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Review

Valuation of natural marine ecosystems: an economic perspective

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ABSTRACT

This paper attempts to examine whether information from valuation studies can help the design of policies adequate to reverse and halt the generally poor state of marine and coastal ecosystems of the Mediterranean and the Black Sea. Economic implications of managing coastal and marine environments are thus discussed by assessing the results of different valuation studies implemented in the area. Lessons and policy recommendations from existing literature are inferred to guide marine resources management decisions. One of our main findings is that there are extremely few published studies within the Mediterranean and Black Sea region which highlights the potential for future research on coastal and marine ecosystems ability to sustain different goods and services as a result of climate change and anthropogenic drivers in the area. However, results reveal that there are substantial positive economic values attached to marketed and non-marketed services provided by marine and coastal ecosystems that justify their sustainable use and management.

1. Introduction

Coastal and marine ecosystems provide a variety of ecological functions that directly or indirectly translate to economic services and values to humans (MEA, 2003; Eggert and Olsson, 2009; Hanley et al., 2003; Freeman, 1995). They support fish populations that constitute a significant source of protein, sustain ecosystem stability through conservation of biodiversity and mitigation of climate change through carbon sequestration, act as sinks for byproducts of industrial or agricultural production and provide recreational and aesthetic benefits. Marine and coastal natural resources are, for the most part, renewable. If properly managed, they should provide continuing returns into the future without diminishing their productivity. Yet, for many of these resources, including those of importance to industries such as fishing and tourism, efficient management and sustainable exploitation have been the exception rather than the rule. Resources have been depleted and have collapsed due to human pressures and climate change (IPCC, 2007; ESF, 2007), with economic and social consequences for humans.

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For the Mediterranean and Black Sea the problem is particularly prominent. The semi-enclosed basin nature of these seas makes them susceptible to excessive degradation resulting from a combination of anthropogenic and natural pressures (BSC, 2009; EEA, 2000). Nutrient enrichment from agricultural, domestic and industrial sources, pollution from insufficiently treated sewage and oil discharges from shipping operations, and uncontrolled fishing activities for the past several decades, have caused severe problems regarding water quality and have made the Mediterranean and Black Sea very sensitive ecosystems aiding the massive invasion of alien species. The introduction of harmful exotic species, through the deballasting of vessels, significantly threatens the biological diversity and productivity of the marine ecosystems in both Seas. Further, pollution and rising temperatures have favored epidemiological outbreaks constituting a threat to public health and consequently posing a barrier to the development of sustainable tourism.

Securing marine reserves is currently at the core of European policy making as highlighted in the recently adopted Green Paper by the Commission (COM, 2006) which defines a European Marine Strategy to achieve good status of the EU's marine environment by 2021. The document stresses that unless prompt action is undertaken, we will soon be unable to manage the increasing, and often conflicting, uses of the oceans. The need for an integrated approach to marine resources management has thus become increasingly evident. To design and implement efficient social and economic policies and institutional arrangements that prevent the excessive degradation and depletion of marine resources, it is necessary to establish their full value, and to incorporate this into private and public decision-making processes (Birol et al., 2006). A variety of valuation techniques to capture the full value of environmental resources have been developed over the years and are generally classified as revealed preference techniques and stated preference techniques. Consequently, in recent years a number of empirical studies have appeared worldwide employing valuation techniques to elicit monetary values for marine and coastal ecosystem benefits.

This paper highlights the importance of economic analysis in guiding efficient, sustainable and equitable coastal and marine resources management for Southern European Seas[1] and reviews the existing literature on valuation studies implemented in the area under investigation. The paper is structured as follows: Section 2 summarizes the Millennium Ecosystem Assessment approach (MEA, 2003) to ecosystem goods and services (EGS) provided by marine and coastal ecosystems. Section 3 attempts the disaggregation of the total economic value of coastal and marine ecosystems and presents different valuation techniques to capture it. A review of marine resources related valuation studies implemented in countries bordering the Mediterranean and the Black Sea follows in Section 4. Section 5 addresses the limitations of the existing literature and proposes future research directions while Section 6 discusses implications for policy. Finally, Section 7 concludes.

[1] Southern European Seas (SES) encompass the Mediterranean and the Black Sea.

2. Coastal and marine ecosystem services

The present paper adopts the framework of Millennium Ecosystem Assessment as a baseline for the classification of Southern European marine and coastal ecosystems as well as the respective provisioning of ecosystem goods and services. The Millennium Ecosystem Assessment (MEA, 2003) is a first attempt to fully interpret, understand and assess the interrelation between ecosystems and human well-being at a global scale. According to the MEA, the ecosystem goods and services from which people benefit can be grouped into four categories: *provisioning*, *regulating*, *cultural* and *supporting services*. *Provisioning services* are physical goods obtained from ecosystems. They include *inter alia* food, fish stocks, timber and genetic resources. *Cultural services* are the nonmaterial benefits that people obtain from the ecosystem through aesthetic experience, reflection, recreation and spiritual enrichment. *Regulating services* include benefits obtained from the regulation of ecosystem processes, including water quality regulation, and climate regulation. *Supporting services* are those that are necessary for the production of all other ecosystem services, for example photosynthesis, primary production, nutrient cycling and provisioning of habitat. Given clearly defined EGS categories, we can identify different services subcategories for each specific ecosystem, map the respective links to human well-being, and provide appropriate economic analysis for the market and non-market values of EGS at European scale. In the present paper, we restrict our emphasis on the Southern European Seas, for which we provide a clearly defined classification of ecosystem goods and services in Table 1.

3. An economic classification of coastal and marine values

Identifying and quantifying (marine and coastal) ecosystem services is not as yet a straight-forward task (Beaumont et al., 2007). On the one hand, data availability varies considerably between 'visible' (e.g. food provision) to less 'visible' but more fundamental services (e.g. climate stabilization). On the other hand, scientific modelling of ecosystem functions is not yet tailored to deliver policy usable indicators for the corresponding level of service provision. At the same time, many of the goods and services associated with coastal and marine reserves, identified in the previous section, are non-marketed. This means that the monetary valuation of the social benefit of using or sustaining these goods and services, is not straight-forward to be measured, although they could amount to significant social values. Likewise, environmental benefits are rarely considered in private investment and economic policy analysis. To address this challenge, environmental economists have developed various methods to value environmental costs and benefits in monetary terms.

Monetary value assessment allows benefit–cost-analysis (CBA) for policy guidance and thus ranking of alternative prevention, restoration and amelioration policy options. In addition, monetary valuation allows economists to perform environmental accounting to assess marine natural resource

Table 1 – A general classification of ecosystem goods and services of marine ecosystems.

Types of ecosystem services	Examples
Provisioning services	Food provision, raw materials, fisheries, etc.
Regulating services	Gas and climate regulation, water regulation, flood and storm protection, bioremediation of waste, etc.
Cultural services	Recreation and ecotourism, aesthetic values, spiritual and religious values, cultural heritage values, etc.
Over-arching support services	Resilience and resistance, biologically mediated habitat, nutrient cycling

Source: Drawn from MEA (2003) and adjusted for marine environment based on Beaumont et al. (2007).

damage assessment, and to carry out proper pricing of marine living resources (Derrin and Gartside, 2001; Skourtos et al., 2005). It follows that the identification of the total economic value (TEV), that is, the sum of all economic values that result from an environmental resource is critical in determining whether an environmental resource management project or policy will pass the CBA test and will thus be implemented.

The total economic value can be defined in terms of the use value (UV) (Bateman et al., 2002) and non-use value (NUV) (Krutilla, 1967; Smith, 1987; Cameron, 1992) of the resource under evaluation. The use value component refers to the set of benefits individuals derive from using the resources while non-use values reflect the values individuals attach to an environmental resource even if they themselves do not use it. Use values can be further divided into direct use, indirect use, and option use value, respectively DUV, IUV and OUV. Direct use values of coastal and marine ecosystems include: (a) marine, tourism and coastal recreation benefits; (b) natural and cultured marine species with commercial value. Indirect use values refer to benefits that relate to the functioning of the marine ecosystem and the survival of marine living resources, even if these have no direct commercial value. Option value recognises that individuals who do not presently use a resource may still value the option of using it in the future. Finally, non-use values can be divided into bequest values (BV) and existence values (EV). Bequest value refers to the benefit accruing to any individual from the knowledge that future generations might benefit from a marine ecosystem (McConnell, 1983; Turner et al., 1994). Existence value refers to the benefit derived simply from the knowledge that marine ecosystems are protected without even being used (Edwards, 1992; Larson, 1993; Spash and Simpson, 1993; Whitehead and Blomquist, 1991). This leads to the following equation:

$$TEV = UV + NUV = (DUV + IUV + OUV) + (BV + EV)$$

In Fig. 1, a widely accepted classification of the economic values of marine and coastal ecosystems is presented.

Various economic methods have been developed to capture the TEV of environmental resources. Market valuation methods are used to estimate the direct use value of marine and coastal ecosystems. These methods use observations of market prices to estimate the economic value related to

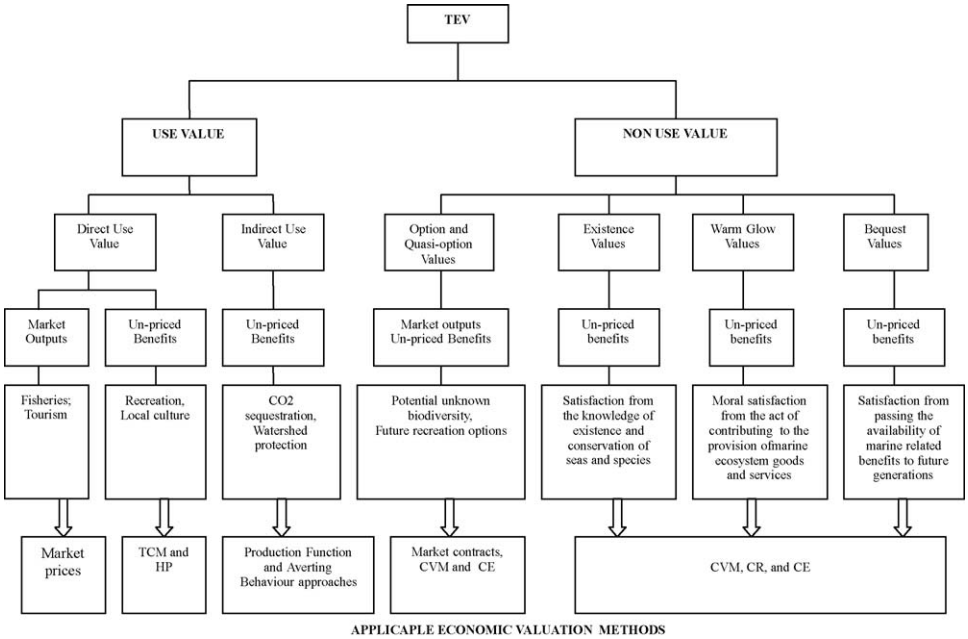
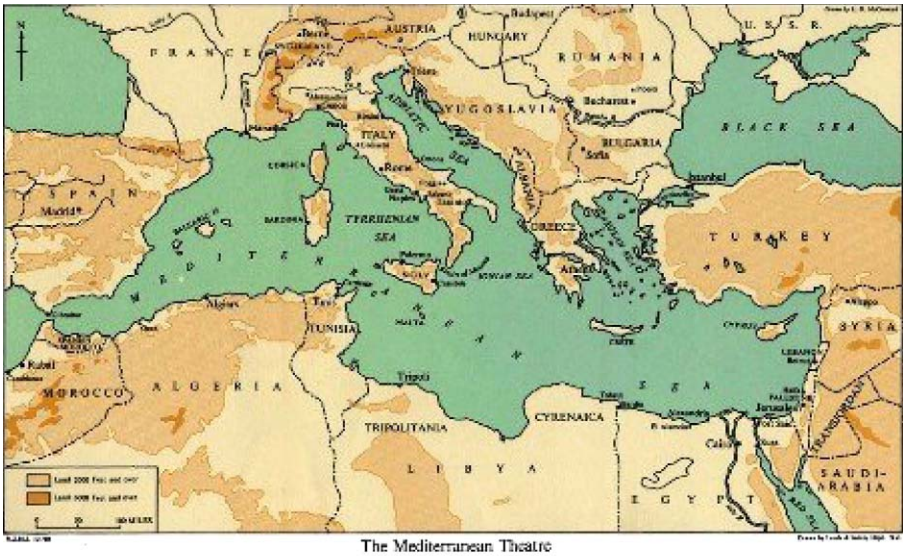


Fig. 1 – Category of the total economic value (TEV) of coastal and marine ecosystems and respective valuation methods. *Source*: Modified from Pearce and Moran (1994).



The Mediterranean Theatre

MEDITERRANEAN SEA
Albania, Algeria, Bosnia/Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Monaco, Morocco, Slovenia, Spain, Syria, Tunisia, Turkey.

BLACK SEA
Bulgaria, Georgia, Romania Russian Federation, Turkey and Ukraine

Fig. 2 – Countries bordering the Mediterranean and the Black Seas.

the use of the related products. Non-market valuation methods are used to estimate non-use values and some direct use values, which can be defined as un-priced benefits from coastal and marine ecosystems because they are not commonly traded in the market. In particular, the direct use values not traded in marketplaces can refer to non-consumptive recreation and ecotourism, aesthetic values, and cultural values. Non-market valuation techniques can be grouped in two main categories, namely, revealed preference and stated preference approaches. The first take into account observable market information which can be adjusted and used for revealing the individual's preference and thus quantifying the associated welfare benefits. They include Travel Cost Method (TCM), Hedonic Price approach (HP) and Averting Behavior approach (see Braden and Kolstad, 1991). The common underlying feature is a functional dependency of environmental benefits on the consumption of a specific market good (weak substitutability).

The stated preference approach includes the Contingent Valuation Method (CVM) and Choice Experiments (CE). These are survey-based methodologies using constructed or hypothetical markets, in which respondents are asked to state their willingness to pay to enjoy and/or protect the resource (Mitchell and Carson, 1989). The use of questionnaires requires economists to work closely with experts from market and survey research, sociology and psychology in order to guarantee the authority of the stated choice methods as a valid instrument to assess economic value of an environmental benefit (Arrow et al., 1993). The respective differences between the two methodologies relate to the way in which the economic values are elicited. In a contingent valuation questionnaire respondents are asked about their maximum willingness to pay, while in a choice experiment questionnaire respondents are presented with a set of choices and are asked to choose their most preferred. Stated preference methods have the advantage to be able to identify and measure passive or non-use values of EGS.

4. Non-market valuation studies in Mediterranean and Black Sea

This section reviews case studies performed in the Mediterranean and Black Sea region (illustrated in Fig. 2) which apply the valuation approaches described in the previous section and infers their main findings and policy implications. Existing databases were thus consulted while other sources including books and journal were also investigated to identify valuation studies that address: (a) the management of marine environments in order to sustain selected goods and services, and (b) the economic valuation of relevant recovery/policy actions (such as halting the loss of biodiversity, improving management of critical habitats, reducing water contamination caused by nitrogen and phosphorus loading. A table summarizing each study's main features (that is author, motivation, environmental technique implemented and the valuation result) is found in Appendix A. All valuations have been converted to 2008 euros.

4.1. *Review of case studies*

For Mediterranean and Black sea countries marine and coastal ecosystems are extremely significant. States that surround these seas (see Fig. 2) use these ecosystems for fish harvesting, as well as for recreational and aesthetic purposes, which attract tourism. The Mediterranean bases a large part of its

economic activity on tourism which accounts for the one third of international tourism activity (EEA, 2000). Tourism is also highly acknowledged to have scope for economic growth in the Black Sea (BSC, 2009). Further, cultural values are also present due to the maritime civilization developed in these regions.

To examine the foundations of tourist preferences Alberini et al. (2004) administered a contingent valuation questionnaire, with dichotomous choice questions in a referendum format, to elicit willingness to pay for a hypothetical project that would improve infrastructure on the island of S. Erasmo (in the Venice Lagoon) to help control erosion, improve beach quality, refurbish sewage and water pipes, and restore a cultural monument. The authors obtained usable data from 1330 phone surveys of a random sample of families in the Veneto Region of Italy, stratified by distance from the Lagoon of Venice. Both users and non-users of the Venice Lagoon and S. Erasmo were surveyed, enabling the estimation of mean and median use and non-use values for the project. The non-use portion of mean willingness to pay is €36, and the values for users and potential users are €56 and €35, respectively.

Studying tourist preferences, Vici et al. (2006) apply a choice experiment to assess a set of characteristics which are likely to influence the tourist evaluation of Rimini, a popular Italian resort, as a holiday destination. Overcrowding is particularly marked in Rimini, especially during weekends calling for a redefinition of Rimini's tourist supply. The attributes considered are the aversion to overcrowding in the seaside location, the preference for pedestrian areas near the main attractions, different impacts on an uncontaminated beach, the types of sea and cultural holiday bundles, the possibility to use the beach for night cultural events, and the cost per night per person in a full board accommodation in double room in a three star hotel. This study was carried out on a sample of about 600 tourists interviewed during their summer holidays in Rimini. Results imply that Italian, foreign and young tourists, while calling for more recreational activities and access to the main tourist promenade, are fundamentally indifferent to other issues, such as the sustainability of the environment and, in particular, of the beach. In particular, authors report that individuals are willing to pay €114 (daily cost per person per night) for the possibility to make use of the beach during the night and €79.85 for the exclusion of vehicles from the promenade.

In a similar study, Brau and Cao (2006) carried out a choice experiment on a sample of tourists on completion of their holiday in the island of Sardinia (Italy) to examine the feasibility of implementing sustainable tourism policies. The particular focus is on how tourist preferences are differentially affected by high or low degrees of accessibility to the tourist attraction, by the existence of protected areas in the vicinity of the accommodation, by the quality of the natural resources as well as by the overcrowding of tourist destinations. Data were collected by means of personal interviews in three major airports of Sardinia and as a basic scenario for carrying out the Choice Experiments, tourists had to choose between various alternatives for a week's holiday. Results reveal that tourists appreciate most the lack of overcrowding and high levels of accessory recreational facilities. Environmental quality is also found to be an important determinant of destination choice. Tourists were willing to pay €40.01 for proximity of the lodging to the sea, €56.83 to avoid the risk of overcrowding and €50.13 for the option of existence of a protected natural area in the surroundings.

The aforementioned valuation studies highlight the existence of substantial values associated with tourist activity in the SES. Nevertheless, human pressures and climate change threaten the marine and coastal ecosystems stability, reducing their capacity to provide key goods and services with high social importance. A number of valuation studies have been conducted over the past decades to capture the social cost associated with the reduction of ecosystems ability to provide goods and services as well as the potential social gains from the design and implementation of efficient restoration policies.

Among the most serious threats to Mediterranean and Black Sea marine and coastal ecosystems is pollution from urban and industrial waste as well as from agricultural runoff, and especially nutrient enrichment, particularly with nitrates and phosphates leading to eutrophication. Eutrophication manifested as decreased water transparency and disproportionate growth of filamentous algae and aquatic plants can affect people's health directly while causing losses to fisheries and recreational activities. The Black Sea is generally in a poorer state than the Mediterranean because modern environmental policies have not been sufficiently introduced, adopted or implemented across the EECCA region. Valuation studies have attributed significant economic benefits to improving the state (through implementation of proper abatement technologies) of eutrophied marine and coastal zones in the area.

Knowler et al. (1997) estimate the effects of pollution abatement on open access fisheries, by developing a bioeconomic model of the Black Sea anchovy fishery which incorporates habitat quality approximated by ambient nutrient levels. In the calculated long run equilibrium of the model, the stock of the anchovy is 290 000 tones while 80 fishing vessels and an annual harvest of 70 000 tones are supported. The harvest is estimated to generate revenues of €12.57 million. They also report that the effect (to the steady state values) of reducing phosphorous loads by one unit is an increase of 14 500 tones in annual harvest, while 17 extra fishing vessels are supported. The increased harvest is estimated to generate €2.57 million annually.

Machado and Mourato (1998) use contingent valuation (CV) and contingent ranking (CR) methods to assess the welfare benefits from a reduction in health risks associated with recreating in polluted marine waters. Lisbon residents using the beaches along the Estoril coast were randomly selected and asked to choose a value that best represented their willingness to avoid several symptoms associated with swimming in polluted water. The contingent ranking (CR) model estimated the recreational/amenity use value per visit at €16.114 for moving from a bad to a good quality beach, and €6.856 for moving from average to good quality beaches. The mean expected WTP to avoid an episode of gastroenteritis for the CR sample was €7.69.

Kontogianni et al. (2003) carried out a contingent valuation study to estimate the willingness to pay (WTP) to make a partially operational wastewater treatment plant on Thermaikos Bay, adjacent to Thessaloniki, Greece fully operational. This would reduce wastewater pollution entering the Bay. Residents and visitors to Thessaloniki responded to questionnaires in face-to-face interviews and results indicated a mean willingness to pay of €15.23 per four-monthly water bill, for 5 years. The highest WTP amounts were given for environmental and moral reasons and for future generations.

Göksen et al. (2002) explore the impact of geographical proximity of environmental problems on environmental concern and willingness to pay (WTP) for environmental improvements, with emphasis on the relevance of Inglehart's postmaterialism thesis on this inquiry. The study uses WTP as revealed through a contingent valuation survey as a measure of individual's propensity to act in response to three distinct environmental issues: Sea pollution in Istanbul (local issue), soil erosion in Turkey (national issue), and ozone depletion (global issue). A questionnaire was administered to 1565 respondents in Istanbul with the sample being separated into three subsamples, each presented with only one issue. A binary discrete choice format was chosen as the elicitation method and a onetime single payment as the payment vehicle. Results indicate that respondents are willing to pay lesser amounts as we move from the local environmental problem to national and global environmental problems. When the determinants of local environmental concern are analyzed, education and urbanity are found to positively influence local environmental concern, whereas there is a negative relationship with postmaterialist values. Authors report a mean WTP of 28.64 euros to combat sea pollution in Instabul while the figure for ozone layer protection against depletion is €25.86.

Alberini and Zannatta (2005) conducted a contingent valuation survey to estimate the welfare improvements associated with a 50% increase in catch rates resulting from a reduction in the discharge of industrial pollutants into the Lagoon of Venice. Using data from a mail survey of recreational anglers, authors derived a demand curve for fishing in the Lagoon of Venice, as well as a shifted demand curve reflecting a 50% improvement in catch rates. Using this information authors calculated the welfare improvements associated with a 50% improvement in catch rates to be €3 415 820 per year, for all anglers from the Province of Venice who fish at the Lagoon.

In addition, the increase in the population residing in the countries bordering the Mediterranean and Black Sea leaded to fishery stocks and aquatic resources overexploitation. As a result of the severe stock depletion the provision of a range of ecosystem services generated by fish populations are also at risk with consequences for biodiversity, ecosystem resilience and ultimate human welfare.

Nunes et al. (2004), used the conjoint valuation framework to estimate the fishermen's willingness to pay (WTP) for alternative clam fishing management practices in the Venice Lagoon in Venice, Italy. Lagoon is threatened by heavy fishing pressure, use of unsustainable fishing practices, and increased pollution from nearby industrial activities. WTP was modelled as a function of the attributes of the management practices, namely, the cost of the permit, the size of the fishing area, the fishing cost of the permit, the type of fishing system, and/or regime system. WTP for a change from the present fishing practice to one that is exclusively based on the manual rake system was found to range from €1.005 and €2.456.

Accadia and Spagnolo (2006) calculate a set of economic indicators for demersal fisheries in North and Central Adriatic Sea. Some of the indicators attained are the added value per unit of revenue (AD), the gross operative margin per unit of revenue (GOM), the Return on Sale (ROS) or the Return on Investment (ROI). The results show the evolution of these indicators that give a picture for 2004 characterized by the fact that the demersal fish stock of the Adriatic Sea produces a ROI minus the risk free rate of 8.54%.

Cannizaro et al. (1999) carry out a study on the economic value of dolfinfish fshery in Sicily (Italy) using a marked based approach. The dolphin fish is captured using fish aggregating devices and purse seiners in Sicily and Pelagic Archipelago during a 6-month season that take place between July and December. This study is based on the sampling of vessels operating in the fishery and concludes that the profit rates generated are between 30% and 46% providing significant economic profits.

Coastal ecosystems in the Mediterranean and Black seas are also under threat from sea level rise attributed to global warming. Besides sea level rise resulting to increased flood risk for coastal areas and increased risk for extreme weather events (hurricanes, cyclones, tsunamis) and coastal wetland loss, the introduction of invasive species in the SES due to increased mean temperatures is a key issue. An understanding of the likely impacts of climate change on human welfare is therefore crucial for making an informed decision about the best response strategy to the enhanced greenhouse effect.

Knowler (2005) uses a dynamic bioeconomic model to assess the economic loss to the Black Sea anchovy fishery associated with the invasion of the exotic comb jelly *Mnemiopsis leidyi*. Results demonstrate that *Mnemiopsis* had a dramatic impact on potential catches leading to a drop in economic profits from €12.29 million to €0.217 million per year, a potential deadweight loss of €12.082 million per year to the Black Sea fishing nations (primarily Turkey).

Further, the loss of biological diversity in SES is causing major concern. The rate of loss of biological diversity is outstripping the natural regenerative capacity of evolution in SES as worldwide. The valuation of preferences for biodiversity can provide essential guidance for conservation policy allowing economists to perform environmental accounting and to carry out proper pricing of environmental damages.

Langford et al. (1998) report the results of an open-ended contingent valuation survey carried out in Greece to estimate the public's willingness to pay (WTP) for conservation of the Mediterranean monk seal (*Monachus-monachus*) in the Aegean area. The monk seal is classified as the most endangered seal species in the world since it has suffered from fishermen because of the damage it causes in fishing gear. Respondents were asked to state their maximum WTP for the protection of this seal given that they were in principle willing to pay for

such protection as detailed from earlier stages of the survey. Authors estimate a simple discrete–continuous mixed model to reveal a median willingness to pay of €11.7.

5. Discussion

European maritime spaces and coasts are sources of food, climate regulators and trade routes while significant values are attributed to fisheries and offshore energy production. However, globalization and climate change have led to the deterioration of the marine environments and their ability to produce goods and services. Pressures on Southern European Seas and Coasts are high putting at risk their capacity to support human well-being.

Although scientific observations render it clear that the future of the Mediterranean and Black Sea ecosystems does not look rosy, the areas have received little attention in terms of valuation studies. The relevant literature, admittedly limited, is yet to examine the threats for the Mediterranean ecosystem resulting from invasive species introduction as well as the pollution-driven reduction in the CO_2 sequestration capacity of the sea. As far as the Black Sea is concerned, there is no literature on valuing the cost of loosing part of the recreational potential of the coastal resources, as well as public health risks associated with chemical pollution. Welfare losses resulting from biodiversity change and living resources decline are also not assessed. Moreover, there exists no literature on valuing the use and non-use benefits of possible restoration policies and of the implementation of an integrated marine and coastal resources management plan, which can address in an efficient, equitable and sustainable way the existing problems.

As far as the technical aspects of the valuation literature are concerned, concepts such as heterogeneity of preferences among respondents, spatial interaction, uncertainty about future socioeconomic and scientific parameters, upscaling and sustainable discounting, are not taken into account in the existing econometric analyses. The absence of stakeholder analysis to guide the design and results interpretations of valuation studies and better inform decision-making is another limitation of the existing literature. Qualitative methods can elicit peoples' perception and thus feed the subsequent valuation studies. In a stakeholder analysis to investigate social risk perception about oil spills, undertaken by Kontogianni and Skourtos (2008), stakeholders expressed mistrust towards state agencies, media, ship owners, and courts. Accordingly, they ask for strengthening the relevant institutional frame which is crucial for integrated coastal zone management. The issue of trust towards state institutions responsible for marine resources management should be further explored in future valuation efforts as it is particularly relevant in the Mediterranean and Black Sea area.

Methodological challenges with regards to values' elicitation mechanisms should be also addressed by future studies. Given the generally poor economic state of the countries bordering the South and Eastern Mediterranean area and the Black Sea, valuation results may be sensitive to the choice of the payment vehicle. Different payment mechanisms should be therefore tested for their capacity to reveal the true valuation, people attach to marine and coastal ecosystems. A tax reallocation scheme, under which proposed policies are financed through the reallocation of existing taxation, may appear to be more appropriate as it may eliminate protest responses, declaring zero willingness to pay, resulting from budget constraints. The different cultural background of the population mix of many countries around the two Seas suggests another challenge for valuation exercises that should account for ethnical heterogeneity in the case study areas.

In the absence of stated preferences studies in the Black Sea comparisons between public preferences towards goods and services from marine and coastal ecosystems and their valuation in the two Seas cannot be attempted. However, knowledge of this potential spatial heterogeneity of preferences regarding marine ecosystem management options, would allow the formulation of policy responses at a European level that would also account for specific regional perceptions and needs. The design and implementation of more valuation studies is thus highly needed. In this process, collaboration between economists and natural scientists should be further enhanced to allow for the formulation of more informed valuation surveys. These should incorporate up-to-date scientific modelling results with regards to the current situation of the attributes under evaluation, as well as to future projections.

However, the studies reviewed in this paper can still serve as valuable references regarding the valuation techniques, the sampling processes, the main research hypotheses and econometric specifications implemented, as well as the conclusions reached from the analysis. While an incomplete reflection of the full range of issues related to the valuation of marine resources, past empirical research raises several important concerns. Studies mainly underline the variety of goods and services provided by the marine environment such as food, recreation activities, coastal protection and breaking down degradable waste which are often neglected in policy making. The results indicate that values from marine reserves can be substantial and avoiding potential losses is an important task for policy making. Valuation studies therefore provide policy makers with the necessary economic information for the development of efficient and effective strategies for sustainable marine and coastal ecosystem management. Further, the studies examined the impacts of social, economic and attitudinal characteristics on individual valuation of marine and coastal ecosystems attributes which can assist policy makers in making resources allocation decisions that maximize social welfare.

Since carrying out an original empirical study is time-demanding and costly, evidence from the literature refereeing to SES can be used for benefit transfer applications (Desvousges et al., 1992; Boyle and Bergstrom, 1992; Loomis, 1992) to allow for values to be predicted in different maritime regions internationally, where similar problems are observed. In a benefit-transfer application value estimates measured in one site, study site, are used to value policy changes in another site, policy site, after proper adjustment to account for differences in the currency, income and population in the

two sites The technique has been extensively applied in environmental valuation studies when primary data collection is not possible and validity tests have proved its capacity of providing robust estimates when properly implemented (Brower, 2000). Benefit transfer can be conducted across national boundaries as well and is also found to generate valid monetary estimates of environmental values (Ready and Navrud, 2006). Pressures, such as biodiversity loss, eutrophication, overfishing, water contamination and climate change addressed and valued in the reviewed studies are common for many maritime regions in Europe and worldwide,[2] and thus estimates from the literature referring to the SES can be transferred to policy sites of interest to inform policy-making in a cost-effective way.

6. Policy implications

National and multinational bodies, such as the European Union, have recognized the significance of marine and coastal ecosystems protection for the well-being of the current and future generations and have introduced a wide range of environmental legislation for sustainable marine governance. Agreements at regional and international level call for integrated coastal management, improved conservation of living resources and understanding of the effects of climate change on ocean and coastal management. The role of economic valuation is highly acknowledged in this process. Valuation studies are increasingly demanded to feedback in the formulation of economic policy adequate to create agent-specific incentives for more efficient marine and coastal management, which is also equitable and environmentally sustainable. A recent example refers to The 'Potsdam Initiative', which was launched at the G8 + 5 environment ministers meeting in Potsdam, in March 2007. This meeting called for a study on the economic significance of the global loss of biological diversity, looking at the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation (see Markandya et al., 2008; Sukhdev, 2008). This study, commonly known as TEEB (The Economics of Ecosystems and Biodiversity, 2008), signals that the knowledge from economic valuation studies on marine ecosystem services remains fragmented and therefore gives high priority in having more economic valuation studies in this area. Without doubt, this suggests promising research directions for future work.

7. Conclusions

From an economic perspective marine and coastal ecosystems provide a diverse array of goods and services that directly or indirectly translate to economic services and values to the humankind and thus contribute to the social well-being. However, many of the values associated with the functions performed by marine and coastal ecosystems are non-marketed and are thus consequently often ignored in planning and decision-making resulting in depletion and degradation of the resources. In recognition of the important benefits that marine and coastal resources provide to humanity, economists in recent years have developed and refined a battery of techniques to capture their total economic value in the absence of markets.

This paper provides a summary of the major literature on valuing marine and coastal ecosystems services. Valuation studies implemented in Mediterranean and Black Sea are classified by specific goods and services. The review may not be exhaustive of past applied research but our effort reveals that there are few marine resources related studies in the Southern Seas region which highlights the significance of future research initiatives to be undertaken. Although scarce, however, existing literature underlines the potential of valuation techniques as tools that can effectively intersect with, and facilitate, the formulation of stronger resource management policies that account more fully for the total economic value of the goods and services generated by marine and coastal ecosystems.

The monetary magnitude of use and non-use values related to coastal and marine ecosystems, as highlighted from the existing literature, signals the potential for governmental intervention and policy formulation. Demonstrating to local communities, governments and other stakeholders that coastal and marine ecosystems and resources play key roles that underpin tourism, fisheries, nutrient regulation, carbon sequestration, amenity services or other ecosystem goods and services can greatly facilitate management. Further knowledge of the marginal valuation different socio-economic groups attach to environmental improvements through valuation studies also allows for equity considerations to be taken into account in the formulation of policy responses.

Governance systems, property rights regimes, economic incentives and other institutions that can adequately deal with the inherently common property nature of the seas are sorely needed (Constanza, 1999). Constanza lists responsibility, scale-matching, precaution, adaptive management, full cost allocation and participation as core principles for sustainable ocean management. All measures should be assessed in terms of their economic efficiency, equity and sustainability. On-going research in the field of ecological economics is very valuable in this direction.

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[2] A recent report from the World Resources Institute has identified over 415 areas worldwide that are experiencing eutrophication symptoms (Selman et al., 2008). According to estimates from the Food and Agriculture Organization (FAO, 2008) over 70% of the world's fish species are either fully exploited or depleted. Finally the IPCC report (IPCC, 2007) predicts that the sea level will rise by 3.1 cm every decade.

Appendix A

Summary of valuation studies.

Author	Motivation	Valuation technique	Result
Nunes et al. (2004)	Estimate the fishermen's WTP for alternative clam fishing management practices in the Venice Lagoon	Conjoint analysis	The WTP for a change from the present fishing practice ranges from €1.005 to €2.456 per year
Vici et al. (2006)	Assess a set of characteristics which are likely to influence the tourist evaluation of Rimini	Choice experiment	Tourists call for more recreational activities and access to the main tourist promenade but are indifferent to the sustainability of the environment
Brau and Cao (2006)	Examine the feasibility of implementing sustainable tourism policies in the island of Sardinia	Choice experiment	Tourists appreciate most lack of overcrowding and high levels of accessory recreational facilities. Regarding environmental quality it is found to be significant determinant of destination choice
Alberini and Zannatta (2005)	Estimate the welfare improvements resulting from a reduction in the discharge of industrial pollutants into the Lagoon of Venice	Contingent valuation – iterative bidding	The authors calculated the welfare improvements to be €3 415 820 per year for all anglers from the Province of Venice The number of trips per year is expressed as a function of the individual's socio-economic characteristics, the price of fishing trips, the catch rate and the price of an alternative fishing location. At the average price per trip for the average household, the welfare improvement associated with a catch rate improvement is €1056 per year. Differentiating between residents and non-residents of Venice, a 50% improvement in catch rate produces a welfare increase of €1379 per year for residents and €745 per year for non-residents
Alberini et al. (2004)	Estimate WTP for a theoretical project that would improve infrastructure on the island of S. Erasmo	Contingent valuation – dichotomous choice	The non-use portion of mean willingness to pay is €36, and the values for users and potential users are €56 and €35 respectively. The average respondent is willing to pay 21% more if he or she is reminded of the reasons to vote for or against the improvements. Respondents with 18 or more years of education were willing to pay 21% less if they received the reminder
Kontogianni et al. (2003)	Estimate WTP for the full operation of a partially operating wastewater treatment plant that discharges into Thermaikos Bay	Contingent valuation – open ended	The mean willingness to pay was €15.23 per 4-monthly water bill, for 5 years The highest WTP amounts were given for environmental and moral reasons and for future generations. Removing the smell from the Bay was also a strong motivator for WTP. Those who were willing to pay tended to believe in state investment for better water quality, believed that water quality was extremely important, and were better informed
Machado and Mourato (1998)	Estimate WTP for marine water quality improvement to acceptable levels	Contingent ranking, contingent valuation – payment card	The mean expected WTP to avoid an episode of gastroenteritis for the contingent ranking sample was €7.69 Income, healthier people and attitudinal variables like considering health to be the most important thing in life had a significant, positive impact on WTP. Age had a significant negative impact on WTP, while sex, family size and education level had no significant effect on WTP

Appendix A (*Continued*)

Author	Motivation	Valuation technique	Result
Langford et al. (1998)	Estimate the public's WTP for conservation of the Mediterranean monk seal (*Monachus-monachus*)	Open-ended contingent valuation	Authors estimate a median WTP of €11.7 Income, sex, age and education were found significant explanatory variables of the bid function. Income has a strong positive relationship with WTP amount pledged while being male makes one significantly less likely to answer positively to the payment principle question, although there is no difference between the sexes in WTP amount. Finally, there are weak effects suggesting that more years of education are associated with higher WTP amounts
Cannizaro et al. (1999)	Estimate the economic value of dolphin fish fishery in Sicily (Italy)	Market-based valuation: producer surplus	Authors estimate that profit rates of the fishery are between 30 and 46%
Accadia and Spagnolo (2006)	Estimate a set of socio-economic indicators for demersal fisheries of the Adratic Sea	Market-based valuation: producer surplus	Authors estimate that the ROI minus the risk free rate was 8.54% in 2004
Göksen et al. (2002)	Explore the impact of geographical proximity of environmental problems on WTP	Contingent valuation – binary choice	Authors report a mean WTP of €28.64 to combat sea pollution in Instabul (local issue) while the figure for ozone layer protection against depletion (global issue) is €25.86 Regression analysis regarding WTP shows that in the case of the local issue, the postmaterialist values variable overrides the effects of all other explanatory variables. Significant interaction effects between postmaterialist values and education variables as well as between education and material security variables indicate, however, that without education and material security, postmaterialist values may not translate into WTP. In the case of the global issue, postmaterialist values and material security were significant predictors of WTP
Knowler (2005)	Assess losses from invasive species in the Black Sea	Bioeconomic model	Results demonstrate that *Mnemiopsis* had a dramatic impact on potential catches leading to a drop in economic profits from €12.29 million to €0.217 million per year
Knowler et al. (1997)	Estimate losses associated with nutrient enrichment of the Black Sea	Bioeconomic model	The increased harvest resulting from the reduction of nutrients is estimated to generate revenues of €2.57 million annually

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