices, nature-based tourism expenditure, CVM)	• Harvesting of marine resources, such as linefish, rock lobster, abalone and bait species, is worth over R1,300 million/year, or R1.12 million/Km/year. • Harvests of fynbos products such as wildflowers and thatching reed, and forest products, timber and ferns, are worth R27 and R26/ha/year on average, respectively, and a total of R78 million/year. • The total economic value of the CFR is at least R10,000 million/year, equivalent to over 10% of the regional Gross Geographic Product. (2000Rands)
Policy implications • Conservation of the biodiversity of the CFR is an international priority and a major obligation for South Africa as a signatory to the Convention on Biological Diversity.				

• A successful conservation plan has to address the three main threats of alien invasion, land transformation and overexploitation. • In a society where economic development is critical to the nation's future wellbeing and where individuals act to maximise their own welfare, conservation action will only be successful if the incentive exists both from a public and private perspective. • Biodiversity values help to promote and justify conservation actions at the public policy and decision-making level, and are essential to define the optimal level of conservation. • Alien clearing subsidies alone are unlikely to persuade farmers to conserve natural vegetation, or to enter into agreements to do so, whenever land transformation is a more attractive option. • The only sure protection against the plough is inclusion in strict protected areas, or finding ways to make natural vegetation more valuable to landowners, such as through ecotourism ventures, with the help of government-funded marketing. • Incentives that work in the absence of agreements will have much more far reaching conservation benefits.				
McGonagle and Swallow (2005)	Examination of the role of public access in WTP for coastal open space preservation in Rhode Island.	• Physical features of parcels (shore type, water type, location, development type) • Management attributes (access level, law enforcement, special facilities) (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• Complex patterns in WTP as related to level of access and to attitudes toward access and environmental protection. • Residency (coastal or non-coastal), environmental attitudes, and access attributes produce WTP for the base parcel (sand, surf, rural location, not developed, not unique ecological and scenic quality, no access, irregular patrols, no rest rooms, no walking trails, boat ramp) in the range $1 and $122. • Support for programs that favour certain water types and ecologically or scenically unique sites. • Provision of public access may not unambiguously increase WTP to support conservation due to the fact individuals view public access only as partially compatible with ecological services. (data collection: 1994-1995)
Policy implications • Results contribute to understand market segments that may motivate heterogeneity in land conservation agents and that reveal opportunities to optimize conservation programs that serve heterogeneous populations. • Mixed policy strategies may offer agencies opportunities to serve multiple constituencies and to encourage cross-constituency support for open access programs. • Agents may evaluate preferences for access in relation to constituencies for conservation in order to identify a more efficient combination of access rights to negotiate within an easement or to determine when to pursue full ownership.				
Petrolia and Kim (2009)	Estimation of the WTP for three restoration options for the state's barrier islands in the state of Mississippi.	• Hurrican protection • Recreational opportunities • Environmental impacts • Impacts on business	• Indirect use value • Non-consumptive direct use value • Non-use value	• The WTP is $22/respondent to maintain the existing footprint over a 30-year period; $152 to increase land mass of the island by 36% (restore 2,338 acres) and maintain it for a 30-year period (pre-Hurricane Camille (1969) option); and $277 to increase land mass by 91% (restore 5,969 acres) and maintain it for a 30-year period (pre-1900 option) (Turnbull lower-bound) • For the Pre-Camille and Pre-1900 options, coastal residents and individuals citing storm protection, recreation impact and environmental impact as primary decision factors are more likely to support restoration, with marginal effects of these

		and other economic activity (regulating and cultural)	(CVM)	greater for the Pre-Camille option. • For the Status Quo option, 75% vote in favor of restoration and only the hurrican-protection and the environmental impact variables are significant. (2008$)
Policy implications				
• Results show support to restore the islands to their pre-hurricane Camille (1969) footprint, although respondents are not willing to pay for a restoration beyond that scale.				
Östberg et al. (2012)	Examination of the feasibility of using an approach for estimating the WTP for marine environmental improvements, based on a holistic, policy-determined scenario, in two Swedish coastal areas.	• Hiking, bathing, fishing and boating/water quality, noise and littering (cultural)	• Non-consumptive direct use • Option value • Bequest value (CVM)	• The mean WTP value for improved water quality is SEK102 for respondents from the East coast region, and SEK71 for respondents from the West coast region. • No statistically significant difference between the mean WTP value for less noise and littering of East coast region residents (46 SEK) and that of West coast regions respondents (38 SEK). (data collection: 2009)
Policy implications				
• Conducting valuation studies based on a policy-determined scenario is beneficial for decision-makers in terms of practical applicability but also for research in terms of data availability. • Valuation of noise and littering in archipelago provides important information for marine policy. • Quantification of costs and benefits associated with measures designed to achieve good ecological status is required by EU legislation such as the Water Framework Directive or the Marine Strategy Framework Directive.				
Voke et al. (2013)	Assessment of the value of the marine environment (beaches, cliff paths and urban areas) around St. David's peninsula in Pembrokeshire, UK, where a tidal stream turbine demonstration project is underway and larger array developments, both wave and tidal, are planned for the next few years.	• Recreational and amenity services/visual aspects and impact of wave height reduction (cultural)	• Non-consumptive direct use value • Non-use value (TCM and CVM combined in one questionnaire)	• The RP average value of £148/person attributed to the area through the travel cost incurred by visitors is higher than their SP average valuation of £6.70/person from a WTP CVM contribution (median values are slightly lower, at £5). • Local residents are much less willing to pay to conserve the local environment compared to visitors. • The final aggregated value for the Pembrokeshire National Park comes to £359.47 million/year in travel costs for the marine environment, and £266.63 million/year in travel costs for local wildlife. (data collection: 2011)
Policy implications				
• Only a small number of visitors (3.5%) would be put off revisiting the area due to renewable energy developments. • Underwater, non-visible devices have the least impact on people's enjoyment of the marine environment compared to surface based designs. • Results suggest that marine energy development projects should not affect tourist revenue.				

Beaumont et al. (2014)	Provision of the first comprehensive inventory of carbon stocks and sequestration for the principal UK coastal margin habitats of saltmarsh, sand dune and machair dune grassland, including change over time from 1900 to 2060.	• Blue carbon sequestration (regulating)	• Indirect use value (carbon price approach)	• If coastal habitats are maintained at their current extent, their sequestration capacity over the period 2000-2060 is valued to be in the region of £1 billion UK sterling (3.5% discount rate). • If current trends of habitat loss continue, the capacity of the coastal habitats both to sequester and store CO_2 will be significantly reduced, with a reduction in value of around £0.25 billion UK sterling (2000-2060; 3.5% discount rate). • If loss-trends due to sea level rise or land reclamation worsen, the above-mentioned loss in value will be greater. (the 2008 non-traded value of carbon is considered to hold for the years 2000-2060)
Policy implications • Results contribute to national and global policy and legislative frameworks in the context of coastal management. • Understanding the underlying processes which support C sequestration and storage enables the quantification of this ES, and in turn more effective sustainable environmental management. • Both monetary and non-monetary valuation can facilitate transparency in the discussion of trade-offs between different ES and associated beneficiaries when assessing development options.				
Durán et al. (2015)	Evaluation of the social benefits of a maritime and fishing cultural heritage public conservation plan in Galicia to be included in a broader conservation policy in the frame of European Commission recommendations.	• Tangible cultural heritage (fishing architecture and traditional boats), enjoyed by viewing, scenery, etc. • Intangible cultural heritage (fishermen's knowledge, folklore and other traditional knowledge relating to fishing activity) (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The WTP/household/year over 5 years is €18.36 for fishing architecture, €17.77 for fishermen's knowledge, €15.52 for other traditional knowledge, €9.82 for fishermen's folklore and €8.47 for traditional boats. • Support for the conservation of maritime cultural heritage, with higher WTP for intangible attributes, although there is a significant heterogeneity in the values obtained depending upon the attitudes of individuals regarding culture. (data collection: 2010)
Policy implications • The results show support for public intervention to conserve maritime and fishing heritage and may be used to design appropriate policies and economic incentives for preservation. • The analysis of the effects from conservation of maritime and fishing heritage can provide understanding of the real interactions between maritime activities, the economy and social wellbeing. • Although conservation's best efforts have traditionally focused on tangible heritage, results show that conservation policies should also consider intangible heritage issues.				

[a] Key: CE, choice experiment; CVM, contingent valuation method; ES, ecosystem service/s; RP, revealed preference; SP, stated preference; TCM, travel cost method; WTP, willingness-to-pay.

3.5 Inland and transitional waters

Economic valuation of services provided by inland and transitional waters can contribute to design strategies aimed to preserve these ecosystems in the framework of the integrated river basin management plans required by the Water Framework Directive (WFD). Indeed, economic valuation can provide information to policy-makers about the benefits of achieving 'Good Ecological Status' (GES) for the waters of the member states, thus giving guidance on the social desirability of alternative options as well as on the disproportionality of some of them (Atkins et al., 2007; Hanley et al., 2006). Valuing the services provided by inland and transitional waters can also help to design policies oriented to protect and improve the cultural dimension of freshwater ecosystems.

Table 5 reports a list of papers dealing with the valuation of services provided by inland and transitional waters. It presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As shown in the Table 5, there has been a growing interest in valuing the services provided by this type of ecosystem, as almost half of the papers have been published during the last five years (10 out of 22) with a majority of them focusing on rivers and lakes (8 out of 10). In fact, rivers and lakes are the ecosystems which have captured a major attention among researchers during the last 16 years (12), followed by estuaries and catchments/watersheds (8). Only two studies frame the analysis in developing countries (Ojeda et al., 2008; Wang et al., 2013). Most of papers employ stated preference (SP) methods (14) and only one study uses, apart from a choice experiment (CE), a benefit transfer (BT) approach (Hanley et al., 2006). Johnston et al. (2002) summarize four integrated economic studies each of them using a different valuation technique (hedonic analysis (HA), travel cost method (TCM), wetland productivity method, a contingent approach). More than half of the papers estimate non-use values attached to inland and transitional waters.

3.5.1 Ecosystem services and values

Cultural services provided by inland and transitional waters are the type of ecosystem service which has captured the major attention among valuation researchers. Indeed, many papers (15) value only this type of services, while others value cultural services together with either provisioning services (Becker et al., 2012; Wang et al., 2013) or supporting services (Johnston et al., 2002). Ojeda et al. (2008) value cultural, provisioning and regulating services, and Zander et al. (2010) and Zander and Straton (2010) value cultural, provisioning and supporting services.

Following cultural services, provisioning services are the second type of ecosystem services which have been valued in many papers (5). Supporting services have been valued in 3 papers, followed by regulating services, valued in 2 studies. Indeed, besides Ojeda et al. (2008), Kragt and Bennett (2011) have also valued regulating services, these being the only type of final ES object of their valuation when analysing community preferences for natural resource management options in the George catchment in Tasmania.

Recreational opportunities and services provided by inland and transitional waters are the cultural service that has been valued in most papers (19). In this context, half of the studies put emphasis on estimating the value of water quality as an important determinant of the recreational value (Atkins et al., 2007; Johnston et al., 2002; Kataria et al., 2012; Miller et al., 2015; Phaneuf et al., 2013; Söderberg and Barton, 2013; Tuttle and Heintzelman, 2015; Wang et al., 2013).

Regarding provisioning services, water supply for irrigated agriculture has been the focus of the majority of papers concerned with this type of services (Becker et al., 2012; Wang et al., 2013; Zander and Straton, 2010; Zander et al., 2010), followed by fisheries (Becker et al., 2012; Ojeda et al., 2008). Provision of nursery and habitat services (Johnston et al., 2002) and supporting habitat for a diversity of plants and animals (Zander and Straton, 2010; Zander et al., 2010) are the two types of supporting services valued in the reviewed studies, while dilution of pollutants (Ojeda et al., 2008) and erosion control (Kragt and Bennett, 2011) have been the regulating services which researchers have focused on. It is worth noting that provision of nursery and habitat services and dilution of pollutants are valued as services provided by wetlands. Indeed, the former is the study object of one of the four works analyzed by Johnston et al. (2002) in their paper about the resource preservation and restoration decisions for the Peconic Estuary System of Suffolk County, which focuses on wetland productivity values. The latter is one of the services Ojeda et al. (2008) examine in the context of the Yaqui River Delta, which is another wetland area. However, as this paper pursues to value the environmental services provided by restored instream flows in the water-scarce Yaqui River Delta, it has been classified in this section.

Non-consumptive direct use values have been estimated for the cultural services, while consumptive direct use values have been quantified when provisioning services have been considered. Some authors have also estimated option values linked to either recreation (Kotchen and Reiling, 2000; Zander and Straton, 2010; Zander et al., 2010) or provisioning and cultural services (Becker et al., 2012; Ojeda et al., 2008). In particular, Becker et al. (2012) only refer to ‘direct use values’ which have been attributed, in this report, to provisioning and cultural services due to the information given to respondents in the CVM. As these authors do not make a clear distinction between these two types of direct use

value, it has been assumed that option values are linked to both provisioning and cultural services. Similarly, as Ojeda et al. (2008) do not indicate if option values refer to recreation, it has been assumed they are associated with both provisioning and cultural services too. Indirect use values have been estimated for regulating services as well as for the supporting services considered in the reviewed papers.

Many papers concerned with services provided by inland and transitional waters estimate non-use values through SP methods. This is reasonable since almost all of them consider cultural services and non-use values are commonly attached to this type of service. In this sense, many studies clearly indicate they estimate non-use values related to cultural values. This is the case of Kotchen and Reiling (2000), who estimate existence, bequest, existence and altruistic values attached to viewing shortnose sturgeon and peregrine falcons; Zander et al. (2010) and Zander and Straton (2010), who estimate bequest and existence values related to cultural services provided by waterholes in good condition for Aboriginal activities; Macdonald et al. (2011), who associate the non-use values to the unique ecological, historical and cultural importance of the River Murray and the Coorong to Australians; Becker et al. (2012), who estimate non-use values assigned to the historical, cultural and spiritual tourism possibilities offered by the Jordan River and the Sea of Galilee as well as the unique geographical, biological and historical features of the Dead Sea; and Miller et al. (2015), who estimate non-use values linked to Maori cultural values as well as the social value associated to the number of jobs related to agricultural land-use.

Non-use values are also usually expressed for biodiversity/habitat. Accordingly, for some papers applying SP methods which do not cleary state they estimate non-use values, it has been assumed they also estimate non-use values if they value one or more environmental attributes in a CE or, for contingent valuation studies, if environmental attitudes and/or concerns have been proved to drive the WTP. This is the case of a series of works which focus on estimating the WTP for water quality improvements: Hanley et al. (2006) and Kataria et al. (2012) in the field of CEs, and Atkins et al. (2007), Söderberg and Barton (2013) and Wang et al. (2013) in the context of CVM. Indeed, Hanley et al. (2006) define CE policy scenarios in terms of combinations of ecological improvements, while Kataria et al. (2012) estimate the WTP for water quality improvements in a framework in which water quality serves to define the environmental conditions for fish and plants. Hanley et al. (2006) estimate non-use values relative to the local agricultural jobs which can be lost or gained through the alternative water management policies. On the other side, Söderberg and Barton (2013) explain to respondents that the diversity of birds and plants also helps to describe the water quality, while Wang et al. (2013) find that people who believe the project will improve the ecosystem health and ecological conditions also value the project. When assessing the WTP for a reduction in eutrophication, Atkins et al. (2007) state that a low

water quality is likely to affect the use and non-use values which are usually attached to marine ecosystems. Besides, 43% of respondents have heard of euthophication identifying macroalgal mats, foaming on local beaches, fish kills and reduced water clarity as its most common symptoms.

Kragt and Bennett (2011) focus on regulating services and hence estimate indirect use values, but we consider that they also measure non-use values, as all the CE attributes represent environmental conditions of the George catchment in Tasmania: native riverside vegetation, which they state that, appart from reducing risk of erosion, contributes to the natural appearance of the river, is important for many native animals and plant species and provides shelter for livestock; rare native animals and plants species; and seagrass area.

3.5.2 Outcomes and policy implications

Studies show social support for strategies aimed at increasing the environmental quality of inland and transitional waters as well as that pro-environmental attitudes result in higher WTP estimates (Kotchen and Reiling, 2000). An improvement in the ecological conditions of estuaries and catchments have been shown to lead to an increase in individuals' welfare (Atkins et al., 2007; Hanley et al., 2006; Kragt and Bennett, 2011; Whitehead et al., 2000). Some studies have shown how the value of environmental quality is capitalized into the value of coastal land and hence into the housing markets linked to coastal areas. Phaneuf et al. (2013) find evidence that proximity to water resources, access to recreation sites, and the water quality at these sites are positively related to property values.

In this context, some studies have put emphasis on showing the effects of water quality on recreational values of estuaries and catchments. This is the case of Phaneuf et al. (2013) in an urban watershed setting; Johnston et al. (2002), who analyze a study where water quality is stated to affect swimming, boating, fishing and bird and wildlife viewing; and Atkins et al. (2007), who examine the WTP for a reduction in eutrophication in the Randers Fjord, which offers recreational opportunities to residents and tourists and where the most popular activity is enjoying the views and the sounds of the water. A focus on euthropication issues has also been central in Hanley et al. (2006), which examine the impacts of water quality on the aesthetic values of two small catchments in Scotland. Indeed, they focus on estimating the WTP for improving smells and visual appearance-related problems derived from non-point pollution from agriculture and find that a "big improvement" in river ecology is the most valued change (household WTP is £24–28 per annum over the base case of "worsening" ecological conditions in the independent preferences model, and £23–36 in the correlated preferences version).

The effects of eutrophication and acidity on recreational values have also been an issue of concern among researchers focusing on the services provided by freshwater ecosystems, especially lakes. Indeed, Söderberg and Barton (2013) evaluate the sensitivity of distance decay in the WTP for water quality improvements in eutrophied lakes in Norway; Wang et al. (2013) reports a valuation study which estimates the total value of a real investment project to improve the water quality of Lake Puzhehei in China, which "is currently at a perilous turning point between medium and heavy eutrophication"; and Tuttle and Heintzelman (2015) uses hedonic analysis to explore how property owners value lake water quality in the Adirondack Park of the State of New York which is threatened by acid and mercury deposition. These authors view water quality as an environmental amenity and hence focus on its effects on recreation, tourism and scenery finding positive WTPs for water quality improvements.

When it comes to rivers, water quality is not only an issue of concern in terms of its effects on recreational activities and tourism, but also in terms of its effects on habitat conditions. Indeed, Kataria et al. (2012) define water quality in four quality categories, in terms of conditions for fish and plants, the recommended use of the river for fishing (coarse and game fishing) as well as for bathing, boating and birdwatching, and show that the average marginal WTP for improving Stretch 1 to the quality that corresponds to "very good" is 586 DKK. On the other side, Miller et al. (2015) relate water quality to habitat conditions finding a positive WTP for all attributes where the change from poor to excellent habitat quality is valued highest ($123/year).

Social support for improvements in the environmental quality of inland and transitional waters is not the only policy-relevant result identified in this review. Indeed, the protection and improvement of the cultural dimension of some rivers, which has also been found to be important, is of great interest for policy-makers. Sometimes, this dimension is related to cultural values associated with indigenous communities living in the area. In this context, Miller et al. (2015) find that Canterbury residents are willing to pay $28/year to enhance Maori cultural attributes of freshwater ecosystems in New Zeland (while Maori are willing-to-pay $40/year). On the other side, Zander et al. (2010) find, when assessing the benefits of different management options for the tropical rivers Daly, Mitchell and Fitzroy in northern Australia, that the highest absolute marginal WTP estimates are for cultural services (AU$238 from poor to good condition) while Zander and Straton (2010) find, when exploring differences in preferences between Aboriginal and non-Aboriginal Autralians, that the WTP of the former is significantly higher than that of the latter for some river attributes, particularly those related to cultural values. Indeed, the largest discrepancy is found for the attribute "condition of waterholes" where the difference equals $437.

In other cases, the cultural dimension has to do with the historical and cultural importance of the river, as happens in Macdonald et al. (2011) when focusing on the services provided by the River Murray and the Coorong in Australia. These authors find high implicit values for all the environmental attributes which can be explained by the unique ecological, historical and cultural importance of the river. Likewise, Becker et al. (2012) find, in their cost-effective analysis of two options to increase the water supply in Israel, desalinating water from the Mediterranean Coast is preferred than diverting water from the Sea of Galilee when the existence and bequest values related to the heritage values of Sea of Galilee, the Jordan River and the Dead Sea are taken into account.

Economic valuation of preferences for environmental quality of inland and transitional waters as well as for protection of cultural values of freshwater ecosystems can help to determine the net benefits of alternative policies aimed at ensuring the preservation of these ecosystems (Bergstrom et al., 2004; Wang et al., 2013; Whitehead et al., 2000; Zander and Straton, 2010; Zander et al., 2010). This is especially true in a context in which the WFD requires member states to improve surface and ground water quality to a GES through integrated river basin management plans whose benefits and costs have to be considered. Knowledge about preferences is important given that the development of EU water quality legislation is imposing significant costs on European economies. So, following Atkins et al. (2007)'s words, "when this policy intervention and associated management action imposes substantial costs on the local community their support for such measures is imperative".

In this context, and especially for small catchments, the tight time schedule the WFD imposes on member states to develop catchment management plans makes the BT method an appropriate one. In particular, as stated by Hanley et al. (2006), it might be "crucial to estimating benefit/cost ratios, and thus identifying cases of disproportionate costs for which derogations can be sought".

Kataria et al. (2012) also point out that environmental cost-benefit analysis (ECBA) can be used to inform member states in their decisions on derogations based on disproportional costs. Interestingly, they show that including respondents who disagree or disbelieve the survey information leads to biased welfare estimates. . In contrast, Söderberg and Barton (2013) find that "WTP for water quality may be more useful as a qualitative indicator of political support for user financed water quality measures, than as a cardinal measure of marginal utility of water quality improvements", which could have implications for BT and the use of benefit estimates to justify measures under the WFD. Indeed, their results suggest that "contingent valuation data do not have enough spatial resolution to be used in evaluating 'disproportionate costs' under the WFD".

The estimated values can also be used by policy makers “in the design and implementation of water buy-back programmes, investments in infrastructure and habitat rehabilitation”, as stated by Macdonald et al. (2011). Indeed, these authors argue that values at the state level can be used in decision-making processes when it comes to “community consultation, negotiation and implementation of water sharing plans in the Murray-Darling Basin”. Becker et al. (2012) also state they can be used as a decision tool for an integrated water management policy.

Other authors propose to use the values to design taxes aimed at funding the costs of cleaning up a toxic site. This is what Chattopadhyay et al. (2005) suggest in their assessment of the benefits of cleaning up a toxic site. Likewise, Tuttle and Heintzelman (2015) state, when exploring the relationship between lake water quality, ecological indicators and property values, that property owners “may be willing to self-fund initiatives to prevent the spread of localized detriments like aquatic invasive species” if they have information about the impacts of water quality on their properties.

Some studies show evidence of the potential impacts of congestion on the resource usage. These results are policy relevant in a context in which preferences for use and congestion are heterogeneous and hence congestion could be an “effective rationing device” (Schuhmann and Schwabe, 2004).

In this framework, estimation of option, existence and bequest values has been argued to be necessary to manage sustainably water resources over the long-term, especially in a context of water-scarce basins (Ojeda et al., 2008). When it comes to resources with non-use values related to indigeneous cultural vaues, measuring these values is also of great policy relevance as its omission could have impacts on welfare estimates and subsequent decision making. As stated by Miller et al. (2015), “it is important to ensure these cultural values are respected and understood when considering freshwater related development in the region”. Also, preference heterogeneity needs to be considered when estimating community WTP for environmental changes (Kragt and Bennett, 2011).

Understanding the value of conservation of inland and transitional waters can lead to better informed policy makers which can more accurately assess the costs and benefits of conservation plans. In this context, Johnston et al. (2002) state that it is also critical that decision makers understand the economic methods employed to deal with coastal policy issues as well as the implications for both the resource being managed and values measured. This is becuase choices among alternative policies can have important implications for estimated benefits and costs.

3.5.3 Research needs and challenges

Research needs and challenges have been identified according to three major areas, namely valuation in the context of estuaries; information, prior knowledge and attitudes; and the assessment of cultural values.

The first group of needs for further research is derived from papers concerned with valuation of services provided by estuaries. Indeed, when measuring the recreational benefits of a given estuarine quality improvement, Whitehead et al. (2000) state that future research with revealed and stated behavior data should investigate the effects of changes in the quality change variable. Additionally, they point out further work should explore the sensitivity of their results to different assumptions about substitute sites. They also suggest future research should examine if stated behavior models lead to hypothetical bias. On the other side, Bergstrom et al. (2004) state that more studies estimating the recreational fishing benefits of estuary restoration are needed "in other coastal areas and situations to provide comparative measures of the responsiveness of fishing trips to fishing success". Atkins et al. (2007) make reference to the difficulties to apply their method and transfer their findings to similar catchments across Northern Europe. They also state that most estuarine systems across Europe drain much larger catchments than the Randers Fjord, which makes difficult to identify the cause and effect of eutrophication controls. They argue that "as more studies are undertaken, common features of public preferences may become apparent, allowing for a greater role for prediction to inform policy makers about the extent and nature of public support for their actions in this field".

The two major challenges have been identified in the context of watersheds. First, the need for collaboration between the ecological and the economic fields. Indeed, Kragt and Bennett (2011) state that assess the impacts of catchment management, "decision makers need both scientific data on environmental changes and information about the economic values of changes in catchment environment goods and services". Second, Phaneuf et al. (2013) suggest that it is relevant to consider the spatial dimensionality of non-market valuation methods as the economic costs of deterioration of watershed quality reflect spatial differences in residential development.

Wang et al. (2013) state that future studies are needed to understand the impact of prior knowledge on the WTP and use such information to calibrate the WTP estimation. Indeed, when estimating the total value of a real investment project to improve water quality of Lake Puzhehei, they find that "people who noticed the water quality change, heard about the project, or observed press discussions about the water quality change and the related issues, generally value the water quality improvement more than those who did not". These authors also point out the need for further research to understand interviewer effects across

different contexts. Indeed, they also find, in contrast with the studies conducted in developed countries, that individuals provide lower WTPs if they are aware that those implementing the questionaire know their reported answers.

The third group of research needs and challenges has to do with papers focusing on measuring cultural values attached to rivers by indigenous communities. Indeed, when it comes to measuring the impact of changes in the non-use values of tropical rivers on Aboriginal Australians' welfare, Zander and Straton (2010) suggest that more research is needed on the use of different proxies for the cost attribute such as travel distances. They find the management cost is not cited as important for the choices of most Aboriginal respondents, which they consider reasonable since indigenous communities might be unfamiliar with paying for water quality improvements. Therefore, they consider it might be more appropriate to use non-monetary payment vehicles for the indirect calculation of welfare estimates to ensure these welfare impacts are incorporated into decision-making.

Miller et al. (2015) also talk about the risk of not communicating cultural values appropriately. However, they state that one reason for the lack of research of indigenous cultural valuation has to do with the critique involved with monetisation of cultural values. In this context, they say that "the difficulty of measuring these values in money metric should be confronted rather than ignored". According to them, the authors consider that future research should explore other ways to measure and present the culture attribute (e.g. comparing verbal and numeric versions), or to include other attributes which may influence the WTP. In this sense, they argue further work could also examine "preference heterogeneity regarding where the outcomes would occur or who would benefit, such as improvement in local rivers or local employment". On the other side, Miller et al. (2015) also state that preferences may differ over culturally important resources and hence "another research direction could explore preferences towards practical means to provide these benefits, such as Māori culture-specific management practices".

An interesting challenge emerges when it comes to measuring cultural values attached by indigeneous communities: modifying not only the CE design but also the valuation procedure is necessary to better suit the Aboriginal context of community relationships and kinship. In this sense, Zander and Straton (2010) suggest that "a better setting for a CE could be in a group setting in which family members can discuss the choice sets and make a communal choice". However, the authors recognize this would imply interacting with many groups and respondents in order to achieve statistical power and to fulfil sample size requirements. So, to reduce the required number of group discussions, they suggest "increasing the repetitions for each group and keeping the design as simple as possible".

Table 5. Papers concerning the valuation of services provided by inland and transitional waters[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Kotchen and Reiling (2000)	Analysis of environmental attitudes and estimation of non-use values for protection of peregrine falcons and shortnose sturgeons in the mouth of the Kennebec river, Maine.	• Shortnose sturgeon and peregrine falcons viewing (cultural)	• Option value • Existence value • Bequest value • Altruistic value (CVM)	• The mean WTP is approximately $26 for the peregrins and $27 for the sturgeon. • The weakest attitudes yield a mean WTP below $5 for both species; moderate attitudes yield a WTP of about $25 for both species; and strong attitudes result in a mean WTP over $40 and $50 for the peregrine and sturgeon, respectively. • Pro-environmental attitudes are associated with stronger reliance on ethical motives for species protection. (data collection: 1997)
Policy implications • Attitudes toward the environment help interpret responses to valuation questions. • Studies integrating attitudinal measures and CVMs allow gaining a better understanding of the influence of environmental attitudes.				
Shafer et al. (2000)	Estimation of the economic value of Lake Erie/Presque Isle Bay, Susquehanna River, Delaware River, Kinzua Reservoir, Lake Wallenpaupack, and Raystown Lake as major power boating resources in Pennsylvania.	• Recreational power boating (cultural)	• Non-consumptive direct use value (TCM)	• The annual total value for these resources is U$396 million, which is 2.5 times greater than the total out-of-pocket expenditures that approximately U$157 million visitors spend to visit these areas. (1994$)
Policy implications • Economic valuation can help resource managers to plan and design programs and policies that are founded on economic values of the natural resources involved.				
Whitehead et al. (2000)	Measurement of recreation benefits of a fixed estuarine quality improvement in North Carolina.	• Recreational services/estuarine quality improvement (cultural)	• Non-consumptive direct use value (combined revealed and stated behavior estimation method/TCM)	• The aggregate CS with current quality is about US$88 million for the Pamlico and US$107 million for the Albemarle and Pamlico Sounds combined. • The change in CS from the quality improvement is about US$25 million for the Pamlico Sound and US$31 million for the Albemarle-Pamlico Sounds. • A quality improvement to pre-1981 levels leads to an aggregate CS of US$113 million and US$138 million for the Pamlico and Albemarle–Pamlico Sounds, respectively. (1995 US$)

Policy implications • Results can be compared to estimates of the policy's costs to determine the net benefits of the policy to society.				
Johnston et al. (2002)	Summary of four integrated economic studies undertaken to contribute to resource preservation and restoration decisions for the Peconic Estuary System (PES) of Suffolk County, New York	• Amenity services/scenery (study 1) • Swimming, boating, fishing and bird/wildlife viewing/water quality and catch rates (study 2) • Nursery and habitat services of wetlands (study 3) • PES natural and environmental resources (study 4) (supporting and cultural)	• Non-consumptive direct use value • Indirect use value • Existence value (HA/study 1, TCM/study 2, wetland productivity/study 3, contigent choice/study 4)	• A parcel of land located adjacent to preserved open space has, on average, 12.8% higher per-acre value than a similar parcel located elsewhere. • Bird and wildlife viewing has the highest value ($27.3 million). • Recreational fishing is the most valued water-based activity ($23.7 million). • Eelgrass productivity has a value of $1,065/acre/year. • Salt marshes value is $338/acre/year. • Intertidal mud flats value is $67/acre/year. • The annual values/acre/household/year range from $0.016 for undeveloped land to $0.087 for farmland. • The total value/acre is $14,024 for undeveloped land and $74,562 for farmland (discounted over 25 years at a 7% discount rate). • Recognition of areas of potential overlap among values estimated using different methodologies. • There are cases where valuation methods used in isolation may lead to misleading or incomplete policy conclusions. (sales data for all real estate parcels sold in the Town of Southold during 1996 of study 1/1995US$ in the rest of studies)
Policy implications • As choices among competing approaches can have important implications for estimated benefits and costs, managers should understand the economic methods brought to bear on coastal policy issues, and implications for specific type of resources addressed and values measured. • A multi-methodology approach may provide policy insights regarding a wide range of coastal resources. • Knowledge of different methods can help managers assess whether these methods provide relevant information, and which specific approaches are appropriate to given policy scenarios. • Due to lack of funding for such large scale research, managers must choose the most appropriate research agenda given the set of resources and resource services under consideration.				
Bergstrom et al. (2004)	Estimation of the recreational fishing benefits of estuary restoration and protection in the Lower Atchafalaya River Basin estuary along the Gulf of Mexico, Louisiana.	• Saltwater recreational fishing/catch rates (cultural)	• Non-consumptive direct use (combined actual and intended TCM)	• Mean WTP/person/trip is $30.73 (95% CI: $27.20-$34.26). • Changes in catch rates have a minor effect on annual fishing trips/angler, but total effects may be large when effects/angler are aggregated across total anglers. • These effects may depend on users and fish populations, environmental conditions, and fishing experiences. (1999 US$)

Policy implications • Resource managers should consider the effects on angling trips when evaluating projects that influence the ecology of coastal estuaries, fish populations, and catch rates. • Economic benefit and cost information can provide useful inputs into decision-making processes by quantifying estuary restoration and protection benefits and costs in commensurate terms in a context of need for allocation of limited funds to the highest priority areas. • As one of the expected outcomes of policies and programs to restore and protect estuaries is improvement in fish habitat and populations, resource managers may need to translate changes in fish habitat and populations to changes in economic benefits in order to evaluate alternative restoration and protection programs. • Improvements in fish habitat and populations can lead to economic benefits through increases in recreational game fish catch.				
Schuhmann and Schwabe (2004)	Comparison of alternative measures of congestion to explain site choice, and analysis of both how the response to congestion measures may differ across "catch and keep" anglers and "catch and release" anglers and which the implications of those differences on WTP/trip for stock enhancement are in the Roanoke River Management area, North Carolina.	• Recreational fishing /catch rate (striped bass), congestion, public access (cultural)	• Non-consumptive direct use value (TCM)	• The CV for a 25% increase in the expected catch ranges from $6.60 to $36.98 for the release anglers, and from $2.67 to $9.74 for the keep anglers (depending on how expected congestion is characterized). • Less support for definitive conclusions about anyone of the eight measures of expected congestion examined. (data collection: 1998)
Policy implications • As users likely differ in both their preferences for use and aversion to congestion, knowledge of the impacts of congestion on resource use is important for policy making because congestion can be used as an effective rationing device. • Heterogeneous preferences among recreational anglers for different quality characteristics can have important implications for how these resources are managed.				
Chattopadhyay et al. (2005)	Comparison of conjoint choice and HA to estimate the benefits of cleaning up Waukegan Harbor, a Superfund site on the Great Lakes.	• Amenity and recreational services (cultural)	• Non-consumptive direct use value (HA and conjoint choice)	• Property value appreciation is $249 million and $535 million for partial and full cleanup, respectively (conjoint choice). • The value of eliminating the proximity effect associated with the hazardous site ranges from $166 million to $273 million if elimination if partial, and from $380 million to $594 million if elimination is complete (HA). • The present value of the tax revenue from the property value appreciation is estimated at $14.46 million for ''full cleanup'' (conjoint choice). • The projected increases in tax revenue for a complete elimination of the negative proximity effects range from $10.25 million to $16.02 million (HA) (2000US$)

Policy implications • As tax revenues resulting from cleanup should more than cover the City of Waukegan's share of the remediation costs, tax increment financing is a feasible option to fund cleanup. • Studying the welfare implications of cleaning up a toxic site is policy relevant as it involves investigating the differential impact of the site on the properties across nearby locations.				
Hanley et al. (2006)	Testing of the transferability of benefit estimates of water quality improvements for two small catchments in eastern Scotland where agricultural-source non-point pollution and irrigation water abstraction are the main threats to ecological status. The paper also examines the most appropriate methods to apply to transfer testing.	• Amenity services/smells and visual appearance, water quality (cultural)	• Non-consumptive direct use value • Non-use value (CE, BT)	• Household WTP for a "big improvement" in river ecology over the base case of "worsening" ecological conditions is £24–28/year (independent preferences model), and £23–36/year (correlated preferences version). • A reduction in the number of low-flow instances is valued at £2.70–3.87/household/month reduction in low flows (uncorrelated case), and £3.20–3.74 (correlated case). • Values associated with improvement in the Brothock catchment tend to be higher than those for the Motray catchment, but not always significantly so. • Implicit prices for river quality attributes are transferable across catchments. (data collection: 2004)
Policy implications • For large catchments, the costs of raising water quality to GES may be high enough to justify the use of primary valuation studies to estimate benefits, although this is not necessarily the case given the tight time schedule the Water Framework Directive imposes on member states to develop catchment management plans. • For smaller catchments, BT are crucial to estimating B/C ratios, and thus identifying cases of disproportionate costs for which derogations can be sought. • Caution is needed when transferring benefit estimates as the study does not incorporate socio-economic variability across the two catchments when it seems to be important for BT accuracy. • Choice modellers interested in BT need to consider allowing for correlated preferences in their models, since it seems to make a difference to the size and transferability of benefits.				
Atkins et al. (2007)	Investigation of public preferences for reduced eutrophication in the Randers Fjord, Denmark.	• Recreation and tourist services • Enjoying views and sounds of the water (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• A majority of respondents are in favour of the action plan, with a mean WTP (in terms of a local tax) of DKK57 (€7.64)/person/month over a 10-year period. • The value of the potential benefit from improved water quality may be DKK22.8 million (€3.06 million)/month over the 10-year period of the proposed action plan. • Eutrophication issues seem to be more important than traffic noise but less of a problem than lake and soil acidification, and a greater problem than other social and economic issues. (data collection: 2003)
Policy implications • Strong public support for the introduction of an action plan to reduce nutrient inputs from water treatment plants and agricultural sources in this estuarine system. • When policy interventions and associated management actions impose substantial costs on the local community, the social support for such measures is imperative.				

Ojeda et al. (2008)	Estimation of the economic value of environmental services provided by restored instream flows in the water-scarce Yaqui River Delta, Mexico.	• Maintenance of local fisheries • Dilution of pollutants • Recreation • Preservation of riparian vegetation, wetlands, and estuaries • Preservation of habitat for birds and other fauna (provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Existence value • Cultural value • Bequest value (CVM)	• Households are willing to pay Pesos73/month. • WTP is related to income, educational level, number of children in the household, and initial bid amount. • Most of the total value is associated with the non-use values related to future use and future generations. (data collection: 2006)
Policy implications • Estimation of existence, option and bequest values is necessary if water resources want to be managed in a sustainable manner over the long-term under unknown conditions, which is especially important in water-scarce basins.				
Zander et al. (2010)	Assessment of the benefits of different management strategies for the tropical rivers Daly, Mitchell and Fitzroy in northern Australia.	• Area of floodplain in good environmental condition (supporting habitat for a diversity of plants and animals and no weed cover) • Water supply/irrigated agriculture • Recreational services • Conditions of waterholes important to Aboriginal people (supporting, provisioning and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Bequest value • Existence value (CE)	• The WTP for an increase of fishing quality from “1-star” to “4-star” is $126; from “1-star” to “3-star” is $74; and from “3-star” to “4-star” is $52, ceteris paribus. • The highest absolute marginal WTP is for cultural services (AU$238 from poor to good condition). • There is a welfare loss from “low income from irrigated agriculture” compared to “high income from irrigated agriculture” and respondents ask for a compensation of $96. • Respondents are willing to pay $35 for medium income over high income from irrigated agriculture. • Respondents derive the highest utility from “development constrained by conservation”. • “Development first” provides the lowest value to urban Australians. • Respondents are willing to pay for high cultural values. (data collection: 2008)
Policy implications • Economic valuation results can contributre to ECBA of tropical river management alternatives.				

• The fact that urban Australians, who account for the majority of the Australian society, obtain higher welfare from tropical river management based on "development constrained by conservation" or "conservation first" than from a "development first" strategy represents a paradigm shift in Australian public opinion that has yet to be translated into legislation or policy.				
Zander and Straton (2010)	Assessment of the potential impact of development/management strategies for the tropical rivers Daly, Mitchell and Fitzroy in northern Australia, and analysis of the differences between the preferences of Aboriginal and non-Aboriginal Australians living in the catchment areas.	• Area of floodplain in good environmental condition (supporting habitat for a diversity of plants and animals and no weed cover) • Water supply/irrigated agriculture • Recreational services • Conditions of waterholes important to Aboriginal people (supporting, provisioning and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Bequest value • Existence value (CE)	• The welfare change associated with a change in the area of floodplain in good environmental condition represents a loss of between \$41 and \$128/household for a change from small area to medium, and a gain of between \$28 and \$92/household from medium to large (panel-RPL with interactions). • Welfare estimates seem to be larger for Aboriginal respondents than non-Aboriginal respondents, the largest discrepancy being found for the attribute "condition of waterholes" where the difference equals \$437. • Aboriginal respondents are indifferent towards water extraction for irrigated agriculture, while non-Aboriginal people prefer moderate rather than large or small scale use. • Most respondents prefer healthy river systems managed under conservation schemes even if it comes at a private cost. • The management cost is important for the choices of most Aboriginal respondents. (data collection: 2008)
Policy implications • Information about the impacts of potential development scenarios on the welfare of Aboriginal Australians can be used in ECBAs, which is of especial relevance in a context in which they represent a large and growing proportion of the population and are also significant landowners. • Knowledge of welfare estimates and their differences between Aboriginal and non-Aboriginal Australians is useful to decision-makers as they show the welfare impacts of changes in tropical river systems where none is previously available. • Welfare estimates can give guidance on the appropriateness of actions that despite not having tangible financial benefits may have environmental, recreational or cultural benefits.				
Kragt and Bennett (2011)	Assessment of the community preferences for the protection of rivers and estuary in the George catchment in north-east Tasmania.	• Reduction of risk of erosion by native riverside vegetation • Length of native riverside vegetation • Number of rare native animal and plant species • Area of healthy seagrass beds in the Georges Bay	• Indirect use value • Non-use value (CE)	• Median WTP is \$0.11 for a hectare increase in seagrass area (significant at the 10% level), \$3.91 for a kilometre increase in native riverside vegetation and \$8.62 for the protection of each rare native animal and plant species, compared to the base level, ceteris paribus. • Considerable variation in preferences towards the attributes. • Value estimates are significantly impacted by the way in which preference heterogeneity is accounted for.

		(regulating)		(data collection: 2008)
Policy implications				
• Economic valuation can contribute to natural resource management options in the George catchment. • There is an increasing requirement for natural resource managers to incorporate environmental and socio-economic trade-offs in their decision-making processes. • Preference heterogeneity needs to be considered when estimating community WTP for environmental changes. • To enable an assessment of the various impacts of catchment management, decision makers need both scientific data on environmental changes and information about the economic values of changes in catchment ES.				
Macdonald et al. (2011)	Estimation of the WTP for improvements in environmental quality in the River Murray and the Coorong, Australia.	• Ecological, historical and cultural services/waterbird breeding along the River Murray, native fish populations in the River Murray, healthy vegetation along the River Murray and waterbird habitat in the Coorong (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The WTP to increase the frequency of waterbird breeding by 1 year ranges from $12.00 to $18.64/year for 10 years, while the WTP for an increase in frequency from once every 10 years to every year is $107.97–$167.80/year for 10 years. • The WTP for a 1% increase in native fish populations ranges from $1.71 to $3.58/year for 10 years. • The WTP for a 1% increase in healthy vegetation is from $2.87 to $4.42/year for 10 years. • The WTP to improve waterbird habitat ranges from $126.63 in Victoria to $198.15 in the Australian Capital Territory. • While the WTP for respondent across New South Wales, South Australia and the rest of Australia are similar, respondents in the Australian Capital Territory have a significantly higher WTP and respondents in Victoria, a significantly lower WTP than respondents in these other States. (2009AUS$)
Policy implications				
• A water-sharing plan should necessarily be subject to careful scrutiny and ECBAs by the Commonwealth and central agencies such as Treasury and Finance departments of the Basin States. • Results are policy relevant as the valued attributes can be used to design and implement water buy-back programmes, investments in infrastructure and habitat rehabilitation. • The attribute values can be used in ECBAs to assist in choosing which alternatives will provide the greatest net-benefit to the community. • State-level values can be used in target setting and planning processes when it comes to community consultation, negotiation and implementation of water sharing plans.				
Morgan and Huth (2011)	Estimation of the use value associated with recreational cave diving in one of Florida's first magnitude springs.	• Cave diving (cultural)	• Non-consumptive direct use value (single site TCM)	• The average use value is approximately $155/person/trip generating an annual cave diving use value of $1075. • Divers are sensitive to scope effects with an additional cave system increasing annual per-person use values by approximately $100, while improved access yields an additional $50 in per-person annual CS.

				• Travel cost preferences vary across RP and SP counts, with divers perceiving an increasing disutility associated with accessing the site in the future. • A model that includes an interactive SP elicitation dummy with the travel cost parameter is preferred. • A single preference structure is appropriate when evaluating policy-based site quality changes. (data collection: 2009)
Policy implications • Economic valuation can contribute to natural resource management.				
Becker et al. (2012)	Cost-effective analysis of two policies to increase the water supply in Israel: divert 300 Million Cubic Meters (MCM) of water from the Sea of Galilee (SOG) to the central part of Israel (existing policy) and replace this diversion with desalinated water plants that will be built on the Mediterranean Coast (alternative policy)	• Water supply (SOG) • Commercial fishery (SOG) • Tourism (historical and spiritual/heritage (SOG) • Birdwatching (JR) • Natural, cultural and religious wealth/heritage (JR) • Unique geographical, biological, and historical features (DS) • Tourism (therapeutic qualities of its minerals) (DS) (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Option value • Existence value • Bequest value (CVM)	• The existence value is the highest in the SOG and the Mediterranean Sea (NIS53.48 and 34.79, respectively), while in the Jordan River (JR), the bequest value is the highest one (NIS43.36) followed by the existence value (NIS41.74). • The use value is small by a significant amount in the JR (NIS3.16) relative to the Mediterranean Sea and the SOG (NIS13.26 and NIS17.56, respectively). • A lower use value for JR is an expected result since the lower JR is not developed at the moment but carries significant potential, which can be seen from an option value of NIS14.26 for JR, which is higher than that for the SOG (NIS11.16). • The first policy has a negative effect on the SOG itself due to the lower lake level, and it also carries negative consequences on the JR and the Dead Sea (DS) which are located downstream. (data collection: 2009)
Policy implications • Coastal non-market values can be used as a decision tool for an integrated water management policy. • When only use values are taken into account, desalinating is more expensive than diverting water from the SOG, thus making the latter more attractive (water desalinization will cost NIS307.08 million/year, while diverting policy will only cost NIS104.93 million/year). • The benefit gained from the expected non-market values exceeds the cost difference between seawater desalination and diverting the SOG's water for agricultural and domestic use. • As the total cost of the diverting water policy is NIS758.4 million/year, which is NIS315.6 million more expensive than desalinating, it is worthwhile to stop diverting water from the SOG and				

desalinate the 300MCM from the Mediterranean Coast. • The issue whether or not to include the non-use values components is crucial in order to compare the two alternatives and it can be generalized to other problems worldwide.				
Kataria et al. (2012)	Analysis of how disbelief in survey information can affect the retrieved welfare estimates associated with improving the water quality of Odense River, Denmark, in line with the objectives of the EU Water Framework Directive.	• Visual character of the water in terms of conditions for fish and plants, the recommended use of the river for fishing as well as for bathing, boating and birdwatching. • Angling possibilities • Accessibility to the river through tracks • Surrounding areas (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The average marginal WTP for improving Stretch 1 to the quality that corresponds to "very good" is DKK586. • If only respondents who agree with the survey information are considered, the WTP is DKK802. • If only respondents who disagree are considered, the WTP for those who believe that the water quality level is worse than described in the survey is DKK1147. • The difference between those who agree and those who believe that the water quality level is better is not statistically significant. • Respondents who find the described scenario is unlikely are willing to pay DKK158, while those who find it rather unlikely are willing to pay DKK444. • About 25% of respondents perceive the current water quality to be worse than presented in the survey information. (data collection: 2008)
Policy implications • Valuation and ECBAs can be used to inform member states in their decisions on the disproportionality of measures aimed at achieving the GES of waters. • Respondents seem to adopt and use new information when environmental quality is worse than they thought, while they stick to their original belief about the environmental quality when the new information claims it is better than they thought, this meaning they do not trust positive news but they believe in negative news. • Mistrust in the environmental improvements, especially when it comes to achievement of the best water quality, can be attributed to the fact that achievement of the best water quality goal is very ambitious, and it can be hard to believe that a quality more or less unaffected by humans (natural conditions) can be achieved in such an agricultural and inhabited area. • Mistrust can lead to a biased average marginal WTP for water quality improvements, and bias increases with the level of both mistrust and improvement in water quality.				
Phaneuf et al. (2013)	Estimation of the effects of changes in land use associated with residential development on water quality and the implied ES at the watershed level in Wake County, North Carolina.	• Recreation/water quality and size of hydrological unit • Recreation access/lake distance (cultural)	• Non-consumptive direct use value (HA, RUM model)	• The largest welfare effects for the water quality reduction are about $16 and $19/household/year in areas most directly affected, and fall to an average of less than $1 in zones that are farther removed from the growth. • The recreation losses and the amenity consequences if Lake Lynn is not available vary throughout the county, and the magnitude depends on the proximity to the lake. • Since the amenity effects only occur within a one-half mile of the lake, the average effect in the zone is small, about $2, and there is no effect in the other zones. • The mean loss for houses within one-half mile of the lake is about S35/year and the maximum amenity loss at the closest house is $266/year (about $5,000 in value).

				• The individual maximum annual loss of recreation value is $41.13 for Lake Lynn. • Proximity to water resources, access to recreation sites, and the water quality at these sites are positively related to property values. (HA: data on home sales occurring between 1992 and 2000/data collection for RUM model: 2003)
Policy implications • Spatial differences in residential development are reflected in the model's estimates of the economic costs of deterioration of watershed quality. • There is substantial variation in the welfare impacts of decreases in water quality, both in magnitude and across space from the different growth scenarios. • Land use changes are significant factors in influencing the amount and quality of the services provided by watershed-based ecosystems. • Measuring the economic value of ES enhancements requires methods capable of incorporating the multiple, spatially delineated pathways that these services take in influencing people. • Recreation site choices and property value data can be used together to gauge how the services provided by an urban watershed are capitalized into housing values.				
Söderberg and Barton (2013)	Analysis of the sensitivity of distance decay in individuals' stated WTP for water quality improvements in eutrophied lakes in Norway. .	• Recreational water quality (cultural)	• Non-consumptive direct use value (CVM)	• Predicted ln(WTP) for the full sample is 4.2783 (first stage) and 4.2844 (second stage); if protesters are excluded, the ln(WTP) is 5.2109 (first stage) and 5.2260 (second stage); if protesters and true zeros are excluded, the ln(WTP) is 6.1227 (first stage) and 6.1977 (second stage) (OLS estimation without correction for sample selection). • Significant distance decay in the first stage classification of individuals as "protesters", "true zero" WTP, or positive WTP. • Little or no significant relationships when correcting for selection in the second stage model for positive WTPs. • According to expectations, WTP is negatively related to the "distance to improved lake" and it is positively related to the "distance to closest unimproved substitute". • Distance effects seem to be non-linear. (data collection: 2008)
Policy implications • WTP for water quality may be more useful as a qualitative indicator of political support for user financed water quality measures than as a cardinal measure of marginal utility of water quality improvements, which has implications for BT and the use of benefit estimates to justify measures under the Water Framework Directive (WFD). • As the specification of "protest" and "true zero" responses is key to correctly interpret distance decay effects, this could have implications for BT used in ECBAs of pollution abatement measures. • As the study cannot predict how large WTP is according to where respondents live relative to improved lakes, results can be used to identify the "economic jurisdiction" but not to determine (with significant accuracy) whether benefits aggregated across households within that area outweigh costs of measures. • Contingent valuation data do not have enough spatial resolution to be used in evaluating "disproportionate costs" under the WFD.				

Wang et al. (2013)	Estimation of the total value of a real investment project to improve the water quality of Lake Puzhehei, Yunnan, China, by one grade level.	• Water supply/water quality for irrigation • Water supply/water quality for recreation, tourism and scenery (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Non-use value (CVM)	• The average household in Qiubei County is willing to pay yuan30/month during 5 years for a water quality improvement by one grade level (roughly equivalent to 2.9% of the average household income). • The WTP elasticity with respect to income is 0.21. • The total annual economic benefitis are yuan12.6 million during 5 years. • Previous knowledge about the water quality changes and about the project can have significant positive impacts on people's WTP, whereas the interviewer effect on valuation can be negative. (data colllection: 2007)

Policy implications

- As the total cost of the project is yuan34.02 million, its IRR and the B/C ratio are 18% and 1.74, respectively (interest rate of 3%), which indicates the investment is socially profitable.
- Without a full understanding of the costs and the benefits associated with water quality improvement measures, Chinese decision makers are less likely to invest on massive and serious water pollution clean-up or preventing further deterioration of water quality in a timely manner.
- Results can contribute to the policy debates on the investments in water pollution clean-up activities in China.

Miller et al. (2015)	Assessment of how Canterbury residents value the protection and improvement of the cultural dimension in New Zealand's rivers, reflecting the values of indigenous Māori culture, in relation to other economic and environmental values.	• Social and recreational services/suitable swimming • Cultural dimension • Habitat/water quality • Number of jobs (cultural)	• Non-consumptive direct use value • Cultural value (CE)	• The value of a change from poor to excellent habitat quality is $123/year (highest value). • The cultural attribute is valued in mid-range between economic, recreational and environmental attributes: the WTP to enhance Māori cultural attributes is $40/year by Māori, and $28/year by the general public. • Māori WTP is only indicative (low number of respondents). (data collection: 2012)

Policy implications

- The omission of cultural values could lead to incomplete information for policy implications.
- Support for preserving cultural values not only by those who directly participate in the ecosystem use.
- It is important to ensure cultural values are respected and understood when considering freshwater related development in the region.
- Information about public preferences is useful for the planning of natural resource management in holistic strategy frameworks, in particular when resources are considered culturally important.

Tuttle and Heintzelman (2015)	Analysis of how property owners value lake water quality in the Adirondack Park, state of New York.	• Environmental amenities/water quality	• Non-consumptive direct use value (HA)	• The average waterfront property located on an acidified lake sells for $69,554 less than one located on a lake with good pH. • If the nearest lake has loons, property values for the average home are $46,158 higher than waterfront property on a lake without loons. • The marginal value of a loon is $3,308 for waterfront parcels

	(cultural)	and $1,819 for the full dataset. • The presence of invasive species on the nearest lake decreases property values by $10,459 (full dataset results). • Multiple measures of water quality such as lake acidity, presence of water milfoil, an invasive species, and presence of loons, an indicator species, have significant effects on property values. (data on residential transactions in the Adirondack Park between 2001 and 2009)

Policy implications

- Results help partially quantify air pollution impacts on Adirondack property values and can be used to justify additional regulations to further restrict sulfur and mercury emissions.
- Results can be used by policy makers and stakeholders to illustrate the economic impact of lake water pollution so that the costs of conservation can be more accurately compared to costly treatment measures to repair affected lakes after they are polluted and to the costs of regulation to prevent further deterioration.
- Valuation provides a framework for communicating water quality information to the public in a way that relates personal observation and experiences to scientific data.
- If property owners know how water quality affects their personal investment, they may be willing to self-fund initiatives to prevent the spread of aquatic invasive species or may be willing to implement more protective measures to maintain loon breeding habitat, protect biodiversity, and minimize anthropogenic impacts.

[a] Key: B/C, benefit/cost; BT, benefit transfer; CE, choice experiment; CI, confidence interval; CS, consumer surplus; CV, compensating variation; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; GES, good ecological status; HA, hedonic analysis; IRR, internal rate of return; RP, revealed preference; RUM, random utility maximization; SP, stated preference; TCM, travel cost method; WTP, willingness-to-pay.

3.6 Coastal waters

Economic valuation of services provided by bays, gulfs, sounds, fiords, inland seas and other coastal waters can contribute to fisheries management, marine biodiversity conservation, natural resource damage assessment and the implementation of the EU Marine Strategy Framework Directive. Additionally, willingness-to-pay (WTP) estimates of services provided by coastal waters can also help design policies aimed at preserving specific species through, for instance, the development of safe minimum standards.

Table 6 reports a list of papers dealing with the valuation of services provided by coastal waters. It presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As shown in Table 6, almost three-quarters of the papers have been published during the last decade (27 out of 37). A majority of papers (23) use stated preference (SP) methods, although three of them also employ other valuation techniques. Indeed, Gillig et al. (2003) extend the joint estimation of revealed and stated preference data literature by accounting for truncation in the revealed preference (RP) data; Massey et al. (2006) combine a bioeconomic model and a conjoint choice approach; and Wang et al. (2010) quantify coastal ecosystem losses caused by land reclamation through the use of different techniques (i.e. direct market approach, benefit transfer, restoration cost method, cost-based approach, defensive expenditure method, shadow project method, travel cost method and contingent valuation method). This suggests that estimation of non-use values attached to the services provided by coastal waters has been of interest among valuation researchers. Three studies apply a meta-analysis approach, from which two also focus on non-use values (Ahtiainen and Vanhatalo, 2012; Loomis, 2006). Only one paper frames the analysis in a developing country (Wang et al., 2010). The majority of works focus on services provided by US coastal waters.

3.6.1 Ecosystem services and values

Cultural services are the type of final ES which has captured the major attention. Indeed, all the studies which value final ES deal with cultural services. Excluding the meta-analysis papers, most of papers (26) only focus on this type of service, while others also consider provisioning services (Nunes et al., 2009) or provisioning and regulating services (Ressurreição et al., 2012, 2011) services together with cultural ones. Wang et al. (2010) focus on intermediate and final ES (i.e. supporting, provisioning, regulating and cultural services). So provisioning services are the services which has been valued in a higher number of papers after cultural services (4), followed by regulating services (3).

Recreational fishing/angling is the cultural ES valued with a higher frequency. Indeed, almost half of the papers focus on recreational fishing (17), from which about 50% deal with fishing specific species. In this sense, some papers estimate the value of recreational fishing of a specific species, while others put emphasis on valuing programs oriented to their protection and/or recovery. Regarding the former, the salmon is the species capturing the major attention among researchers (Anderson and Lee, 2013; Lew and Larson, 2014, 2011). In contrast, Gillig et al. (2003) estimate the value of changes in recreational red snapper fishing in the Gulf of Mexico, while Yamazaki et al. (2013) quantify the value of a day's recreational fishing in the inshore saltwater and rock lobster fisheries in Tasmania. In this context, some studies value water quality improvements under the assumption they can lead to increase catch rates and hence improve the recreational experience. This is what happens in Massey et al. (2006), who estimate the value of water quality changes for the Atlantic Coast summer flounder fishery in Maryland's coastal bays; and in Eggert and Olsson (2009), who examine the relative benefits of improving coastal water quality with respect to cod fishing possibilities in Sweden. Only this latter study emphasizes the link between water quality and biodiversity levels.

Examples of studies valuing programs oriented to the recovery/protection of a specific fishing species are Bell et al. (2003), who value local coho salmon enhancement programs in Willapa Bay, and Cantrell et al. (2004), who assess a potential stock enhancement program for Pacific threadfin in Hawaii.

Other papers focus on the 'recreational use' of coastal waters. In this context, the contribution of water quality to the recreational experience has been an issue of concern among researchers (Czajkowski et al., 2015). As a particular case, Okmyung and Czajkowski (2013) estimate the value of a healthy water body through a hedonic analysis using water quality as the amenity of interest. Again, some of the papers emphasize the link between water quality and biodiversity. Indeed, Ressurreição et al. (2011) and Ressurreição et al. (2012) estimate the WTP to avoid increased levels of species loss for different marine taxa by putting emphasis on the role of biodiversity maintenance in achieving water quality, among others.

In fact, the role of marine biodiversity in allowing the enjoyment of recreational experiences has been pointed out by many researchers. Ruiz-Frau et al. (2013) present an assessment of the economic importance and spatial distribution of non-extractive uses of marine biodiversity in the coastal temperate area of Wales and its application to Marine Spatial Planning, while Rees et al. (2010) value, using both monetary and non-monetary methods, the marine leisure and recreation industry in Lyme Bay, England, with a focus on the role of marine biodiversity.

Recreational boating (Thomas and Stratis, 2002), enjoyment and scenery (Jim and Chen, 2009; Krueger et al., 2011; Tsuge and Washida, 2003) and bird watching (Myers et al., 2010) are other types of cultural services that have also captured the attention of researchers focusing on the services provided by coastal warters.

Other papers valuing cultural services have moved their attention towards assessing programs oriented to recovering specific species. This is the case of Solomon et al. (2004), who use a contingent valuation method (CVM) to elicit maximum donations for protection of the manetees in Florida, with emphasis on their contribution to wildlife and captive observation as well as to information gained by educational media; and Loomis (2006), who estimate recreation/tourism and existence values of expansion of the southern sea otter population into California coast.

The type of provisioning services which have been valued by researchers concerned with the valuation of services provided by coastal waters are fisheries (Nunes et al., 2009; Ressurreição et al., 2012, 2011) and food supply, genetic resources and marine transport (Wang et al., 2010). Ressurreição et al. (2011) and Ressurreição et al. (2012) also focus on the role of species richness in guaranteeing regulating services such as erosion control and coastal protection. Apart from erosion control, Wang et al. (2010) also identify gas regulation, waste treatment and biological control as regulating services attributed to coastal ecosystems. Primary production and biodiversity maintenance are the two types of supporting services also considered by Wang et al. (2010).

All the papers estimate non-consumptive direct use values as all of them focus on cultural services. Consumptive direct use values have also been estimated for provisioning services, while indirect use values have been inferred for regulating and supporting services. Only two papers estimate option values (Ressurreição et al., 2012, 2011).

Among the primary valuation papers using SP methods (22), the majority indicates which type of value they estimate (13). From these latter, 10 studies estimate, together with use values, non-use values. In this sense, it is worth noting the estimation of non-use values related to warm glow in Nunes et al. (2009), who assess alternative shellfishery policies in the Dutch Wadden Sea. Particular cases are Carson et al. (2003), Loureiro and Loomis (2013) and León et al. (2014), who only focus on non-use values associated with biodiversity losses resulting from oil spills. Indeed, Carson et al. (2003) reports on the results of a large-scale contingent valuation study undertaken after the Exxon Valdez oil spill to assess the environmental damages caused by it; Loureiro and Loomis (2013) focus on environmental damages linked to large oil spills off the coast of Spain which may go well beyond the territorial limits of affected countries; and León et al. (2014) estimate non-use benefits

related to oil prevention in Spanish coasts by putting emphasis on the role of emotions in heterogeneous responses of individuals. Note that Ahtiainen and Vanhatalo (2012) and Loomis (2006) also focus on non-use values in their meta-analyses.

For the rest of papers applying SP methods which do not indicate which type of values they estimate, it has been assumed that only two of them estimate non-use values together with use values. This is the case of Whitehead et al. (2002), who assess, through a CVM, the WTP for a coastal (saltwater) recreational fishing license in North Carolina in a context where the license can contribute to habitat restoration and hence help fisheries; and Cantrell et al. (2004), who value, usign the same method, a potential stock enhancement program for Pacific threadfin in Hawaii which implicitly involves protection values. Besides, in this latter case, the authors remark that CVM is the only method allowing for the estimation of non-use values. Lew et al. (2010) is a particular case as it has been assumed they only estimate non-use values in their choice experiment (CE) oriented to value public preferences for enhancements to the protection of the western stock of Steller sea lion in the Gulf of Alaska and Aleutian Islands. Indeed, they use a sample of residents to value different degrees of protection (in terms of populations and status of the species –endangered, threatened, recovered) considering a time horizon of 60 years.

In contrast, it has been considered that Lawrence (2005), Hu et al. (2009) and Krueger et al. (2011), despite using a CE, only estimate use values. Indeed, Lawrence (2005) values attributes such as the average catch rates of favourite species and other species, the size of the fish, the quality of the surrounding environment and the bag limits. Although the bag limit attribute could be assiged non-use values, the findings show it is not an important attribute for respondents. Besides, the quality of the surrounding environment, which is also found to be of less importance for individuals, is described in terms of aesthetic and facilities. On the other side, the attributes valued by Hu et al. (2009), which refer to non-consumptive direct uses, only relate to the quality of the recreational dolphin excursions. As Krueger et al. (2011) focus on valuing the visual disamenity related to offshore wind turbines located at different distances from the coast, it has also been considered they only estimate use values. In the case of Yamazaki et al. (2013), the motivations to go fishing the authors analyze in their CVM are just related to consumptive and non-consumptive purposes.

3.6.2 Outcomes and policy implications

In general, the literature shows that the quality of the recreational experience influences the value individuals assign to the activities they undertake in coastal waters (Hu et al., 2009; Lawrence, 2005; Yamazaki et al., 2013). Thomas and Stratis (2002) show that “the minimum dollar amount per trip necessary to compensate a boater for reducing the choices of boating areas from 37 to 19” is $8.03 for boaters (assuming a marginal wage rate of $5). Criddle et

al. (2003) find that the net benefits of anglers change with variations in trip costs and angler success, while Carson et al. (2009) show that site quality plays an important role in the assessment of anglers' total WTP for sport fishing opportunities. In their meta-analysis, Johnston et al. (2006) show systematic WTP variation associated with the type of species targeted, context and angler attributes, the real WTP per fish ranging from $0.048 to $612.79.

In this context, there is social support for water quality improvements as water quality positively contributes to the recreational experience. Ahtiainen and Vanhatalo (2012)'s results indicate that the benefits of reducing eutrophication in European marine areas can be considerable. Indeed, they find that the predicted annual WTP per person ranges from $6 for small local changes to $235 for substantial changes relating to large sea areas. Czajkowski et al. (2015) find that the proportional increases in recreation benefits from the Baltic Sea derived from a water quality improvement scenario range from 7 to 18% of the current annual benefits across countries. Massey et al. (2006) show a positive value ($715) for a 25% increase in dissolved oxigen levels in the study area and predict that "improving water quality conditions in Maryland's coastal bays alone would have relatively small impacts on the Atlantic Coast summer flounder fishery as a whole". However, improvements "throughout the range of the species could lead to substantial increases in fish abundance and associated benefits to recreational anglers from increased catch rates". Other papers focus on how the value of water quality is capitalized into property values, as Okmyung and Czajkowski (2013), who find the WTP estimates range from $7,531 to $43,158.

Individuals are also willing to pay for improvements to marine biodiversity as a key factor affecting many recreational activities. In Ressurreição et al. (2011), the majority of respondents have positive preferences for marine biodiversity conservation and generally acknowledge it should be a priority for governments. Interestingly, they find that respondents value "the conservation of the ecosystem as a whole rather than simply as the sum of its components". While the authors recognize this may not mean people clearly understand the meaning of biodiversity or have even complete awareness of why it should be preserved, they view it as an indicator that people understand that "biodiversity is a much more expansive concept than simple measures of species richness". In this context, Ressurreição et al. (2012) suggest that cultural differences may be important drivers of valuation and show that the commonly assumption that charismatic taxa have a disproportionately strong influence on WTP for biodiversity conservation does not hold. Eggert and Olsson (2009) emphasize the link between biodiversity and water quality and find that the highest average marginal WTP values (around SEK 1300) correspond to both avoiding a reduction in biodiversity levels and improving cod stocks.

In fact, individuals show positive preferences for biodiversity protection regardless of whether they are users or not, as shown by Loureiro and Loomis (2013). Indeed, people are willing to pay to prevent further oil spills in offshore waters. The authors show that WTPs are positive even in the country where the accident has not occurred, although those who have been most affected by the oil spill are willing to pay more. Interestingly, León et al. (2014) demostrate that heterogeneity in WTP responses is explained by the emotional reactions (upset, sadness, indifference) rather than by socioeconomic characteristics. Their results show the difficulty to isolate emotional and cognitive dimensions in individuals' perceptions and behavior, as suggested by previous research.

People are also willing to pay for species protection, as shown by Solomon et al. (2004). They propose the development of a safe minimum standard (SMS) for the Florida manatee and find that the benefits of its protection greatly exceed the development benefits foregone by approximately $8.2–$9 million. Loomis (2006) show how the benefit estimates of sea otter expansion are "several million dollars for the increased number of sea otters expected by US Fish and Wildlife Service in the next decade if the 'no otter zone' is eliminated and otters are allowed to expand along the Santa Barbara coast". These benefits exceed the costs to commercial fishing. Under the assumption that the western stock of Steller sea lion will decrease in the future from its current population of 45,000 to 26,000 and remained endangered, Lew et al. (2010) find that respondents are willing to pay about $20 more, on average, for a situation where the eastern stock has an increased population of 20,000 more sea lions than under the baseline.

Other authors show that the value of protection of fishing species is partly driven by the positive effects of the stock enhancement programs on the recreational experience mainly represented by an increase in the number of catch rates. Cantrell et al. (2004) show that the estimated net WTP for the current average catch rate of 3.8 fish per trip is US$ 7.95, while estimates are US$ 10.05, 13.67, 19.95, and 20.52 for the current average catch rate plus hypothetical increments of 1, 3, 9, and 11 fish per trip, respectively. Interestingly, Bell et al. (2003) find that the WTP is higher when the public demonstrates confidence in the objectives of the programs and the management institutions.

In contrast, fishing regulations do not seem to get a high social support by anglers. Lew and Larson (2014) show that the value of a single-day marine private boat fishing trip where one species is caught with catches less than or equal to the allowable bag (or take) limit ranges from US$248 to US$313, depending upon whether the fish is kept or released. They find that, generally, anglers value the fish they keep the highest and the fish they release, and potential catch, less. When examining how the value of fishing activity is affected by changes in wild and hatchery salmon regulations and catch rates, Anderson and Lee (2013) show that

the marginal WTP values range from –$10 for a 30-pound hatchery king salmon, which must be released, to $180 for a 30-pound hatchery king salmon, which may be kept. Whitehead et al. (2002) find out that support for saltwater license as a management tool is relatively low, although most anglers are willing to purchase a license if they need it for fishing provided the funds are used to improve fishing quality. On the other side, and with a focus on professional fishing, Nunes et al. (2009) conclude that "the reduction of the current quota of cockles by half is an unattractive policy measure for all stakeholder groups" as "none of the stakeholders reveals a clear preference for a quota policy measure".

Literature also shows support for the preservation of the coastal environment. Indeed, when estimating the economic value of both the natural environment damaged in the Seto Inland Sea after the introduction of the Setouchi Law[5] and the natural environment that survived, Tsuge and Washida (2003) show that individuals prefer the maintenance of the existing environment to the "artificial recovery" of the damaged environment. Wang et al. (2010) demonstrate that the external costs linked to coastal ecosystem damages are significantly higher than the internal costs of land reclamation projects. Krueger et al. (2011) find that the annual cost to inland residents derived from turbines is higher when turbines are located near the coast. Indeed, for turbines located at 0.9, 3.6, 6, and 9 miles offshore the costs are $19, $9, $1, and $0 per household, respectively. The cost to residents living near the ocean is even higher ($80, $69, $35, and $27 per household for the same increments).

Economic valuation of the services provided by coastal waters can serve to judge the economic efficiency of different policies designed to protect coastal waters ecosystems (Johnston et al., 2006; Lawrence, 2005; Tsuge and Washida, 2003), thereby providing policy guidance in a cost–benefit framework (Eggert and Olsson, 2009; Hu et al., 2009). In this sense, it can serve to provide economic justification for implementing specific management actions (Carson et al., 2009).

An important contribution of economic valuation is to fisheries management. Lew and Larson (2011) state that an understanding of the demand for fishing trips and how it is affected by harvest is important for fisheries managers as it enables to evaluate the potential effects of changes in harvest regulations. Raguragavan et al. (2013) say that estimates can be used to "inform the development of fishery management policies through, for example, setting out the welfare costs of imposing bag limits or closing fishing sites". As these bag limits can affect angler participation and slow harvest rates, they "may better protect stocks and increase the length of time until a particular harvest level is reached", thus becoming interesting tools to help protect fish stocks and achieve social and economic goals for society (Lew and Larson, 2014). Findings of positive WTPs for a fishing license are

[5] Law on Temporary Measures for the Environmental Conservation of the Seto Inland Sea.

also policy relevant as license revenues could be used for fisheries management activities oriented to improve fishing quality through habitat restoration, better enforcement, expanded research and education (Whitehead et al., 2002).

Results from recreational fishing studies can also be used to meet the needs of environmental and regulatory impact analyses. Criddle et al. (2003) explain their model was first developed in part to meet the needs of environmental and regulatory impact analyses related to outer continental shelf minerals exploration, development and production activities in the Cook Inlet Planning Area. Additionally, their preliminary results were used in regulatory analyses related to management actions designed to constrain the uncompensated reallocation of halibut from the commercial fishery to the charter-based sport fishery. Raguragavan et al. (2013) point out that evaluating the welfare effects derived from both stock reallocating policies and management strategies targetting specific fishing species and/or sites requires an understanding of recreational values. Haab et al. (2008) state that estimates can demonstrate the benefits and costs of netting bans and/or different spatial regulations.

Economic valuation can also help implement and design effective policies aimed at protecting specific fishing species (Lew et al., 2010). Bell et al. (2003) point out salmon restoration and protection decisions can benefit from an improved understanding of local WTP for specific protection , which is especially important in a context where conflicts between salmon preservation uses and other economic uses of water and land are common and salmon restoration and enhancement options, abundant. In this setting, they emphasize the importance of community outreach and education when planning salmon enhancement and protection strategies. Solomon et al. (2004)'s results support a SMS policy at current or higher population levels of Florida manatee as its protection can provide Citrus County with a significant net benefit. The authors argue that a SMS can be an alternative to environmental cost-benefit analysis (ECBA) especially when it comes to endangered species management. Loomis (2006) highlights the importance of estimating sea otters' existence and option values of recovery of endangered species to include them in the economic analysis and environmental impact statements. They argue that, "once recovery and expansion of the species has occurred, there may also be an on-site recreation use value". According to them, sea otter tourism can contribute to the creation of many jobs and generate income in the Santa Barbara area, as well as provide important non-market benefits to California households. To overcome problems of time and/or budget restrictions associated with undertaking primary valuation studies, the authors propose the use of a benefit transfer approach.

The design of policies to preserve marine biodiversity also benefits from WTP estimates. Interestingly, Ressurreição et al. (2011) emphasize the need of collaborative work among social and ecological researchers. Indeed, they state that information derived from SP methods can complement biological information/research, thus contributing to the design of projects and policiespursuing the sustainable use of marine resources. Ressurreição et al. (2012) point out that "economic analysis can make a valuable contribution to conservation science by offering alternatives whereby the value of biodiversity and public preferences can be accounted for in policy planning; identifying the main beneficiaries of conservation; and providing evidence of the social demand for biodiversity protection,reinforcing, thereby, scientific support for conservation". In addition, they also suggest cultural variation in preferences for marine biodiversity should be understood if "conservation objectives are to include societal preferences in addition to scientific considerations".

Other authors argue that highlighting the economic importance of non-extractive uses associated with marine biodiversity, which are less likely to contribute to biodiversity degradation than industrial activities, can help promote conservation as these uses can be more easily regulated. In this sense, Ruiz-Frau et al. (2013) outline the relevance of integrating spatially explicit socioeconomic data for different uses of marine biodiversity to inform policy makers about the potential consequences of implementing a spatial management regime. According to the authors, such data show "the value of marine biodiversity to different sectors of society and contribute to develop comprehensive marine spatial plans". In other words, the mapping of activities provides relevant information to develop "suitable zoning systems for the sustainable management of human interactions with the marine environment". They also state that such information can facilitate stakeholder engagement as well as help solve conflicts when designing networks of marine protected areas (MPA).

On the other side, Rees et al. (2010) point out that valuing the marine leisure and recreation industry can provide an economic justification for the sustainable use of rich marine biodiversity areas, although they recognize this value does not necessarily reflect the value of marine biodiversity and its ecological functions. Additionally, they suggest decision makers must carefully examine "how mutually exclusive activities are from one another as many fishing and recreation activities can remain compatible within a management framework". They also refer to the relevance of stakeholder involvement when stating that, if different stakeholders are involved in mapping areas of value, more focussed management actions can be undertaken at the time that local involvement in the management process is promoted.

Estimating the WTP for water quality improvements can also be used in the implementation of European Directives, such as the EU Marine Strategy Framework Directive, as stated by Ahtiainen and Vanhatalo (2012). When estimating the value of reducing eutrophication in European seas, these authors suggest relying on the results of existing valuation studies that estimate people's WTP for improvements in the marine environment as conducting new primary valuation studies is resource intensive. According to them, there is a growing interest in using "methods that summarize the existing information and/or apply the available benefit estimates to a new context", such as benefit transfer (BT) and meta-analysis. Interestingly, Czajkowski et al. (2015) state that achieving improvements in water quality in the context of shared waters like the Baltic Sea requires international cooperation and that the likelihood of effective cooperation depends on the distribution across countries of the benefits and costs of water quality improving actions. Providing information on the size of the potential economic benefits to each country can contribute to foster joint actions. According to these authors, estimation of aggregate benefits can also help inform countries in case of unilateral action. Their use in national environmental accounting exercises is an example, whilst information on the benefits from changes in water quality is vital for social ECBA.

Some researchers state that WTP estimates can also contribute to natural resource damage assessment and oil spill prevention and response programs as well as it can help to determine the level of compensatory resources (Carson et al., 2003). Loureiro and Loomis (2013) suggest that policy makers should consider the importance of non-use values when it comes to compensation decision-making processesin a context of environmental damages caused by large international oil spills, especially within the EU. As they show that there is a loss of passive use values in other EU countries, outside Spain, the authors believe that "it appears economically justified for the EU, acting on behalf of its member countries not directly physically impacted by the spill, to seek damages on behalf of the citizens of member countries". In fact, the authors remind that "the spirit for EU compensation of member countries for environmental damages sustained by them is already behind the 2000/60/EC Directive", whichestablishes a framework for water quality standards and EU action. The authors point out that this Directive "considers that the use of economic instruments by Member States may be appropriate as part of a programme of measures… in particular, the polluter-pays principle".

Quantifying the value of nature and scenic endowments can also inform policies and strategies on urban planning, development, nature conservation, and property appraisal (Jim and Chen, 2009).

3.6.3 Research needs and challenges

To better contribute to fisheries management, researchers suggest that further research should be undertaken in a number of areas. One of them has to do with the shadow value of time. Given Lew and Larson (2011)'s findings show that models with shadow values that have a random component outperform those without a random component, the authors state that better representing the shadow value of time in recreation decision making is a high priority for future work. Another issue for further exploration has to do with the projections of the value of fishing. These are based on relatively large changes in expected harvest in a model that is linear in harvest rate. However, Lew and Larson (2011) point out that the effect may be non-linear.. Likewise, Lew and Larson (2014) state that "non-linear utility effects of the attributes is plausible in cases such as the effect of average size, which might well depend on the number of fish caught". Consequently, further work is needed on this issue. In addition, they suggest the results on economic values per fish "may need to be updated periodically to reflect economic changes".

On the other side, Raguragavan et al. (2013) point out that integrating random utility maximization (RUM) models with biophysical models that simulate the dynamics of fish stocks and marine ecosystems could help increase the influence of valuation in decision-making.Indeed, the RUM model would use information on fish stocks and catch rates from the biophysical model, while this latter would use fish extraction information simulated by the RUM model. This would allow the integrated model to "account for feedback effects and make it possible to evaluate the effects of management changes on economic and ecological outcomes".

In terms of fishing licenses, Whitehead et al. (2002) state that further research should continue to explore the WTP for a coastal recreational fishing license. They recognize that, due to time and budget constraints, they use unrepresentative samples and hence future research related to a license fee payment vehicle in the CVM should be conducted. Given the existing uncertainty over the magnitude of the fee, future work should examine the WTP for lower and higher fees.

Some research needs have also been identified in the context of stock enhancement programs. Indeed, Bell et al. (2003) state that understanding preferences and sensitivity to run sizes is required to better measurethe WTP for salmon enhancement programs. Also, further research should compare the WTP for local enhancement by local residents and non-local residents as it may provide additional insight on how the value of enhancing a particular stock varies across regions. In this setting, Cantrell et al. (2004) point out that "future studies should allow for a more refined analysis of the efficiency of a stock enhancement program in improving catch rates of Pacific threadfin in Hawaii".

The importance of further research on biodiversity issues to better contribute to marine environment management has also been stated by some researchers. Ressurreição et al. (2011) point out that there is still poor public understanding about the welfare implications of biodiversity loss. This is unsurprising given the limited scientific knowledge about the ecological consequences of marginal or severe biodiversity loss, and problems in perceiving changes in marine biodiversity. Accordingly, and from a scientific perspective, the authors consider that further work should be focused on clarifying some issues regarding the relationship between marine biodiversity and ecosystem functions. “Ecological processes that need to be included in the assessment of the ES supported or provided by marine biodiversity, ecological indicators to measure marginal changes, or critical thresholds” are some examples. In this context, they argue that ecological uncertainty may make individuals be insensitive to the scope of the change, this resulting in biased estimates.

Following Ressurreição et al. (2012)’s words, “understanding and conserving marine biodiversity is one of the most pressing challenges of the next decades and a strategic subject in the EU political arena”. In this cotext, Ressurreição et al. (2011) outline the need for more cooperation and network research as well as interdisciplinary work both to help define feasible approaches to estimate the value of marine biodiversity and also to “shed some light on the uncertainty underlying biodiversity loss and human welfare implications”. Importantly, Ressurreição et al. (2012) state that “effective policies must be not only scientifically valid and economically feasible but also culturally adaptable (i.e. consistent with prevailing social beliefs and values)”. To this aim, the authors think that scientific research should extend its scope “towards the community/ecosystem scale and towards less studied taxa”. This would contribute to fullfil knowldege gaps relating to the status and ecological role of Europe’s marine environment and to better understand the links between social, economic and cultural diversity in the value attributed to marine biodiversity among member states.

As another challenge when it comes to valuing marine biodiversity, Rees et al. (2010) point out the difficulty to value the supporting and regulatory services provided by marine biodiversity and its intrinsic value. According to them, “this issue will continue to underpin the case that is made for designating marine protected areas on scientific criteria alone regardless of monetary values”.

Ruiz-Frau et al. (2013) outline the importance of spatial information on the distribution of uses and services provided by marine biodiversity for a proper marine environmental management. While the spatial distribution of ecological components has been examined in-depth, the spatial heterogeneity of coastal human activities has remained highly underexplored, this becoming another area for further research. According to the authors,

for the marine spatial planning to be successful, both ecological and human factors determining the spatial heterogeneity of the different ecosystem components need to be understood. An analysis of the elements affecting the distribution of human activities is also needed. In this context, “the integration of existing ecological information with human patterns of activity can contribute to the identification of pressures on the marine environment by highlighting areas of high levels of activity on sensitive environments thus allowing for adequate management to be implemented on a zone by zone basis”.

Investigating how uncertainty over future populations and health of species affects the value of their protection is another area for further research, as stated by Lew et al. (2010) when valuing programs aimed at protecting specific species. They also suggest that improvements to the species could be measured by reductions in the risks of extinction (rather than by improvements related to population sizes and status). It would be interesting to see if there is value added to use risk as a single attribute.

Other researches point out the need for further work on the links between subjective and objective perceptions of water quality variations across different cultural backgrounds. Indeed, Czajkowski et al. (2015) state that, “although using perceived water quality change is appropriate as people's behavior is based on perceptions […] it might be difficult to link this to actual changes in water quality”. In this context, they also highlight the need to get knowledge on how the benefits and costs of actions to reduce nutrient pollution are distributed across countries as depending on this distribution “there may be significant barriers to achieving further international agreements on cleaning up the Baltic Sea”. Cooperation is then essential in this setting.

The importance of cooperation has also been highlighted by Ahtiainen and Vanhatalo (2012) when estimating, through a meta-analysis, the WTP for reduced eutrophication in European seas areas. They state that “the transboundary nature of the marine environment requires, in many cases, international cooperation and coordination”. Meta-analysis studies would also benefit from collaboration between countries as it would allow having more accurate and comparable valuation scenario descriptions, “especially regarding the before-change level of the environmental good and the scope of the change”.The authors also highlight the need to undertake primary studies in areas that lack valuation information and provide important recreational and ecological values as the existing studies do not cover all European marine areas and the estimates may not be up-to-date for some of them. A larger sample of available primary studies would also increase, according to the authors, the accuracy and applicability of the meta-analysis results and improve the reliability of the welfare estimates.

A related area where cooperation is also essential is the context of large oil spills, as pointed out by Loureiro and Loomis (2013). Indeed, as oil spills can affect other countries especially in terms of non-use values, the authors point out that EU should also be able to sanction countries causing damages, as already may happen when a country doesn't follow the water regulation setting water quality standards. In this sense, they suggest that, if other researchers undertake similar studies about EU-wide damages derived from oil spills, "it might be an incentive for an institutional innovation in the EU governance based on the design of a supranational common environmental policy aimed at enabling environmental damage claims".

Table 6. Papers concerning the valuation of services provided by coastal waters[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Thomas and Stratis (2002)	Estimation of site choice probabilities and CV for changes in boating speed limits in Florida Bay.	• Recreational boating (cultural)	• Non-consumptive direct use value (TCM)	• The minimum compensation/trip/boater for reducing the choices of boating areas from 37 to 19 due to imposition of the speed zone is $8.03 and $2.88 assuming a marginal wage rate of $5 and $2.88, respectively. • The annual compensation/boater for the loss in site quality due to the new speed zones is $423.94 and $353.23 for a marginal wage rate of $5 and $2.88, respectively. (data collection: 1998)
Policy implications • Estimates of the costs to boaters provide regulatory officials in Florida with an indication of the costs to boaters of the proposed rule. • Results are used in policy applications in Florida.				
Whitehead et al. (2002)	Assessment of the WTP for a coastal (saltwater) recreational fishing license in North Carolina and comparison of three types of recreational anglers (fishing club members, commercial license holders with an endorsement to sell, and intercepted anglers).	• Coastal saltwater recreational fishing (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• The WTP for a coastal saltwater recreational fishing license is $188.43 for fishing club members, $62.63 for license holders and $66.51 for intercepted anglers (full model). • Most anglers are willing to purchase a license if they need it for fishing and if the funds are used to improve fishing quality (fishing club members have the highest WTP among the three groups). (data collection: 1998)
Policy implications • Economic valuation can contribute to fisheries management. • License revenues can be used to improve fisheries management activities designed to improve fishing quality through habitat restoration, better enforcement, expanded research and education.				
Bell et al. (2003)	Examination of the WTP of coastal residents for local coho salmon enhancement programs in Willapa Bay.	• Recreational local fishing/local coho salmon (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• Mean WTP of high income people in the first of 5 years ranges from $25.39 to $120.5 for a high enhancement program, and from $50 to $121.81 for a low enhancement program. • Mean WTP of low income people in the first of 5 years ranges from $20.88 to $77 for a high enhancement program, and from $24.48 to $78.94 for a low enhancement program. • Mean WTP is higher when the public trust the objectives of the programs and the management institutions. (2000$)

Policy implications • An improved understanding of local WTP for specific protection may inform future salmon restoration and protection decisions. • Valuation is important to implement and design effective policies. • Results give evidence of the importance of community outreach and education when devising salmon enhancement and protection strategies.				
Carson et al. (2003)	Report on the results of a large-scale contingent valuation study undertaken after the Exxon Valdez oil spill to assess the harm caused by it in Prince William Sound, Alaska.	• Biodiversity	• Non-use values (CVM)	• The median WTP to prevent an Exxon Valdez type oil spill is $48/household. • The original study reports an estimate of $2.8 billion as the lower bound on the estimated aggregate loss of passive use values (using median WTP). • Using the most conservative mean WTP consistent with the non-parameteric Turnbull density parameters, the aggregate lost passive use is $4.87 billion. • Using the mean WTP from the parametric three-parameter Weibull distribution yields an estimate of $7.19 billion. (1990$)
Policy implications • The State of Alaska and US government settled their lawsuits against Exxon for $1 billion in natural resource damages and restitution for injuries. • Exxon also spent over $2 billion on oil spill response and restoration. • Economic valuation can contribute to natural resource damage assessment and oil spill prevention and response programs. • Valuation helps determine the level of compensatory resources.				
Criddle et al. (2003)	Prediction of changes in angler welfare and regional economic activity occasioned by changes in the demand for sportfishing fisheries in Cook Inlet in Alaska that arise from changes in trip costs or the expected number, size, or mix of species caught.	• Sport fishing (cultural)	• Non-consumptive direct use value (stochastic binary choice model, simulation-based sample enumeration procedure, regionally adjusted zip-code level I/O model)	• The estimated average daily CV for fishing trips is $82.51 for Alaskans and $118.88 for non-residents. • The total CV is $19.46 million ($10.34 million for non-residents and $9.12 million for residents (i.e. Alaskans and locals)). (data collection: 1997)
Policy implications • The model meets needs of environmental and regulatory impact analyses related to outer continental shelf minerals exploration, development and production activities in the area. • Preliminary model results have been used in regulatory analyses link to management actions aimed at constraining the uncompensated reallocation of halibut from the commercial fishery to the charter-based sport fishery.				

Gillig et al. (2003)	Estimation of the value of changes in recreational red snapper fishing in the Gulf of Mexico.	• Recreational fishing/ red snapper (cultural)	• Non-consumptive direct use value • Non-use value (CVM, truncated TCM, joint truncated model)	• The CVM yields the highest WTP ($85.70/angler), whereas the truncated TCM yields the lowest WTP ($9.85/angler). • The WTP of the joint model is $14.50. • The joint model improves the precision of estimated recreational red snapper valuation. (data collection: 1991)
Policy implications • Results can help evaluate and implement policies and regulations on the shrimp, commercial, and recreational red snapper fisheries.				
Tsuge and Washida (2003)	Estimation of the economic value of both the natural environment damaged in the Seto Inland Sea after the introduction of the Law on Temporary Measures for the Environmental Conservation of the Seto Inland Sea (Setouchi Law) and the value of the natural environment that survived.	• Enjoyment and scenery • Maintenance of the ecosystem (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• The WTP for plan 1 (restore 4 ha of reclaimed land) is about yen205 billion ($1,744 million), which allows estimating the value of the damages derived from the original reclamation. • The WTP for plan 2 (transplant Zostera (eel-grass) into an area of 10 ha offshore is about yen200 billion ($1,701 million). • The WTP for plan 3 (preserve the shore area, a natural habitat for rare animal species, under the National Trust Program) is about yen350 billion ($2,979 million). • Plan 2 and plan 3 WTPs allows estimating the value of the shore area and the areas a little farther offshore. • Maintaining the existing environment is more important than the artificial recovery of the damaged area. • The value of the damages as a result of reclaiming projects after the introduction of the Setouchi Law and the value of the existing natural environment is about yen172 trillion ($1.46 trillion) and about yen424 trillion ($3.60 trillion), respectively. • Coastal residents have a higher WTP than non-coastal residents. (data collection: 1998)
Policy implications • The estimated benefits assist directly in a decision-making as they allow assessing the economic efficiency of the plans.				
Cantrell et al. (2004)	Evaluation of the value of a stock enhancement program for Pacific threadfin in the windward coast of Oahu, Hawaii, in terms of demand for fishing quality improvements by recreational anglers.	• Recreational fishing/Pacific threadfin (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• The net WTP for the current average catch rate of 3.8 fish/trip is US$7.95. • The net WTP for the current average catch rate plus hypothetical increments of 1, 3, 9, and 11 fish/trip are US$10.05, US$13.67, US$19.95, and US$20.52, respectively. (data collection: 1998-1999)

Policy implications • Economic valuation can contribute to the support for enhancement programs as it allows measuring their demand and welfare implications.				
Solomon et al. (2004)	Development of a safe minimum standard (SMS) for the Florida manatee in Citrus County to determine if preservation benefits of its recovery exceed forgone development benefits.	• Wildlife observation • Captive observation • Information gained by educational media/Florida manatee (cultural)	• Non-consumptive direct use value • Existence value • Bequest value (CVM)	• The benefits of manatee protection greatly exceed the foregone development benefits by approximately $8.2–$9 million (forgone net development benefits are proxied only on the cost of law enforcement of boating speed limits). • The residents should forego further development that conflicts with the Florida manatee and obey the SMS rule of preservation at the current or a larger population level. • The largest benefit derived from manatees' protection is gained through eco-tourism. (2001$)
Policy implications • Results support an SMS policy at current population levels or higher. • The protection of the manatee costs relatively little compared to the total benefits. • Manatee protection provides Citrus County with a significant net benefit.				
Lawrence (2005)	Assessment of how the value of the recreational sea angling experience in South West England would change as characteristics of the angling experience change.	• Recreational sea angling (cultural)	• Non-consumptive direct use value (CE)	• Anglers are willing to pay £13.56 to increase their catch of the favourite species from 0 to 1 fish/day. • Their WTP for additional fish on top of this decreases at higher catch levels, and is ultimately negligible (they would only pay £2.03 to increase their catch from 6 to 7 fish/day). • Catch levels of anglers' favourite species are very important until they reach around 6 fish/day, situation in which they become satiated. • Anglers are willing to pay an extra £1.02 to catch one additional fish of any species other than their favourite (no evidence found to support a non-linear relationship). • The WTP for a 50% increase in the size of individual fish averages £13.27. • The presence or absence of rod or bag limits and the environmental quality of a site are minor factors in anglers'decisions on where to fish. (data collection: 2004)

Policy implications • Decision-makers should base decisions on the welfare impacts of changes from the current situation. • Increasing either the number of fish caught or the size of fish increases anglers' welfare, although increasing the fish size has a larger welfare impact of the two and varies by species. • Managers who are well informed about anglers' preferences can take decisions which more closely reflect the needs of the sea angling sector.				
Johnston et al. (2006)	Assessment of whether variation in WTP for increased recreational catch may be explained sufficiently by systematic variation in resource, context and angler attributes to justify the use of such measures for policy analysis. The paper uses studies from US and Canada.	• Recreational fishing (cultural)	• Non-consumptive direct use value (meta-analysis)	• Real WTP/fish over the sample ranges from $0.048 to $612.79 with a mean of $16.82. • There is systematic WTP variation associated with the type of species targeted, context and angler attributes, and the study methodology. • Lower WTP when discrete choice methods are used (not expected according to prior findings), although these results are not robust and should be treated with caution. (2003$)
Policy implications • Results provide insight regarding WTP for recreational fishery resources. • Results suggest researchers should consider the potential for methodological effects when conducting applied welfare analysis. • Results contribute to ECBA which often incorporate assessment of WTP for changes in the quality of recreational fishing sites.				
Loomis (2006)	Application of value transfer and meta-analysis BT approaches to estimate the recreation and existence values of expansion of the southern sea otter population into Santa Barbara, California.	• Tourism/Sea Otter (cultural)	• Non-consumptive direct use value • Existence value (meta-analysis BT)	• The WTP to increase the sea otter population from 1,500 to 3,000 (close to the current population estimate of 2,500 otters) is $10.71/household/year. • 196 additional sea otters imply $16.1 million annual benefits. • Benefit estimates of several million dollars for the increased number of sea otters expected by US Fish and Wildlife Service (USFWS) in the next decade if the "no otter zone" is eliminated and otters allowed expanding. • Benefit estimates of sea otter expansion exceed the costs to commercial fishing. (2002$)
Policy implications • BT can help overcome problems of too little time and/or too little budget to perform an original species-specific study to estimate the economic benefits of recovery of endangered species. • The BT approach can contribute to a more complete economic analysis of endangered species recovery or critical habitat efforts than the current USFWS approach. • Sea otter tourism has the potential to support a high number of jobs and income in the Santa Barbara area as well as providing non-market economic values to millions of California households.				
Massey et al. (2006)	Combination of a dynamic fish population model, a statistical model	• Recreational summer flounder	• Non-consumptive direct use value	• The benefits of a 25% increase in dissolved oxigen (DO) levels are $715 (annualized value based on a 5% discount rate in

	of angler catch rates, and a recreation demand model to estimate the value of water quality changes for the Atlantic Coast summer flounder fishery in Maryland's coastal bays.	fishing/water quality (cultural)	(bioeconomic model, conjoint choice)	thousands of dollars). • The benefits of a 25% increase in DO levels everywhere are $81,600 (annualized value based on a 5% discount rate in thousands of dollars). • Improving water quality conditions alone have relatively small impacts on the fishery as a whole, but water quality improvements throughout the range of the species can lead to substantial increases in fish abundance and associated benefits to recreational anglers from increased catch rates. (water quality data collection: 2002/stated choice data collection: 2000)
Policy implications • The structural modeling approach provides the flexibility to evaluate a wider range of water quality policies than most previous models.				
Haab et al. (2008)	Investigation of small boat fishing on the island of Oahu, Hawaii, through a locational choice model in which anglers choose where to launch their trailered boats, as well as their ocean destination.	• Small boat fishing for recreational and cooperative giving purposes (cultural)	• Non-consumptive direct use value (locational choice model)	• Anglers with small moored boats (<20 feet) are willing to pay $13.44 to prevent a closure of coastal Hawaii Division of Aquatic Resources (HDAR), while anglers with large moored boats (>=20 feet) are willing to pay $35.02. • Anglers with small trailered boats (<20 feet) are willing to pay $5.91 to prevent a closure of coastal HDARs, while the WTP for anglers with large trailered boats (>=20 feet) is $14.37. • Locational choices by small boat anglers are made through choice of where to launch boats as well as the ocean location. • Influence of species availability for the important species. (data collection: 1997-1998)
• Spatial allocation of fishing effort is a critical choice for both anglers and policy makers. • Understanding choices of recreational anglers is especially important as competition for fish stocks by commercial and recreational anglers increases. • The model allows calculating the welfare effects of both restrictions on locational choices and changes in land-based or ocean attributes (ramps or fish aggreggation devices, respectively). • Models can be used to demonstrate the benefits and costs of net bans or various types of spatial regulations				
Carson et al. (2009)	Prediction of summer sport fishing behavior in Southcentral Alaska.	• Summer sport fishing (cultural)	• Non-consumptive direct use value (TCM)	• The average net per person choice occasion value ranges from $0.30 for red salmon (late run) in Russian River (average net WTP being $211,000) to $21.47 for all species in Kenai River (average net WTP being $15,241,000). • Site quality plays an important role in the assessment of anglers' total WTP for the sport fishing opportunities. (data collection: 1986)

Policy implications • As the quality of the experience increases, so do the measurable benefits, thereby providing economic justification for implementing specific management actions. • A temporal demand model is very useful for fish management purposes as important economic effects such as changes in CS or angler spending from changes in resource condition can be evaluated with application of the model.				
Eggert and Olsson (2009)	Estimation of the relative benefits of improving coastal water quality with respect to fishing possibilities, bathing water quality and biodiversity levels for a random sample of individuals in the southwestern parts of Sweden.	• Recreational fishing/water quality-coastal cod stock • Recreational bathing/water quality • Biodiversity level/water quality (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The highest average marginal WTP values (around SEK1,300) are found for avoiding a reduction in biodiversity level and for an improved cod stock. • The average marginal WTP for improved bathing water quality is SEK600. (data collection: not indicated)[b]
Policy implications • Estimated benefits can be compared with estimated costs for achieving improvements and provide policy guidance in a cost–benefit framework.				
Hu et al. (2009)	Analysis of individual choice and the implied economic values associated with spinner dolphin excursions in Hawaii.	• Recreational dolphin excursions (cultural)	• Non-consumptive direct use value (CE)	• Swimming with dolphins is attractive to all individuals who are 25 regardless whether they are visitors or residents: visitors are willing to pay $41 more to swim with dolphin as compared to viewing alone, while Hawaii residents are willing to pay $20 for the same activity. • Swimming with dolphins becomes insignficant for residents who are 45 years, while visitors of 45 are willing to pay $24 additional for it. • When they are 65, respondents (visitors or residents) no longer value swimming with dolphins compared to viewing them from the boat. • Preferences are highly heterogeneous, although the derived marginal values are moderately different across respondents. (data collection: 2006-2007)
Policy implications • Results have implications for dolphin excursion operators and for policy makers managing Hawaii's ocean resources. • Understanding preferences helps guide the future development of natural resource-based recreational activities, while contributing to sustainable policies. • As proper dolphin management strategies may involve designing economic incentives for both excursion providers and consumers, rigorous analyses of the economic values attached to these excursions are essential. • Economic valuation can be useful for policy makers in their ECBAs to compare sustainable management strategies of spinner dolphins.				

Jim and Chen (2009)	Assessment of the amenity value of a two major types of natural landscape in Quarry Bay district, Hong Kong: harbor and mountain.	• Scenic views (cultural)	• Non-consumptive direct use value (HA)	• A broad harbor view increases the value of an apartment by 2.97%, equivalent to US$ 15,173, while a confined harbor view lifts price by 2.18%, or US$ 11,137. • A broad mountain view depresses apartment price by 6.7%, whereas a confined mountain view is statistically insignificant. • Increasing distance between an apartment and a preferred natural landscape lowers transaction price. • The negative perception of street view induces a price reduction by 3.7%, while building views are tolerated as an inevitable feature of the compact and vertical city. (1,474 transactions in 2005 and 2006 in 18 private housing estates in a residential district)
Policy implications • Quantifying the value of nature and scenic endowments in cities can inform policies and strategies on urban planning, development, nature conservation, and property appraisal.				
Nunes et al. (2009)	Assessment of individual preferences for alternative shellfishery policy measures in the Dutch Wadden Sea, the largest natural area of the Netherlands.	• Total harvest of cockles permitted by law • Surface of area where fishing of cockles is allowed • Rotation among areas where fishing is allowed (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Non-use value (material and moral warm glow) (CE)	• Natural scientists are willing to pay €94 for adoption of fishing half the current area policy, whereas their marginal willingness to accept the no-take (ban) fishing option is €109. • Dutch citizens, tourists, and local residents present a marginal WTP for the adoption of the rotation principle that ranges from €10 to €12, while natural scientists have an average WTP of €41 to prevent the introduction of rotation. • For local residents, the marginal WTP for “More birds” is €72 and the marginal WTP for “Many more birds”, €51. • Policy makers are willing to pay €122 to have “Many more birds”. • Tourists and natural scientists value the “Many more birds” scenario at €96 and €51, respectively. • Material warm glow values differ among stakeholders, ranging from €4.1 to €12.9. • Moral warm glow values are non-negative and of a similar magnitude for tourists and Dutch nationals, while there is no statistically significant moral warm glow for local residents. (data collection: 2003)
Policy implications • While ignoring the moral warm glow type can lead policy makers to disregard a significant welfare gain for tourists and citizens, it does not change the ranking of policies. • Ignoring the material warm glow type implies a revision of the rankings and a noteworthy distributional welfare impact.				

Lew et al. (2010)[c]	Valuation of public preferences for enhancements to the protection of the western stock (WS) of Steller sea lion in the Gulf of Alaska and Aleutian Islands which is listed as endangered and analysis of sensitivity of WTP to different baselines futures.	• Protection of Steller sea lion	• Non-use value (CE)	• The WTP for scenario 1 where the WS remains at its current level (45,000) and status (endangered) is lower than that for scenario 2 where a population of 50,000 WS sea lions results in 60 years but the status remains endangered. • The WTP for scenarios 1 and 2 are lower than that for scenario 3 where the WS increases at 70,000 (a level beyond the minimum population needed to achieve a threatened status). • The WTP for a scenario where the WS reaches a population of 90,000 (a level above that needed to remove from the Endangered Species Act list of threatened and endangered species) is statistically equal to that for scenario 3. • Across all scenarios, when the WS decreases in the future from its current population to 26,000 and remains endangered, an additional 1,000 eastern stock sea lions is worth $1/household. • The marginal WTP decreases when future baseline population forecast improves. (data collection: 2007)
Policy implications • Information about Steller sea lions protection value is useful to assist resource managers and policy makers in evaluating the merits of policies that may affect Steller sea lions.				
Myers et al. (2010)	Measurement of the recreational use value of migratory shorebirds on the Delaware Bay.	• Bird watching (cultural)	• Non-consumptive direct use value (CVM)	• A value of a day trip is about $66-90/household and for an overnight trip is about $200-425/household. ($2008)
Policy implications • Economic valuation can contribute to preservation of natural resources, which can improve recreational experiences.				
Rees et al. (2010)	Assessment of the value of the marine leisure and recreation industry of Lyme Bay, England, for dive businesses, dive clubs, sea anglers and charter boat operators in both monetary and non-monetary terms.	• Leisure and recreation industry/marine biodiversity (cultural)	• Value of the marine leisure and recreation industry (frequency counts for non-monetary valuation/expendit	• 12.3% of the Bay planning units contain sites used by the marine leisure and recreation industry, from which sites that can be defined as hotspots have a frequency count >38. • Sea anglers have the highest total estimated expenditure/year (£13,687,992). • The expenditure by divers through trips they make with dive clubs is £1,048,956/year.

			ure and business turnover for monetary valuation)	• The boat charter and dive businesses which rely on marine biodiversity have a combined turnover of £3,542,919/year. • The total value for recreation activities of £18,279,867/year. • An area closed to trawling activity enables the protection of some of the most valuable sites but has limited benefits for protecting the full resource base. (sites visited and businesses operating in 2008)
Policy implications • An ES approach to valuing marine biodiversity is a framework by which economic, ecological and social values may be incorporated into the decision making process. • Estimating the value of direct uses can provide an evidence base for the sustainable use of marine biodiversity when set against other competing economic interests in marine spatial planning. • Valuing the marine leisure and recreation industry is not necessarily a meaningful proxy for the value of marine biodiversity and its ecological functions. • How mutually exclusive activities are from one another should be examined as many fishing and recreation activities can remain compatible within a management framework. • The non-monetary valuation is an important tool for use in marine spatial planning (MSP) as the frequency count provides a relative value of sites to the marine leisure and recreation industry which can be discussed by all stakeholders involved in the MSP process. • Projects in which the different stakeholders are involved in mapping areas of value enables more focused management actions and can empower local involvement in the management process. • Data can be used to support compensation claims by members of the recreation and leisure industry if a site they consider valuable has been damaged or destroyed by human actions.				
Wang et al. (2010)	Estimation of coastal ES losses caused by four land reclamation schemes (RS) going from small (scheme 1) to large (scheme 4) scale in Tong'an Bay, Xiamen, China. The new land resulting from the projects is planned for city construction and commercial real estate. The paper also includes the development of a framework for selecting valuation methods and relevant models.	• Primary production • Biodiversity maintenance • Food supply • Genetic resources • Marine transport • Gas regulation • Erosion control • Waste treatment • Biological control • Recreation and ecotourism • Science and education (supporting, provisioning, regulating, and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Non-use value (direct market method, BT, restoration cost method, cost-based approach, defensive expenditure method, shadow project method, TCM, CVM)	• Looking at the damage estimates for RS 1, land reclamation causes significant damages to the waste treatment service (US$17.2 million/year), the marine space provisioning service (US$0.9million/year), the supporting service (US $0.7 million/year), and the coastal recreational service (US $0.2 million/year). • The total loss of coastal ES associated with RS 1 is US$19.3 million/year, or US$429 million lump sum (4.5% discounting). • The losses increase with the scale of land reclamation. • For RS 4, the total loss is US$247 million/year, or US$5.5 billion lump sum. • The annual loss per unit area rises substantially from US$9.73/$m^2$ for RS 1 to US$ 14.72 for RS 2, and then declines slightly for RS 3 and 4. • The ecological losses of reclamation associated with RS 1 to 4 are considerably higher than the internal cost of reclamation (project cost) which is US$5.75/$m^2$/year (annuity over 70 years at 4.5% discounting). (data collection: not indicated)[d]

Policy implications • Results provide information on the ecological losses associated with land reclamation, and help stakeholders and decision-makers to make informed choices among various options and to promote sustainable marine resource uses. • Economic valuation of ecosystem damages can lead to improvements in environmental policy making. • Complete ECBA of a land reclamation project must include information on the benefit side, so that the total cost (sum of both internal and external costs) may be compared with benefit. • The benefits associated with reclaimed land in China, which are functions of specific land uses, and net revenues they generate, are still uncertain for the proposed schemes.				
Krueger et al. (2011)	Estimation of the external costs to residents of the state of Delaware for off-shore wind turbines located at different distances from the coast.	• Visual disamenity (cultural)	• Non-consumptive direct use value (CE)	• The annual cost to inland residents is $19, $9, $1, and $0/household for turbines located at 0.9, 3.6, 6, and 9 miles off-shore. • The cost to residents living near the ocean is $80, $69, $35, and $27/household for the same increments. • Disamenity costs decline with distance from the coast, level off at approximately nine miles, and are significantly higher for people living nearer the coast. (2006$)
Policy implications • As the benefits and costs of off-shore wind power are considered, the visual disamenity of wind turbines located in seascapes valued for their natural beauty should be taken into account. • Estimates of both the costs savings and the external costs associated with moving turbines closer to the shore are useful for policy making.				
Lew and Larson (2011)	Estimation of the values of fishing opportunities and changes in harvest rates for single-day private boat saltwater recreational fishing for king and silver salmon in southeast Alaska by addressing both the challenge of valuing time in recreation and how best to measure variables related to harvest expectations in recreational fishing demand.	• Recreational fishing/king (Chinook) and silver (coho) salmon (cultural)	• Non-consumptive direct use value (RML model using an endogenous stochastic value of time function nesting a non-stochastic empirical specification)	• The mean value of a fishing choice occasion is approximately $45/angler, and mean marginal values of a king salmon and a silver salmon are approximately $71 and $106. • The standard assumption that the shadow value of time is a fixed fraction of the angler's wage is rejected in favor of a more flexible model. (data collection: 2007)
Policy implications • While expenditures are a good measure of economic activity, the more relevant measure of economic importance for policy purposes is its net economic value to society. • Understanding the demand for saltwater fishing trips and how it is affected by harvest is needed for fisheries managers to evaluate the potential effects of changes in harvest regulations. • State-of-the-art angler surveys can be combined with the best scientific information available on harvest patterns by species and site, which is creel census information on recreational harvest and effort by fishing location collected by the state agency responsible for fishery management.				
Ressurreição et al. (2011)	Estimation of the public's WTP to avoid a loss in the number of marine	• Professional fisheries/marine	• Consumptive direct use value	• The WTP to avoid a loss in the number of all marine species (ranging from €405 to €605/only payment) is higher than the

	species (mammals, fish, algae, birds and invertebrates) in the waters around the Azores archipelago.	biodiversity • Water quality • Erosion control • Coastal protection • Recreational opportunities/marine biodiversity (fishing, scuba diving, whale watching, bird watching) (provisioning, regulating and cultural)	• Indirect use value • Non-consumptive direct use • Option value • Existence value • Bequest value (CVM)	sum of the individual taxa (for individual marine taxa the maximum payments range from €45 to €100). • WTP to prevent losses in mammals and fish are slightly higher than the WTP to prevent losses in birds, invertebrates and algae possibly due to the intimate and frequent contact between respondents and marine mammals near the coast. • The degree of attachment to the study site may be a driver of valuation rather than level of income or education. (data collection: 2007)
Policy implications • Although people may not understand the concept of biodiversity or may not have even complete awareness of why its conservation is important they are aware that biodiversity is a much more expansive concept than simple measures of species richness. • Respondents acknowledge that marine biodiversity conservation should be a priority for governments. • Valuations of aspects of biodiversity should examine all components of total economic value rather than individual elements of it. • Economic valuation of marine biodiversity provides important information for marine management and conservation. • Findings challenge the commonly held premise that charismatic taxa have a disproportionately strong influence on WTP. • Greater benefits are attached to the conservation of all ecosystem rather than partial conservations plans. • SP methods provide useful information about individual preferences that complement biological information/research contributing for the design of projects and policy measures seeking the sustainable use of marine resources.				
Ahtiainen and Vanhatalo (2012)	Estimation of the value of reducing eutrophication in European sea areas.	• Recreational and amenity services/water quality (cultural)	• Non-consumptive direct use value • Non-use value (meta-analysis)	• The perceived benefits of reducing eutrophication can be considerable, with the predicted annual WTP/person ranging from $6 for small local changes to $235 for substantial changes covering large sea areas. • The values differ between marine regions. • Importance of investigating unstudied geographical areas. (2010$)
Policy implications • Benefit estimates can be used in the implementation of the EU Marine Strategy Framework Directive. • Methods that summarize the existing information and/or apply the available benefit estimates to a new context, such as BT and meta-analysis approaches, are policy relevant in a context in which conducting new primary valuation studies is resource intensive. • The WTP predictions give insights into the importance of protecting marine areas, and suggest that the benefits from implementing marine policies may be substantial.				

• As there are significant differences in the WTP for reducing eutrophication between marine regions in Europe, simple mean value benefit transfers from one sea area to another may be biased.				
Ressurreição et al. (2012)	Estimation of the public's WTP to avoid reduction of species richness for different marine taxa (mammals, birds, fish, invertebrates and algae) in Azores islands; Gulf of Gdansk, Poland; and Isles of Scilly, UK.	• Commercial fisheries • Water quality • Erosion control • Coastal protection • Leisure/recreation • Biodiversity protection (provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Existence value • Bequest value (CVM)	• Residents in the Azores are willing to pay more to avoid species loss ($90 for mammals, $75 for birds, $91 for fish, $72 for inverts) than residents in the Gulf of Gdansk region ($58 for mammals, $35 for birds, $47 for fish, $21 for inverts). • Although residents are more likely to attach higher values to prevent species loss than visitors, WTP values allocated by visitors are also significant. • Income, education and environmental awareness are significant predictors of WTP for marine species conservation. • Charismatic/likeable taxa don't necessarily have a strong influence on WTP for biodiversity conservation. • Valuation of components of marine biodiversity may be context dependent and driven by the specific maritime culture of each location. (data collection: 2007)
Policy implications • 96% of respondents consider marine biodiversity conservation should be a priority for policy makers. • Preserving species for the benefit of future generations is the most frequently cited WTP reason, this showing both a societal ethical principle and the relevance of non-use values in the valuation of complex environmental amenities such as biodiversity. • Understanding the cultural variation in public preferences for marine species is required if conservation objectives are to include societal preferences in addition to scientific considerations. • Information about human preferences and values is needed to ensure that conservation measures succeed both ecologically and socially. • Economic analysis offers alternatives whereby the value of biodiversity and public preferences can be accounted for in policy planning; identifies the main beneficiaries of conservation; and provides evidence of the social demand for biodiversity protection; thus reinforcing scientific support for conservation.				
Anderson and Lee (2013)	Examination of how the value of recreational fishing is affected by changes in wild and hatchery salmon regulations and catch rates in the Northwest region of the US.	• Recreational saltwater fishing/wild and hatchery salmon (cultural)	• Non-consumptive direct use value (CE)	• Marginal WTP values for a 30-pound hatchery king salmon range from –$10 when it must be released to a high of $180 when it may be kept. • WTP values for hatchery king salmon are $25 to $50 higher than those of equally sized wild king salmon. • Across species and sizes, anglers would rather release wild salmon than hatchery salmon. • The magnitude of differences in values of fish which must be released ranges from $8 for small silvers to $82 for large kings. • Wild and hatchery salmon are not perfect substitutes to the recreational angler and differences depend on baseline levels of catch rates and bag limits. (data collection: 2006-2007)

Policy implications • At the baseline set of regulations, increases in hatchery king catch are more highly valued than increases in wild king catch. • At the baseline set of catch levels, increases in the wild king limit are more highly valued than increases in the overall king salmon limit. • This apparent contradiction simply illustrates the importance of using the true baseline conditions in WTP calculations. • Considering the economic efficiency of fishery management decisions requires distinguishing between the recreational values of wild and hatchery salmon instead of treating them as substitutes.				
Loureiro and Loomis (2013)	Comparison of environmental damages linked to a large oil spill off the coast of Spain and affecting Spain, UK, and Austria.	• Biodiversity loss • Beach closures	• Non-use value (CVM)	• The WTP to avoid a future similar accident is statistically greater in Spain (€124.37) than that in UK (€80.87) and that in Austria (€89.08). • Those who have been most affected by the spill are those who are willing to pay the most. (2009€)
Policy implications • Policy makers should consider the importance of non-use values in the compensation process of environmental damages caused by large international oil spills, especially within the EU. • It appears economically justified for the EU, acting on behalf of its member countries not directly physically impacted by the spill, to seek damages on behalf of the citizens of member countries.				
Okmyung and Czajkowski (2013)	Estimation of the value of a healthy water body using water quality as the amenity of interest. The paper compares results of using technical measures of water quality with results of using a non-technical measure of water quality (location grade) available in an urban coastal housing market of South Florida.	• Amenity services/water quality (cultural)	• Non-consumptive direct use value (HA)	• Significant mean WTP estimates for water quality improvement range from $7,531 to $43,158. • Water quality improvement implies higher property values. • The technical measures provide better prediction of housing prices. (July and August 2004 sales data)[e]
Policy implications • Economic valuation can contribute to inform policy decisions.				
Raguragavan et al. (2013)	Investigation of fishing site choices in Western Australia using national survey data covering eight major fishing regions and forty-eight fishing sites.	• Recreational fishing (cultural)	• Non-consumptive direct use value (TCM-binomial model of angler specific catch rates)	• The part-worth estimate for prize fish is $15.94/fish; for reef fish, $9.47/fish; for key sports fish, $9.40/fish; for table fish, $4.65/fish; and for butter fish, $2.28/fish. • The value of a 100% catch rate increase of prize fish is $31.41/trip, with a sample mean catch/trip of 1.28. (data collection: 2000-2001)
Policy implications • There is a need to understand recreational values to evaluate the welfare impacts of both policies that reallocate stocks between recreational and commercial sectors and management strategies that target specific fish types and/or sites.				

• Estimates can be used to inform the development of fishery management policies through, for example, setting out the welfare costs of imposing bag limits or closing fishing sites.				
Ruiz-Frau et al. (2013)	Assessment of the economic importance and spatial distribution of non-extractive uses of marine biodiversity in terms of the provision of recreational services in the coastal temperate area of Wales and its application to Marine Spatial Planning.	• Recreational opportunities (diving, kayaking, wildlife watching from boats and seabird watching)/marine biodiversity (cultural)	• Non-consumptive direct use value (expenditure)	• The mean cost of a diving trip is £71/person/day regardless of whether the diver is spending the night away from home. • The mean cost for a sea-kayaking trip is about 40% of the cost of a diving trip, with a mean of £27/person/day. • The mean expenditure of a passenger taking a wildlife viewing trip is £44/person/day. • The mean cost of a seabird watching day out is 28/person/day regardless of whether the respondent spends the night away. • The total annual expenditure associated with non-extractive recreational uses of marine biodiversity ranges between £21.8 and £33 million. • Spatially, there is an overlap among areas used by the different recreational groups and the distribution of uses can be linked to different aspects of marine biodiversity. (data collection: divers, kayakers and wildlife cruise customers interviewed in 2008/seabird watchers surveyed in 2009).

Policy implications

- Maintaining a high quality marine environmental status in rural areas is necessary to preserve the additional revenues and local employment opportunities depending on the marine ecosystem.
- The integration of spatially-explicit socioeconomic data for different uses of marine biodiversity provides information about the potential effects of implementing a spatial management regime.
- Such data provide a balanced overview of the value of marine biodiversity to different sectors of society and contribute to the process of developing comprehensive marine spatial plans.
- Valuation of non-extractive uses associated with marine biodiversity in temperate areas can contribute to promote conservation as these uses are more easily regulated and their effects are less likely to contribute to biodiversity degradation than industrial scale activities.
- Valuation of non-extractive uses facilitates their incorporation into management plans, especially if the geographic distribution of these services can be integrated into marine spatial planning.
- Values can facilitate stakeholder engagement and help in conflict resolution when designing networks of MPAs from which some activities may be excluded or more strictly regulated.

Yamazaki et al. (2013)	Estimation of recreational fishers' WTP for their most recent day's fishing in two important Tasmanian recreational fisheries, the inshore saltwater and rock lobster fisheries.	• Recreational fishing/inshore saltwater and rock lobster (cultural)	• Non-consumptive direct use value (CVM)	• The mean WTP for the last fishing day in the inshore saltwater fishery ($78.18) is statistically equivalent to that for the last day of lobster fishing ($87.43) (anchoring/shift effect model). • High and low catch fishers value equally a fishing day. • The value of fishing in the inshore saltwater and rock lobster fisheries cannot be properly captured through the number of fish caught or the expenditure on a day's fishing activity. • The value of fishing depends on the motivation and quality of fishing experience and demographic features of fishers. (data collection: 2008-2009)

Policy implications • Importance of understanding the behaviour of recreational fishers for the sustainable management of aquatic resources.				
León et al. (2014)	Estimation of non-use benefits of preventing further oil spills in the coasts of Spain with emphasis on investigating the role of emotions in heterogeneous responses of individuals.	• Biodiversity	• Non-use values (CVM)	• The WTP of segment 1 (53%) is €53.88; the WTP of segment 2 (24%) is €21.74; and the WTP of segment 3 (31%) is €0. • The overall mean WTP for all groups encountered in the sample is €31.18. • Heterogeneity in WTP responses is explained by the specific emotional reactions of individuals (upset, sadness, indifference) rather than by their socioeconomic characteristics. (data collection: 2005-2008)
Policy implications • Oil spills are a sensitive policy issue that raise a wide array of potential emotions. • Results support previous evidence arguing the difficulty in isolating emotional and cognitive dimensions in subjects' perceptions and behavior. • The investigation of the emotional reactions of individuals can provide useful tools for the design of non-market valuation studies, providing more accurate predictions of the potential behavior of individuals in constructed markets for damage assessment.				
Lew and Larson (2014)	Investigation of how bag limits interact with economic values in an analysis of recreational fishing values associated with Pacific halibut and Pacific salmon in Southeast and Southcentral Alaska.	• Saltwater sport fishing/Pacific halibut, Chinook salmon and Coho salmon (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The mean value assigned by Southeast Alaska residents to a single-day private boat fishing trip where one species is caught with catches less than or equal to the allowable bag (or take) limit ranges from US$248 to US$313 (depending on whether the fish is kept or released). • Alaska residents value single-day private boat fishing trips in Southcentral Alaska between $284 and $385, and charter fishing trips in the area between $228 and $328. • Non-residents value charter fishing trips in Southeast Alaska and Southcentral Alaska between $1,849 and $2,686, and $1,954 and $2,819, respectively. • Non-residents and Alaska residents anglers value increases in number of fish caught and kept, potential catch, and fish size. • Anglers value the fish they keep the highest and the fish they must release, and potential catch, less. • For two trips with the same catch, the one with a higher bag limit is valued at no less than the trip with a lower bag limit. • The mean trip values linked to catch-and-release only trips and trips where anglers harvest fish are statistically equal. (data collection: 2007)

Policy implications

- The value anglers place on their fishing opportunities is critical information for fully informing marine policy within an economic efficiency framework.
- Understanding the values of fishing in its different forms (charter boat fishing, private boat fishing, and shore fishing) and how they are affected by policy measures is crucial to fully assess to fully assess the implications of changing sport fishing regulations.
- Bag limits in recreational fisheries can be used in fishery management for both biological and economic reasons as they affect angler participation and slow rates of harvest, which may better protect stocks and increase the length of time until a particular harvest level is reached.
- Accounting for the full economic benefits of different types of fishing experiences under alternative bag limits is necessary to identify the one that maximizes the net benefits to society.

Czajkowski et al. (2015)	Estimation of the benefits associated with recreational use of the Baltic Sea in current environmental conditions.	• Recreational use/water quality (cultural)	• Non-consumptive direct use value (TCM)	• The total annual recreation benefits are close to €15 billion, of which over 1/3 accrues to Germany (€5.14 billion), followed by Sweden (€4.43 billion), Poland (€2.07 billion), Finland (€1.04 billion), coastal regions of Russia (€0.94 billion), Denmark (€0.72 billion), and the Baltic States Estonia, Latvia and Lithuania (€0.15, €0.11 and €0.19 billion, respectively). • Value differences between the countries are explained by differences in the average CS of a single recreational trip, how common and how frequent visiting the Baltic Sea in each country is, and the population of each country. • Under a water quality improvement scenario, the proportional increases in benefits range from 7 to 18% of the current annual benefits across countries. (data collection: 2010)

Policy implications

- The heterogeneity across countries with respect to the willingness to undertake trips to the Baltic Sea coast show that individual preferences and availability of coastal recreation sites are important determinants of the value of access to the Baltic Sea.
- Effective international cooperation required to achieve water quality improvements depends on the distribution across countries of the benefits and costs of water quality improving actions.
- The provision of information on the size of the potential economic benefits to each country from enhanced environmental quality can foster joint actions.
- Such information can also inform countries to improve the condition of global commons when it comes to unilateral action.
- Aggregate recreation benefits are important for national environmental accounting, whilst benefits from water quality changes are vital for social ECBA.

[a] Key: BT, benefit transfer; CE, choice experiment; CS, consumer surplus; CV, compensating variation; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; HA, hedonic analysis; I/O, input-output; MPA, marine protected area; RML, repeated mixed logit; TCM, travel cost method; WTP, willingness-to-pay.
[b] The year of data collection could be assumed to be 2008 as the authors report the equivalence household income using €1=SEK 9.4 in January 2008.
[c] Under each scenario, the WTP is calculated by assuming the eastern stock is recovered but alternatively with a 60,000 or 80,000 population size.
[d] The authors use different data from different sources.
[e] Despite having July and August 2004 sales data, a second-quarter index has been chosen (the last complete quarter of home sales) such that April through August 2004 home sale prices have not been adjusted. The analysis has been based on the assumption of rapid price adjustment within the housing market.

3.7 Coral reefs

Coral reefs are highly productive ecosystems that provide a variety of valuable goods and services to humans which include recreational opportunities for diving, snorkelling, and viewing; coastal protection and habitat/nursery functions for commercial and recreational fisheries; and the welfare associated with the existence of diverse natural ecosystems. Due to their public good nature, the use of coral reefs is sub-optimal, this leading to the absence, or underdevelopment, of markets for coral reef services. Consequently, these ecosystems are undervalued in decision-making processes concerning their use and conservation (Brander et al., 2007). Economic valuation of services provided by coral reefs can provide evidence of the importance of sustaining and enhancing these ecosystems. Quantifying the value of reef services can facilitate a "transition to an ecosystem-based management by providing both an economic justification and a decision-making framework for prioritizing management actions" (Grabowski et al., 2012).

Table 7 reports a list of papers dealing with the valuation of services provided by coral reefs excluding studies focusing on cold-water coral (CWC) reefs. Indeed, as CWC are deep-sea organisms and hence the majority of people cannot make a direct use of their services, they are analyzed in section 3.8 within the Deep Sea/Open Ocean category or in section 3.9 if the focus of the paper is on marine protected areas (MPA) aimed at CWC protection. The table presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

Only 11 papers have been reviewed in this section. This does not mean that, during the last 16 years, the interest in valuing the services provided by coral reefs has been low among researchers. In fact, many papers dealing with the valuation of benefits derived from the creation of MPAs (analyzed in section 3.9), focus on protected coral reef areas. Consequently, these papers also examine the benefits provided to society by coral reefs. However, as not all the papers valuing services provided by coral reefs focus on the creation of MPAs to protect them, and economic valuation of coral reef services can serve to demonstrate the benefits of their sustainable management regardless of the management tool (Laurans et al., 2013), it has been considered convenient to include a section which only analyzes the studies concerned with coral reef conservation without making any reference to the creation of an MPA as a conservation tool. Besides, it is worth noting that MPAs involve marine environments possessing features of uniqueness and national importance which are not exclusive of coral reefs. However, it is expected the analysis made in this section complements that of the benefits associated with protected coral reef areas.

As shown in Table 7, half of the papers have been published since 2012 onwards (6 out of 11). Excluding Laurans et al. (2013), which analyses how extant valuations address the various management challenges of coral reef regions, and Brander et al. (2007), who employes a meta-analysis approach, most of studies use stated preference (SP) methods either alone (4) or together with revealed preference (RP) techniques (3). However, only 4 of them estimate non-use values. Almost half of the papers (5) frame the analysis in developing countries or in economies 'in transition'.

3.7.1 Ecosystem services and values

Excluding Laurans et al. (2013) and Brander et al. (2007), almost all the papers (6) focus on valuing cultural services provided by coral reefs. This is reasonable since these ecosystems are especially valued for the recreational opportunities they offer to society. Marre et al. (2015) value cultural services together with provisioning and regulating ones. Indeed, they estimate, through a choice experiment (CE), the willingness-to-pay (WTP) of users and non-users for coral reef ecosystem protection by using the attributes 'quantity of fished animals' (referring to the total catches from recreational, commercial and subsistence/traditional fisheries), 'health and richness of marine life' (referring to ecological conditions of coral reefs and associated ecosystems, such as abundance and diversity of habitats and species, as well as water quality), 'coastal and lagoon natural landscapes' (referring to the natural aspect of current coastal landscapes), and 'areas of practice' (referring to coastal and lagoon places that people and the community use for common activities). On the other side, Grabowski et al. (2012) focus on US oyster reefs and only value supporting, provisioning and regulating services. Thus, provisioning and regulating services are both valued in two papers, while supporting services, only in one study.

The type of cultural service which has been valued with a higher frequency is scuba diving (Andersson, 2007; Gill et al., 2015; Wielgus et al., 2003). Chen et al. (2013) focus on both scuba diving and recreational boating, while some studies value the 'recreational benefits' provided by coral reefs (Ahmed et al., 2007; Carr and Mendelsohn, 2003).

Regarding the type of regulating services, Grabowski et al. (2012) develop a framework to assess the value of enhancing water quality and erosion protection as two important regulating services provided by oyster reefs. Marre et al. (2015) implicitly value the role of reefs in enhancing water quality when valuing the attribute 'health and richness of marine life'. Oyster production and commercial fisheries are the two provisioning services considered.

As almost all the papers focus on cultural services, the majority estimate non-consumptive direct use values. Consumptive direct use values are estimated for provisioning services, while indirect use values are quantified for regulating and supporting services.

Excluding Laurans et al. (2013), only 4 primary valuation papers using SP methods indicate the type of values they estimate. In particular, Ahmed et al. (2007) and Marre et al. (2015) estimate non-use values together with non-consumptive direct use values. Indeed, the former state that "coral reef values in Bolinao are estimated in terms of the recreational benefits and the use and non-use values attached to their conservation", while the latter assume, for users, that any WTP for preserving the coral reef services during their expected life duration may be linked to both use and non-use values (as well as to option values), and that any WTP for preserving the services beyond one's expected life-time can be assumed to be a measure of the non-use values. In contrast, Madani et al. (2013) only estimate non-use values when measuring, through the contingent valuation method (CVM), the economic value assigned by Iranian households to the preservation of coral reefs at Kish Island. Indeed, they point out that "the answer to the elicitation question does not depend on whether the respondent is a previous visitor" to the island or a non-visitor, which is viewed as evidence that both types of respondents provide the same type of value, that is, non-use value.

On the other side, Andersson (2007) only estimate use values when measuring the welfare loss derived from ecological damage at a recreational site attracting international visitors by comparing SP information collected before and after the actual change in quality. The authors state that, as the change really occurs, an RP method can also be used to estimate the value of the same change. So, they compare both methods and point out that "the respondents state their WTP for the use of the site and the willingness-to-accept for the loss of quality only in the case of using it and not for any possible non-use values attached to the site".

For the 3 remaining papers using SP methods, which do not indicate which values they estimate, assumptions about the type of inferred values have been made. In this sense, it has been considered that only Wielgus et al. (2003) infer non-use values together with use values as respondents are told that "converting the Eliat Coral Beach Nature Reserve into a conservation area could serve to protect the remaining corals and rehabilitate degraded areas, thereby improving the quality of dive sites". In contrast, it has been assumed that Chen et al. (2013) and Gill et al. (2015) only estimate use values. Indeed, the former uses a sample of tourists to estimate the recreational value of artificial reefs in Taiwan. To do it, they use a travel cost method and a CVM and state that both methods are valid and widely used to estimate recreational benefits, thus providing useful information for decision

making. The latter estimates, through a sample of tourists, the WTP of divers for changes with respect to the current dive experience quality as perceived by them and explain the WTP as a function of attributes representing non-consumptive use purposes (i.e. abundance and size of reef fishes, the presence of fishing activity/gear, and dive price).

3.7.2 Outcomes and policy implications

In general, the reviewed studies give evidence that people assign a high value to the recreational benefits of coral reefs. For instance, Carr and Mendelsohn (2003) show that the recreational value of the Great Barrier Reef is worth from US$18 to 40 billion (using a discount rate of 4%), while Brander et al. (2007) estimate, through a meta-analysis, an average value of coral reef recreation of 184 US$ per visit. Although most coral reefs studies have focused on tourism and recreation, thus putting emphasis on estimation of direct use values (Laurans et al., 2013), others have also highlighted the importance of their non-use values (Marre et al., 2015), this meaning conservation benefits of coral reefs are also important for individuals. In this context, Wielgus et al. (2003) demonstrate that the annual social costs of activities contributing to coral reefs degradation in Israel are aproximately US$2.86 million.

As shown by Grabowski et al. (2012) for the US oyster reefs, reefs can also be valued for their provisioning, supporting and regulating services. In particular, their results show that oyster reefs provide value not only as a commercial fishery resource for exploitation but also as a biogenic habitat providing diverse ES of high economic value. For instance, they estimate the value of nitrogen removal from 1 hectare of oyster reef habitat at $1,385–$6,716 per year.

According to Carr and Mendelsohn (2003), valuation studies can serve to demonstrate the very high benefits associated with protecting high quality coral reefs, whose sustainability and health are threatened by human-induced impacts such as global warming, mining, overfishing and water pollution. In other words, it can provide evidence of the importance of sustaining and enhancing coral reefs and the ecosystems that provide them. Quantifying the value of reef services can facilitate a “transition to an ecosystem-based management by providing both an economic justification and a decision-making framework for prioritizing management actions” (Grabowski et al., 2012).

Carr and Mendelsohn (2003) also state that “the large benefits accruing to foreign visitors suggest that international support for coral reefs is warranted” and conservation policies should be supported. This is especially of relevance in poor coral reef countries, where socio-economic factors can lead local goverments not to consider preservation of natural resources and the environment as a priority. In this context, Ahmed et al. (2007) state that

the recognition of recreational and conservation benefits of coral reefs can serve to support public investment for their conservation. In this sense, the authors state that advocacy, education, and awareness campaigns can play a role in creating a larger WTP for the management of these ecosystems. In a context of artificial coral reefs, Chen et al. (2013) also refer to the role of education and outreach for a better planning. Gill et al. (2015) point out that "results can be used to justify investment in preemptive management strategies targeted at improving reef fish stocks (namenly reducing unsustainable fishing activities and land-based reef impacts), managing conflicting uses, as well as to indicate a possible source of financing for such conservation activities". Indeed, they say that as divers show large WTPs to improve the size and abundance of fish and to avoid encountering fishing activity/gear, "it should therefore be feasible to capture some of the consumer surplus to partially or wholly finance the establishment and management of no-take zones that are designated for diving". The revenues from user fees could also be used to design compensating mechanisms for the displacement costs incurred by fishers and other types of users.

Some authors state that results may be useful not only from a reef management perspective but also for implementing strategies aimed at managing recreational access. According to Brander et al. (2007), "reef managers should realise that restricting the area of dive sites or increasing the number of permitted visitors will reduce the attractiveness of that reef area". Andersson (2007) considers that ecosystem resilience to cope with shocks such as coral bleaching can be increased if the number of tourists is limited and that changes in the supply of healthy reefs can be compensated for.

Other researchers argue that environmental authorities could use estimation results to impose charges for damage to coral reefs (Wielgus et al., 2003).

Gill et al. (2015) state that marine spatial planning (MSP) could help to sustain the value of multi-use reef areas where select locations can be designated for scuba diving with limited/no fishing activity, especially taking into account the benefits of marine reserves and divers' aversion to fishing activity/gear.In particular, MSP together with reducing land-based reef stressors, could increase the diving recreational experience at the time of improving reef health, allowing for spillover of commercially important species into fished areas and potentially reducing user conflicts. "Such management interventions should also be cognisant of the carrying capacity of each use zone, where for dive areas, factors such as diver damage to reefs and aversion to crowding must be considered for high-traffic locations".

3.7.3 Research needs and challenges

The need to determine whether the benefits of activities such as coral mining, eutrophication, and destructive fishing are worth the resulting damages has been identified as an area for further research. Indeed, Carr and Mendelsohn (2003) suggest that, although it is likely that large-scale environmental problems such as global warming will cause significant damage to coral reefs, smaller-scale threats should also be examined. According to the authors, "establishing simple programs to dissipate water pollution, limit mining, and limit unsustainable or destructive fishing could be cost effective for many coral reef countries and may provide additional benefits by increasing coral resilience to other threats". They also state that the benefits accruing to countries sending visitors to coral reef areas should also be examined as this could serve to protect coral reefs in low developed countries by means of international funds.

The need to estimate non-use values has also been identified as an area for future work by some authors. In this sense, Madani et al. (2013) state that the WTP for coral reef conservation assigned by users and non-users elsewhere in the country would lead to a better accounting of the non-use value from the coral reefs at Kish Island in particular, and from the coral reefs in the region in general.This is especially relevant in a context of expected climate change (CC) impacts on coral reefs. In this setting, the authors state not only that their findings help understand how coral reefs may successfully adapt to CC but also that adaptation strategies could benefit users and non-users of coral reefs regardless of whether they are located in the region or not. On the other side, Marre et al. (2015) point out that studying respondent's perceptions with regards to different time-frames could also be an interesting are for further work as respondents may have considered uncertainty over the (distant in time) benefits when making their choices.

Marre et al. (2015) also point out that, due to their multidimensionality, considering non-use values might not be enough to get support for conservation. Thus, they suggest further research on exploring whether stakeholders would consider non-use values as well as other valuation metrics when assessing the trade-offs associated with coastal development project management. The importance of doing research into the design of reef management that addresses local stakeholders' concerns has also been highlighted by Brander et al. (2007).

In the context of developing countries, one of the major challenges for the sustainable management of coral reefs has to do with the low WTP for coral reef conservation likely due to the low income level of local respondents and the free rider problem characterizing public goods. In this setting, Ahmed et al. (2007) suggest that massive advocacy and education campaigns would help increase public awareness and understanding of the importance of coral reefs, which would increase the values and "promote responsible stewardship" of

these ecosystems. They also recommend future work on investigating the relationship between coral reef services and income growth since both the recreational demand and WTP are determined by income.

The use of correct and balanced long-term information about environmental damages on coral reefs also seems to be crucial especially for low income economies. Andersson (2007) points out that, in a context in which "the patchy nature of the damage from bleaching makes it difficult to provide an accurate description of the change in quality at any tourist destination", negative information could have important impacts on economic activites which are critical to the local economy by "marking" a site. According to the author, this is especially true when there are recovery possibilities for the reefs, as in the case of Mafia Island. Accordingly, the author states that an area that needs further study is the role of information.

On the other side, increasing the use of coral reef services valuation by different kinds of stakeholders in different settings becomes one of the most important challenges identified in this literature. In the context of South Pacific coral reefs, Laurans et al. (2013) state that economic valuation is seen as a promising approach to demonstrate the benefits derived from sustainable management of coral reefs to policy makers. However, they point out that these valuations "have been used in an 'informative' way rather than in a 'decisive' or 'technical' perspective" which explains the limited number of cases actually used to inform ex-ante decision-making processes. Thus, although valuations have been effectively used to raise awareness regarding coral reef conservation, "methodologies will have to be further developed, with multidisciplinary inputs, if they are to provide valuable inputs in local and technical decision-making". Clarification and harmonisation of concepts used in coral reef assessments can contribute to this aim. They also suggest considering the cultural relations to reefs as well as enhancing the understanding between valuation authors and decision makers.

Another challenge has to do with the use of meta-analysis approaches. Brander et al. (2007) state synthesis techniques will allow assessing the results of the existing valuation literature as a whole and identifying key determinants of coral reef values. However, there is a need for further high quality valuation research on coral reefs. Indeed, the majority of studies are published as grey literature, and the fact that authorship is a significant explanatory variable in the meta-regression is also, according to the authors, "a sign that past coral reef valuation studies may not have followed an unbiased approach". The lack of relevant information such as the coral reef characteristics and the specifics of the methods used is also common among the existing valuation studies. The authors consider that the existence of a standard

protocol for the reporting of valuation results would improve the performance of meta-analyses and consequently the accuracy of transferred values.

Finally, Laurans et al. (2013) advocate for the need of a multidisciplinary approach to better manage coral reefs when stating “there is a need to improve the ecological knowledge base in relation to coral reef service valuation, such as the need to address the ‘Maximum Sustainable Yield’ difficulty by better specifying the ecological-economic feedbacks in fisheries management”.

Table 7. Papers concerning the valuation of services provided by coral reefs[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Wielgus et al. (2003)	Economic valuation of welfare changes from coral reef damage at Eilat, Israeli Red Sea.	• Scuba diving (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• The value of coral and fish diversity is US$1.20/dive. • The marginal price of water visibility is US$1.20/dive. • The annual social costs of activities contributing to coral reef degradation are aproximately US$2.86 million. (data collection: 2001-2002)
Policy implications • Israelian environmental authorities can use these results to impose charges for damage to coral reefs.				
Carr and Mendelsohn (2003)	Estimation of the recreational benefits provided by the Great Barrier Reef (GBR) and analysis of the problems related to functional form and measurement of travel costs for international visits.	• Recreational services (cultural)	• Non-consumptive direct use value (TCM)	• The annual recreational benefits of the GBR range between US$700 million to US$1.6 billion. • The domestic value to Australia is about US$400 million. • The estimated value to more distant countries depends on the definition of travel costs and the functional form. • The recreational value associated with the GBR is worth from US$18 to US$40 billion, from which domestic Australian visitors enjoy between 20% to 60% of the benefits, and foreign tourists enjoy the rest (discounting at a 4% real interest rate). (data collection: 2000)
Policy implications • Healthy, intact coral reef systems can have very high values for both coral reef and distant nations. • The high benefits accruing to foreign visitors suggest that international support for coral reefs is warranted, which is evident for many coral reef countries being poorer than Australia. • Conservation policies to protect coral reefs should be supported.				
Ahmed et al. (2007)	Measurement of the value of recreational and conservation benefits of coral reefs along the Lingayen Gulf, Bolinao, Philippines.	• Recreational services/tourism (cultural)	• Non-consumptive direct use value • Non-use value (TCM and CVM)	• CS is PhP10,463 (US$223)/person/year, and net revenues worth PhP220.2 million (US$4.7 million)/year. • Individual WTP equals to PhP20.46 (US$0.45)/visit, or PhP73.17 (US$1.60)/year (Tobit regression). • Potential user fee revenues are PhP1.54 million (US$33,695.9) and can be used to help finance improvements in reef quality. • The mean WTP/visit of locals (PhP25.01 or US$0.55) is 38% below that of foreign respondents (PhP40.33 or US$0.88). (data collection: 2000)

Policy implications • The recognition of recreational and conservation benefits of coral reefs provides a sound economic rationale for their management. • In developing countries, determining the values of coral reefs to support public investment for their conservation and management is challenging as ecosystem preservation may not be an immediate priority among local travelers due to socio-economic considerations. • Advocacy, education, and awareness campaigns can create a larger WTP for the management of coral reefs in developing countries.				
Andersson (2007)	Estimation of the recreational welfare loss caused by El Niño in 1997/1998 in Zanzibar and Mafia, typically visited for their pristine coral reefs, situated outside Tanzania in the West Indian Ocean.	• Scuba diving and snorkelling/tourism (cultural)	• Non-consumptive direct use value (RP and SP methods)	• A person is willing to pay about 300US$ less for access to Zanzibar after the bleaching of the reefs. • The WTAC for the reefs on Zanzibar is non-significant. • For Mafia, all relative values for bleaching are negative and significant, especially for the reefs. • The WTP for access to Mafia is reduced by 110US$ after the bleaching, and the WTAC, by 555US$ (255 US$ for the constrained estimate). • The annual welfare loss due to coral bleaching is estimated to US$22–154 million, which implies US$254-1780/visitor (depending on whether the median or the mean is used) • Despite losses in utility due to bleaching, the tourists still visit the sites. (data collection: 1996, 1997, 1999)
Policy implications • Some sort of resilience in the ability to cope with shocks such as coral bleaching is possible if both the number of tourists is limited and any change (within certain boundaries) in the supply of healthy reefs can be compensated for.				
Brander et al. (2007)	Estimation of the value of coral reef recreation.	• Recreational opportunities (cultural)	• Non-consumptive direct use value (meta-analysis)	• The average value of coral reef recreation is 184US$/visit, while the median value is 17US$/visit (distribution of values is skewed with a long tail of high values). • The meta-regression results reveal that individuals prefer reefs with a larger size and fewer visitors. • Different valuation methods produce widely different values, with the CVM producing significantly lower value estimates. • Authorship effects prove to be highly significant in explaining variation in value estimates. • The assessment of the prospects for using the analysis for out-of-sample value transfer shows average transfer errors of 186%. (2000$)

Policy implications • Results are useful from the perspective of reef management and the design of recreational access. • Reef managers should realise that restricting the area of dive sites or increasing the number of permitted visitors will reduce the attractiveness of the reef area. • There is a need for further high-quality valuation research on coral reefs. • Synthesis techniques such as meta-analysis allow assessing the results of the existing literature as a whole and identifying the key explanatory factors that determine coral reef value.				
Grabowski et al. (2012)	Assessment of the enhancing water quality and stabilizing shoreline services provided by US oyster reefs.	• Habitat for recreationally and commercially valuable fish species • Oyster production • Enhancing water quality • Erosion protection (supporting, provisioning and regulating)	• Consumptive direct use value • Indirect use value (market price method/avoided-cost proxy/different studies)	• The value of nitrogen removal from 1 ha of oyster reef habitat is $1385–$6716/year. • The commercial fish value/ha of oyster reef is $4123/year. • The present value of stabilization services/ha of oyster reef habitat over the life of human-made structures ranges from $1,074,475 to $1,504,265. • When oyster reefs are subjected to destructive oyster harvesting, they do not recover the costs of restoration. • The average annual value of services provided by restored and protected oyster reefs ranges from $10,325 to $99,421/ha, depending on where the restored reef is located and the ES the restored reef provides, and is greater than the commercial value derived from harvesting the oysters produced by degraded reefs. (2011$)
Policy implications • The total potential return on oyster reef restoration investments justifies restoration and protection of the existing oyster reefs and shows these investments are economically efficient strategies. • Valuation information, together with restoration cost and habitat loss information, can assist resource managers in deciding how best to use limited restoration funds and in prioritizing among the range of possible restoration projects.				
Chen et al. (2013)	Estimation of the recreational value of artificial reefs (AR) in Penghu, Taiwan.	• Recreational boating • Scuba diving (cultural)	• Non-consumptive direct use value (TCM, CVM)	• Boat anglers' recreational benefit is US$281.9/trip and scuba divers' recreational benefit is US$348.5/dive (TCM). • The projected ticket fares are US$13 and US$12.7 for boat fishing and scuba diving, respectively (CVM). • Yearly revenues from ticket sales are approximately US$1.7 million and US$1.9 million, while the yearly economic values of boat fishing and scuba diving are US$37 million and US$52 million, respectively. (data collection: 2008)
Policy implications • The development of recreational activities on and around ARs can provide substantial economic benefits.				

• TCM and CVM remain valid and are can be used to estimate recreational benefits and hence provide useful information for decision making.				
Laurans et al. (2013a)	Analysis of how extant valuations address the various management challenges of coral reef regions in general and more specifically for the South Pacific.	• Provisioning, regulating and cultural	• Consumptive direct use value • Non-consumptive direct use value • Indirect use value • Existence value • Bequest value	• The development of coral reef ES valuation in the South Pacific depends on a combination of factors, each of them pointing to different research and policy programmes. • Although ES valuations have been effectively used to raise awareness with respect to coral reef conservation, methodologies will have to be further developed, with multidisciplinary inputs, if they are to provide valuable inputs in local and technical decision making.
Policy implications • Economic valuation of coral reef ES can demonstrate the benefits of sustainable management of coral ecosystems to policy makers and provide useful information for improved decisions. • Coral reefs ES will generally result from a site-specific careful management of uses, activities and ecological conditions. • ES provision is maximised where and when a high variety of uses and activities can be undertaken at the same site, this requiring that each service has to be moderately used. • As the reviewed figures do not provide economic consolidated accounts or any basis for an optimisation of public policies at country or regional scale, they should be considered as informative contributions to policy-making and political debates. • Consideration of ES in discussions on coral reef management can help advocate a better management of coral reefs.				
Madani et al. (2013)	Estimation of the economic value assigned by Iranian households to the preservation of coral reefs at Kish Island.	• Conservation value	• Non-use value (CVM)	• The total WTP for five years of services provided by coral reefs ranges from US$20 to US$155 million, and from US$1.21 to US$9.13 on a per-household basis. (data collection: 2010)
Policy implications • Economic valuation can contribute to conservation of coral reefs. • Individuals assigning use and non-use values to coral reefs located elsewhere benefit from the conservation of coral reefs located in the Persian Gulf, the Gulf of Oman, and the Arabian Sea. • As findings help understand how coral reefs may successfully adapt to climate change (CC), CC adaptation strategies could benefit users and non-users of coral reefs regardless of whether they are located in this region or not.				
Gill et al. (2015)	Quantification of the potential effects of changes in Caribbean reef fish populations on the CS of recreational divers.	• Scuba diving (cultural)	• Non-consumptive direct use value (CE)	• Divers are willing to pay US$74.43 for a 2-tank dive where 10–25% of the fish are large as compared to 1–10% (status quo). • Strong aversions to fishing activity/gear encounters and dives with low numbers of large fish, with WTP values over US$100 to avoid such trips (combined model). • Declines in the abundance of reef fishes, especially in the number of large fishes, results in reductions in diver CS. • Effects can be compounded if changes in dive quality result in lower visitor return rates and/or damage to the reputation of the dive destination, thus discouraging future demand. (data collection: 2011-2012)

Policy implications • Results can be used to justify investment in preemptive management strategies targeted at both improving reef fish stocks such as reducing unsustainable fishing activities and land-based reef impacts and managing conflicting uses. • Findings can give guidance on possible sources of financing for conservation activities.				
Marre et al. (2015)	Proposal of a pragmatic interpretation of non-use values to derive estimates that capture their main dimensions, based on the identification of a WTP for coral reef ecosystem protection beyond one's expected life in two coastal areas in New Caledonia with different institutional, cultural, environmental and socio-economic contexts.	• Abundance and diversity of habitats and species • Quantity of animals fished/total catches • Water quality • Coastal and lagoon natural landscapes • Areas of practice (provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value • Non-use value (existence, bequest and other motives) (CE)	• The minimum and maximum non-use value components of the total WTP are, respectively, around CFP1,000 and 10,500/month for Zone Cotiere Ouest for West Coastal Area; and around CFP400 and 5,700/month for Voh, Kone' amd Pouembout site. • Non-use values range from 11% to 100% of individual total WTP for preservation of different attributes over 100 years. (data collection 2011-2012)
Policy implications • Results highlight both the difficulty to estimate non-use values and the possibility to identify a lower bound for these values. • The final estimates are reliable enough to at least be used to raise awareness, or communicate about non-use values in the context New Caledonian coral reef ecosystem management. • The non-use value estimates reflect the values that are held by users and non-users, and should be considered in decision-making. • Ignoring non-use values in coastal ecosystem management decision making can lead to significant welfare losses.				

[a] Key: CE, choice experiment; CS, consumer surplus; CVM, contingent valuation method; ES, ecosystem service/s; RP, revealed preference; SP, stated preference; TCM, travel cost method; WTAC, willingness-to-accept a compensation; WTP, willingness-to-pay.

3.8 Deep Sea/Open Ocean

As stated by Jobstvogt et al. (2014a), "the Deep Sea includes over 90% of the world's oceans and is thought to be one of the most diverse ecosystems in the world". The authors point out that, "the direct links between deep-sea species and benefits to society have not been successfully shown to date, except for the fishing sector, and might not be shown in the near future", which can undermine the value society assigns to marine biodiversity. The lack of familiarity, and hence knowledge and awareness, of most of people with deep-sea services helps to explain the scarce number of studies focusing on Deep Sea protection.

Economic valuation provided by deep-sea services can contribute to a better governance of ocean waters, with special emphasis on fisheries management.

Despite Table 8 only reporting 2 papers dealing with the valuation of services provided by the Deep Sea/Open Ocean, published in very recent years, it is woth noting that a few more papers focusing on deep-sea services are examined in section 3.9 due to their main focus on marine protected area design to ensure their long-term provision. The table presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

The two studies use stated preference (SP) methods as non-use values, option values and indirect use values related to supporting services are estimated. In particular, one paper uses the contingent valuation method and the other one, a choice experiment implemented in a valuation workshop setting (Aanesen et al., 2015).

3.8.1 Ecosystem services and values

As shown in Table 8, one paper focuses on provisioning services and the other one, on supporting services. Indeed, Ojea and Loureiro (2010) measure individual preferences for different recovery levels of commercial fisheries focusing on South Western European collapsed stocks in Galicia (Spain), while Aanesen et al. (2015) value the protection of the cold-water coral (CWC) off the Norwegian coast and state that the most obvious services provided by CWC is as habitat for fish and other marine organisms, which is an intermediate or supporting ecosystem service. It is worth noting that Jobstvogt et al. (2014a) consider that "a fully monetary approach to estimate the total economic value of the oceans, using only final ES and ignoring supporting services, would likely drastically undervalue the deep ocean".

Regarding the values being estimated, Ojea and Loureiro (2010) survey current consumers and non-consumers of the local population to elicit option values linked to a high stock level of recovery of the commercial resource and existence values related to a lower recovery degree, where the species minimum survival population is taken as the threshold level between existence and option values. So, they state that a high recovery level "is associated with an option value to enjoy the stock in the future where, for the same period, fishing will be guaranteed once the stock is recovered and reaches that higher level". On the other side, a lower recovery level is associated with non-use values as, despite "the success of the programme suggested in reaching the survival level, fishing or exploitation will not be recommended in the valuation time frame, even when the species reaches a threshold above its minimum viable population".

Aanesen et al. (2015) estimate non-use values related to the role CWC plays for biodiversity and as an organism and try to identify an indirect use value attached to the role of CWC as habitat for fish and other marine organisms. However, the authors state that they are not able to disentangle the values people attach to CWC due to its role as habitat for fish compared to its pure existence.

3.8.2 Outcomes and policy implications

Results show that people are willing to pay to support the future existence of local endangered commercial resources. Ojea and Loureiro (2010) state that their results provide insights for the assessment of fishery regulations and can serve to conduct future environmental cost-benefit analysis (ECBA) of such regulations. Despite catching restrictions and recovery plans might negatively affect local economies, the authors show that species recovery can also provide high benefits to society in the long-term including those from preserving fish stocks for future generations. So non-market benefits are relevant and derive from the existence values resulting from maintenance ofcurrent biodiversity levels.

On the other side, Aanesen et al. (2015) provide evidence that people assign positive values to CWC protection despite the fact that marine industries such as oil/gas and fisheries could be adversely affected by such protection. People are willing to protect CWC not only because they consume fish, but also because "they value the fact that fish have good and sufficient living conditions". These authors also state that, CWC might be an important habitat for many commercially important fish species, which makes CWC policy relevant. In fact, they argue that from a management perspective, "it is of considerable interest to identify types of ES values to which CWC may contribute as well as their economic significance".

3.8.3 Research needs and challenges

The main area for future work which has been identified from the two reviewed papers has to do with the valuation of deep-sea commercial resources. Indeed, Ojea and Loureiro (2010) recommend to conduct further research on high use value resources and minimum survival levels to draw stronger conclusions. Indeed, they expect that preferences are influenced by information and knowledge about species survival levels and the specific values derived from the recovery programs. On the other side, and when it comes to assessing recovery programs, they also suggest conducting further research on the relevant managerial conflicts given restrictions and fishing bans may not have short-term benefits for the involved individuals.

The need for further analyses on high use value resources and minimum survival levels implicitly involve the need for collaboration between ecological and economic sciences, which is one of the major challenges when it comes to protection of Deep Sea/Open Ocean waters. This need has also been pointed out by Aanesen et al. (2015) when they state that the lack of scientific knowledge partly motivates the lower degree of public awareness regarding the benefits of deep-sea protection. These authors state that “valuing intangible, and for most people unheard of, organisms” could lead, in the worst scenario, to use an invalid dataset given the lack of understanding of what is being valued. This is why they use a valuation workshop instead of a traditional SP survey. However, while using a workshop leads to a valid survey valid, it can also lead to “possible sample bias due to self-selection and knowledge acquisition and the social desirability effect”.

Additionally, Aanesen et al. (2015) state their work “illustrates the challenges inherent in the alignment of the MEA (2005) classification of ES with the older concept of Total Economic Value” as they cannot match the estimates on peoples' willingness-to-pay for CWC protection to specific ES this resource provides. Indeed, some of the valued attributes can be assigned both non-use values linked to the pure existence of the CWC and indirect use values linked to intermediate ES values.

Table 8. Papers concerning the valuation of services provided by the Deep Sea/Open Ocean

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Ojea and Loureiro (2010)	Measurement of individual preferences for different levels of recovery of South Western European collapsed stocks in Galicia, Spain.	• Commercial fisheries/ hake and Norwegian lobster (provisioning)	• Option value • Existence value (CVM)	• The median household WTP is about €17.73 for a recovery programme regulated by the EU. • Median WTP for recovery action is €15.83 for the Norwegian lobster and €24.57 for the hake. • Identification of the survival level allows individuals to choose between reaching that level and attaining a higher population level, though WTP estimates are not significantly affected by the stock levels. (data collection: 2006)
Policy implications • Results provide insights for the evaluation of fishery regulations, and are a first step towards conducting future ECBAs of such policy actions. • Regulations based on catching restrictions and recovery plans have negative effects on local economies, but species recovery also brings important benefits to society in the long term. • Despite the costs derived from EU regulations for recovering European hake and Norwegian lobster, economic benefits are also derived from their application, with the aim of preserving stocks.				
Aanesen et al. (2015)	Estimation of the WTP of participants in a valuation workshop for increasing the protection of cold-water coral (CWC) off the Norwegian coast and analysis of the determinants of people's WTP for CWC protection.	• Cold-water coral reefs/habitat for fish (supporting)	• Indirect use value • Non-use value (CE)	• High degree of preference heterogeneity, with an average WTP for CWC protection in the range of €274–287. • The possibility that CWCs play an important role as habitat for fish is the single most important variable to explain respondents' WTP for CWC protection. • Although people value CWCs due to the fact they provide habitat for fish, and for their pure existence, it is difficult to disentangle these two values. (data collection: not indicated)[b]
Policy implications • Results can contribute to ocean management. • From a management and policy perspective, it is of considerable interest to identify types of ES values to which CWC may contribute and their economic significance. • As results show that people are not only motivated to protect CWC because they consume fish, but also because they value the fact that fish have good and sufficient living conditions, such considerations should be given significant weight in Norwegian resource management.				

[a] Key: CE, choice experiment; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; WTP, willingness-to-pay.
[b] As the authors report the July 2014 nominal exchange rate for Euro against Norwegian kroner (8.4), it could be assumed that the year of data collection is 2014.

3.9. Marine Protected Areas

The uniqueness and national significance of some marine environments, such as coral reefs and coastal waters being habitat of iconic species, have led to the establishment of marine protected areas (MPA) to ensure their conservation. MPAs include, among others, marine conservation zones (MCZ), marine parks, marine reserves, marine sanctuaries and marine critical habitat units (CHU), and aim to protect environments which "support rich biological communities possessing extensive conservation, recreational, commercial, ecological, historical, research, education and aesthetic values" (Park et al., 2002).

MPAs are established to protect marine environments which involve some of the ecosystem types already analyzed in this report (e.g. coral reefs, Deep Sea, coastal waters). However, the papers focusing on MPAs have been grouped into this new category regardless of the type of ecosystem affected by the MPA management. In other words, the ecosystem type which the MPA refers to has not led to classify a paper within this ecosystem type but to include it in this new MPA category.

Economic valuation of services provided by MPAs can inform negotiations about MPA design to better manage ocean waters as well as to preserve unique ecosystems being the main tourist attractions in nature-based tourism destinations. Also, it can inform negotiations about the designation of networks of MCZs as well as inform bio-economic models used to identify optimal locations for these protected areas. Results from MPA-focused valuation studies can also help design self-financing mechanisms pursuing effective management of MPAs to ensure their sustainability, which is especially of concern in developing countries. In fact, when it comes to low income economies where marine resources provide important life-support functions, MPA valuation can contribute to give guidance on whether local communities should continue with their current uses of coastal resources or, in contrast, they should protect them through the establishment of MPAs. Interestingly, MPA valuation can also help to develop more participative approaches to effective MPA management.

Table 9 reports a list of papers dealing with the valuation of services provided by MPAs. It presents the papers in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

Over the last 16 years, valuation researchers have been increasinlgy interested in contributing to MPA design. Indeed, Table 9 shows that the majority of papers (31) have been published since 2006 onwards. As stated in section 3.7, many papers dealing with

MPAs focus on services provided by protected coral reef zones. Indeed, excluding Peters and Hawkins (2009), who apply meta-analysis, and Hussain et al. (2010), who employs a benefit transfer (BT) approach, Table 9 shows that more than 50% of the studies (19 out of 34) consider recreational opportunities offered by coral reefs, 4 of them centering on the services provided by the Great Barrier Reef Marine Park (Kragt et al., 2009; Prayaga et al., 2010; Rolfe and Windle, 2012a, 2012b). As expected, very few studies deal with MPA designed to protect deep-sea environments (Börger et al., 2014; Glenn et al., 2010; Jobstvogt et al., 2014a; Wallmo and Edwards, 2008; Wattage et al., 2011).

Excluding the meta-analysis study and those which apply a BT approach either alone (Hussain et al., 2010) or together with other techniques (O'Garra, 2012; Samonte-Tan et al., 2007), most of studies apply stated preference (SP) methods (29), from which a few also use other valuation techniques (4).[6] The majority of SP papers estimate non-use values (22). This is reasonable since an important part of the value assigned by society to MPAs has to do with protection values. A considerable number of papers (12) deal with MPAs located in developing countries.

3.9.1 Ecosystem services and values

Cultural services are the type of service which has been valued more frequently, followed by provisioning services. Indeed, excluding Peters and Hawkins (2009) and Hussain et al. (2010), the majority of papers (23 out of 36) only focus on cultural services. In this context, it is worth noting that Brown et al. (2001) is a particular case as they outline a trade-off analysis approach to natural resource management which uses a framework based on multicriteria analysis (MCA), thus incorporating multiple objectives for protected area management within a decision-making framework. In specific, they combine stakeholder analysis and economic, social and ecological assessment within an MCA framework. In this sense, the authors only quantify in monetary terms the macro-economic benefits and recreational user benefits associated to Buccoo Reef Marine Park. These are the recreational benefits Table 9 refers to in the third and fourth columns.

Other papers value cultural services together with either provisioning ones (Barr and Mourato, 2009; Subade and Francisco, 2014) or with regulating and provisioning services (McVittie and Moran, 2010). Samonte-Tan et al. (2007) deal with the three MEA final ES together with the supporting service of mangroves as 'nursery for fish/mollusc'.

Studies which do not value cultural services are Casiwan-Launio et al. (2011) and Jobstvogt et al. (2014a), who only value provisioning services; O'Garra (2012), who value provisioning

[6] Rolfe and Windle (2012b) is part of these 29 SP studies because their primary objective is to estimate, through a CE, use and non-use vaues associated with the Great Barrier Reef Marine Park. They apply a BT approach at a second stage to test if these values could be easily transferred to other sites in the region.

and regulating services; and Glenn et al. (2010), who consider provisioning and regulating services together with the supporting service of cold-water corals (CWC) related to their role as essential fish habitat.

Thus, after cultural services, provisioning services are the type of ES valued in a higher number of papers (8), followed by regulating and supporting services (4 and 2, respectively).

Recreation has been the type of cultural service which has captured the major attention among researchers undertaking primary valuation studies. Despite many papers not specifying which recreational services they value, the majority do. In this sense, the type of service provided by MPAs which has been valued with a higher frequency is scuba diving. This is reasonable since more than 50% of the papers focus on recreational opportunities offered by coral reefs from which scuba diving is the most representative one. This recreational service has been valued in 10 papers, from which half of them only focus on scuba diving (Arin and Kramer, 2002; Pascoe et al., 2014; Sorice et al., 2007; Tapsuwan and Asafu-Adjaye, 2008; Thur, 2010), while the rest consider scuba diving together with other recreational services offered by coral reefs. One of these alternative recreational services is snorkelling, which has been valued in 3 studies (Bhat, 2003; Kragt et al., 2009; Park et al., 2002).

In fact, snorkelling represents the second type of service valued with a higher frenquency, a position shared with 'viewing of marine life', a service which has also been valued in 4 studies (Batel et al., 2014; Giraud et al., 2002; Glenn et al., 2010; Ransom and Mangi, 2010). Recreational fishing/angling (Jobstvogt et al., 2014b; Prayaga et al., 2010; Wielgus et al., 2009) and glass bottom boating (Bhat, 2003; Ransom and Mangi, 2010) are other types of services provided by MPAs which researchers have also been interested in valuing.

It is worth noting that Jobstvogt et al. (2014b) also consider aesthetic, spiritual, therapeutic and other cultural services provided by MPAs and state that many potential marine cultural ES benefits to the general public and specific communities "are associated with history, heritage and identity in relation to the sea".

Regarding provisioning services in primary valuation studies, provision of raw materials has been valued in 3 papers, while food provision, in 6 papers. Interestingly, when it comes to services provided by the Deep Sea, Glenn et al. (2010) and Jobstvogt et al. (2014a) focus on raw materials for biomedical industry provided by CWCs and deep-sea organisms, respectively.

Among the primary valuation studies considering regulating services, shoreline protection and climate regulation/carbon sink have been valued in 2 papers each, while disturbance prevention/alleviation, nutrient cycling and waste treatment have been valued in one paper each.

Non-consumptive direct use values have been estimated for cultural services, while consumptive direct use values and indirect use values have been inferred for provisioning and regulating services, respectively. Supporting services have also been assigned an indirect use value.

Among the papers applying SP methods (29), the majority indicate the type of value they estimate (23). In this context, non-consumptive direct use values have been estimated in 16 studies, and both consumptive direct use values and indirect use values in 3 and 2 papers, respectively. Option values have been estimated in 11 studies and have been mostly attached to cultural services, although some authors have also assigned them to provisioning services (Casiwan-Launio et al., 2011; Subade and Francisco, 2014). Nineteen papers estimate non-use values attached to MPAs (18). In most of cases, they have been estimated together with other types of values. In this sense, 4 papers have only estimated non-use values together with option use values, thus overlooking current uses (Casiwan-Launio et al., 2011; Jobstvogt et al., 2014a; Subade and Francisco, 2014; Wattage et al., 2011). Very few studies focus exclusively on non-use values (Börger et al., 2014; Boxall et al., 2012; Wallmo and Edwards, 2008). Börger et al. (2014) consider that species diversity enhances the natural functions provided by the Dogger Bank such as climate regulation, maintenance of clean water and support of fish populations. While this is usually viewed as a supporting service with indirect use value, the authors state they estimate non-use values for these services. Thus, following the assumption made in this report about not reporting in the tables any ES for papers which only estimate non-use values, no ecosystem (supporting) services have been reported for this paper.

For the 6 studies applying SP methods which do not specify which type of value they estimate, it has been assumed that 4 of them estimate non-use values together with the use values assigned by direct users to the MPAs. This is the case of Barr and Mourato (2009), Svensson et al. (2008), Mccartney (2006) and Arin and Kramer (2002), which apply the contingent valuation method (CVM). Indeed, Svensson et al. (2008) and Arin and Kramer (2002) show that the degree of environmental awareness of respondents positively affects their WTP. In particular, Arin and Kramer (2002) show that “college education is associated with a higher level of WTP entrance fee to a marine sanctuary” which “accords with the expectation that higher education increases environmental awareness and thus the willingness to contribute to conservation efforts”. Likewise, Barr and Mourato (2009) find

that individuals consider important the fact that local communities are able to access the resource as they have right to do it. Mccartney (2006) has been assumed not only to estimate non-use but also option values which the author also refers to as non-use values. In this case, she states that choice experiment (CE) and CVM are useful methods to estimate the non-use values which might be associated to seascapes.

In contrast, it has been assumed that Wielgus et al. (2009) and Ransom and Mangi (2010) only estimate non-consumptive direct use values. Indeed, the CE attributes valued in Wielgus et al. (2009) only relate to the quality of the recreational fishing and scuba diving experiences in terms of number and weight of fish caught; while Ransom and Mangi (2010) clearly state, in their contingent valuation study where residents and tourists are surveyed, that they don't assess the values of non-users. Accordingly, and despite respondents show interest in recycling, it has been assumed they only estimate use values.

3.9.2 Outcomes and policy implications

The reviewed studies show that individuals assign important non-consumptive direct use values to MPAs. In this sense, results give evidence not only that people are willing to pay for the recreational opportunities offered by unique marine ecosystems (Mwebaze and MacLeod, 2013; Pascoe et al., 2014; Prayaga et al., 2010; Ransom and Mangi, 2010; Tapsuwan and Asafu-Adjaye, 2008) but also that the quality of the recreational experience is an influencing factor of their WTP. Kragt et al. (2009) show that "a hypothetical reduction in fish abundance, coral cover and coral diversity of 80%, 30% and 70%, respectively, may lead to an 80% decrease in the number of reef trips taken by divers and snorkellers" to the Great Barrier Reef. These results can serve to justify the implementation of MPAs as conservation tools as MPAs have been proved to increase the quality of the recreational experiences. Bhat (2003) finds that "an average visitor would undertake 43–80% more trips to the Florida Keys and experience a 69% increase in the use values per trip, as a result of a marine reserve-induced reef quality improvement". This is of special relevance in nature-based tourism destinations where the recreational opportunities offered by unique ecosystems are services of great economic importance (Park et al., 2002).

However, the economic justification for implementing MPAs becomes sounder if the non-use values provided by these marine environments to society are also considered. In fact, resources provided by MPAs often have a potentially larger non-use value than use value (Glenn et al., 2010). When examining visitors' WTP for the National Marine Park of Zakynthos, Togridou et al. (2006) show that existence and bequest values are the most frequent reasons provided for WTP, with significantly higher percentages in the case of domestic visitors. Subade and Francisco (2014) analyze whether non-use values exist among residents of Quezon City, which live hundreds of kilometers away from Tubbataha Reefs in

Philippines, and find that 46% of all respondents are willing to pay for conservation of the reefs, with bequest concerns for future generations as their main reason.

Despite non-use values have been mostly related to the willingness to preserve the ecological components and functions of MPAs, cognitive (research and development, education and training) and cultural values are also important drivers of the willingness-to-pay (WTP) for MPAs, as shown by Hussain et al. (2010) and McVittie and Moran (2010) when estimating the non-market benefits resulting from implementation of proposed MCZs under the UK Marine and Coastal Access Bill (2008). On the other side, when eliciting divers' and anglers' WTP for potential MPAs, Jobstvogt et al. (2014b) give evidence of use and non-use values attached to cultural services which include, besides recreation, aesthetic, spiritual and therapeutic services, among others. Following the UK NEA (2011)'s place-based cultural ES framework, they characterize marine cultural ES as "environmental spaces with features including the underwater seascape, and iconic and non-iconic species", and state that many potential marine cultural ES benefits are "associated with history, heritage and identity in relation to the sea".

Option values for direct use also seem to be an important component of the total economic value of MPAs, and may be a key driver of their protection values, as shown by Rolfe and Windle (2012a) when estimating the value to protect the health of the Great Barrier Reef at the national level. In their paper to estimate the WTP for recovery programs that double research funding and increase the restrictions of commercial fishing around western stock of the Steller sea lion's critical habitat units (CHU), Giraud et al. (2002) state that CHUs provide not only direct use, existence and bequest values but also an "option value to visit the critical habitat and possibly see the Steller sea lion in the future". In contrast, Boxall et al. (2012) state that values associated with the recovery of marine mammals "seem to be primarily of passive-use nature" as recovery can only occur over a long period of time, this implying active-use values are expected to occur far into the future. In other words, "changes in active-use or use values for consumptive or non-consumptive uses are expected to be relatively small". When estimating the value of seascapes in Jurien Bay Marine Park in Australia, Mccartney (2006) argues that the option to use the good in the future and existence values may be associated with public goods such as seascapes. Samonte-Tan et al. (2007) only estimate use and option values.

Future use values and non-use values are especially relevant when it comes to valuing services provided by deep-sea MPAs as direct uses of the services provided by them are difficult to happen for most of people. This is shown by Glenn et al. (2010) and Wattage et al. (2011) when valuing cold-water deep coral reefs off the Republic of Ireland where option, existence and bequest values are the major components of the WTP in the former and the

only ones being estimated in the latter. It is worth noting, however, that in both studies the cost attribute is proved to be non-significant. Although this makes impossible to calculate WTP values, as recognized by the authors, they state that the lack of significance serves to further emphasize the significance of the other choice variables. Wattage et al. (2011) find, for instance, that 90% of the sample support coral protection for the benefit of future generations, while 84% consider that "corals should be protected purely in their own right given the unique and fragile ecosystem they represent".

Likewise, Jobstvogt et al. (2014a) estimate option and existence values when asking Scottish households for their WTP for additional MPAs in the Scottish Deep-Sea and find participants support increased protection of Deep Sea habitats. Interestingly, they state that, "despite very limited public knowledge about such habitats, given basic information, citizens can be useful participants in policy formation regarding the Deep Sea". The authors remind that overlooking non-users will lead to undervalue marine ecosystems and hence "policy makers are better off to consider the existence value that people associate with species protection in combination with the direct benefits of marine protection".

Wallmo and Edwards (2008) estimate the existence value of protecting species and habitat diversity on the sea floor in MPAs that vary in size and allowable uses in the US. While they find that "protecting areas as ecological reserves is utility increasing for most size/use combinations, smaller reserves with liberal use policies produce the largest increases", strict no-take, no-use MPAs are the least valuable type of design for the majority of individuals. Similarly, Börger et al. (2014) indicate that the non-market benefits arising from the conservation of an off-shore sandbank in UK waters are mostly non-use in nature.

MPAs are regulatory conservation tools for which environmental cost-benefit analysis (ECBA) is increasingly required or used to help support their adoption (Boxall et al., 2012). For instance, ECBA supports the objectives of the UK Marine and Coastal Access Act (2009) to introduce an integrated system for sustainably managing the marine environment. In fact, as stated by Jobstvogt et al. (2014b), UK Governments are currently establishing a network of MPAs informed by ecological and socio-economic data. Although MPA designation is usually driven by physical science, MPA implementation has been argued to consider political and socio-economic issues. Economic tools are needed to "maximise society's potential benefits, both in terms of minimising the impact on those sectors of society and industry that have traditionally used and exploited those areas and those that gain from its protection" (Glenn et al., 2010). In a context which is increasingly dependent on ECBA in regulatory and management proposals, considering not only market values but also non-market values including non-use values is critical (Wattage et al., 2011).

Valuations can inform negotiations about marine management plans by providing information about social preferences, thus helping to establish priorities among conflicting management goals (Börger et al., 2014). Discussions about MPA design to manage ocean waters represent one area that could greatly benefit from valuation studies. As pointed out by Jobstvogt et al. (2014a), good ocean governance requires "a more democratic approach and should encourage the inclusion of the general public into the decision making process for conservation". In specific, they consider that for ocean management to be sustainable recognising and quantifying the economic value of biodiversity is essential. Likewise, Jobstvogt et al. (2014b) state that "an understanding of key stakeholders' cultural ES values can inform a more holistic and sustainable approach to marine management, especially for decisions involving trade-offs between marine protection and opportunity costs of the blue economy".

Negotiations about MPAs to preserve unique ecosystems as attractions in nature-based tourism destinations are another area where valuation can contribute to. Indeed, Sorice et al. (2007) state that knowledge of scuba divers' preferences for management strategies is relevant for "succesfully enhance the adoption of coral reef conservation strategies, while maintaining the site as a tourism attraction". Park et al. (2002) point out that marine ecologists and reef scientists have emphasized the importance of estimating the non-market values of coral reefs to assess the cost effectiveness of management programs. Similarly, Kragt et al. (2009) state that valuation can help assess the effects of policy measures acting on reef quality as well as the overall cost effectiveness of management strategies. Economic valuations provide information about the opportunity costs associated with trading off the recreational use of marine resources for other uses (Tapsuwan and Asafu-Adjaye, 2008). Prayaga et al. (2010) point out that it is policy relevant understanding the value of recreational fishing in the area, and how this can be affected by changes in management as "fish stocks underpinning recreational fishing are also relevant to biodiversity protection and commercial fishing interests". In regions where the weight of the tourism is considerable, analyzing tourists' opinions and integrating them into conservation management plans is important (Batel et al., 2014).

Economic valuation can also give guidance on the size and type of uses that can be allowed within the MPA boundaries, as shown by Wallmo and Edwards (2008). These authors state that, despite large MPAs being justified for biological and ecological reasons, information about the tradeoffs between existence values and opportunity costs of forgone economic production is useful for policy makers. In fact, as earlier said, they find that, although results show support for a policy that protects ecological diversity in the ocean, smaller networks with liberal uses seem to be a better option.

Interestingly, Rogers (2013) find that, in instances of divergence between public and expert opinion, it may be preferable to support environmental policies through community awareness campaigns, rather than using uninformed public preferences in policy design. Indeed, they state that while expert consultation, especially in terms of technical advice, is essential in environmental decision making, “it may not represent the value judgments of the public”.

Results from MPA-focused valuation studies can also help design self financing mechanisms pursuing effective management of MPAs to ensure their sustainability (Samonte-Tan et al., 2007). Economic valuation can show that MPA users have a WTP for access that may be higher than the revenue requirements of the management authority. Thur (2010) point out that, in a context where public budgets aimed to fund MPAs are “only secured until the start of the next fiscal year”, sustainable, self-financing mechanisms to increase government or non-governmental organization funding become the most attractive alternative.

The role of economic valuation to inform fee structures that more accurately reflect the value of MPAs has been one of the issues that have captured more attention among researchers (Mwebaze and MacLeod, 2013; Togridou et al., 2006). In this sense, Bhat (2003) show that the marine reserve-induced incremental benefits of recreation can justify a user-financed marine protection program. These authors also consider that increased expenditure taxes on diving and snorkeling activities, room and meals, and transportation services could be alternative self-financing mechanisms, although taxes on diving gears and activities seem more plausible. In addition, they suggest different tax rates to be applied to different types of travelers according to their incurred travel costs. .

After examining a series of recent reports focusing on the WTP for entrance fees aimed at funding the management of coral reef marine parks, Peters and Hawkins (2009) conclude that there is “a general acceptance for the introduction of fees or an increase in those where charges already exist”. Visitors’ income, education level, environmental awareness, residency and concern about future generations appear to be the factors explaining the social acceptability. Thur (2010) finds that that doubling the US$10 user fee to visit the Bonaire National Marine Park would have no impact on visitation rates. In contrast, Sorice et al. (2007), who investigate divers’ choices of trips to a hypothetical MPA, find they do not agree with the establishment of fees to access protected areas. However, they do prefer a more restricted management scenario, favor reductions in the level of site use and increased levels of conservation education.

The revenue generated by users’ fees could contribute to the cost of regional conservation strategies (Green and Donnelly, 2003). This is especially relevant when it comes to ensuring

the sustainability of MPAs in developing contries which are usually characterized by a lack of funding and low-income populations (Barr and Mourato, 2009). In this context, many studies have put emphasis on analyzing the role of economic valuation to establish proper user fees which can be used to collect funds to support coral reef conservation. In this sense, evidence has been found that visitors are willing to pay higher fees to support preservation (Mwebaze and MacLeod, 2013; Ransom and Mangi, 2010; Wielgus et al., 2009). Arin and Kramer (2002) state that "the revenues could also be used to create alternative employment opportunities for locals who would be barred from fishing, their traditional income generating activity", as well as to cover "anti-fishing rule enforcement costs of a marine reserve". These authors also state that an entrance fee could help regulate the number of visitors, thus helping to minimize recreationists' damage, a suggestion also made by Tapsuwan and Asafu-Adjaye (2008). Interestingly, Ransom and Mangi (2010) highlight the importance of demonstrating that the increased revenue will be invested in activities aimed at improving the ecosystem quality.

As a response to existing concerns about the fact that entry fees may dissuade divers, Pascoe et al. (2014) examine the price elasticity of demand for dive tourism in three countries in South East Asia and find it is very inelastic. The authors point out that the fee impact on diver numbers "is likely to be substantially less than the impact of resource degradation through poor management". They suggest that, as already happens in Thailand a lower fee could be imposed on local divers. In addition, they state that, "given the inelastic demand, higher fees represent more revenue, which in turn (potentially) enables better management, better park quality and ultimately more tourists".

Finding an average WTP higher than the average daily expenditure per person has also led some authors to justify the design of ecological taxes per person per day as another self-financing mechanism for developing countries, which would also lead to an overall increase of seasonal country's income (Batel et al., 2014). Comparisons between the WTP and the willingness-to-work for the continued existence of the San Miguel Island fishery reserve in Bicol Region in Philippines have led Casiwan-Launio et al. (2011) to suggest the use of voluntary labor as a management option for MPAs in developing countries as well as to establish "own village" MPAs to increase the value residents attach to conservation.

In a developing country context, and to cope with the lack of funding, some authors have examined the role of Hotel Managed Marine Reserves (HMMR) with different participation levels from the local governments and/or communities. Svensson et al. (2008) demonstrate that most tourists would be willing to pay more per night to stay at a HMMR, which is viewed as an interesting way of getting the necessary funds to finance MPA management. However, as pointed out by the authors, "the vast majority of HMMRs are not recognized as

MPAs by The World Conservation Union". Thus, since no central body certifying HMMRs exists, the hotels should find mechanisms to advertise their HMMR and associated projects. Using their homepage and the country's official tourism website, organizing seminars, explaining projects, providing brochures at the hotel, and collaborating with both a local Environmental agency and dive companies could contribute not only to this aim but also to raise public awareness and interest.

Interestingly, Barr and Mourato (2009) assess the potential of Payment for Ecosystem Services (PES) schemes to reduce overfishing within a newly established MPA in Mexico under the assumption that marine-based tourism will benefit from the derived-increased fish abundance and biodiversity. More specifically, they explore fishermen's willingness to accept working outside of the fishing sector as well as the necessary compensation to provoke such a move. Despite they find that the required compensation exceeds tourists' WTP (which could be explained by both the fact that fish stocks are not in collapse and the potential high transaction costs), they consider that these PES are still interesting tools to be considered when it comes to coastal and marine protection. Indeed, they believe PES schemes would be feasible in sites which are less productive and where fishermen's opportunity costs are low. Interestingly, they point out that PES schemes have the potential to address not only conservation but also poverty issues. In this context, Casiwan-Launio et al. (2011) suggest that a willingness-to-work approach could be used to "initially determine the amount of such fees in MPAs with incipient tourism".

In fact, in the framework of developing countries where marine resources provide important life-support functions, economic valuation can contribute to give guidance on whether local communities should continue with their usual harvesting practices or, in contrast, they should actively protect their local resources through the establishment of MPAs and hence alternative livelihoods, such as coastal-based tourism (O'Garra, 2012).

Results from MPA-focused valuation studies can also contribute to determining appropriate management plans for the seascapes of marine parks which offer "aesthetic or amenity values to the local and tourist communities that enjoy their views, or whose enjoyment of other activities undertaken in the marine park is enhanced by the views" (Mccartney, 2006).

MPA economic valuation can also inform negotiations about the designation of networks of Marine Conservation Zones (MCZ), as shown by Hussain et al. (2010) and McVittie and Moran (2010) for the case of English territorial and UK offshore waters. Börger et al. (2014) show that valuations can also inform bio-economic models used to identify optimal locations for offshore MPAs.

In conclusion, economic valuation can also help develop more holistic approaches to effective MPA management, as demonstrated by Brown et al. (2001). Indeed, the authors state that MPAs are "multiple use, complex systems […] where many different users are in conflict and where linkages and feedbacks between different aspects of the ecosystem and economy exist". Thus, a more holistic approach such as MCA can be used "to enhance stakeholder involvement in decision-making and develop consensus-based approaches" to MPA management. According to these authors, the marginalisation of relevant stakeholders could explain resource depletion in many of the designated MPA. Thus, considering stakeholder opinions can provide important information for policy makers and regulators "seeking to manage marine park resources in partnership with other stakeholders".

3.9.3 Research needs and challenges

The reviewed studies suggest different areas for further research which can improve the contribution of economic valuation to effective MPA management.

One of these areas has to do with the contribution of valuation studies to the design of self-financing mechanisms pursuing effective management of MPAs to ensure their sustainability. In this context, it has been argued that, despite economic valuation seeming to justify the establishment of user fees to fund conservation programs, the broader implications of such management fees should be examined by further research. Indeed, Bhat (2003) points out that further investigations into political and economic implications for service providers should be conducted as they might perceive fee increases on different services differently compared to recreational users. Similarly, Ransom and Mangi (2010) state there is a need for further work on the implications of fee increases for tour operators as they could have both economic and conservation consequences. Indeed, fee increases could lead, for instance, to a redistribution of visitor spending in favour of the MPA and "away from other local sources" or to a reduction of visitors' numbers which, while allowing a greater protection, "may undermine local constituency support for the reef and increase the number of illegal, unmanaged visits" to the area. Ransom and Mangi (2010) also state that further research work could explore the "potential increase in return visitors, their WTP for a richer total experience, the subsequent impacts on park fees and effects on wages of boat staff" which would result from both training boat staff in marine ecology and more reef conservation initiatives.

Further investigation on the implications of management fees has also been advocated for in cases where the fee-generated revenue wants to be used for non-MPA purposes as divers' support for the user fee may change. Thur (2010) states that MPA conservation often leads to a modification or banning certain practices related to traditional ways of either getting income or enjoying MPA waters by local communities. In these cases, the authors say that "it

may be socially and morally appropriate to use a portion of the revenue generated by MPA user fees to compensate those negatively impacted by the MPA regulations". They suggest the revenue could be used for job training for alternative life-support activities or food assistance programs.

Replications of the studies with larger samples to more fully understand the drivers of demand for visits to MPAs and the feasibility of using entrance fees to ensure both revenue generation and conservation have also been suggested by Arin and Kramer (2002). Bhat (2003) also argues that their results need to be refined through both "collecting data from a larger sample and using updated information on quality changes since the beginning of the program".

The need for further research regarding the factors which can help explain the estimated values has been pointed out by different authors. In this sense, the analysis of both how respondents discount future payments as well as the attitudes and motivations explaining the WTP are some areas suggested for further research (Giraud et al., 2002; Park et al., 2002). In this context, Rogers (2013) point out that additional work is required to better identify the cause of divergence between public and expert opinion in some cases. Indeed, future case studies should be aimed at "identifying instances of true preference divergence and instances where divergence is due to lack of awareness, to aid development of a more targeted approach for applying either choice experiments (or other public consultation mechanisms) or educational tools to inform or support policy, respectively". The author states that value convergence might be driven not only by awareness but also by the fact that ecologically-important attributes attract individuals aesthetically. If aesthetics rather than awareness determined convergence, then the role of awareness in achieving convergence would be non-relevant. Indeed, people with a high degree of awareness could still attach different values than those assigned by experts.

On the other side, Rolfe and Windle (2012a) recommend further work on distance decay issues as it seems that distance decay effects also depend on choice task framing. Besides, the authors find variation across populations, groups of resource users and value components. Börger et al. (2014) also suggest additional work on the issue as non-use values "might not exhibit linear distance effects but instead could show other spatial patterns".

Due to existing concerns about the extent to which the estimated values would correspond to an actual referendum or allocation decision about conservation programs, Boxall et al. (2012) state further efforts should be exerted "to make the surveys consequential and to check for robustness". Interestingly, they also point out that policy makers would benefit

from analysis of the cost effectiveness of alternative recovery programs and their distributional impacts.

To better contribute to management of seascape of marine parks, Mccartney (2006) state that it would be interesting to further examine both the application of the contingent valuation method (CVM) and spike model to value seascapes in other settings involving either different marine parks or coastal regions or different infrastructure types.

Further research to estimate how reef trip demand is related to marginal reef quality changes is considered desirable by some authors. In this sense, Kragt et al. (2009) state that including additional travel costs associated with reef visitation would help to estimate the total economic value of the Great Barrier Reef. Considering a wider variety of visitors and substitute sites, economic sectors other than diving and snorkelling, and non-use values could also contribute to this aim. The importance of considering travel costs to substitute sites has also been highlighted by Tapsuwan and Asafu-Adjaye (2008), who point out that time or financial constraints can be important drivers of divers' choices. On the other side, Jobstvogt et al. (2014b) state that other recreational MPA users, such as surfers and yachters, as well as other threats to marine habitats and species, should be included in future studies "to better understand values and trade-offs with commercial fishing and other sectors of the 'blue economy'".

Of particular interest for developing countries are three areas for further research suggested by some authors. First, and given Hotel Managed Marine Reserves (HMMR) represent very recent management strategies, thus still being quite scarce, Svensson et al. (2008) state that investigating the effectiveness of HMMRs from a biological and socioeconomic perspective should be object of further research work, especially taking into account the support for this tool shown by the existing studies. Second, Barr and Mourato (2009) point out that more work is required in different policy, social, economic and environmental contexts to draw stronger conclusions about the long-term feasibility of PES schemes for coastal and marine protection. Third, Casiwan-Launio et al. (2011) recommend both further exploration of the opportunity cost of time and understanding of the labor market if a willingness-to-work approach is going to be used as an eliciting method for SP studies in developing country settings.

Different types of challenges have been identified, from which the challenges of attaching economic values to MPAs which have to do with the lack of information and knowledge are some of the most important ones. To face them, some authors advocate for the use of educational programs. This is especially true when it comes to deep-sea MPAs. Indeed, some authors point out that the unfamiliarity of most of people with the deep-sea environment

represents a bigger challenge of assigning economic values to deep-sea services and biodiversity than the lack of scientific certainty about the baseline and future trends (Jobstvogt et al., 2014a, 2014b; Wattage et al., 2011). Additionally, as stated by Jobstvogt et al. (2014a), the concept of biodiversity is still poorly understood by the general public. Thus, according to them, it is "the lack of knowledge rather than the lack of interest" what seems to explain "the near absence of wider societal values associated with deep-sea protection". Increasing public understanding for deep-sea services through educational programmes highlighting the links between the deep-sea services and social benefits is then crucial if the value of these services is to be considered in decision-making. In this context, the authors also recommend considering supporting services (besides final ES) to avoid undervaluation of the deep ocean.

Togridou et al. (2006) also advocate for the need of environmentally-oriented educational programs for nature-based tourism to "produce long lasting changes in tourists' behavior". Indeed, these programs would "motivate and encourage group problem solving […] and provide the social context necessary to augment behavior intentions, modify expectations one has for oneself and for others, and enhance efficacy of one's actions, which has been proved to be a determining factor in decisions regarding environmental conservation". Batel et al. (2014) highlight the importance of public awareness when pointing out that the lack of information regarding MPAs and the local situation can adversely affect the successful implementation of conservation strategies in nature-based tourism economies. In this sense, Wallmo and Edwards (2008) consider that public awareness of the marine environment can have an impact on its value.

The lack of information regarding the use of entrance fees as a management tool represents another challenge. Peters and Hawkins (2009) highlight the need for informing visitors about why user fees are being imposed, where the money is going to be invested and which the resulting actions have been to ensure the acceptance of fees. In this context, the authors also suggest that user fees should not completely replace government funding as in contexts of social and political instability and/or natural disasters, "visitor arrivals and the fees they generate could be halted at a stroke".

A related area has to do with the existence of uncertainty when it comes to MPA frameworks, which also represents a challenge as elicited WTP is likely to be affected by how people process and interpret uncertainty and the risk of irreversibilities in the absence of conservation action (Jobstvogt et al., 2014b). Indeed, the authors state that "there is substantial uncertainty around the designation outcomes for the UK MPA network in terms of the number of protected sites, when protection will start, how protected sites will be managed, how restrictions on marine activities will affect recreational users and whether

marine users will comply with the restrictions". Scientific uncertainty regarding the ecological benefits of the MPA network is also an issue of concern as it could lead to understate the true WTP if respondents think, for instance, that sustainability of the sites will probably be ensured without protection; or protection may not be effective and hence there is no need to pay for it. Wielgus et al. (2009) recommends delivering information about the uncertainty of the future state of the environment in valuation studies.

In this context, the need for collaboration between ecological and social sciences is essential as it can help not only to reduce scientific uncertainty but also to obtain unbiased valuation estimates by presenting individuals more realistic scenarios in valuation studies. In other words, collaboration between these two disciplines allowing for integration of ecological knowledge into decision-making is needed if economic valuation has to play a role in marine management. Indeed, following McVittie and Moran (2010)'s words, "if the science evidence is behind the policy then a pragmatic methodological compromise must be adopted". According to these authors, and compared to a traditional stated preference (SP) approach, an economic alternative integrating ecological knowledge would improve understanding about ES generation by biophysical functions and processes. The authors state that, despite the "policy enthusiasm for the ecosystem approach, there is no obvious guidance on what endpoint valuation method is most appropriate". This makes difficult to use an SP approach which might be very reductionist when describing the environmental change.

Another type of challenge involves the need for both monitoring and evaluating management impacts and considering the findings in the decision-making processes. Glenn et al. (2010) highlight the need for including socio-economic and ecological attributes and impacts within such monitoring programmes.

As valuation and policy challenge, Hussain et al. (2010) point out "the need to use benefit transfer (BT) in a context where biophysical provisioning functions are not well-developed, where there are gaps in the valuation literature related to temperate marine ecosystem goods and services, and where values (where available) are presented in aggregate terms". However, as suggested by Rolfe and Windle (2012b), the opportunities for BT of protection values are limited because of the small number of relevant primary valuation studies.

Another important challenge revolves around the need for approaches searching for stakeholder involvement when it comes to managing coastal and marine resources, as pointed out by Brown et al. (2001). According to these authors, "working closely with the regulatory agency and decision-makers within the responsible government agencies enables stakeholders to use their collective voice to urge action, and also demonstrates that regulators are engaged and willing to respond". On the other side, Jobstvogt et al. (2014b)

acknowledge that, in some cases, it will be difficult for economic valuation to account for the benefits of cultural ES and “complex cultural experiences such as the shaping of peoples’ personal and communal identities that cannot be reduced to economic categories, and are not always amenable to the utilitarian and individualistic assumptions underlying economic assessments”. In this context, the authors make reference to other “extensive, complementary non-monetary assessment of cultural ES subjective wellbeing and a series of deliberative workshops” which were also included in the second phase of the UK NEA (2014) which their paper is associated with.

Three relevant challenges have been identified in the context of developing countries. First, the lack of proper data and expert opinion on the impacts on ES of management interventions based on locally managed marine areas (O’Garra, 2012). Secondly, as stated by Ransom and Mangi (2010), the lack of trust toward institutions regarding where the additional revenues from increased user fees are going to be invested . This lack of trust is of especial concern as it can deter WTP (Peters and Hawkins, 2009). Thirdly, as pointed out by Barr and Mourato (2009), ensuring the feasibility of a marine-based Payment for Ecosystem Services (PES) scheme as it relies on a positive WTP for an environmental quality improvement and an acceptance of compensation by fishermen. Also, it requires the participation of the government due to the open access nature of the resource base. In specific, and given greater fish populations are required if benefits have to be transferred to tourism, vigilance and quota systems need to be implemented “to ensure environmental gains are not reversed through increased catches by others, or positive leakage into the sector resulting from increased resource rents”. In this framework, the authors point out that scientific monitoring and government administration and enforcement will also be needed due to the dynamic nature of fishery economics and hence of willingness-to-accept a compensation, which will require prevention of re-entry or dynamic compensation contracts.

Table 9. Papers concerning the valuation of services provided by MPAs[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Brown et al. (2001)	Description of a trade-off analysis approach based on the MCA to enhance decision-making for marine and coastal resources. The approach combines stakeholder analysis and economic, social and ecological assessment and is applied to the case of Buccoo Reef Marine Park (BRMP) in Tobago.	• Recreational services/tourism (economic criteria) • Water quality, productivity of seagrasses, coral reef health and mangrove habitat (ecological criteria) • Local employment in tourism, informal sector benefits, costs of local access to BRMP (social criteria) (cultural)	• Non-consumptive direct use value • Non-use value (CVM, tourism revenue)	• The mean WTP by users and non-users of BRMP, including those not willing to pay, to prevent further deterioration in the quality of Buccoo Reef ranges from US$3.70 (open-ended questions) to 9.30 (dichotomus choice qustion). • MCA suggests consensus around development options characterised as limited tourism development for the area surrounding the park in association with the implementation of complementary environmental management. (data collection: 2007)
Policy implications • A holistic approach is appropriate for multiple use, complex systems such as MPAs, where many different users are in conflict and where linkages and feedbacks between different aspects of the ecosystem and economy exist. • A holistic approach can enhance stakeholder involvement in decision-making and develop consensus-based approaches to management of MPAs. • Inclusion of stakeholder views and values can provide rich information for regulators seeking to manage marine park resources in partnership with other stakeholders.				
Arin and Kramer (2002)	Examination of diver demand for visits to protected coral reef areas in the Philippines.	• Scuba diving (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• No statistically significant difference between the average WTP to visit protected coral reef areas in Anilao (US$3.7), on Mactan (US$5.5) and on Panglao (US$3.4). • The annual potential revenues range from US$0.85–1 million on Mactan Island, from US$95–116 thousand in Anilao and from US$3.5–5.3 thousand on Alona Beach. • Most divers are willing to pay an entrance fee to marine sanctuaries where fishing is prohibited. • Most tourists prefer NGOs as the most trustworthy organization type to collect and manage entrance fees. (data collection: 1997)

Policy implications • Entrance fees paid by divers to enter marine sanctuaries can be a potential revenue source to finance coral reef conservation and create alternative employment opportunities for local fishermen who would be barred from their traditional income generating activity. • The revenues collected can help cover maintenance and anti-fishing rule enforcement costs of a marine reserve. • The entrance fee can also be used as a tool to regulate the number of visitors to minimize diver damage.				
Giraud et al. (2002)	Estimation of the value of an expanded federal recovery program that doubles research funding and increases the restrictions of commercial fishing around the western stock of the Steller sea lion's CHUs in the Gulf of Alaska, Bering Sea and North Pacific Ocean.	• Viewing Steller Sea Lion (cultural)	• Non-consumptive direct use value • Option value • Existence value • Bequest value (CVM)	• The annual value is $100.22/household, adjusted to $61.13 to account for non-responses (assumed to be zero WTP) (dichotomous choice voter referendum format). • The aggregated WTP for the program is about $6.2 billion/year (CI: $5.8 billion-$16.17 billion). • US WTP is the highest one, while the lowest WTP corresponds to the boroughs. (data collection: 2000)
Policy implications • The costs of the federal program and the economic impacts to coastal communities should also be taken into consideration before any policy recommendation can be made.				
Park et al. (2002)	Estimation of the WTP to preserve the current water quality and health of the coral reefs in the Florida Keys National Marine Sanctuary.	• Snorkeling and other recreational activities involving access to coral reefs (cultural)	• Non-consumptive direct use value (TCM-CVM)	• The annual average per person-trip user value for snorkeling trips is $481.15 (truncated negative binomial model/TCM with a standard error of $68.06) • The CS for visitors who plan to increase visits above current levels is $207 (CVM). • In contrast to the TCM, a measure of the availability of substitute sites and total recreation activities does not have a significant impact on WTPs of snorkelers. (data collection: 1995-1996)
Policy implications • Estimating non-market values of coral reefs is crucial to assess the cost effectiveness of coral reefs management and remediation programs. • As scuba diving tourism is one of the most important economic services to reef-based economies, the maintenance of sustained reef tourism is a central element in the justification of MPAs.				
Bhat (2003)	Measurement of the non-market recreational benefits of reef quality improvements resulting from MR establishment in the Florida Keys.	• Scuba diving • Snorkeling • Glass-bottom boating (cultural)	• Non-consumptive direct use value (TCM, CB)	• The use value of the trips (6.31) made by an average visitor over a 5-year period for diving, snorkeling and/or glass-bottom boat riding purposes at the current quality is $2,924, which results in $463/person-trip and $122/day trip. • The quality improvement leads to increase the number of trips and the use value/trip by 43-80% and 69%, respectively. (data collection: 1996)

Policy implications • The annual management costs of the MR program areonly around 1-2% of the annual recreational benefits that the MR would generate. • The quality of the coral reefs in the Florida Keys is essential to sustain nature-based tourism in the area. • MRs are expected to improve the reef environment, particularly coral and fish abundance and diversity. • The MR-induced incremental benefits of recreation can provide justification for either a user-financed marine protection program or other financing mechanisms such as increased expenditure taxes on diving and snorkeling activities, room and meals, and transportation services, although taxes on diving gears and activities seem more plausible. • As travel costs vary across expenditure categories, different tax rates may need to be applied on different categories to collect a given amount of money to support marine programs.				
Mccartney (2006)	Estimation of aspects of the social value of the pristine seascapes, including views of the ocean and of the coastline, of the Jurien Bay Marine Park, Australia.	• Aesthetic and amenity services/scenery, pristine views of both the ocean and the coastal interface (cultural)	• Non-consumptive direct use value • Option value • Non-use value (CVM)	• The net WTP values to preserve current coastal views and ocean seascapes are $36.15 and $34.30, respectively (final restricted model). • Positive net WTP to maintain seascapes in their current condition. (data collection: not indicated)
Policy implications • Careful management of the natural state of both perspective seascapes is important. • It is important to consider the aesthetic or amenity value offered to the local and tourist communities that enjoy their views, or whose enjoyment of other activities undertaken in the marine park is enhanced by the views, when assessing seascape management plans. • Protecting seascapes contributes to minimise the disturbance that any marine or coastal developments and infrastructure can cause to the pristine views. • Despite the significant net positive value, management of the marine park should be sensitive to the proportion of the population which would like a change in the seascape.				
Togridou et al. (2006)	Examination of the influence of visitors' profile, information sources, environmental dispositions, and visit evaluation on visitors' WTP for the National Marine Park of Zakynthos, Greece.	• Recreational services/loggerhead sea turtle nesting beaches (cultural)	• Non-consumptive direct use value • Option value • Existence value • Bequest value (CVM)	• 80.79% of the sample are willing to pay, and WTP ranges from €1 to €100 (the median being €5). • Visitor and visit features, and nationality are not significant determinants of visitor WTP. • Greek visitors show more pro-environmental attitudes than foreign visitors. • Non-use values dominate over use values and higher WTP amounts are associated with bequest value. • Taking into account a rough estimate of 350,000 tourists visiting the park annually, as well as the 80.79% of the sample, a fee range from minimum (€1) to median (€5) WTP yields a €300,000 to €1,400,000 source of revenue. (data collection: 2004)

Policy implications • Financial support of nature conservation, usually enacted in the form of fees, is one of the primary components of the environmentalist dimension of ecotourism, and such a support is. • The estimated annual revenue that could be gained could cover the operating costs of MPA management. • Before establishing fees, national park authorities should investigate visitors' WTP for the park, as well as their WTP motivations.				
Samonte-Tan et al. (2007)	Estimation of the net benefits derived from the natural resources in Bohol Marine Triangle (BMT), in the Philippines, where twelve MPAs cover a total area of 160ha and are distributed as follows: one in Baclayon, three in Dauis and eight in Panglao.	• Fishing • Gleaning • Seaweed farming • Shoreline protection of coral reefs and mangroves • Nursery for fish/mollusc of mangroves • Biodiversity • Tourism-oriented recreational services • Research (supporting, provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Option value (official data, key informant interviews, net revenue, cost-based approaches, BT)	• Tourism and the municipal fisheries provide the most important direct use values accounting for 44% and 39% of the total net benefits. • The most important non-market benefits that can be derived from coastal ecosystems, which account for 9% of the BMT total net benefit, are shoreline protection (US$169,674/year) and biodiversity (US$125,703/year). • The accumulated total net benefits of BMT resources over a 10-year period is US$11.54 million (10% discount rate). • The coral reef and beach/intertidal areas yield the highest net value (US$1.26 million and US$1.12 million, respectively), accounting for 70.6% of the BMT total net benefits. • Marine waters, mangroves and seagrass account for 19.1%, 7.1%, and 3.2% of the total annual value, respectively. (data collection: 2004)
Policy implications • Non-market values show the important life-support functions of coastal and marine ecosystems on BMT. • There is a need for economic valuation as a basis for understanding and developing appropriate economic instruments for sustaining the use of the BMT resources. • Putting monetary value can lead stakeholders to recognize the importance of coastal and marine resources to economic development on a sustainable and ecologically sound basis. • The net benefits show the magnitude of potential losses that can be derived from improper management of coastal and marine resources in the BMT. • Valuation can contribute to justify investment in coastal management policies to sustain the flow of coastal services in the interest of current and future generations. • Valuation information can be used in ECBA of management interventions, programs and investments. • Resource valuation gives guidance on how resources can be allocated and how to design user fees to account for the environmental costs associated with the activities of users.				
Sorice et al. (2007)	Investigation of choices divers make in selecting diving trips to a hypothetical MPA in Texas, US.	• Scuba diving (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• Divers are willing to pay US$0.70 for a 1% decrease in the number of divers at a site. • Divers favour reductions in the level of site use and increased levels of conservation education. • They don't favor fees to access protected areas, having less access to the resource, or extensive supervision.

				• Divers require a compensation of US$ 15.67 before they can accept an increase in supervision that requires guided tours. • Divers are more willing to accept increasingly restrictive management scenarios when they can expect to see increased marine life. (data collection: 2003)
Policy implications • Although carrying capacity strategies can be used to cope with use-related impacts, understanding of divers themselves, their management preferences and how preferences relate to conservation goals is also important for policy making. • Knowledge of scuba diver preferences for management strategies can help to succesfully adop coral reef conservation strategies while maintaining the site as a tourism attraction.				
Svensson et al. (2008)	Investigation of tourists' support and WTP extra to stay at Hotel Managed Marine Reserves (HMMR), at Whale Island Resort (WIR), Vietnam.	• Recreational services/tourism (cultural)	• Non-consumptive direct use value • Non-use value (CVM)	• Most tourists (86.27%) are willing to pay more per night to stay at a HMMR, the average being US$12.86 extra/room/night (median is US$9.6). • Of the 159 tourists willing to pay at least something, 84.28% state a percent figure of the room rate, with the difference between the averages given in percent (US$14.31) and in dollars (US$19.46) being significant (Two-Sample Kolmogorov–Smirnov Z=1.403; p=0.039). • The total amount tourists are willing to pay on top of the normal room rate to stay at an HMMR equals US$162,437, based on WIR's average room rate (US$96), which is equivalent to US$23.18/room/night at 60% occupancy. • The only variables affecting WTP relate to a person's environmental knowledge and interest. (data collection: 2005-2007)
Policy implications • The vast majority of HMMRs are not recognized as MPAs by the International Union for Conservation of Nature, with the exception of Chumbe Island Coral Park in Tanzania. • The constant supply of funding from user fees can help finance and hence effectively manage protected areas. • A user fee of only 1%/room/night would generate US$6728/year and hence would cover the conservation costs at WIR, covering leasing costs (the marine portion equaling approximately US$4,000), moorings, maintenance and repairs (US$300), management and salaries (US$3,800). • The hotels should advertise their HMMR on their homepage and with help of a local environmental agency, and if possible, using the official tourism website and/or through dive companies. • Additional advertising with travel guides and information dissemination through seminars and brochures available at the hotel would contribute to raise public awareness and interest. • When the hotels initiate marine protection, the period during which they protect these areas could be seen as money saved by the government.				
Tapsuwan and Asafu-Adjaye (2008)	Estimation of the economic value of the Similan Islands in Thailand,	• Scuba diving	• Non-consumptive direct use value	• The CS is US$3,233/visit and the economic value of the Similan Islands from scuba diving is estimated to be up to US$54.96 million (truncated negative binomial model).

	officially called Mu Koh Similan Marine National Park, from scuba diving.	(cultural)	(TCM)	• The aesthetic value of the site is an important factor affecting the visitation rate. (data collection: 2004)
Policy implications • Maintaining the quality of the dive sites should be considered a priority due to the importance of scuba diving to the tourism industry. • Maintaining coral reefs of the Similan Islands is crucial to both Thai and overseas scuba divers even if non-use values are not considered. • Valuation can provide economic justification for the conservation of marine resources not only in the Similan Islands, but also in other marine parks in Thailand and overseas. • The values can help to establish a realistic schedule of user fees. • An appropriate system of fees can be used as a tool to control the number of visitors in order to minimize coral reef damage. • The economic values can be used in ECBAs of decisions involving reef management programs and potential investments. • Economic valuations draw the attention of decision makers to the opportunity costs associated with trading off the recreational use of marine resources for other uses.				
Wallmo and Edwards (2008)	Estimation of the value of protecting species and habitat diversity on the sea floor in areas which vary in size and allowable uses of the water column to partly address the question of allocation for the US Northeast regions.	• Biodiversity	• Existence value (CE)	• Welfare estimates range from $26/year/household to $144/year/household depending on the size/use combination. • While protecting areas as ecological reserves is utility increasing for most size/use combinations, smaller reserves with liberal use policies produce the largest increases. • MPA policies are likely to have winners and losers. (data collection: 2005)
Policy implications • A habitat area of particular concern (HAPC) policy protecting the proposed candidate areas provides positive utility for households in the Northeast Region. • The public seems to be attuned to the personal and opportunity costs of setting aside large areas of the ocean for protection, as individual welfare decreases over the range of sizes of the proposed long-term HAPCs in the Northeast region. • Information about the trade-offs between existence values and opportunity costs of forgone economic production provide useful information for resource managers. • Although the data support a public policy that protects ecological diversity in the ocean, strict no-take, no-use MPAs are the least valuable type of design for the majority of respondents.				
Barr and Mourato (2009)	Estimation of tourists' WTP to reduce fishing pressure in Espiritu Santo Marine Park and assessesment of fishermen's WTA alternative employment outside of the fishing sector, and the level of compensation required to provoke such a move, to examine the potential of a PES scheme for marine protection in La Paz, Mexico.	• Fisheries • Recreational services/tourism (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Non use value (CVM)	• The median WTP/trip is US$12.50 and US$30 (additional to existing price) for day excursions and longer trips, respectively. • The median WTA of fishermen is about US$135/week and the required compensation is US$60/week. • The aggregated median WTP can cover annual compensation costs for approximately half of the fishing population. (data collection: 2007)

Policy implications • PES can take various forms such as a transfer from tourists, enjoying pristine marine ecosystems, to local communities, called upon to give up degrading activities. • Despite the required compensation values outweigh the WTP of the tourist sector; PES for marine protection should not be dismissed entirely as sites which are less productive and where fishermen's opportunity costs are low will be more suited to such a compensation scheme.				
Kragt et al. (2009)	Estimation of the effect of reef degradation on demand for recreational dive and snorkel trips for a case study of the Great Barrier Reef Marine Park (GBRMP), Australia.	• Sknorkeling • Scuba diving (cultural)	• Non-consumptive direct use value (CB)	• The CS current reef visitors derive from a diving or snorkelling trip is approximately A$185/trip (negative binomial random effects panel model). • A hypothetical reduction in fish abundance, coral cover and coral diversity of 80%, 30% and 70%, respectively, may lead to an 80% decrease in the number of trips taken by divers and snorkellers, which corresponds to a decrease in their tourism expenditure on full-day reef trips in the GBRMP Cairns management area of about A$103 million/year. (data collection: 2004)
Policy implications • Estimating non-market values of the reef is policy relevant in a context of increasing degradation. • Results can help evaluate the effects of policy measures that influence reef quality and can be used to assess the overall cost effectiveness of coral reef management programs.				
Peters and Hawkins (2009)	Determination of whether entrance fees are an appropriate vehicle for MPA funding (particularly in cases of coral reef protected areas) by examining the characteristics that influence visitors'WTP and the levels of charging.	• Scuba diving • Snorkeling • Beach general activities (cultural)	• Non-consumptive direct use value • Existence value • Bequest value (meta-analysis and examination of studies)	• People are willing to pay higher user fees for access to MPAs. • Influencing WTP factors include visitors' income, level of education, environmental awareness, residency and desire to provide a legacy to future generations. • Trust in the fee collection agency and openness in how the money is spent are aspects which deter individuals. • Revenues range between a modest $4,000/year for Alona to $133 million/year ($3.6 million/mile) for Orange County. • Large MPAs have the potential to generate higher returns although they also have higher costs. (data collection: not indicated)[b]
Policy implications • Studies show a general social acceptance for the introduction of fees or an increase in those where charges already exist. • Understanding the factors that positively influence users of marine parks can contribute to their efficient management and help establish mechanisms to ensure their financing.				
Wielgus et al. (2009)	Exploration of the effects of including information on			• Recreational anglers are willing to pay between $232 and $460 for unit (1 lb) increases in fish size and numbers during

	probabilities of attribute improvement and provision within the framework of a study on the recreational value of marine resources at the Loreto Bay National Park (LBNP) in the Gulf of California, Mexico.	• Recreational fishing • Scuba diving (cultural)	• Non-consumptive direct use value (CE)	an average fishing vacation (10 days), and scuba divers are willing to pay between $5 and $10/day for unit increases in coral-associated fish and large fish. • Visitors are willing to pay higher fees than those currently charged to obtain improvements in recreational attributes. • Stating explicitly a high probability for the occurrence of the valuation scenario can improve the goodness-of-fit of choice models and the consistency of choices. (data collection: 2005)
Policy implications • As including risk information makes the valuation scenarios more credible, omitting this information may lead to hypothetical bias and impair the validity of SP valuations. • The results of the study cannot be considered conclusive due to relatively small sample sizes used in the valuation surveys.				
Glenn et al. (2010)	Demonstration of the contribution of CEs to the process of MPA decision-making and their application in the context of CWC off Ireland to measure the preferences and WTP of the Irish public for their protection using various possible scenarios of MPA.	• Raw materials • Carbon sink • Essential fish habitat (supporting, provisioning and regulating)	• Consumptive direct use value • Indirect use value • Option value • Existence value • Bequest value (CE)	• The most preferred combination of attributes is to ban trawling in all coral areas with no additional taxation; followed by banning trawling in all coral areas with a tax of €10; and, thirdly, banning all fishing in all coral areas with a tax of €1. • While respondents prefer the option that incurs no personal cost to them, many are willing to pay a tax to ban trawling in all and known coral areas. (data collection: 2007)
Policy implications • The non-significance of the cost attribute undermines the CE ability to extrapolate an overall monetary value for the CWC protection through MPAs. • Despite the non-significance of the cost attribute, the intra-attribute comparisons and the list of preferred alternatives provided by CEs offer useful information for policy makers. • The list of preferred alternatives indicates preferences for different MPA management scenarios, an aspect rarely visible at the operational level. • Through intra-attribute comparison, CEs permit the disaggregation of the attributes and levels and identify their part-worth utilities, which is of especial relevance in a context in which there may be conflicting objectives and many management options as it permits identifying the trade-offs involved in different combinations of the attributes and levels. • There is a need for tools to assist in the MPA design and management, which is especially true when it comes to promoting the creation of MPA networks as required by the UK Marine Bill. • Socio-economic factors can potentially shape MPAs more than biological and physical factors. • Economic valuation can help maximise MPA-derived social benefits in terms of both minimising the impact on sectors that have traditionally used MPAs and maximizing protection gains. • Valuation information can be used in ECBA of MPA management strategies.				
Hussain et al. (2010)	Estimation of the benefits of the proposed designation of a network of MCZs in English territorial and UK	• Food provision • Raw materials • Nutrient cycling • Gas and climate regulation	• Consumptive direct use value • Indirect use value	• The study is an ex ante appraisal of benefits and one specifically bound by a set of conditions (network scenarios/management restrictions) defined by the UK

	offshore waters and development and application of a methodology that first apportions these aggregate benefits across the diverse range of marine landscapes and habitats and then estimates the marginal benefit of protection.	• Disturbance prevention and alleviation • Leisure and recreation • Cognitive values/research and development, education and training (provisioning, regulating and cultural)	• Non-consumptive direct use value • Non-use value (BT)	government for the proposed Marine and Coastal Access Bill. • The monetary estimate of benefits, calculated for 3 different configurations of MCZs under 2 different management regimes, ranges between £10.2 billion and £23.5 billion in present value terms (3.5% discount rate). (2007£)
Policy implications • Estimates were used in the Impact Assessment that accompanies the Bill and were juxtaposed with a separate cost estimate of between £0.4 billion and £1.2 billion, this leading to a B/C ratio ranging from 5.5 to 12.7 depending on the network scenario and the proportion of sites protected under "Less Restricted" and "More Restricted" settings. • Results can contribute to the development and application of a methodology to estimate the incremental impact of a policy intervention where the limited information on benefits is available only in aggregate form (across a wide spatial scale and across a diverse range of marine landscapes and habitats).				
McVittie and Moran (2010)	Estimation of the non-market benefits derived by UK residents from the conservation of ecosystem goods and services resulting from implementation of proposed MCZs under the UK Marine and Coastal Access Bill (2008).	• Food source • Raw materials • Climate regulation • Nutrient cycling • Disturbance prevention • Treatment of waste • Recreation and leisure • Cultural values • Environmental resilience • Biodiversity (provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Existence value • Cultural value (CE)	• The total aggregate value for a policy that achieves a halt in the loss of biodiversity through the introduction of the UK wide MCZ network is £1,714 million/year, the bulk of this value arising from England (£1,510 million). • An increase on the current level of biodiversity has an aggregate value of £1,659 million. • With respect to the level of environmental benefits (all attributes but biodiversity), a halt in the decline in provision has an aggregate value of £891 million, while increasing the flow of benefits relative to the current situation has a value of £1,007 million. • Survey respondents are indifferent to the levels of restrictions on activities needed to achieve these outcomes. (data collection: 2008)
Policy implications • Policy actions to increase the flow of environmental benefits have a greater potential to pass a cost-benefit test than would be the case with respect to improving biodiversity.				

• The results inform an impact assessment that compares benefits to projected policy costs. • Welfare improvements from the Marine Bill significantly outweigh projected regulatory costs.				
Prayaga et al. (2010)	Estimation of the value of recreational fishing in the Capricorn Coast which is in the southern part of the Great Barrier Reef Marine Park (GBRMP), Central Queensland.	• Recreational fishing (cultural)	• Non-consumptive direct use value (TCM, CB)	• The CS per trip for fishing is $385.34/group, which extrapolates to a total annual CS value of approximately $5.53 million (TCM). • The demand for recreational fishing is inelastic and values are relatively insensitive to changes in catch rates. (data collection: 2007)
Policy implications • Understanding the value of recreational fishing in the area and how changes in management may affect the recreational value is policy relevant. • Findings are important to GBRMP users and managers since the fish stocks underpinning recreational fishing are relevant to biodiversity protection and commercial fishing interests. • The value of marginal effects provides useful information to policy makers who might consider different management and protection options. • Policy makers could compare the marginal effects of a change in catch rates on the recreational sector with those on the commercial sector when assessing how to allocate resources among these competing activities.				
Ransom and Mangi (2010)	Estimation of the value of recreational benefits arising from coral reefs at Mombasa Marine National Park and Reserve (MMNPR), Kenya	• Glass bottom boating • Scuba diving • Viewing of marine life supported by reef and coral gardens (cultural)	• Non-consumptive direct use value (CVM)	• Citizen and foreign visitors are willing to pay an extra $2.2 (median = $1.6) and $8 (median = $6.7)/visit, respectively, in addition to current park entrance fees, to support reef quality improvements. • The value of aggregated benefits is estimated at $346,733, which is more than twice the total annual operational expenditure of $152,383 for MMNPR. • Annual revenues from citizen and foreign visitors may be increased by 60% to $261,932 by implementing higher park fees of $3.10 for citizens and $15 for foreign visitors. (data collection: 2007)
Policy implications • Valuation help decision makers and stakeholders justify the sustainable use and management of coral reefs. • Valuing the protection of habitats and species provided by MPAs can contribute to identify and develop financing mechanisms and economic incentives for effective MPA management. • Park managers need to demonstrate that the extra revenue will be used to fund the proposed conservation activities. • If higher park fees are implemented and greater revenues generated, a proportion of the additional revenue could be returned to the MPAs in the form of increased budget allocations.				
Thur (2010)	Examination of the fees scuba divers' are willing to pay for access to quality recreational sites in the Bonaire National Marine Park, Netherlands Antilles.	• Scuba diving (cultural)	• Non-consumptive direct use value (CVM)	• Depending on question format, mean WTP for annual access ranges from US$61 to US$134. • All model specifications show that doubling the US$10 user fee has virtually no impact on visitation rates. (2002$)

Policy implications • Successful protection of marine ecosystems depends not only upon an understanding of their biological and physical processes, but also their associated social and economic aspects. • An attractive alternative for MPA managers is to use sustainable, self-financing mechanisms to augment government or non-governmental organization financing. • The increased revenue generated from this sustainable financing mechanism is more than sufficient to fund both current and enhanced marine park operations. • Marine park users have a WTP for access that may exceed the revenue requirements of the management authority.				
Casiwan-Launio et al. (2011)	Investigation of the local residents' WTW and WTP for the continued existence of the San Miguel Island (SMI) fishery reserve in Bicol Region, Philippines.	• Spillover effect to fish catch • Fish biomass (mt/km^2/year) • Live coral reef cover • Seaweed beds area • Species richness and diversity (provisioning)	• Option value • Existence value • Bequest value (CVM, WTW)	• The lower-bound mean WTW is 3.5 days/month for residents in the "owner" village and 1.9 days/month for residents in adjacent villages. • Using a fraction of mean daily income to impute the monetary equivalent of WTW, the result is more than 3 times higher than the Php16 to 25/month (US$0.34 to 0.75/month) estimated mean WTP. • Island villagers are willing to voluntarily supply labor or money to help in patrolling and monitoring the sustainable use of marine resources. (data collection: not indicated)[c]
Policy implications • The use of voluntary labor can be a management option for MPAs. • Establishing "own village" MPAs may increase residents' conservation value.				
Wattage et al. (2011)	Determination of the economic value held by the Irish public for the conservation of deep-sea corals using several variants of the concept of MPAs.	• Enjoyment/use of CWC (cultural)	• Option value • Existence value • Bequest value (CE)	• In terms of the probabilities attached to the individual attributes, the most preferred policy options are to ban trawling, protect all areas where corals are thought to exist, and pay a ring-fenced personal tax of €1/year. • Coral protection for the benefit of the next and future generations is endorsed by 90% of the sample, while 84% consider that corals should be protected purely in their own right given the unique and fragile ecosystem they represent. • Only 61% see protection as important because it gives them the option to see or use them in the future. (data collection: 2007)
Policy implications • The lack of statistical significance of the cost paramater undermines the ability to extrapolate a monetary WTP for the attributes, levels and choices. • The lack of significance serves to further emphasise the preeminent significance of the other choice variables. • MPAs are not a panacea for solving marine resource management problems, and the effect of MPAs on yield remains a critical issue. • ECBA helps assess MPA proposals and can contribute to provide their economic justification.				

• Estimating a more complete economic value including non-use values (rather than only market value) is critical in a context in which ECBAs are increasingly required or used to help support the adoption of regulatory and management proposals.				
Boxall et al. (2012)	Evaluation of the economic benefits of three MPA options aimed at protecting three marine mammal species found in the St Lawrence Estuary, as well as other management actions that could produce improvements in the species'populations.	• Marine mammal species	• Existence value • Bequest value (Hybrid between CVM and CE)	• The WTP for different levels of mammal recovery ranges from $77 to $229/year/household and varies according to the species affected and the recovery program effort. • The highest valued recovery program ($229.17/household) is for a program which has the largest MPA size and major restrictions on whale watching and shipping, but offers the greatest improvement in population numbers for all of the threatened marine mammal species in the estuary. • People are willing to pay more for programs that contribute to greater increases in marine mammal populations, but the additional value of programs that improve a species status beyond the ''at risk'' threshold is relatively small. • Aggregate WTP ranges from $962 to $2,850 million, depending on the magnitude of the expected recovery. (2006$)
Policy implications • The assessment of the economic benefits and costs of actions that might improve the status of species at risk is required by the Canadian Species at Risk Act. • Economic analysis of protection options can contribute to make more informed decisions regarding the management of marine mammal species at risk and the establishment of an MPA. • As the recovery programs that provide benefits above the threshold of ''threatened'' are not highly valued, approaches minimizing the cost of achieving this threshold are most desirable from an economic efficiency standpoint.				
O'Garra (2012)	Estimation of the economic value of the main goods and services provided by the coastal ecosystems in Navakaku fishing ground, located near Suva, Fiji, 4 years after the establishment of a Locally Managed Marine Area and 2 years after the establishment of a MPA.	• Fisheries • Coastal protection of coral reefs and mangroves (provisioning and regulating)	• Consumptive direct use value • Indirect use value • Bequest value (production approach, BT, CVM)	• The value of fisheries, bequest value and coastal protection function provided by the coral reefs and mangroves are estimated to provide net benefits of just over FJ$3m (US$1,795,000)/year. • The present value of the coastal ecosystems, over a 99-year time horizon, is under US$20m (10% discount rate). • The coastal protection provided by the coral reefs and mangroves makes up the largest component of the total economic value (55%), followed by fisheries (44%). • Bequest values only make up 1% of the total economic value, although they represent 6.8% of stated income. (2006FJ$)
Policy implications • Valuation of coastal ecosystems in Navakaku fishing ground can assist decision-making at all levels, which is crucial given increasing pressures on resources, particularly near urban centres.				

• Estimation of the net flow of benefits helps social and economic agents to take decisions as to how to proceed with the use and management of their resources. • Valuation of the total flow of benefits may show decision-makers the true value of resource and the potential losses if the resource is over-exploited or destroyed.				
Rolfe and Windle (2012a)	Estimation of the values to protect the health of the Great Barrier Reef (GBR) at the national level and examination of the effects of distance decay on valuation estimates.	• Recreation (cultural)	• Non-consumptive direct use values • Option value • Non-use value (CE)	• The average WTP across Australian households is $21.68/household/year for 5 years. • Values are higher for respondents with higher levels of education and income, who live in Queensland, who live further away, and who plan to visit more often in the future (pooled model). • Patterns of direct use explain some variation in protection values. • Use values do not decline linearly as a function of distance for interstate communities; this suggesting distance is not a good proxy for accessibility and use. • Distance-decay effects are limited for iconic resources. • Values are higher for the people planning to visit in the future, and significantly related to the number of planned future visits. (data collection: 2010)
Policy implications • Results contribute to a more efficient management of the GBR.				
Rolfe and Windle (2012b)	Estimation of the protection values for three different Great Barrier Reef (GBR) sites to test if the values could be easily transferred to other sites in the region.	• Recreation (cultural)	• Non-consumptive direct use value • Option value • Non-use value (CE, BT)	• The total WTP per Brisbane household for a 1% improvement in GBR condition is $22.05 in Cairns, $31.51 in Townsville and $39.97 in the Capricorn coast, although these values are not significantly different. • No significant difference in values between the local population and the Brisbane population. • Evidence for distance effects is identified for the Brisbane population, with closer sites valued more highly. • Respondents are sensitive to both the amount of change involved and whether changes involve gains or losses. (data collection: 2010)
Policy implications • Protection values might be higher for reef areas being currently in good condition with risks of future losses than for areas in poor condition with opportunities for future improvements. • Understanding if protection values at a particular GBR site may be easily transferred to other case studies of interest in the region is policy relevant. • The results are encouraging for the use of BT as values are robust to various site and population differences.				

Mwebaze and MacLeod (2013)	Analysis of the economic value of a group of marine parks in Seychelles through calculation of the WTP of international tourists for trips to these parks.	• Recreational opportunities (cultural)	• Non-consumptive direct use value (TCM)	• The average per-trip CS is approximately €128 for single-site visitors and €65 for multiple-site visitors. • The total social welfare value attached to recreational services of the parks is approximately €3.7million/year. (2009€)
Policy implications				
• Economic valuation can provide policy makers with information about the value of marine resources and the cost of neglecting MPAs. • Results provide policy makers with a strong justification for government investment in maintaining marine sites in Seychelles. • Findings can be used to inform a new fees structure which more accurately reflects the value of marine parks.				
Rogers (2013)	Investigation of whether public and expert preferences diverge in a valuation of both the iconic Ningaloo Marine Park and the less well known Ngari Capes Marine Park in Western Australia.	• Recreational opportunities (cultural)	• Non-consumptive direct use • Non-use value (CE)	• The WTP ranges from $28/year/individual for the abalone protection program to $69/year/individual for the iconic whale attribute at its maximum conservation level (50% for whales and 10% for abalones). • The cost attribute coefficient is not statistically significant in the Capes expert model, so the values calculated for them are not informative. • Evidence of both divergence and convergence between public and expert values is found, with public awareness factors helping to explain differences of opinion. (data collection: 2008)
Policy implications				
• In the case of the Capes, relying on expert value judgments to inform policy would not accurately represent community values due to the existence of divergence. • The statement that divergence exists is context specific. • For Ningaloo, there is a convergence of values between public and experts, suggesting that expert value judgments could provide a cost-effective source of social value information. • When it comes to divergence, it is preferable for policy design to support environmental policies through community awareness campaigns rather than using uninformed public preferences. • While expert consultation is an essential component of environmental decision making, particularly in relation to technical advice, it may not represent the value judgments of the public.				
Batel et al. (2014)	Investigation of visitor environmental perception and WTP for conservation of bottlenose dolphins in the Cres-Losinj Marine Protected Area (CLMPA), Croatia.	• Bottlenose dolphin watching (cultural)	• Non-consumptive direct use value • Option value • Existence value • Bequest value (CVM)	• Individuals are willing to pay between 10% and 29% more for guided dolphin watching tours, which leads to a total WTP ranging from €16.5 to €19.35/person. • The attractiveness of Losinj Island is more influenced by its nature than by the presence of the dolphin population. (data collection: 2011)
Policy implications				

• In order to use the dolphins as a flagship species, the resident population should gain greater public awareness which could then lead to a higher support of the MPA. • The average WTP is 6-10% higher than the average daily expenditure/person, which results in a potential ecological tax of approximately €1/person/day, and an overall estimated increase of seasonal income of between €2.4 million and €9.9 million. Consequently, there is a viable option for the CLMPA to be self-financed due to the high WTP of visitors and the potential additional income derived from dolphin watching trips. • In regions where tourism is an important economic driver for the local economy, analysing tourists' opinions to integrate them into conservation management plans is important.				
Börger et al. (2014)	Examination of the applicability of a discrete CE to value the expected benefits arising from the conservation of an offshore sandbank in UK waters (the UK part of the Dogger Bank in the southern North Sea) which is a MPA. The study is based on real-world management options for fisheries, wind farms and marine protection currently under discussion for the site.	• Diversity of species • Protection of porpoises, seals and seabirds/charismatic species with cultural significance • Invasive species	• Non-use values (CE)	• While respondents are willing to pay £4.19/year on average for a 10% increase in species diversity, their average WTP for a 25% increase is £7.76, with decreasing marginal utility of species diversity (mixed logit model). • Respondents show decreasing marginal utility for protection of porpoises, seals and seabirds as they are willing to pay £24.02 on average/year to protect these species on 25% of the area, whereas the WTP for the protection on 50% of the area is £30.32 (mixed logit model). • Designing a future wind farm on the Dogger Bank that results in wide spread of invasive species yields a negative WTP of £−25.39 on average (mixed logit model). (data collection: 2013)
Policy implications • Findings show support for marine conservation measures despite the general public's limited prior knowledge of current marine planning. • Results have implications for policy and management with respect to commercial fishing, wind farm construction and nature conservation. • Economic valuation can be used to assess potential benefits from marine management by the general public, a group beyond the immediate stakeholders and direct marine user sectors. • Valuations can inform negotiations about marine management plans by providing the wider societal perspective and, thus, help to establish priorities among conflicting management goals.				
Jobstvogt et al. (2014a)	Estimation of the WTP of Scottish households for additional MPAs in the Scottish deep-sea.	• Deep-sea organisms (provisioning)	• Option value • Existence value (CE)	• High WTP for deep-sea protection, ranging from £70 (conditional logit) to £77 (mixed logit) for the "best" option (highest species protection plus high potential for new medicinal products). (data collection: 2012)
Policy implications • Despite very limited public knowledge about deep-sea habitats, citizens can be useful participants in policy formation regarding the deep-sea. • Policy makers are better off to consider the existence value that people associate with species protection in combination with the direct benefits of marine protection as overlooking non-users will lead to undervaluation of marine ecosystems. • Recognising and quantifying the economic value of biodiversity is the key to sustainable ocean management and help to make more democratic the decision-making processes. • Protection of species and habitat diversity should be a priority, since several deep-sea habitats are biological hotspots and should be protected under the precautionary principle. • The estimates from this study should not be used in a full ECBA as they are not based on a representative sample. • The value for potential medicinal products should be used more often in justifying protection of certain areas which, while hosting low biodiversity, have high bio-technological utility.				

Jobstvogt et al. (2014b)	Elicitation of divers' and anglers' WTP for potential MPAs, which is a case study from the UK National Ecosystem Assessment.	• Cultural services (aesthetic, spiritual, therapeutic, recreational or others)/scuba diving and angling (cultural)	• Non-consumptive direct use value • Option value • Non-use value (travel cost-based CE, attribute-based CVM)	• The WTP in travel cost to go diving regardless of the site attributes is €7.52, and the WTP to go angling is €20.78 (values are determined by socioeconomic variables). • "Rocky tide swept channels" are among the most valued habitats by divers and anglers, which assign to them a value of £23.85 and £25.14, respectively. • Shipwrecks are more valued by divers (£18.98) than by anglers (£8.87). • Divers value seals, bird colonies and octopus (£7.02–£15.97). • Anglers do not value seals, and bird colonies and octopus reduce their site value by £4.13 and £4.17, respectively. • Divers are willing to pay £8.83 for a one-off donation to protect a hypothetical site against potential future harm and degradation, while anglers are willing to pay £8.29. • A wide variety of marine spaces influence user-WTP, while stewardship-WTP is most influenced by management restrictions, species protection, and attitudes towards marine conservation. (data collection: 2012-2013)
Policy implications • Understanding key stakeholders' cultural ES values can serve to inform a more holistic and sustainable approach to marine management, especially for decisions involving trade-offs between marine protection and opportunity costs of the blue economy. • Omitting cultural ES use and non-use values from impact assessments underestimates the social and economic value of nature to people. • Conservation features important for a national network of MPAs can be translated into cultural ES benefits and be valued using SP surveys. • The study provides new evidence for impact assessment reviews by UK Governments. • Cultural ES values of marine sites in combination with ecological conservation evidence are likely to be a stronger argument for protection than conserving biodiversity alone.				
Pascoe et al. (2014)	Examination of the potential impact of entry fees for marine parks on dive tourism in South East Asia through estimation of the price elasticity of demand for dive tourism in three countries in Indonesia, Thailand and Malaysia.	• Scuba diving (cultural)	• Non-consumptive direct use value (TCM)	• The total non-market use value associated with diving in the area is estimated to be in the order of US$4.5 billion/year. • The price elasticity of demand is highly inelastic, such that increasing the cost of diving through a management levy would have little impact on total diver numbers. (2010$)
Policy implications • Marine reserves provide important recreational benefits to scuba divers diving within the reserve and to recreational and commercial fishers outside the reserve through spillover effects. • To finance ongoing monitoring and surveillance and hence ensure the marine reserve sustainability, marine reserve managers have to impose an entry fee. • Well management of reefs is essential to ensure their recovery after coral bleaching events, and hence minimize potential welfare losses of both local communities and divers themselves.				

• The impact of the fee on diver numbers is likely to be substantially less than the impact of resource degradation through poor management. • For local divers, who have a lower CS, a lower fee rate could be imposed. • There is an economic rationale for implementing mechanisms such as user fees to transfer some of the benefits realised by overseas visitors toward local reef conservation. • Given the inelastic demand, higher fees represent more revenue, which in turn (potentially) enables better management, better park quality and ultimately more tourists.				
Subade and Francisco (2014)	Determination of whether non-use values exist among residents of Quezon City, hundreds of kilometers away from Tubbataha Reefs National Marine Park in the Philippines.	• Fisheries • Enjoyment of the park (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value • Option value • Existence value • Bequest value • Altruistic value (CVM)	• The mean WTP ranges from Php437 to Php233. • The total social WTP ranges from Php112 million (or US$2.15 million)/year to Php210 million (US$4 million)/year. • 46% of all respondents are willing to pay for conservation of the reefs, with bequest motive or concern for future generations as their main reason. (data collection: not indicated)[d]
Policy implications • The substantial non-use values justify the need for regular government appropriation for conserving Tubbataha Reefs. • Tapping a portion of non-use values provides potential source of conservation funding for TRNMP as the total social WTP will dwarf the required cost of conserving TRNMP (presently 10 million pesos to cover the core costs).				

[a] Key: BT, benefit transfer; CB, contingent behavior; CE, choice experiment; CHU, critical habitat unit; CI, confidence interval; CS, consumer surplus; CVM, contingent valuation method; CWC, cold-water coral; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; MCA, multicriteria analysis; MCZ, marine conservation zone; MPA, marine protected area; MR, marine reserve; NGO, non-governmental organization; SP, stated preference; TCM, travel cost method; WTA, willingness-to-accept; WTP, willingness-to-pay; WTW, willingness-to-work.
[b] The authors report results from 18 studies conducted in developed and developing countries, all of them but one published in 2000s.
[c] The year of data collection could be assumed to be 2008 as, for the WTP Non-Parametric and Parametric Estimates, the authors use the average exchange rate in September 2008 (Php46.7 = 1US$).
[d] The authors refer to Subade (2005) for further details on the survey, questionnaire and methods.

3.10 Coastal and marine ecosystems

This section analyzes papers which either value services provided by more than one of the ecosystems examined in previous sections (excluding studies focusing on marine protected areas) or don't make any reference to any specific type of ecosystem and just refer to 'marine and/or coastal ecosystems'. For this reason, these studies have been grouped into an ecosystem category called "Coastal and Marine Ecosystems". The review of these studies is expected to complement the previous analyses about the value of services provided by coastal and marine ecosystems as well as the contribution of economic valuation for their better management.

Table 10 reports a list of 10 papers presented in terms of their study object, the ecosystem service/s (ES) being valued (together with the Millenium Ecosystem Assessment (MEA) category/ies which they belong to), the types of value being estimated (together with the estimation technique/s), their main outcomes (indicating the year the monetary values refer to), and their main policy implications.

As seen in the table, almost half of the studies have been published during the last 4 years (4). Half of them value services provided by more than one of the ecosystem types analyzed in this report (5), while others deal with services provided by 'marine and coastal ecosystems' (Beaumont et al., 2008; Ghermandi and Nunes, 2013; Lange and Jiddawi, 2009; Norton and Hynes, 2014; Raheem et al., 2012). The valuation approaches employed by researchers are very heterogeneous. Indeed, one paper combines hedonic analysis (HA) and choice-based conjoint analysis, while four studies apply a choice experiment (CE). Barton (2002) uses the contingent valuation method (CVM) and the benefit transfer (BT) approach, and Ghermandi and Nunes (2013) integrate meta-analysis with Geographic Information System (GIS) information. On the other side, Beaumont et al. (2008) employ data derived from, among other sources, peer reviewed journals, Defra Sea Fisheries Statistics 2004, European Parliament Report, 2004 and Hebridean Whale and Dolphin Trust, and refer to different valuation techniques such as the market price method, the avoidance costs, the CVM and the replacement costs, while Lange and Jiddawi (2009) refer to methods established by the World Tourism Organization to measure the economic value of tourism for national accounts and market prices. Raheem et al. (2012) develop a matrix in which the rows are ES types and the columns are types of marine ecosystems and, where possible, they populate it with ES values per unit of area drawn from the economics literature. Six studies estimate non-use values. Three papers focus on coastal and marine ecosystems of developing countries.

3.10.1 Ecosystem services and values

Excluding Ghermandi and Nunes (2013), the ES type which has been valued more times by these authors is cultural services (valued in 8 papers).[7] Some authors have focused only on cultural services (Earnhart, 2001; Liu and Wirtz, 2010; Liu et al., 2009), while others have considered cultural services together with either provisioning ones (Barton, 2002; Lange and Jiddawi, 2009) or provisioning and regulating services (Oleson et al., 2015). Beaumont et al. (2008) and Raheem et al. (2012) value the three MEA final ES together with supporting services. Thus, provisioning services have been valued in 5 papers, followed by regulating and supporting services (3 and 2, respectively).

The cultural service which has captured a major attention by these authors has been the recreational services provided by coastal and marine ecosystems, which have been valued in 6 papers. In this context, Barton (2002) focuses on the role of water quality in the recreational experience, thus valuing swimming water quality.

On the other side, Beaumont et al. (2008) consider, together with leisure and recreation, the cognitive values related to marine biodiversity, while Earnhart (2001) estimate the aesthetic benefits generated by the presence and quality of both land-based and water-based (Long Island Sound, marsh, river/stream, lake/pond) environmental amenities associated with residential locations. Interestingly, Oleson et al. (2015) deal with social cultural cohesion which is considered "a cultural ES which captures the idea that activities enabled by ecosystems, such as traditional fishing and the management of natural resources, are associated with interactions between individuals that contribute to rich cultural networks of relationships".

Among the provisioning services, food provision has been valued in three papers (Beaumont et al., 2008; Oleson et al., 2015; Raheem et al., 2012), followed by drinking water quality, raw materials, seaweed farming and mangrove harvesting, and wild plants and animals products, which have been valued in one paper each.

Regarding regulating services, disturbance prevention and alleviation/natural hazard regulation has been valued in two papers (Beaumont et al., 2008; Raheem et al., 2012), followed by control of beach erosion and shoreline protection which have been valued in one paper each.

The supporting services considered have been nutrient cycling (Beaumont et al., 2008), and habitat and refugia, primary production and water cycling (Raheem et al., 2012).

[7] Note that Barton (2002) is one of these 8 primary valuation studies because they test the reliability of transferring willingness-to-pay estimates of improvements in coastal water quality which have been previously inferred through the CVM.

Non-consumptive direct use values have been estimated for the cultural services, while consumptive direct use values and indirect use values have been assigned to regulating services. Indirect use values have also been estimated for supporting services. Among the six papers eliciting non-use values, only three clearly state they estimate them: Beaumont et al. (2008) and Oleson et al. (2015), who estimate non-use values together with use values, and Norton and Hynes (2014), who only estimate non-use values. It has been assumed that, through their pilot survey, Liu et al. (2009) and Liu and Wirtz (2010) elicit a mix of use and non-use values as they find that being member of an environmental organization positively affects the WTP to protect environmental resources from oil spills. Raheem et al. (2012) do not specify whether they estimate non-use values. However, as they provide information about the value of cultural heritage and cultural values are usually associated with non-use values, it has been assumed they might provide a mix of values for this cultural service.

3.10.2 Outcomes and policy implications

Results from these studies confirm conclusions from previous analyses in this report: people are willing to pay to protect coastal and marine ecosystems. Indeed, findings show that the services provided by these ecosystems are assigned relevant direct and indirect use values as well as non-use values. Cognitive and cultural heritage values have also proved to be important components of the willingness-to-pay (WTP) of individuals (Beaumont et al., 2008; Raheem et al., 2012). In a context of oil spill prevention, Liu et al. (2009) find, like León et al. (2014), that political attitudes and values of the respondents affect their WTP.

Again, the studies give evidence that the value attached to marine biodiversity represents an important driver of the value of protection of coastal and marine ecosystems. When assessing each good and service provided by UK marine biodiversity “to detail current knowledge, provide a better understanding of the research required to value biodiversity, and clarify the role of valuation in the management of marine biodiversity”, Beaumont et al. (2008) demonstrate that, despite efforts need to be made to raise awareness of the importance of marine biodiversity, high economic values are associated to it. Norton and Hynes (2014) show that the costs of degradation resulting from not implementing the Marine Strategy Framework Directive (MSFD) to achieve good (marine) environmental status can be large. These authors also show that, “while increased biodiversity is preferred to the current biodiversity levels, there is no difference seen in utility levels from an increase to a decrease”, which can be explained by the difficulty to understand the concept of biodiversity.

Other authors confirm that there are aesthetic benefits associated with the presence and quality of environmental amenities which are capitalized into the housing market (Earnhart,

2001). A positive WTP for coastal water quality has also been shown by Barton (2002), whose results reject the hypothesis that transfer of values adjusted by the benefit function outperforms transfers of unadjusted or simple income-adjusted WTP. In addition, they demonstrate that socio-economic site characteristics are not enough to explain site-specific differences in WTP. Liu et al. (2009) and Liu and Wirtz (2010) show again that people are willing to pay for oil spill prevention programs.

The importance of considering spatially explicit values for the services provided by coastal and marine ecosystems is again highlighted by some authors (Ghermandi and Nunes, 2013; Raheem et al., 2012).

In the context of developing countries, Lange and Jiddawi (2009) again show that coastal and marine ecosystems highly contribute to the income of local communities. Indeed, they show that these ES contribute 30% of GDP and that "these figures would be even higher if the indirect ES were included". On the other side, Oleson et al. (2015) demonstrate again that "bequest values […] can be particularly significant for indigenous communities whose livelihoods and cultures are tied to ecosystems".

As expected, the studies reviewed in this section show that economic valuation of services provided by coastal and marine ecosystems can contribute to their more efficient management (Raheem et al., 2012). This is true even if concepts such as biodiversity are difficult to understand by most of people. Indeed, Beaumont et al. (2008) state that, despite this and other limitations related to valuation methods, an ES approach is a useful methodology as it enables evaluate the costs and benefits of alternative options, thus contributing to a more sustainable management of marine biodiversity. Even more, they state that "economic value is a currency that is universally understood by policy makers, economists, scientists and politicians alike" and hence valuation information can help distribute conservation funds as well as guide marine planning processes as required by different regulations at the national and European level. Indeed, "the translation of ecological importance into a representative monetary value" facilitates assessing the trade-offs and synergies inherent in ecosystem-based management of marine and coastal environments. Understanding the value of marine biodiversity is crucial in this context to better contribute to the efficient management of these ecosystems. Liu et al. (2009) highlight the role of economic valuation not only in environmental cost-benefit analysis (ECBA) but also in multicriteria analysis (MCA). In particular, they think that CE results can constrain the weights assigned to different environmental resources used in MCA.

Interestingly, Norton and Hynes (2014) state that, to measure the costs of degradation, the European Commission (EC) examines a number of different approaches. In this sense, they

remind that the EC considers two alternatives to the ecosystem-based approach: the cost-based approach, which only takes into account the costs of meeting the good ecological status (GES) targets and hence could be considered a cost-effectiveness approach, and the water accounts approach, which uses national economic data from sectors that would be affected by GES-driven quality changes. In this context, the authors state that, despite the benefits of these two approaches in terms of information availability, it seems better to follow an ecosystem-based approach, as required by the MSFD, when estimating the costs of marine degradation.

In this context, some authors examine the usefulness of applying benefit transfer (BT) approaches. Ghermandi and Nunes (2013) point out that value transfer methods are attractive in a context of "time and budget constraints when reliable primary valuations are absent". In this sense, they believe that their proposal of a meta-analytical framework including Geographic Information System (GIS) information and hence allowing for the exploration of the spatial dimension of the valued ecoystems can better contribute to identify and rank conservation priorities as well as identify determinants of value within each spatial dimension. According to the authors, this work can add to the debate on the importance of both using value transfer methods and developing "more refined and reliable transferred values".

On the other side, Barton (2002) state that decision makers could view as too restrictive rejecting transfers with errors being as low as 1.6% as suggested by common statistical tests of model coefficient and predicted WTP transferability. However, they acknowldege "there is no rule of thumb regarding 'acceptable levels' of transfer error in ECBA" and, acceptability will depend "on decision-makers' risk aversion, the relative uncertainty of policy costs, and the reduction in uncertainty about policy benefits relative to study cost achieved by doing primary studies instead of BT".

Again, these authors show that economic valuation of services provided by coastal and marine ecosystems can contribute to management areas such as wetland management (Earnhart, 2001) or operational and strategic planning of oil spill combat as well as design of measures in an Integrated Coastal Zone Management framework (Liu and Wirtz, 2010; Liu et al., 2009).

Norton and Hynes (2014) show that economic valuation can also help developing the Marine Strategy Framework Directive (MSFD) which requires to consider the costs of degradation "within a broader 'Economic and Social Assessment' of the marine environment by EU member states". To this aim, the authors use as CE attributes eleven GES descriptors outlined within the Directive. Interestingly, they state the number of exemptions to

implementing policies aimed at achieving GES based on disproportionate costs can be low if non-use values of coastal and marine ES are taken into account.

In a developing country context, Lange and Jiddawi (2009) state that economic valuation can provide information about the level of dependency of the economy on an ecosystem as well as the costs of inaction, thus being a very policy relevant tool. In this sense, 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 ecosystem can contribute to reducing poverty. On the other side, Oleson et al. (2015) show that local communities are willing to make trade-offs to ensure the long-term bequest values, despite their poverty conditions and hence their focus on daily activities. Indeed, their results show the importance that these communities attach to bequest values compared to other direct and indirect use ES, suggesting that actions involving "short-term sacrifices" to improve the ecological conditions may be more acceptable to them than previous research suggests. In this context, information on bequest values can help ensure long-term ecological and socio-cultural sustainability as well as improve livelihoods (e.g., by encouraging resource stewardship).

3.10.3 Research needs and challenges

Regarding the research needs identified by these studies, those aimed at coping with the limitations of current scientific knowledge regarding marine biodiversity are important ones. In this sense, Beaumont et al. (2008) points out the need for estimating the values of other components of marine biodiversity for which there is currently no information such as marine biologically mediated habitats. Indeed, the authors do not provide a unique value for biodiversity because only 8 of the 13 services they consider are assigned a monetary value, and hence aggregating the data into a single value would have led to underestimate it as well as to assume no knowledge gaps exist. Additionally, Beaumont et al. (2008) consider that to fully understand the welfare implications of biodiversity loss, more information linking biodiversity to the provision of goods and services is needed especially in a context of inter-dependency between the different marine biodiversity components.

Another area for further research is dealing with uncertainty over the future ecosystem state in valuation studies. Norton and Hynes (2014) point out this would provide policy makers with useful information on the costs associated with different potential future states of the marine environment.

These authors have also pointed out three more areas for further research. First, the need for considering not only preference heterogeneity, including the analysis of the effect of attitudes, but also differences in cultures and attitudes towards environmental issues across

the member states sharing a coastline at a regional sea level. Second, and in the context of marine water degradation, they consider that the effect on the estimated value of measures affecting more than one descriptor require further exploration, as in their study they assume there is no correlation between their CE attributes representing MSFD GES descriptors. Third, they recommend that similar valuation studies are undertaken after the initial MSFD assessment by all EU member states to allow for comparison of regional sea level policies' costs and benefits across member states.

Ghermandi and Nunes (2013) also propose some directions for further research in the context of meta-analysis including spatial information. First, and to estimate recreational values, they suggest estimating "a spatially explicit function for the standardized recreation value on a per person (or household) per day basis", and then "a separate recreation demand model that predicts the number of person days of recreation at each stretch of coastline". Second, they recommend exploring visitor-type effects due to the existing differences in preferences of local excursionists and international travelers. Moreover, they consider a more refined analysis about the composition of recreationists at a given location should be conducted, with a focus on pull factors that determine the choice of international tourists. Third, the authors advocate for the need for more primary valuations "to allow for more stringent requirements on welfare consistency in the selection criteria". Indeed, they point out that the low number of existing studies leads to "balance the requirements for a consistent definition of the effect-size estimates with an adequate number of degrees of freedom in the meta-regression".

In the context of developing countries, Lange and Jiddawi (2009) point out the lack of information about regulating and habitat services. In this sense, they state that additional biophysical research is needed to be able to estimate an economic value of these important services. On the other side, Oleson et al. (2015) state that they hope their empirical approach and methods for validation can contribute to better quantify bequest and other cultural ES on a global scale. However, according to them, more stated preference (SP) valuation studies on tangible and intangible cultural heritage should be undertaken to improve the use of the method and allow for comparisons. In terms of tangible heritage, they consider it would be also desirable to compare different valuation approaches.

The review of these studies has also allowed identifying some challenges. Barton (2002) points out one of them in the framework of benefit transfer (BT) approach. He states that, for the BT function "to pass from experiment to a standard toolkit", meta-analyses will be needed in order to get knowledge of the determinants of the value, thus ensuring it can be predicted in different settings. However, as the use of the BT function depends on the availability of socio-demographic census-type data, it could be difficult to apply it to

countries characterized by “infrequent census, high population growth and rapid socio-economic change”. Besides, the authors also show that similarity in socio-economic regression coefficients and population features is not enough to statistically justify value transfers. Indeed, sanitation and institutional factors are also important drivers of WTP variation within and between sites.

Another challenge has to do with the lack of spatially explicit non-market values for services provided by coastal and other ecosystems, as stated by Raheem et al. (2012). These authors suggest conducting original valuation studies in each spatially explicit area which will be affected by a given policy to get more accurate estimates. This is of special relevance in a context of high variability of values as evidenced by the existing literature. When conducting this type of studies is difficult or not possible, they recommend using replacement or avoided cost methods for some ES. However, the authors recognize both that accurately and spatially explicitly valuing ES is challenging, as coastal and marine ecosystems “are often interdependent at a scale beyond that managed by any one agency”, which makes it difficult to value the services they provide to society. Thus Raheem et al. (2012) recommend collaborating with natural scientists “to help economists refine their methods to reflect the ecological reality of any valuation scenario” as they belive “it is preferable to map and value ES at the level of ecological units rather than political units”.

In a developing country context, Lange and Jiddawi (2009) point out an important challenge. It has to do with the fact that promoting life-support activities related to coastal and marine ecosysems do not seem to be enough to reduce either poverty or pressure on natural resources as “they involve limited numbers of people and the potential increase in income is relatively small”. To overcome this challenge, the authors highlight the importance that these activities be part of a broader conservation strategy built on the principles of eco-tourism, which can create a higher number of jobs as well as generate important revenues. Another challenge in this context has to do, according to the authors, with the “fragmentation of decision-making and management” which they believe can be overcome through a “comprehensive economic valuation” which seeks for stakeholder involvement.

Also in the framework of low-income countries, Oleson et al. (2015) highlight another important challenge which has to do with the “potential issues of literacy, low scientific understanding and education, low local research capacity, spiritual and cultural nuances which outside researchers may have difficulty understanding, and potential issues gaining access to marginal groups”. Additionally, these authors state that measuring cultural ES is challenging and, despite their valuation can contribute to implement conservation strategies, there is still the risk they are not considered in the decision making.

Table 10. Papers concerning the valuation of services provided by coastal and marine ecosystems[a]

Papers	Study object	ES being valued (MEA category/ies)	Type of value/s (technique/s)	Outcomes
Earnhart (2001)	Estimation of both the aesthetic benefits generated by the presence and quality of land-based and water-based (Long Island Sound, marsh, river/stream, lake/pond) environmental amenities associated with residential locations in Fairfield, Connecticut, and the benefits derived from restoration of the coastal Pine Creek Marsh.	• Aesthetics (cultural)	• Non-consumptive direct use value (discrete-choice HA of RP data, choice-based conjoint analysis of SP data)	• Long Island Sound and rivers/streams generate benefits of $7,924 and $6,137, respectively, representing 3.2% and 2.5% of the median house price, which equals $245,000. • Restored marshes generate $40,578 in benefits and disturbed marshes generate negative benefits of $32,412, respresenting 16.6% and 13.2% of the median house price, respectively. (data collection discrete choice HA: sales of residential single-family dwellings contracted between 1994 and 1996/data collection choice-based conjoint analysis: 1996)
Policy implications • Results contribute to understand wetlands' benefits derived from their restoration and hence are useful for wetland management.				
Barton (2002)	Testing of the reliability of transferring WTP estimates of improvements in coastal water quality (seawater, river/estuarine water, and groundwater) between and within two urban areas along the Pacific Coast of Costa Rica (Jaco and Port of Puntarenas), in the context of an ECBA of centralised sewage treatment options.	• Drinking water/water quality • Swimming water/water quality (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value (CVM, BT)	• The mean WTP for improvements in coastal water quality for Jaco sample is ₡3,080, and for Port of Puntarenas pooled sample, ₡2,382 (truncated normal, only true zeros included). • No basis for the claim that the reliability of BT increases with proximity between the study and the policy sites. • The claim that transfer of WTP adjusted by the benefit function outperforms transfers of unadjusted or simple income-adjusted WTP is rejected. • Socio-economic site characteristics are not sufficient to explain site-specific differences in WTP. (1998₡)
Policy implications • All applied models are wrong to some degree, and what is at issue in a policy-context is the acceptability of the transfer error in each application. • The common statistical tests of transferability of model coefficients and predicted WTP may be viewed as strict by decision-makers as transfers with errors as low as 1.6% are rejected. • Acceptability depends on decision-makers' risk aversion, the relative uncertainty of policy costs, and the reduction in uncertainty over policy benefits relative to the study cost associated with conducting primary studies. However, most of this information can be collected on an experimental basis, but will be too time consuming and expensive for practical policy-making. • Benefit function transfer is limited by the available socio-demographic census-type data, which may be a problem for countries with infrequent census, high population growth and rapid socio-economic change. • Similar socio-demographic regression coefficients and broad similarities in the population characteristics are not enough to justify transfers on statistical grounds as sanitation, use and institutional factors are also important explanations of WTP variation within and between sites.			

Beaumont et al. (2008)	Investigation of the linkages between marine biodiversity and the provision of the service to place an indicative monetary value on each service where possible in UK.	• Nutrient cycling • Food provision • Raw materials • Gas and climate regulation • Disturbance prevention and alleviation • Cognitive values • Leisure and recreation (supporting, provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Existence value • Bequest value (market price method, avoidance costs, CVM, replacement costs)	• The monetary value for food provision is £513 million/year. • The monetary value for gas and climate regulation is £0.4-8.47 million/year. • The monetary value for cognitive values is £317 million/year. • The monetary value for leisure and recreation is £11.77 billion/year (billion=10^9). • Bequest and existence values are £0.5-1.1 billion (billion=10^9). • A decline in UK marine biodiversity could result in a varying and at present unpredictable change in the ES provision, including reduced resilience and resistance to change, declining marine environmental health, reduced fisheries potential, and loss of recreational opportunities. (2004£ for food provision, gas and climate regulation and existence and bequest values/2002£ for cognitive and leisure and recreation values)
Policy implications • An ES approach can facilitate biodiversity management by enabling the optimal allocation of limited management resources and raising awareness of the importance of marine biodiversity. • An ES approach provides a comprehensive and transferable framework for site specific assessment, enabling the costs and benefits of exploitative activity to be evaluated, facilitating the management and conservation process for marine biodiversity. • Understanding the value of marine biodiversity will be beneficial to support and influence future marine environmental policies.				
Lange and Jiddawi (2009)	Estimation of the value of marine ES in Zanzibar, linking of the values to the national income accounts, and quantification of how the benefits from each ES are distributed among five different stakeholder groups.	• Fishing • Seaweed farming • Mangrove harvesting • Tourism (provisioning and cultural)	• Consumptive direct use value • Non-consumptive direct use value (methods established by the World Tourism Organization to measure the economic value of tourism for national accounts and market prices)	• In thousand US$, the income generated by seaweed framing is US$1,616; by fishing, US$29,179; by mangrove harvesting, US$28; by recreation and tourism services, US$23,903. • Marine ES contribute 30% of GDP (figures would be even higher if the indirect ES were included). (data collection: 2007-2008)
Policy implications • Marine ES are undervalued, resulting in underinvestment in conservation and lost opportunities for economic growth and poverty reduction. • Economic valuation provides a powerful tool for sustainable development by showing how dependent the economy is on an ecosystem and what would be lost if the ecosystem is not protected.				

Liu et al. (2009)	Analysis of how German households value specific natural resources (coastal waters and beaches) protected by oil pollution combat strategies in the North Sea coast area of the state of Schleswig–Holstein.	• Recreational services • Eider ducks watching (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• Each unit (1 km) increase in the length of beaches prevented from oil spill has a marginal value of €0.13/household. • Each unit (1 km^2) increase in the surface of coastal waters prevented from oil spill has a marginal value of €0.10/household. • An increase of 1 bird prevented from oil pollution has a marginal value of €0.78x10^{-3}/household. • Up to 42% of respondents consider that tidal flats should be protected first from oil pollution. • Plants, beaches, birds and seals are given a priority for protection by only 18%, 14%, 13% and 13% of interviewees. (data collection: 2007)
Policy implications • Efficient contingency management in responding to oil spills is critically important. • Strategic priorities in contingency management depend on the importance attributed to different economic and ecological resources such as beaches or birds. • An oil spill combat process should focus on the protection of coastal waters, beaches and eider ducks. • Preferences elicited from CEs can be used in ECBA and MCA to help decision makers find optimal combat options. • Findings of a CE survey can constrain the weights of the importance between environmental resources used in the MCA.				
Liu and Wirtz (2010)	Evaluation of coastal waters and beaches in a context of a hypothetical oil accident at the German Bight.	• Recreational services • Eider ducks watching (cultural)	• Non-consumptive direct use value • Non-use value (CE)	• Each unit (1 km) increase in the length of beaches prevented from oil spill has a marginal value of €0.70/household. • Each unit (1 km^2) increase in the surface of coastal waters prevented from oil spill has a marginal value of €0.32/household. • An increase of 1 bird prevented from oil pollution has a marginal value of €6.92x10^{-3}/household. • Beach and eider ducks are of key concern for households. • Households with a lower number of children, higher monthly income and a membership of environmental organization are willing to pay more for oil spill combat options. (data collection: 2005)
Policy implications • Efficient contingency management responding to oil spills on waters, which aims at minimizing pollution effects on coastal resources, are critically important. • Such a decision making highly depends on the importance attributed to different coastal economic and ecological resources. • CEs can offer useful information for decision makers to consider coastal resources into a decision making process and can contribute to finding a cost-effective oil preventive measure. • CEs can also have a wide application potential in the field of ICZM.				

Raheem et al. (2012)[b]	Development of a matrix in which the rows are types of ES and the columns are types of marine ecosystems along the California coast, and where ES values per unit of area drawn from the economics literature are reported when possible. Whether the values for given services, in given ecosystems, could be reasonably approximated by applying the replacement cost or the avoided cost method is evaluated too.	• Habitat and refugia • Primary production • Water cycling • Capture fisheries • Wild plants and animals • Natural hazard regulation • Erosion regulation • Cultural heritage • Recreation and ecotourism (supporting, provisioning, regulating and cultural)	• Consumptive direct use value • Indirect use value • Non-consumptive direct use value • Non-use value (economics literature)	• The value per acre per year of provisioning services provided by estuaries is \$55-\$81 and \$26 for capture fisheries and wild plants and animals products, respectively. • The value of regulating services is \$278-332 for natural hazard regulation. • The value of cultural services is \$17 and \$8-346 for cultural heritage values and recreation and ecotourism, respectively (while these two values for beaches are \$27 and \$16,946, respectively). • The value of supporting services is \$77-415 for habitat and refugia. (matrix)
Policy implications • Better understanding of the total economic value of ecosystems can improve coastal policy and management decisions. • Given the variability of values reported in the literature, original valuation should be applied to each spatially explicit area affected by a given policy decision to obtain more accurate values. • Original research fulfills the requirements of standard guidance for ECBAs, which recommends the use of values obtained from a sample of people in a geographic area sufficiently extensive in such a way that the sample can adequately represent all salient stakeholders. • Although rigorous application of non-market values to policy decisions requires original valuation studies for specific services in specific ecosystems, where original, place-based valuation studies are not possible, valuation by replacement or avoided cost methods is feasible for some ES.				
Ghermandi and Nunes (2013)	Development of a comprehensive framework for the meta-analytical transfer of the value of recreational activities and its application to produce a global map of coastal recreation values (sandy beaches, coral reefs, mangroves, lagoons, coastal marshes, estuaries, and other coastal ecosystems).	• Recreational services (cultural)	• Non-consumptive direct use value (integration meta-analysis and GIS)	• The recreational values of the coastal ecosystems range between 0.13 I\$/ha/year and 59,533 I\$/ha/year. • The lowest values are found at high absolute latitudes (Arctic Circle, North of Canada, East Russia, South of Chile and Patagonia). • The highest values are located in correspondence of large cities (Los Angeles, Caracas, Rio de Janeiro, Abidjan, Hong Kong, Taipei, Tokyo, and Sydney), particularly in the Mediterranean (Rome, Naples, Marseille, and Barcelona) and Florida (Miami, Orlando, and Tampa), as well as in several tropical islands (Canary Islands, Puerto Rico, and Andaman Islands). (I\$2003)[c]

Policy implications • The developed meta-analytical framework built upon a GIS, which allows for the exploration of the spatial dimension of the valued ecosystems, including the role of spatial heterogeneity of the selected meta-regression variables as well as the spatial profile of the transferred values, leads to the first global map of the values of coastal recreation. • The study contributes to the emerging field of spatial economic valuation of ES by fully integrating GIS tools and geo-referenced information in the meta-analytical model. • Sustainable management strategies for coastal tourism and recreation require a thorough assessment of their value in the relevant policy context. • Value transfer techniques are an attractive option for policy-makers facing time and budget constraints in the absence of reliable primary valuations. • Estimates can help identify weaker and stronger determinants of recreational value within each spatial dimension, thus allowing setting priorities for the conservation of coastal areas and complementing other existing classification schemes for marine coastal areas where a social economic dimension is typically absent.				
Norton and Hynes (2014)	Estimation of the value of the non-market benefits associated with the achievement of marine GES as specified in the EU Marine Strategy Framework Directive (MSFD).	• Degradation of marine waters/biodiversity and healthy marine ecosystem; sustainable fisheries; pollution levels in the sea; non-native species; physical impacts to the sea	• Non-use values (CE)	• The estimated compensating surplus per person varies between €99.31 for the low degradation scenario and €217.77 for the high level of degradation scenario. • The aggregated compensating surplus ranges between €343 million for the low degradation scenario to €749 million for the high degradation scenario per year. • Changing from a decrease in pollution to an increase in pollution results in a marginal cost of €74.37/person/year, and changing from sustainable and healthy fisheries to unsustainable and unhealthy fisheries results in a marginal cost of €73.04. • Preferences are heterogeneous. (data collection: 2012)
Policy implications • Highly valued marine programs by the Irish public are those that target pollution and ensure that fisheries are both sustainable and safe to eat. • The next highest change in welfare derives from policies aimed at reducing physical impacts to the marine waters including those from marine construction and drilling. • Passing from sustainable and safe-to-eat seafood to unsustainable but safe-to-eat seafood causes a higher welfare impact changes related to biodiversity and prevention of new invasive species. • Assessing the costs of degradation as defined by the MSFD implies that changes in marine ES provided in each State should be analysed. • This study is the first attempt to undertake an ecosystem management approach to protect and maintain the marine environment while ensuring that marine-based activities are sustainable. • The non-use value associated with the achievement of GES has to be assessed in conjunction with how the MFSD will affect the provision of ES before policy makers can make any marine planning decisions aimed at achieving the MFSD objectives. • The number of exemptions to implementing measures to reach GES based on disproportionate costs may be low if non-use values compose a significant portion of the GES total economic value.				
Oleson et al. (2015)	Determination of indigenous fishers' preferences and WTP for bequest gains from management actions in a locally managed marine area in	• Commercial fisheries • Shoreline protection of coral reefs and mangroves	• Consumptive direct use value • Indirect use value • Non-consumptive	• The mean individual WTP for 1 additional generation to live as Vezo is about MGA24,000/spring tide, and that to move from 1 additional generation living as Vezo to 5 future generations living as Vezo is about MGA57,000/spring tide. • The mean individual WTP to move from a situation where only 2 people per village are attending intervillage meetings to a situation where 6 people per village are attending is about

	Madagascar, and use of the results to estimate an implicit discount rate.	• Cultural social cohesion (provisioning, regulating and cultural)	direct use value • Bequest value (CE)	MGA15,000/spring tide. • The mean WTP to increase shoreline protection to a point where homes would only need to be rebuilt at minimum every 5 years vs. the status quo of every 3 years is also about MGA15,000/spring tide. • For commercial fisheries, the mean WTP to move from an expected baseline average income of MGA60,000 to 70,000 and 80,000/spring tide from year 2 through year 10 after implementing the hypothetical scenario is about MGA6,000 and 14,000, respectively. • Bequest emerges as the highest priority, even when respondents are forced to make trade-offs among other livelihood-supporting ES. (2010MGA)

Policy implications

- Results show the overwhelming importance of cultural bequest in comparison to other direct and indirect use ES, suggesting management actions that entail short-term sacrifices to improve ecological structures and functions may be more acceptable to the local community than previous research suggests.
- Information on the value of bequest in comparison to other ES benefits can play a crucial role in resource policy and management, and can be leveraged to help ensure long-term ecological and socio-cultural sustainability as well as improve livelihoods (e.g., by encouraging resource stewardship).

[a] Key: BT, benefit transfer; CE, choice experiment; CVM, contingent valuation method; ECBA, environmental cost-benefit analysis; ES, ecosystem service/s; GES, good ecological status; GIS, geographic information system; HA, hedonic analysis; ICZM, integrated coastal zone management; MCA, multicriteria analysis; WTP, willingness-to-pay..
[b] The authors state that supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2012.01.005.
[c] International dollars.

4. CONCLUSIONS

This report has aimed to provide, through an extensive review of the literature, a comprehensive overview of the current (2015) knowledge base regarding the valuation of services provided by coastal and marine ecosystems, in an attempt to consider the scope for economic valuation to play in the better management of these resources. In this sense, it has shown that, over the last 16 years, valuation researchers have been particularly interested in contributing to the management of beaches, coastal waters, marine protected areas (MPA) and wetlands. However, if one takes into account that half of the MPA studies focus on protection of coral reefs due to their features of uniqueness and national importance, it can be said that the interest of valuation researchers in contributing to reef management is not negligible either. In other words, protection of coral reefs through establishment of either MPAs or other conservation tools also seems to attract the attention of researchers.

In the context of coastal ecosystems, and unlike wetland valuation, it is worth noting that 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. 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. Although the number of studies focusing on this type of ecosystem is not high, it is expected it will increase in the next years if economic valuation is 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. Indeed, the majority of papers focusing on services offered by coastal waters, coral reefs and MPAs have been published during the last decade. 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 ecosystem service provision, and hence the difficulty of their valuation.

The growing interest in valuing services provided by coastal and marine ecosystems can be explained by the need for designing local and national policies aimed at preserving these resources in a context of continuous environmental pressures which are expected to be intensified by global warming. In this framework, and by contributing to the assessment of trade-offs in marine and coastal environments, economic valuation can help to increase efficiency of coastal and marine decision-making processes.

In this sense, this report has shown that many management settings can greatly benefit from the information contained in willingness-to-pay (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. 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. In this context, economic valuation can 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.

The role of economic valuation in coastal and marine decision-making processes is especially relevant in a context in which both member states are required to follow the guidelines set by the EU water policy in order to achieve certain quality standards and environmental policies increasingly call for a balancing of the benefits and costs of regulations. In fact, valuation has been proved to play an important role in the implementation of European legislation. Indeed, 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 as well as on the potential disproportionality of some of them. 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" (Brander et al., 2013). On the other side, 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. A contribution to the implementation of the Marine Spatial Framework Directive (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.

In a developing country context, the contribution of economic valuation to coastal and marine management has also been shown to be of great interest for decision makers. Indeed, in many low income economies coastal and marine resources provide important life-support services to local communities. 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 ecosystem

can contribute to reducing poverty (Lange and Jiddawi, 2009). 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 ensure long-term ecological and socio-cultural sustainability as well as improve livelihoods through, for instance, encouraging resource stewardship (Oleson et al., 2015).

In other cases, results from valuation studies can give guidance on whether local communities should continue with damaging extractive resource uses or, in contrast, should pursue their protection through different conservation practices. In this context, valuation can help to design compensation mechanisms, such as Payment for Ecosystem Services, for local communities to contribute to a more sustainable use of coastal and marine resources and/or motivate locals to attract nature-based tourists as a way to capture greater benefits from the management of their resources (Barr and Mourato, 2009; Shrestha et al., 2002). Importantly, valuation can also increase awareness of the value of local resources, which is crucial to ensure their sustainability.

Both in developing and developed country settings, economic valuation 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" (Grabowski et al., 2012). To this aim, researchers have mainly focused on valuing cultural services provided by coastal and marine ecosystems. This is especially true for papers focusing on services offered by beaches and other coastal areas, inland and transitional waters, coastal waters, coral reefs and MPAs, where the recreational opportunities provided by these ecosystems have been the type of service capturing a major attention among researchers. Exceptions are the papers around valuation of wetland and deep-sea services, which have mostly centered on regulating, provisioning and supporting ecosystem services (ES). Indeed, wetlands and mangroves are especially valued by their regulating functions and, when it comes to developing countries, these ecosystems represent an important source of life for many local communities. On the other side, the links between deep-sea species and direct benefits to society have only been successfully shown to date for the fishing sector (Jobstvogt et al., 2014a). This fact, together with the high importance attributed to the services provided by deep-sea biodiversity, makes provisioning and supporting services proper objects of valuation.

In this context, studies have shown that the high recreational benefits associated with coastal and marine ecosystems as well as the positive correlation between these values and the environmental quality can provide an economic justification for implementing

conservation strategies. 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. But even more importantly, the studies show that the economic justification can be sounder if the non-use values recreationists usually attach to the cultural services provided by coastal and marine ecosystems are also considered. In fact, valuation papers give evidence not only that resource users normally assign a mix of use and non-use values to ES but also that non-users show a high, positive WTP for coastal and marine ecosystem protection. In this context, estimation of option, existence, bequest, cognitive and cultural values and its inclusion in policy assessments is considered essential for the sustainable management of coastal and marine ecosystems. Accordingly, and due to their multidimensionality, the estimation of non-use values is viewed as a priority area for further research for economic valuation to better contribute to preserve coastal and marine resources.

Many other research areas for future work can also help to increase the use and influence of economic valuation in coastal and marine decision-making. In this sense, it is especially of concern the need to undertake more primary and high-quality valuation studies to raise the possibilities of using better benefit transfer (BT) approaches and hence better respond to the growing political demand of ES values. To date, few studies have undertaken meta-analyses and applied BT approaches, the majority in the context of wetland valuation. A larger sample of available site-specific studies would increase the accuracy and applicability of meta-analysis results and improve the reliability of the welfare estimates (Ahtiainen and Vanhatalo, 2012). Future meta-analyses should include relevant socio-economic information as well as spatially-defined context variables to better represent the determinants of ES values (Brander et al., 2012b). Working on these areas can help to increase the accuracy of the prediction of values based on previous studies. It is then of interest of valuation researchers to move their attention towards these issues to enhance the role of BT methods, and consequently, of economic valuation, in coastal and marine decision making. Indeed, BT can allow overcoming 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 WFD on member states to develop integrated river basin management plans (Hanley et al., 2006; Loomis, 2006).

Intra-disciplinary cooperation not only across researchers but also across countries is relevant for increasing the use of valuation in coastal and marine decision-making too. Indeed, if researchers from different states cooperate to provide more precise and comparable descriptions of the valuation scenarios, meta-analyses can greatly benefit from this. On the other side, if researchers replicate, in their own countries, studies about EU-wide environmental damages, this can also enhance the role of valuation in the

management of these specific problems. It can even serve as “an incentive for institutional innovations in the EU governance based on the design of supranational common environmental policies aimed at collecting damage claims” (Loureiro and Loomis, 2013).

Another relevant area for further enhancing the influence of valuation studies in coastal and marine decision-making is inter-disciplinary work with natural scientists. Ecological knowledge can help us to model the specific threats faced by coastal and marine ecosystems as well as provide information about biophysical factors such as representativeness and connectivity which are essential to identify areas of protection in efficient conservation planning (Brander et al., 2012b; Turpie et al., 2003). In addition, it can increase the ecological understanding of the co-provision or conflicting provision of different ES, which is essential to understand how ES are generated by biophysical functions and processes (Brander et al., 2013). It is also crucial to have information about existing environmental uncertainties over future impacts to examine how this information can affect the values of coastal and marine ecosystem protection.

Consequently, collaborating with natural scientists can contribute to a better measurement of the economic values associated with the multiple, interdependent services provided by coastal and marine ecosystems. On a separate note, it can help economists refine their methods to reflect the ecological reality of any valuation scenario. Indeed, it is preferable to map and value ES at the level of ecological units rather than political units (Raheem et al., 2012). Besides, more scientific knowledge about the ecological consequences of marginal or severe biodiversity loss can increase understanding about the welfare implications of this loss (Ressurreição et al., 2011). In this sense, network research can help to define feasible approaches to estimate the value of marine biodiversity. Scientific knowledge can also increase public awareness regarding the benefits of deep-sea protection.

On the other side, economic analysis can valuably contribute to conservation science by giving evidence of the social demand for biodiversity protection which, in turn, reinforces scientific support for conservation (Ressurreição et al., 2012). 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 (Ruiz-Frau et al., 2013).

Collaborative work between scientists and economists is then critical to adopt an integrated natural and social science approach which is necessary not only to ensure the sustainability of coastal and marine ecosystems but also to increase the acceptance among the scientific community of the role of economic valuation in decision-making.

Exploring the potential of economic valuation to complement alternative decision-making approaches based on more participatory and deliberative processes is also essential to increase the influence of economic valuation on coastal and marine ecosystem management. 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 (Kenter et al., 2015; NEA, 2014). Also, despite it providing a valuable framework for interpreting biophysical findings of environmental impact assessments in economic welfare terms (Gunawardena and Rowan, 2005), its single-criterion approach falls short when significant environmental and social impacts cannot be assigned monetary values. Likewise, public participation in ecosystem decision-making processes, which is viewed as crucial to ensure broad support for the implementation of management strategies (Abelson et al., 2001), is also beyond the scope of economic valuation. In this context, participatory approaches are viewed as valuable contributions to the success of implementation of policies given involvement of the stakeholders across all sectors is a key part of the social process by which these methods structure and conduct the analysis (Lepetu, 2012; MCA, 2009). In fact, the EU Marine Spatial Planning Directive requires the member states to seek the input of stakeholders to design policies allowing for the equitable allocation of space and resources in the coastal zone. Specifically, it requires EU countries to implement strategies following the principles and elements of Integrated Coastal Zone Management. Thus, examining the possibilities of economic valuation to complement, rather than substitute, more participatory approaches to coastal and marine ecosystem governance can be a way to increase the validity of the method and hence its influence in decision-making.

It is also of special interest in a developing country context, where many local communities might be unfamiliar with paying for the resource usage, to modify the design and procedure of valuations to better suit the context of community relationships and kinship (Zander and Straton, 2010).

Despite this, it is worth noting that important challenges still remain for the method. In this sense, it is of special concern the challenge related to understanding and conserving marine biodiversity, which represents “one of the most pressing challenges of the next decades and a strategic subject in the EU political arena” (Ressurreição et al., 2012). The lack of information and knowledge regarding the benefits of deep-sea protection constitutes the second biggest challenge (Aanesen et al., 2015; Jobstvogt et al., 2014a). Network research and outreach and education campaigns can help to overcome these challenges as they can play a role in creating a larger WTP, thus enhancing the influence of valuation on policy assessments. They can also contribute, together with a major participation of governments, to overcome the major challenges faced by valuation 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.

Thus, cooperation across the different actors involved in the management of coastal and marine ecosystems becomes, again, a key issue to overcome the major economic valuation challenges.

In fact, beyond enhancing the use and influence of economic valuation in the complex process of coastal and marine ecosystem management, the interest in cooperation should be driven by the need to give a voice to all the actors involved in the process to make coastal and marine governance much more democratic. Thus, exploring the possibilities for cooperation and collaboration across all the economic and social agents, as well as claiming for poverty elimination and legal recognition of the rights of many local communities, should be of high priority for the scientific community if coastal and marine ecosystems are to be sustainably managed. Hopefully, the contents of this survey paper can shed some light on identifying areas for further collaborative action.

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BT	Benefit Transfer
CB	Contingent Behavior
CC	Climate Change
CE	Choice Experiment
CHU	Critical Habitat Unit
CVM	Contingent Valuation Method
CWC	Cold Water Coral
ECBA	Environmental Cost-Benefit Analysis
EIA	Environmental Impact Assessment
ES	Ecosystem Service/s
EU	European Union
EV	Economic Valuation
GES	Good Ecological Status
GIS	Geographic Information System
HA	Hedonic Analysis
HMMR	Hotel Managed Marine Reserve
ICZM	Integrated Coastal Zone Management
MCA	Multicriteria Analysis
MCZ	Marine Conservation Zone
MEA	Millenium Ecosystem Assessment
MPA	Marine Protected Areas
MSFD	Marine Strategy Framework Directive
MSP	Marine Spatial Planning
NEP	New Environmental Paradigm
NOEP	National Ocean Economics Program
PES	Payment for Ecosystem Services
RP	Revealed Preference
SMS	Safe Minimum Standard
SP	Stated Preference
TCM	Travel Cost Method
WFD	Water Framework Directive
WTP	Willingness-to-Pay