I - Executive Summary of CIESM Workshop 37

"Economic valuation of natural coastal and marine ecosystems"

by

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1. Introduction

The workshop took place from 22 to 25 October 2008 in Bodrum, the ancient Halicarnassus of historical fame, now a major touristic center on the Anatolian coast. An original mix of resource economists and marine biologists from eight countries (see list at the end of volume) attended this four-day exploratory seminar at the invitation of CIESM. As Dr Frederic Briand, Director General of the Commission, and Dr Enric Sala, Chair of the CIESM Committee on Coastal Systems, made clear in introducing the meeting, the choice of the venue was deliberately set on a prime touristic destination of the eastern Mediterranean, illustrating both the economic benefits derived from very attractive shores and the significant environmental costs associated with huge tourism and market pressure.

Obviously the challenge of ensuring the sustainability of fragile, highly impacted coastal habitats is too complex to be the exclusive province of economists and ecologists, but it requires that both sets of experts at least exchange their own vision of a world-wide problem and assimilate the 'peculiar' language of the other at the scale of the Mediterranean. That objective alone was worth the voyage but the meeting went beyond by reaching areas of consensus on the multi-dimensional nature of the issue and on the set of tools that looked most promising.

2. Definition of issue – *"Economic valuation of natural coastal and marine ecosystems"*

Scientists have been warning about the impacts of human activities on ecosystems and about their repercussions on humans for decades (climate change is a great example), but a precautionary approach to management has not been adopted yet. A major reason is that natural ecosystems have typically been perceived as renewable, exploitable resources to be used for human benefit, and most people take for granted the many vital services that marine ecosystems provide for our well-being. This wrong perception is starting to change although marine ecosystems are still considered by many as less vulnerable and inexhaustible despite clear warning signals (see for example Sala and Knowlton, 2006; Worm *et al.*, 2006).

Because of the growing disconnect between humans and the natural world, the services provided by marine ecosystems are often ignored, and therefore their intrinsic value is poorly appreciated. Marine biodiversity is inherently irreplaceable, and its intrinsic value cannot be expressed in monetary terms. In contrast, the instrumental value of marine biodiversity, estimated as the services that marine ecosystems provide, can be defined in terms that most people relate to (see Table 1). Valuation is a compromise, it is not about absolute values (any economic valuation of marine ecosystem services will be an underestimation), and it should be considered as a process, which empowers stakeholders in decision making.

Table 1. Summary of ecosystem services and their relative magnitude provided by different Mediterranean marine habitats. The larger circles represent higher relative magnitude (adapted from Agardy and Alder, 2005).

Direct and Indirect Services	Beach-dune systems	Estuaries and marshes	Littoral hard bottom habitats	Seagrass beds	Pelagic (offshore) waters	Deep Sea
Food	•	●	⬤	●	⬤	
Fiber, timber, fuel	●	●	•			
Medicines		•	•			⬤
Biodiversity	•	●	⬤	●	●	●
Biological regulation	●	●	●	●	●	●
Freshwater storage & retention	•	•				
Biochemical		•		•	●	●
Nutrient cycling & fertility	●	●	●	⬤	●	⬤
Hydrological	•	●				
Atmospheric & climate regulation	•	●	•	●	⬤	•
Waste processing	●	⬤	•	•	⬤	⬤
Flood/storm protection	⬤	⬤	•	⬤		
Erosion control	⬤	●		●		
Cultural and amenity	⬤	●	●	•		
Recreational	⬤	⬤	⬤	●	•	
Aesthetics	⬤	●	⬤	●		

For instance, the Mediterranean Sea has served the riparian countries for waste disposal, decomposition and detoxification, but we have never internalized the true cost of these processes in economic models. The region generates large volumes of wastewater, with urban water alone accounting for about 38×10^9 m^3/year (UNEP/MAP, 2004). Wastewater also comes from industry and agriculture and includes toxic, persistent and bioaccumulable pollutants. Economic instruments can be used to estimate the value of the capacity of the Mediterranean ecosystem to dilute, disperse and break down pollutants. The cost of effluent management, from prevention and minimization to rectification and effluent re-use, to a level similar to that already provided by the Mediterranean ecosystem is the true value of that service.

What are the challenges of conducting economic valuation of marine ecosystems? The uses of marine ecosystems differ from those of terrestrial ecosystems, and the economic valuation of their services is difficult. For instance, while hunting land animals as the main source of protein for humanity was abandoned by most societies thousands of years ago, marine fisheries continue an industrial-scale hunting operation. According to recent statistics, aquaculture delivers an amount of protein comparable to wild fisheries (FAO, 2006), but aquaculture is not true farming since much of the feed of farmed fishes is fishmeal obtained from wild fisheries, thus further reducing natural resources. Property rights are not clearly established in the sea, and activities in the high seas outside of the exclusive economic zones are generally not properly regulated. Finally, access to underwater habitats is limited in time and space, impeding a greater understanding of the functioning of marine ecosystems and of the impact of human activities. Therefore, importing the paradigms, assumptions and methods used on land to marine systems may not be appropriate. CIESM Workshop 37 explored the challenges and opportunities of economic valuation from the perspective of Mediterranean marine ecosystems.

3. Tools and perspectives

3.1 Values, environmental damage and valuation

Ecosystem services play a crucial role in offering a wide range of benefits, and are therefore important steering forces of human well-being. The Millenium Ecosystem Assessment (Breitbart *et al.*, 2002) distinguishes four broad categories of benefit: provisioning services, cultural services, regulating services and supporting services.

Monetary value assessment of marine ecological damage has its foundations in welfare economics since it establishes the concept of marine ecological value in terms of its impact on the welfare of human beings. In a conceptual framework, one can define the total value (TV) of the damages in terms of the use value (UV) and non-use value (NUV) (Figure 1). The use value component refers to the set of damages that arise from the actual impact of the marine ecological damage. These damages can be further divided into direct use, indirect use, and option use value, respectively DUV, IUV and OUV. Direct use values of damages include: (a) the loss of marine tourism and coastal recreation benefits; (b) the loss of natural and cultured marine species with commercial value, and (c) the value of risks to human health. Indirect use values of damages refer to damages that relate to the functioning of the marine ecosystem and the survival of marine living resources, even if these have no direct commercial value.

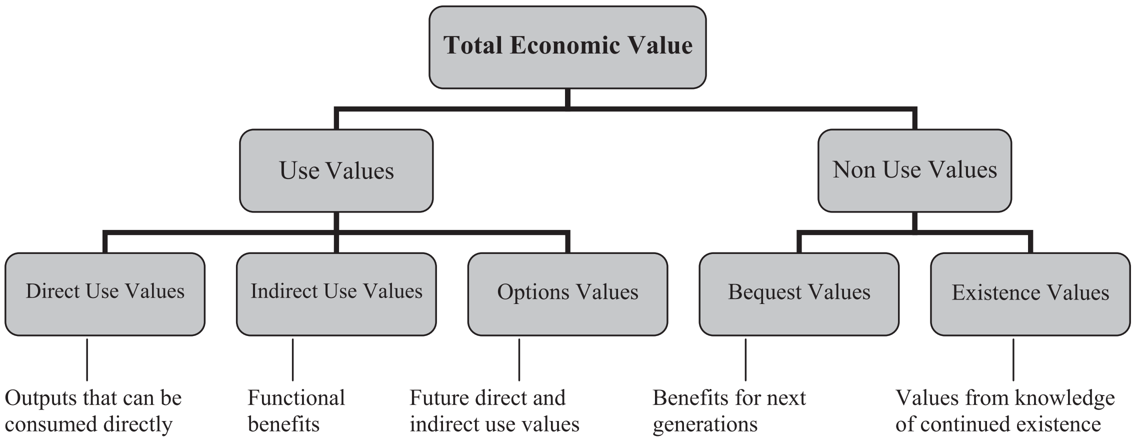

Figure 1. Types of values of marine ecosystems, including instrumental values and intrinsic values (adapted from The World Bank, 1998).

Non-use values of damages can be divided into a bequest value (BV) and an existence value (EV). Bequest value refers to the benefit accruing to any individual from the knowledge that future generations might benefit from a marine ecosystem being free from marine ecological damages. Existence value refers to the benefit derived simply from the knowledge that marine species are protected without even being used. This leads to the following equation

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

Note that non-use values of damages have a public good character, i.e. they do not have a market price. As a consequence, market price evaluation of marine ecological damages provides an undervaluation of the associated negative impacts. This can be interpreted as signaling a misallocation of financial resources in marine prevention, restoration or amelioration programs. An accurate and complete monetary assessment of environmental-economic damages requires the application of specific monetary valuation tools. In the absence of market prices, economists use specific monetary valuation techniques to measure use and non-use damages. Since the consequences of marine ecological damages are multifaceted, the techniques must cover a broad range of effects, including economic, cultural, and ecological effects (Nunes *et al.*, 2000). The tools that have been identified in the literature are hedonic pricing, aggregate market analysis, contingent valuation, the travel cost method, production functions, and the averting behavior method (Nunes and van den Bergh, 2001). Most of these tools have seen few applications to value marine ecological damages. Bearing in mind both the described damage categories and the scope of each valuation technique, it is possible to suggest the most suitable valuation methodology for each value or damage type (Table 2).

Table 2. Classification of marine ecological damages and appropriate valuation techniques.

Economic Value		**Examples of damages**	**Most suitable valuation technique**
Use value (UV)	Direct use value (DUV)	Loss of tourism and recreational benefits (e.g., visits to the beach, sport fishing, swimming and sailing)	Travel cost method, contingent valuation
		Destruction of marine living resources with commercial value, e.g. fish (codfish, salmon), shellfish, mollusk	Aggregate price analysis*, hedonic pricing
		Risks to human health, e.g. food poisoning	Averting behavior method, contingent valuation
	Indirect use value (IUV)	Effects on marine ecosystem health (e.g., changing local chemical composition of the water, toxicity accumulation along the food chain, loss of biodiversity)	Production function method, averting behavior method
	Option use value (OUV)	No insurance that marine coastal areas are free from HABs (e.g., beach with foams during tourist season)	Travel cost method, contingent valuation
Non use value (NUV)	Bequest Value (BV)	Risk of loss of legacy benefits (e.g., no legacy of marine species for future generations)	Contingent valuation
	Existence Value (EV)	Risk of loss of existence benefits (e.g., no knowledge guarantee that some marine species are locally extinct)	Contingent valuation

*Also known as a market price valuation technique.

As one can see, contingent valuation (CV), a survey based valuation technique that is widely used in the context of environmental valuation (Carson *et al.*, 1992; Nunes and de Blaeij, 2005) can fulfill an important potential role in the overall assessment of damages. Indeed, it can be applied to assess the monetary value of most types of damages, and it is the only valuation method that is capable of shedding light on bequest and existence values related to marine ecological damages. In addition, CV has the advantage that marine policies may be valued even if they have not yet been adopted or lie outside current institutional arrangements. Thus, it offers much scope and flexibility for specifying different restoration and amelioration programs. For monetary value assessment of the damages to ecosystem health however, CV does not emerge as the most suitable valuation technique. This is because the involved effects cannot be easily described in a questionnaire survey (e.g. toxicity accumulation along the food chain) and are often related to complex issues with which the general public is unfamiliar.

If the marine ecological damage is reflected in the output of an economic activity such as fishing, the production function method provides a suitable alternative. This method translates physical changes in relationships between environmental inputs and economic outputs through markets prices, production costs, profits and producer and consumer surpluses into damages values. An example is the mass mortalities of commercial fish caused by harmful algal blooms that produce a toxin (also known as 'fish killers'). Finally, monetary value assessment of tourism and recreational damages can be performed by using the cost of travelling to a non-priced coastal site (Nunes and van den Bergh, 2004). Questionnaire surveys are used to collect data on the number of visits that the household makes to the site, on the money spent in travel time and on costs of gaining access to clean beaches, free from foams and repellent odors.

3.2 The challenge of evaluating biodiversity

The shortcomings of evaluating biodiversity are manifold, in addition to the ethical problem of doing so. Many species are yet unknown, and we cannot evaluate the unknown. A potential mechanism for assigning value to species could be to measure the role of the species in the ecosystem, "keystone" species (those with the strongest per capita interaction strength in the community) or "foundation" species (those providing a key architectural role) being the highest valued. The problem is that the roles of most species are unknown.

We may put forth the argument that species should be valued equally. However, our perception of value depends on the characteristics of the species in question. If we had to choose between an inconspicuous and unknown species that is the sole representative of a family (such as the Mediterranean hydrozoan *Tricyclusa singularis*), and a large commercially important species that has close relatives in the same region (such as the Mediterranean dusky grouper, *Epinephelus marginatus*), the general focus would be on the large, charismatic grouper. Charismatic species are given great emotional and even monetary value. Such "triage" is based upon subjective 'beauty', commercial interest and familiarity. However, biodiversity can be valued through its impact on the ability of ecosystems to provide services (see Reid, 2005).

3.3 Modeling vs. scenario building

Economic valuation, and in particular stated preference methods, requires models to forecast the impact of a particular activity on the environment and the economy. Unfortunately a major intrinsic barrier to communication between ecologists and economists makes valuation difficult. Ecologists tend to believe that they are expected to produce accurate forecasts for their part and economists do not understand why a good number of ecologists are uncomfortable making forecasts while others do so even with systems that are highly nonlinear. While traditional linear models are impractical for forecasting, non-linear forecasting models have been shown to predict future outcomes with more success (Sugihara and May, 1990). A limitation is that they require relatively long time series, which are largely missing in the marine ecological realm.

An alternative to quantitative forecasts is scenario building, which consists in postulating a sequential series of events by using verbal models, graphic models, or both. Scenarios do not pretend to predict the future with accuracy but, being more flexible than mathematical models, allow for weak inference on what might happen in the future. They are working hypotheses, and also negotiating tools between stakeholders. The Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment have been successful in building multiple scenarios based on a range of human activities, and by combining quantitative models and qualitative assessments.

Several issues make it difficult for valuation studies to be fully acceptable by decision makers:

a) Welfare change vs. monetary change: the idea that one can put on balance fishermen's loss vs. society benefit through willingness to pay (WTP) sounds odd to most decision makers. While fishing losses are given in "real" terms, WTP is also given in monetary units but is a mere reflection of benefits, not real currencies.
b) In order to estimate non-use values, one has to rely on stated preferences which are hypothetical by nature. This by itself causes decision makers to hesitate.
c) Even if we accept the hypothetical nature of the analysis, there is still the standing issue. Non-use values are associated with people that did not visit the area concerned and probably will not in the future. The idea to take those individuals into account sounds odd to most decision makers. This is also related to the issue that follows.
d) While the costs of nature protection are concentrated with a small group (e.g., a group of fishermen), the benefits are spread over a much larger number of people. Therefore, even if the benefit of preservation is higher in total, the average benefit per capita will generally be lower than the average cost. In such cases lobbying will be stronger in the group who is standing to lose.

3.4 Non-linearity and thresholds

One highly challenging aspect of economic valuation of marine ecosystems is the non-linearity of ecological-economic systems. Much classical theory in both disciplines relies heavily on locally linear methods to estimate stability and times of return to equilibria, thereby ignoring many phenomena of overriding importance such as the potential for catastrophes.

The most extreme form of convex relationships is a threshold. In a non-linear systems, small perturbations can become magnified and lead to qualitatively unexpected behaviors at macroscopic levels. Identifying the thresholds, or tipping points, on which one system shifts from the influence of one ecological attractor to another is thus essential for evaluating the impacts of human activities on marine ecosystems. Furthermore, an ecological phase shift is associated with a shift in value. Therefore, unpredictable, putative future phase shifts may make estimation of present value impractical, and present serious problems for management.

For instance, an unexpected consequence of overfishing is that fish could be replaced by jellyfish. This, in turn, will cause a further decrease in fish abundance, since jellyfish feed on fish larvae and their planktonic food. Until recently jellyfish had never been considered in fisheries models (Boero *et al.*, 2008); only now are they starting to receive proper attention (Pauly *et al.*, 2009). What is the threshold leading to the shift from a fish to a jellyfish coastal sea? Is this shift reversible? Are there any management actions that can be implemented to help reverse this shift?

Is it possible to predict the timing and location of thresholds and thus estimate the present value of marine ecosystem services more accurately? In general, it is difficult to detect strong signals of change early enough, and so to develop scientific consensus in time for implementing effective solutions. The quantification of thresholds requires knowing what keeps a system into a more or less predictable domain where changes are mostly fluctuations (e.g. seasonal fluctuations) and not variations (i.e. the emergence of a new attractor, leading to a new condition). But typically the passage from one attractor to another is determined by an episodic, often unpredictable event (Boero *et al.*, 2008). The identification of trends, however, allows for some weak inference about the future.

The concave non-linearity case offers different challenges. We refer here mainly to what is defined in economics as the marginal benefit, and the marginal cost, of preservation. The interrelationship of ecosystem structure, function, and economic value is also of great importance to decision makers who are often concerned with how much natural habitat to "preserve" and how much to allocate for economic development. In assessing such trade-offs, it is frequently assumed that ecosystem services change linearly with critical habitat variables such as size. This assumption can lead to a misrepresentation of the economic values inherent in the resources; it can overestimate or underestimate the service value, resulting in an "all or nothing" habitat scenario as the only decision choice. A common reason for invoking such an assumption is that few data exist for examining the marginal losses associated with changes in nonlinear ecological functions, making it difficult to accurately value the changes in ecosystem services in response to incremental changes in habitat characteristics.

An example of misuse of the linearity assumption is provided in this seminal paper of Costanza *et al.* (1997) which attempted to estimate the total value provided by the world's ecosystem services. This value was estimated at about three trillion USD, three times the world's GDP at that time. However, the analysis overlooked the non-linearity of the ecological system, assuming that each ecosystem unit is worth the same. Economic analysis would measure the benefits and costs of preservation only at the *margin* and not on *average.* In the case of mangrove preservation in Thailand, it was shown (Barbier *et al.*, 2008) that total preservation results in a net loss to society vs. only partial preservation when devoting the other part to shrimp farming. This is precisely because of the concavity relationship: it turned out that the last units of mangroves were worth less than shrimp fishing while the other units were worth more.

In summary, taking benefits and costs at the margin is more likely to get support from the general public. However, one must be careful not to apply the concavity case when one is in the convex part. To avoid this, a very important challenge for ecologists will be to understand better where the non-linearity actually occurs; that is, where thresholds are. When we will have a better understanding of the issue, valuation studies will be better accepted in the concave range.

3.5 How to evaluate highly complex systems?

In addition to the unpredictability of chaotic dynamics, marine ecologists have to deal with very complex ecosystems composed of thousands of interacting species. The good news is that, while individual species may have chaotic dynamics, food webs have emergent properties that can be predictable and change in understandable ways at the ecosystem level. For instance, prohibition of fishing in a marine reserve causes populations of target species to increase in abundance, but their prey may consequently decrease over time. The relative abundance of different target species will also change with time along a process called ecological succession, and total biomass will often increase, unless an event (e.g., fishing in the reserve) reverses the predictable ecological trajectory. It is very important to understand that, while the abundance of individual species may not be predictable over time, there are emergent properties that can be forecast with more certainty as long as the system remains under the influence of a known attractor. Economic valuation will require that ecologists identify the minimum number of parameters (dimensions of the ecosystem) that can explain the general behavior of the ecosystem and allow for reliable modeling and scenario-building. Linking food web and ecosystem theory with empirical marine ecology will be fundamental to achieve this goal.

3.6 The syndrome of the shifting baselines

Our perception of what is a natural environment changes across generations: we believe that what is natural is what we experienced at an early age, or the first time we visited a place or ecosystem. As humans increasingly degrade the environment, our expectations of what is natural are lowered (Pauly, 1995). Thus, our baseline of what is natural slides across generations. The problem is that baseline shifting affects evaluation of environmental states and changes by scientists as well as by other people, paving the way for lower valuation of marine ecosystems' services.

The effects of shifting baselines can be exacerbated by modern production techniques that alienate end-consumers from marine ecosystems, so that they do not perceive the changes in the environment. For instance, because of economic subsidies and imports of seafood from other seas, Mediterranean populations have not yet realized that fish stocks are plummeting. Society and culture will also shape the perception of the desired state of the environment. The greater environmental awareness in some countries has also reshaped our perception of value of marine life. For instance, when Moby Dick was written, the hunted whale was typically perceived as evil and dangerous; whereas today many readers would consider the whale hunter as cruel.

Certain economic models formulate past consumption as complement to present consumption capturing in that way the effect of shifting baselines on valuation. But how to account for baseline shifting in valuation studies? Does environmental change coincide with variance in valuation across respondents' age (in surveys), knowing that those exploiting a resource are more likely to perceive a change in real time than end-consumers detached from the natural environment?

3.7 Developing a new common toolkit in a fast-changing world

To cope with the new challenges imposed by the complexities of global change, an interdisciplinary approach integrating science, economics and sociology is needed. This new approach includes techniques such as the DP-S-I-R (Driving Pressures-States-Impacts-Response), and increased focus on ecosystem services. The analysis of driving pressures on an ecosystem and their impacts on the environment and on society requires fundamental information both from the ecological and the sociological side. Economics, through the valuation of the ecosystem services involved, provides an important component of this interdisciplinary decision support system.

In this context, an important question is when and where the valuation of ecosystem services fits into existing environmental policies. Whenever possible, environmental impacts should be valued in monetary terms. Where this is not possible, these impacts should be expressed either in quantitative terms or as a mere qualitative assessment of potential impacts.

The joint initiative in regard to the global economic benefits of biodiversity and the costs of ecosystems degradation (European Communities, 2008) proposed a valuation framework as a future policy toolkit for policy-makers and practitioners. Combined with practical guidebooks (DEFRA, 2007), the approach could be as follows:

• **Establish an environmental baseline to examine the causes of biodiversity loss:** ecosystem services are identified and grouped into functional categories (provisioning, regulating, cultural and supporting). A quantitative and/or qualitative assessment of the potential impacts of human activities on ecosystem services requires a rigorous baseline against which to assess putative changes expected from different policy options.

• **Evaluate alternative policies by quantifying the impact of policy options on specific ecosystem services:** this approach is also used on impact assessments and cost-benefit analysis to ensure that decision-makers can make informed decisions on the basis of a systematic analysis of all the implications of various policy choices. While the focus of valuation should be on marginal changes rather than on the "total" value of an ecosystem, it is important to take a broad view of the ecosystem and the spatial scale of possible impacts.

• **Assess the costs and benefits of actions on human welfare:** the analysis will need to assess the effects of changes in the identified ecosystem services. It is important to note that there could be both costs and benefits for human welfare. As some services might be incompatible (e.g. water extraction and groundwater recharge), combining these values would over-estimate the ecosystem services.

• **Consider the distribution of impacts of ecosystem services loss and conservation:** the beneficiaries of ecosystem services are often not the same as those who incur the costs of conservation ('positive externalities'). Mismatches can lead to taking decisions that are right for some people locally, but wrong for others and for society as a whole. In the name of effective and equitable policies, these spatial dimensions should be recognized and corrected with appropriate tools, such as payments for ecosystem services and redistribution to those who actually maintain these services.

4. Governance

The Mediterranean basin is a complex geopolitical system involving 21 countries, which implies several layers of governance with different degrees of overlap. Like ecosystems, local societies are complex: they may be multi-level and include competing groups and different interests by social and ethnic groups, as well as gender and age discrimination. These complex communities are embedded in larger complex systems at national, regional, and global scales, with accelerating changes that influence both property rights dynamics at the local level, the role of traditional governance, and social values. Among others, the case of the tuna fishery in the Mediterranean (Fromentin and Powers, 2005) exemplifies a shift from artisanal to industrial fisheries, and from regional to international actors.

The general shift from subsistence and livelihood use of local resources towards the pursuit of economic growth and international markets created rifts among local communities and also conflicts with the outside world, as the interests of Mediterranean communities have been colliding with the interests of a larger system of resource users. The increase in the spatial scale of resource use increases the heterogeneity of users, inducing commons governance to become multi-scale and multi-jurisdictional.

The functioning of the Mediterranean ecosystem (including humans) is source of debate, making difficult consensual agreement over the future of the region. Scenario-building should be a tool to stimulate dialogue about external pressures and internal dynamics of the sub-region or locality, to help build capacity for resource management. Besides vulnerabilities, the scenario planning should also reveal previously unconsidered opportunities for enhanced learning and collaboration among the many associations and organisations that work in the same area or on the same type of system (e.g., marine protected areas) in each of the Mediterranean sub-regions (see Becker, this volume). Throughout this planning process, economic valuation is likely to contribute to building a common background not only within communities but also between scientists, managers and policy-makers.

Environmental and resource management is a socio-political undertaking (Nadasdy, 2007). At the beginning of the twentieth century, state wildlife management was linked to the expansion of state power and new forms of governance will need to build trust by seriously considering culture and identity. In this context four categories of factors, identified by Folke *et al.* (2003) for building resilience in social-ecological systems are relevant:

(1) learning to live with change and uncertainty: in a changing, non-linear world, accurate forecasts are unlikely;

(2) nurturing diversity as a means of ensuring greater options for renewal and reorganization: diversity, in fact, contains the possibility of unexpressed solutions to unforeseen problems, from rare species to unhorthodox social-economic practices, preadapted to future conditions;
(3) combining knowledge types to enhance learning: for instance the blend of scientific and traditional culture has much to offer;
(4) creating conditions and opportunities for self-organization.

Social dynamics are as difficult to predict as ecological dynamics, due to the diversity of human values, the rapid pace of social change, and the reflexive nature of people (Westley *et al.*, 2002). Cooperation between different populations, organizations, and types of management requires mechanisms for linking social and ecological knowledge, such as the history of coastal uses, with more universal knowledge, such as the dynamics of sediment accretion/erosion cycles (see Scapini, this volume). This requires that stakeholders have some minimal level of trust in one another, and some shared vision of the management issues that they face.

In the Mediterranean, a variety of cross-scale ecological issues, like the spread of invasive species (see Galil, this volume), and a lack of ecological regional management emphasize the need for trusted mechanisms linking local and more general socio-ecological knowledge.

To quote Berkes *et al.* (2007) "Resource management is at a crossroads. Problems are complex, values are in dispute, facts are uncertain, and predictions are possible only in a limited sense. The scientific system that underlies resource management is facing a crisis of confidence in legitimacy and power. Top-down resource management does not work for a multitude of reasons, and the era of expert-knows-best decision making is all but over". Stakeholders' values and expectations must be properly identified and communicated to policy makers. Stakeholders are more likely to participate in management if the policies and strategies are generated by their direct contribution. Although participatory management is costly in terms of money and time, this approach is sine-qua-non for fair distribution of cost and benefit of valuation of environmental resources (Tosun, 2006). In complex, adaptive systems, disequilibrium and surprise are the rule, and failure is as instructive as success. "The devil is not just in the details, it's in the dynamics" (Westley, 2002).

5. Case studies of Mediterranean ecosystem services valuation

This section presents three case studies exploring the valuation of (1) rocky shore habitats threatened by illegal date-mussel fisheries, (2) coastal ecosystems affected by jellyfish outbreaks, and (3) a charismatic species that has no market value.

5.1 Case study 1 – Destructive date mussel fishery on rocky habitats

This study considers the case of the rocky shore in south-western Apulia (SE Italy), highly impacted by the illegal fishery (prohibited since 1988) of the date-mussel *Lithophaga lithophaga* (Linnaeus, 1758) a mollusk considered a delicacy in many Mediterranean countries. Date-mussels live inside galleries that they bore in the rocks. The only way to collect them is to dismantle the rocks (Fanelli *et al.*, 1994). As a consequence, the biological covering of the marine substrate is eradicated, explaining why this fishery is considered as the most destructive of the entire planet (Dayton *et al.*, 1995). It has been shown that rocky substrates impacted by date-mussel fisheries may remain void of any biological covering for a long time with potential negative effects for fishes using this habitat for shelter, food, nesting and nurseries (Guidetti and Boero, 2004; Guidetti *et al.*, 2003; 2004). Because of the high catch (around 100 kilograms of date-mussels per day) the rate of depletion was two kilometres per year before the ban (Fanelli *et al.*, 1994).

The economic valuation of the rocky shore ecosystem in south-western Apulia should be carried out via the following steps:
1) identifying the ecosystem services provided by the rocky shore;
2) collecting quantitative data on mussel fisheries and on other fisheries lost each year and their market price or economic valuation (via revealed or stated preference techniques);
3) a cost-benefit analysis on a specific proposed policy.

If a protection plan were suggested, a cost-benefit analysis of the plan would show the economic feasibility of the proposal. In this case study the ecosystem services and benefits of the rocky shore in south-western Apulia are identified in Table 3. For each service/benefit, possible economic valuation methods are proposed, and some quantitative data currently available reported. The policy analysis would consider enhanced controls on illegal fishing of date-mussels.

Table 3. Ecosystem services and benefits of the rocky shore in south-western Apulia, Italy. Based on Table 19.2 of the Millennium Ecosystem Assessment (Reid, 2005: chapter 19), modified to avoid double counting of ecosystem services.

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	Fishing date mussels	Prohibition of date mussel fisheries	Quantitative data currently available
Provisioning services					
Food (date-mussel).	Market prices.	Approximated value of date-mussels based on the current price on the 'illegal' market.	+ The current price of date mussels in the illegal market can be used as a proxy for valuation purposes, but cannot be considered as a gain from an economic point of view because it is an illegal market.	- The loss of jobs related to this illegal activity could be taken into account by policy makers to avoid social conflicts.	?40.00/kg
Date mussel-driven tourism.			+ Italians travel to Albania to eat date mussels.	-	
Food (marketed fish).	Market prices.	This is an approximated value of the fish, molluscs, and crustaceans based on their current market price.	- Fish, mollusks, and crustaceans are deprived of their habitats (at various stages of their life cycles) so becoming rarer and less exploitable by fisheries.	+	
Medicines (potential).	Market prices (if any; or substitutes).	This is the price at which the drugs derived by the organisms, or the price of similar drugs, are sold.	- no drugs have been isolated from the organisms that live in the habitats affected by date mussel fisheries, but they might be in the future.	+	Currently no data are available.
Raw materials (sponges).	Market prices.	The market price of commercial sponges.	- Commercial sponges are destroyed.	+	
Regulation services					
Atmospheric and climate regulation (carbon dioxide control) depending on the scale.	Damage cost avoided.	This is the cost of carbon dioxide emissions (the price of carbon) based on the estimated damage because of CO_2 emissions (Pearce *et al.*, 1996; Tol, 2005; Stern, 2006).	- The destruction of biological covering impairs production of oxygen and consumption of carbon dioxide.	+	
Erosion control.	Market prices / damage cost avoided.	This can be either the price of artificial defence protection, if the rock is eroded, or the cost to avoid damages in absence of any coastal protections from the rock.	- Date mussels erode the rock and cause it to collapse; the biological covering retards the process, whereas fisheries accelerate it.	+	

Table 3. Continued

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	Fishing date mussels	Prohibition of date mussel fisheries	Quantitative data currently available
Cultural services					
Recreation, amenity and aesthetics (for illegal consumers).	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments).		+ These people are happy to find date mussels, and go to places where they can be found. This has a beneficial effect on the local economy, beyond the price paid for the date mussel meal (accounted for in another section). These persons travel to Albania just for this.	- These people are not happy with the ban on date mussels. They go to Albania where date mussels are available with no limitation, which contributes to the destruction of Albanese and Croatian habitats.	
Recreation, amenity and aesthetics for people who value environmental integrity.	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments)	This can be inferred by the cost sustained to travel to the area, or the willingness to pay of individuals to preserve/restore the area.	- Loss of tourists not willing to spend their vacation in a place where nature is being eradicated.	+ The restoration of the environment, if any, will attract sensitive people to environmental integrity (also with the presence of MPA).	
Cultural (possible cultural loss).	Survey of affected community.	People can be asked if they feel this loss and how much they value it.	- The "culture" of eating this dish is lost.	+ A culture of respect of nature is gained.	
Supporting services					
Nursery (other species not sold in the market).	Stated preference methods; benefit/value transfer.	This is the value people put on the fisheries that are not sold in the market but that have a function as biodiversity. The value can be obtained with a specific study or using previous studies (value transfer).	- Habitat destruction impairs the support provided to species of commercial interest such as fish, crustaceans and molluscs.	+ The stopping of habitat destruction might lead to an improvement in these services, even though full restoration seems difficult to obtain due to the presence of sea urchins which contribute to the persistence of barrens.	
Resilience/stability.	Non-monetary indicators.		- The removal of biological covering leads to barrens that are kept stable due to sea urchin grazing. Even the stopping of the fisheries does not lead to improvement because the barrens are then caused by sea urchin grazing.	+ This positive effect is real if the sea urchins are removed, for instance by allowing the growth of populations of fish that predate on the sea urchins.	

5.2 Case study 2 – Mediterranean coastal ecosystems and the prevention of jellyfish outbreaks damages

Mediterranean countries are facing more extensive and more frequent jellyfish outbreaks (CIESM, 2001). The analysis of possible benefit/loss due to jellyfish outbreaks is done by examining their impacts on coastal ecosystem services (see Table 4). At high densities, jellyfish

Table 4. Impact of jellyfish outbreaks on coastal ecosystem services.

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	With jelly fish outbreaks	Without jelly fish outbreaks
Provisioning services				
Food (sea food).	Market analysis.	This is an approximated value of the fish, molluscs, and crustaceans based on their current market price.	- Diminish and damage seafood availability.	+ Some large species of jellyfish are consumed in SE Asia.
Coastal installations.	Damage cost avoided.	This is the cost to be sustained if jellyfish enter seawater intake pipes in coastal installations.	- Clearing jellyfish from intake pipes; stoppage of seawater cooles power plants.	+
Regulation services				
jellyfish stings.	Cost of illness and loss of earnings.	Costs of medical treatment of jellyfish stings, and earnings lost by patients	- Painful stings, can lead to hospitalization and scarring.	+
Human mortality from jellyfish stings.	Costs of premature mortality as value of statistical life.	This value is subject to estimation.	- Possible but too rare to be of concern.	+
Cultural services				
Recreation, amenity and aesthetics.	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments).	This can be inferred by the cost sustained to travel to the area, or the willingness to pay of individuals to preserve/restore the area.	- See the text for reference.	+ See the text for reference.
Cultural (perceived loss of beach amenity and cultural symbolism).	Survey of affected communities.	People can be asked if they feel this loss and how much they value it.	- If the jellies are stingers.	+ A potential for attraction.
Supporting services				
Nursery (other species not sold in the market).	Stated preference methods; benefit/value transfer.	Value of the bycatch fisheries that have a function as biodiversity.	- Jellies may cause the depletion of fish populations.	+
Resilience/stability.	Non-monetary indicators.		- The ecosystems may be dominated by dinoflagellates and procaryotes (e.g. bacteria that cause mucilage events).	+

may cause the ecosystem to shift towards states that are usually not considered as positive for humans (Boero *et al.*, 2008). Jellyfish prey on zooplankton, including fish eggs and larvae, and at the same time compete with fish for the same food resources. Large annual jellyfish shoals are vast consumers of zooplankton and, especially in the more oligotrophic parts of the sea, may have dramatic impact on the fisheries. The loss to commercial fisheries stems from predation and competition on the fish stock, prevention of certain modes of fishing (trawling, purse seining) during shoaling periods, difficulties in sorting the catch and damaging it. When the shoals are driven ashore they can clog the seawater cooling systems of power plants, leading even to local interruption of electricity supplies (Galil *et al.*, 1990; 2007). The venomous stinging cells of certain jellyfish species harm humans. The native mauve stinger, *Pelagia noctiluca*, and the Erythrean alien, *Rhopilema nomadica* Galil, 1990, inflict painful stings that may necessitate medical treatment (Galil, this volume), and increase costs of illness and loss of earnings. Jellyfish outbreaks negatively affect tourism and reduce the recreational attractiveness of entire coastlines. Some cultural loss may be involved considering that the locals' traditional recreational use of the beach is replaced by swimming pools or shopping malls.

5.3 Case study 3 – The non-market value of a charismatic species: application to the Mediterranean monk seal

There are quite a few examples of species that have dramatically greater appeal to humans than others. These species are immediately identifiable by name and often have some charismatic or symbolic attributes. They are commonly associated with a particular geographic location or habitat. Because of this association between the species and their habitats, these charismatic species are also sometimes referred to as "flagship" species. For humans, they are the leading representatives of the habitats from which they derive.

Meta-analyses of the willingness to pay for individual species have shown a significant preference for a few charismatic species relative to the vast majority of species. Flagship species are often used as representatives of the general problem of habitat transformation and biodiversity conservation. For example, conservation organizations often focus their appeals for funding around the plight of a particular charismatic species. These species are thus not just highly valued for themselves, but also highly valued as representative of entire ecosystems. In other words, the demand for individual species conservation can be either a complement to or a substitute for the demand for habitat conservation.

A valuation study considered the willingness to pay for the endangered Mediterranean monk seal (*Monachus monachus*) in the island of Lesvos, Greece. In spite of numerous restrictions, regulations and conservation measures imposed by Greek authorities, the seals are killed by inshore fishermen because they damage fishing gear whilst trying to extract fish from fishing nets. The problem can be seen as an example of competition between fishermen and seals for the fish resource.

The mean willingness to pay to help preserve the seals was estimated at 12 Euros but, interestingly, only 5% of this amount was associated with use value (Langford *et al.*, 1998; 2001). The authors of the study are skeptic about the use of their study to help preserve the species, although the positive side of this study is that people express their willingness to pay for a species even though they expect never to get in direct contact with a seal at sea. Another question is whether the conservation of monk seals will help preserve other less charismatic species.

6. Glossary

The workshop participants decided early on to draw a list of terms commonly used in their discussions so as to make sure that both economists and environmental biologists used the same semantic references.

alien (non-indigenous) species: a species living outside its known natural range, introduced intentionally or unintentionally by humans.

amenity: any tangible or intangible benefits of a property or a place, especially those which increase the attractiveness or value of the good or which contribute to its comfort or convenience.

assets: something possessed by an entity from which future economic benefits may be obtained. Everything owned by a person or company (all tangible and intangible property) that can be converted into cash.

attractor: a set to which a dynamical system evolves after a long enough time. In an ecosystem, an attractor would be the endpoint of ecological succession towards which any state of that ecosystem will evolve to, in the absence of disturbance.

bequest value: the personal or social benefit received by the present generation from leaving a resource for future generations to enjoy or use.

biodiversity: the full range of natural variety and variability within and among living organisms, and the ecological and environmental complexes in which they live; it includes genetic diversity within species, the diversity of species in ecosystems, and the diversity of habitats and ecosystems.

biodiversity asset: a living entity or group of entities that is of (perceived) value to humans.

common and public goods: goods that are non-rival and non-excludable. This means that consumption of the good by one individual does not reduce the amount of the good available for consumption by others; and no one can be effectively excluded from using that good. A public good is one which, if made available to one person, automatically becomes available to all others in the same amount.

carrying capacity: the maximum number of organisms that can be supported in a given area or habitat.

consumer surplus: an estimate of total economic benefits from consuming a good or service. It is measured by the maximum willingness to pay over and above the actual cash cost of consumption.

contingent valuation: a technique used in the valuation of environmental goods, to estimate either the willingness to pay for an improvement in the quantity or quality of some environmental good, or the willingness to accept compensation for the deterioration in environmental provision. It is an analytic survey technique that relies on hypothetical situations to place a monetary value on goods and services.

cost-benefit analysis: a process to assess the desirability of public interventions ex-ante. Benefits and costs are estimated by taking into account both private and external impacts of the intervention.

discount rate: rate at which the future value is discounted to estimate the present value.

ecosystem: the entire biological and physical content of a biotope interacting as an ecological unit (including humans).

ecosystem function: basic ecological processes necessary for the self-maintenance of an ecosystem (such as primary production, nutrient cycling, and decomposition) and all the evolutionary processes contributing to the basic ones (e.g., species interactions).

ecosystem services: the fundamental life-support services provided by ecosystems; the benefits people obtain from ecosystems; these include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

endemic species: species native of and restricted to a particular geographical region.

existence value: value from knowledge of continued existence based on moral conviction.

externalities: the impact of one person's actions on the wellbeing of a bystander (can be positive or negative). A side effect or consequence of industrial or commercial activities that affects other parties without this being reflected in the costs of the goods and or services involved.

goods: any object, service or right that increases utility, directly or indirectly, not to be confused with the adjective "good" as used in a moral or ethical sense. Goods and services are those things produced by human or nature that yield benefits or increase our well being. They may be tangible or intangible.

habitat: the environment on which a given species or ecological community depends for its survival. The environment can be physical (e.g., rocky reefs, marine caves) or created by living organisms (e.g., seagrass meadows, deep coral banks).

instrumental value (or extrinsic value): the value of objects, both physical objects and abstract objects, not as ends-in-themselves but as means of achieving something else.

intrinsic value: the inherent worth of something, independent of its value to anyone or anything else.

invasive species: an alien species whose population has undergone exponential growth and is extending its range.

linearity: attribute of a system in which causes of a given size produce effects of proportional size. Linear systems are predictable, if initial conditions are known.

marginal changes: small incremental adjustments to a plan of action.

marginal cost: the increase in total cost associated with the production of an additional unit of the good produced. Marginal cost = Change in total cost / Change in quantity produced.

marginal damage: the damage caused by an additional unit of disturbance (e.g., pollution).

market failure: a situation in which a market left on its own fails to allocate resources efficiently.

marginal revenue: the contribution to total revenue associated with the production (and selling) of an additional unit of the good produced by the firm. Equals change in total revenue / Change in quantity produced.

maximum sustainable yield: the maximum yield that can be harvested from a renewable resource stock without reducing the size of the stock.

market value: price at which an asset would be traded in a competitive setting.

non linearity: a system whose functioning cannot be modeled as a linear sum of independent variables. Non linear systems are extremely sensitive to initial conditions.

non renewable resources: resource that exists in a fixed amount (stock) in various places in the earth's crust and has the potential for renewal only by geological, physical, and chemical processes taking place over hundreds of millions of years.

opportunity cost: what must be given up to obtain a certain item. It is the second best alternative foregone.

phase: a distinct period in which a given system maintains its features either by remaining stable or by undergoing cyclical changes along a predictable sequence of events (e.g. seasonal cycles).

phase shift: an abrupt transition from one ecological state to another (i.e. from top-predator dominated food web to a gelatinous predator dominated one).

price: the intersection of supply and demand. The amount of money or goods asked for or given in exchange for something else.

private benefits: benefits that are obtained directly by the consumer from its consumption activities or by the producer in its production activities.

private costs: costs that are directly supported by the consumer in its consumption activities or by the producer in its production activities.

property rights: set of rights that ensures/allows the specific use/management of a renewable or a non-renewable resource.

renewable resource: a natural resource that is replenished by natural processes at a rate comparable or faster than its rate of consumption by humans or other users.

scenarios: account or synopsis of a projected course of action, events or situations. Scenarios are widely used to understand different ways in which future events might unfold.

social benefits: all benefits created by a consumption activity or a production activity. Equals private benefit + external benefit.

social costs: all costs involved in a consumption activity or a production activity. Equals private cost plus external cost.

sustainable development: economically viable development that does not result in the degradation of the environment, and loss of resources or native biodiversity; it must not compromise the welfare of future generations for the benefit of present generations.

threshold: the minimum level or value of a stimulus necessary to illicit response.

use value: the value people place on the actual use of an environment.

value: the preferred end-states of existence, which taken together circumscribe human well-being.

willingness to pay: the maximum amount that a buyer will pay for a good.

I - Executive Summary of CIESM Workshop 37

"Economic valuation of natural coastal and marine ecosystems"

by

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1. Introduction

The workshop took place from 22 to 25 October 2008 in Bodrum, the ancient Halicarnassus of historical fame, now a major touristic center on the Anatolian coast. An original mix of resource economists and marine biologists from eight countries (see list at the end of volume) attended this four-day exploratory seminar at the invitation of CIESM. As Dr Frederic Briand, Director General of the Commission, and Dr Enric Sala, Chair of the CIESM Committee on Coastal Systems, made clear in introducing the meeting, the choice of the venue was deliberately set on a prime touristic destination of the eastern Mediterranean, illustrating both the economic benefits derived from very attractive shores and the significant environmental costs associated with huge tourism and market pressure.

Obviously the challenge of ensuring the sustainability of fragile, highly impacted coastal habitats is too complex to be the exclusive province of economists and ecologists, but it requires that both sets of experts at least exchange their own vision of a world-wide problem and assimilate the 'peculiar' language of the other at the scale of the Mediterranean. That objective alone was worth the voyage but the meeting went beyond by reaching areas of consensus on the multi-dimensional nature of the issue and on the set of tools that looked most promising.

2. Definition of issue – *"Economic valuation of natural coastal and marine ecosystems"*

Scientists have been warning about the impacts of human activities on ecosystems and about their repercussions on humans for decades (climate change is a great example), but a precautionary approach to management has not been adopted yet. A major reason is that natural ecosystems have typically been perceived as renewable, exploitable resources to be used for human benefit, and most people take for granted the many vital services that marine ecosystems provide for our well-being. This wrong perception is starting to change although marine ecosystems are still considered by many as less vulnerable and inexhaustible despite clear warning signals (see for example Sala and Knowlton, 2006; Worm *et al.*, 2006).

Because of the growing disconnect between humans and the natural world, the services provided by marine ecosystems are often ignored, and therefore their intrinsic value is poorly appreciated. Marine biodiversity is inherently irreplaceable, and its intrinsic value cannot be expressed in monetary terms. In contrast, the instrumental value of marine biodiversity, estimated as the services that marine ecosystems provide, can be defined in terms that most people relate to (see Table 1). Valuation is a compromise, it is not about absolute values (any economic valuation of marine ecosystem services will be an underestimation), and it should be considered as a process, which empowers stakeholders in decision making.

Table 1. Summary of ecosystem services and their relative magnitude provided by different Mediterranean marine habitats. The larger circles represent higher relative magnitude (adapted from Agardy and Alder, 2005).

Direct and Indirect Services	Beach-dune systems	Estuaries and marshes	Littoral hard bottom habitats	Seagrass beds	Pelagic (offshore) waters	Deep Sea
Food	•	●	⬤	●	⬤	
Fiber, timber, fuel	●	●	•			
Medicines		•	•			⬤
Biodiversity	•	●	⬤	●	●	●
Biological regulation	●	●	●	●	●	●
Freshwater storage & retention	•	•				
Biochemical		•		•	●	●
Nutrient cycling & fertility	●	●	●	⬤	●	⬤
Hydrological	•	●				
Atmospheric & climate regulation	•	●	•	●	⬤	•
Waste processing	●	⬤	•	•	⬤	⬤
Flood/storm protection	⬤	⬤	•	⬤		
Erosion control	⬤	●		●		
Cultural and amenity	⬤	●	●	•		
Recreational	⬤	⬤	⬤	●	•	
Aesthetics	⬤	●	⬤	●		

For instance, the Mediterranean Sea has served the riparian countries for waste disposal, decomposition and detoxification, but we have never internalized the true cost of these processes in economic models. The region generates large volumes of wastewater, with urban water alone accounting for about 38×10^9 m^3/year (UNEP/MAP, 2004). Wastewater also comes from industry and agriculture and includes toxic, persistent and bioaccumulable pollutants. Economic instruments can be used to estimate the value of the capacity of the Mediterranean ecosystem to dilute, disperse and break down pollutants. The cost of effluent management, from prevention and minimization to rectification and effluent re-use, to a level similar to that already provided by the Mediterranean ecosystem is the true value of that service.

What are the challenges of conducting economic valuation of marine ecosystems? The uses of marine ecosystems differ from those of terrestrial ecosystems, and the economic valuation of their services is difficult. For instance, while hunting land animals as the main source of protein for humanity was abandoned by most societies thousands of years ago, marine fisheries continue an industrial-scale hunting operation. According to recent statistics, aquaculture delivers an amount of protein comparable to wild fisheries (FAO, 2006), but aquaculture is not true farming since much of the feed of farmed fishes is fishmeal obtained from wild fisheries, thus further reducing natural resources. Property rights are not clearly established in the sea, and activities in the high seas outside of the exclusive economic zones are generally not properly regulated. Finally, access to underwater habitats is limited in time and space, impeding a greater understanding of the functioning of marine ecosystems and of the impact of human activities. Therefore, importing the paradigms, assumptions and methods used on land to marine systems may not be appropriate. CIESM Workshop 37 explored the challenges and opportunities of economic valuation from the perspective of Mediterranean marine ecosystems.

3. Tools and perspectives

3.1 Values, environmental damage and valuation

Ecosystem services play a crucial role in offering a wide range of benefits, and are therefore important steering forces of human well-being. The Millenium Ecosystem Assessment (Breitbart *et al.*, 2002) distinguishes four broad categories of benefit: provisioning services, cultural services, regulating services and supporting services.

Monetary value assessment of marine ecological damage has its foundations in welfare economics since it establishes the concept of marine ecological value in terms of its impact on the welfare of human beings. In a conceptual framework, one can define the total value (TV) of the damages in terms of the use value (UV) and non-use value (NUV) (Figure 1). The use value component refers to the set of damages that arise from the actual impact of the marine ecological damage. These damages can be further divided into direct use, indirect use, and option use value, respectively DUV, IUV and OUV. Direct use values of damages include: (a) the loss of marine tourism and coastal recreation benefits; (b) the loss of natural and cultured marine species with commercial value, and (c) the value of risks to human health. Indirect use values of damages refer to damages that relate to the functioning of the marine ecosystem and the survival of marine living resources, even if these have no direct commercial value.

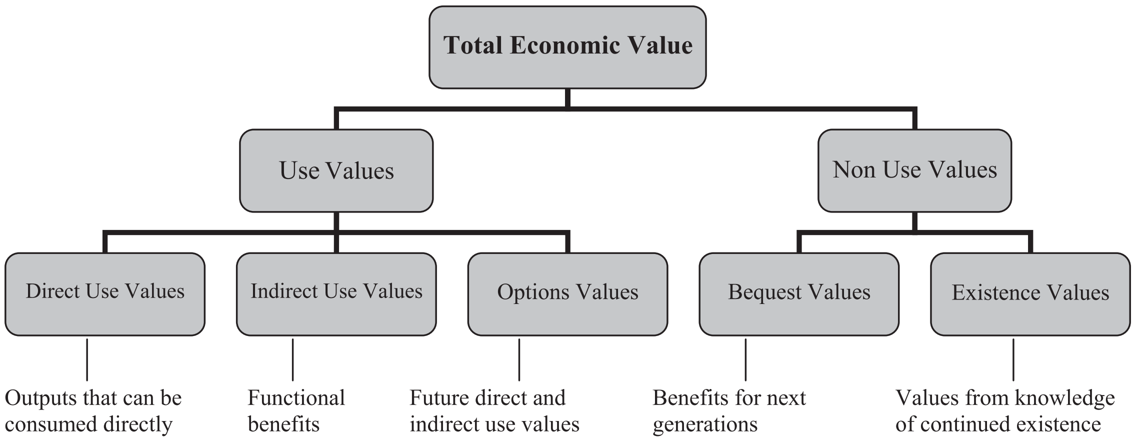

Figure 1. Types of values of marine ecosystems, including instrumental values and intrinsic values (adapted from The World Bank, 1998).

Non-use values of damages can be divided into a bequest value (BV) and an existence value (EV). Bequest value refers to the benefit accruing to any individual from the knowledge that future generations might benefit from a marine ecosystem being free from marine ecological damages. Existence value refers to the benefit derived simply from the knowledge that marine species are protected without even being used. This leads to the following equation

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

Note that non-use values of damages have a public good character, i.e. they do not have a market price. As a consequence, market price evaluation of marine ecological damages provides an undervaluation of the associated negative impacts. This can be interpreted as signaling a misallocation of financial resources in marine prevention, restoration or amelioration programs. An accurate and complete monetary assessment of environmental-economic damages requires the application of specific monetary valuation tools. In the absence of market prices, economists use specific monetary valuation techniques to measure use and non-use damages. Since the consequences of marine ecological damages are multifaceted, the techniques must cover a broad range of effects, including economic, cultural, and ecological effects (Nunes *et al.*, 2000). The tools that have been identified in the literature are hedonic pricing, aggregate market analysis, contingent valuation, the travel cost method, production functions, and the averting behavior method (Nunes and van den Bergh, 2001). Most of these tools have seen few applications to value marine ecological damages. Bearing in mind both the described damage categories and the scope of each valuation technique, it is possible to suggest the most suitable valuation methodology for each value or damage type (Table 2).

Table 2. Classification of marine ecological damages and appropriate valuation techniques.

Economic Value		**Examples of damages**	**Most suitable valuation technique**
Use value (UV)	Direct use value (DUV)	Loss of tourism and recreational benefits (e.g., visits to the beach, sport fishing, swimming and sailing)	Travel cost method, contingent valuation
		Destruction of marine living resources with commercial value, e.g. fish (codfish, salmon), shellfish, mollusk	Aggregate price analysis*, hedonic pricing
		Risks to human health, e.g. food poisoning	Averting behavior method, contingent valuation
	Indirect use value (IUV)	Effects on marine ecosystem health (e.g., changing local chemical composition of the water, toxicity accumulation along the food chain, loss of biodiversity)	Production function method, averting behavior method
	Option use value (OUV)	No insurance that marine coastal areas are free from HABs (e.g., beach with foams during tourist season)	Travel cost method, contingent valuation
Non use value (NUV)	Bequest Value (BV)	Risk of loss of legacy benefits (e.g., no legacy of marine species for future generations)	Contingent valuation
	Existence Value (EV)	Risk of loss of existence benefits (e.g., no knowledge guarantee that some marine species are locally extinct)	Contingent valuation

*Also known as a market price valuation technique.

As one can see, contingent valuation (CV), a survey based valuation technique that is widely used in the context of environmental valuation (Carson *et al.*, 1992; Nunes and de Blaeij, 2005) can fulfill an important potential role in the overall assessment of damages. Indeed, it can be applied to assess the monetary value of most types of damages, and it is the only valuation method that is capable of shedding light on bequest and existence values related to marine ecological damages. In addition, CV has the advantage that marine policies may be valued even if they have not yet been adopted or lie outside current institutional arrangements. Thus, it offers much scope and flexibility for specifying different restoration and amelioration programs. For monetary value assessment of the damages to ecosystem health however, CV does not emerge as the most suitable valuation technique. This is because the involved effects cannot be easily described in a questionnaire survey (e.g. toxicity accumulation along the food chain) and are often related to complex issues with which the general public is unfamiliar.

If the marine ecological damage is reflected in the output of an economic activity such as fishing, the production function method provides a suitable alternative. This method translates physical changes in relationships between environmental inputs and economic outputs through markets prices, production costs, profits and producer and consumer surpluses into damages values. An example is the mass mortalities of commercial fish caused by harmful algal blooms that produce a toxin (also known as 'fish killers'). Finally, monetary value assessment of tourism and recreational damages can be performed by using the cost of travelling to a non-priced coastal site (Nunes and van den Bergh, 2004). Questionnaire surveys are used to collect data on the number of visits that the household makes to the site, on the money spent in travel time and on costs of gaining access to clean beaches, free from foams and repellent odors.

3.2 The challenge of evaluating biodiversity

The shortcomings of evaluating biodiversity are manifold, in addition to the ethical problem of doing so. Many species are yet unknown, and we cannot evaluate the unknown. A potential mechanism for assigning value to species could be to measure the role of the species in the ecosystem, “keystone“ species (those with the strongest per capita interaction strength in the community) or “foundation“ species (those providing a key architectural role) being the highest valued. The problem is that the roles of most species are unknown.

We may put forth the argument that species should be valued equally. However, our perception of value depends on the characteristics of the species in question. If we had to choose between an inconspicuous and unknown species that is the sole representative of a family (such as the Mediterranean hydrozoan *Tricyclusa singularis*), and a large commercially important species that has close relatives in the same region (such as the Mediterranean dusky grouper, *Epinephelus marginatus*), the general focus would be on the large, charismatic grouper. Charismatic species are given great emotional and even monetary value. Such “triage“ is based upon subjective 'beauty', commercial interest and familiarity. However, biodiversity can be valued through its impact on the ability of ecosystems to provide services (see Reid, 2005).

3.3 Modeling vs. scenario building

Economic valuation, and in particular stated preference methods, requires models to forecast the impact of a particular activity on the environment and the economy. Unfortunately a major intrinsic barrier to communication between ecologists and economists makes valuation difficult. Ecologists tend to believe that they are expected to produce accurate forecasts for their part and economists do not understand why a good number of ecologists are uncomfortable making forecasts while others do so even with systems that are highly nonlinear. While traditional linear models are impractical for forecasting, non-linear forecasting models have been shown to predict future outcomes with more success (Sugihara and May, 1990). A limitation is that they require relatively long time series, which are largely missing in the marine ecological realm.

An alternative to quantitative forecasts is scenario building, which consists in postulating a sequential series of events by using verbal models, graphic models, or both. Scenarios do not pretend to predict the future with accuracy but, being more flexible than mathematical models, allow for weak inference on what might happen in the future. They are working hypotheses, and also negotiating tools between stakeholders. The Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment have been successful in building multiple scenarios based on a range of human activities, and by combining quantitative models and qualitative assessments.

Several issues make it difficult for valuation studies to be fully acceptable by decision makers:

a) Welfare change vs. monetary change: the idea that one can put on balance fishermen's loss vs. society benefit through willingness to pay (WTP) sounds odd to most decision makers. While fishing losses are given in “real“ terms, WTP is also given in monetary units but is a mere reflection of benefits, not real currencies.
b) In order to estimate non-use values, one has to rely on stated preferences which are hypothetical by nature. This by itself causes decision makers to hesitate.
c) Even if we accept the hypothetical nature of the analysis, there is still the standing issue. Non-use values are associated with people that did not visit the area concerned and probably will not in the future. The idea to take those individuals into account sounds odd to most decision makers. This is also related to the issue that follows.
d) While the costs of nature protection are concentrated with a small group (e.g., a group of fishermen), the benefits are spread over a much larger number of people. Therefore, even if the benefit of preservation is higher in total, the average benefit per capita will generally be lower than the average cost. In such cases lobbying will be stronger in the group who is standing to lose.

3.4 Non-linearity and thresholds

One highly challenging aspect of economic valuation of marine ecosystems is the non-linearity of ecological-economic systems. Much classical theory in both disciplines relies heavily on locally linear methods to estimate stability and times of return to equilibria, thereby ignoring many phenomena of overriding importance such as the potential for catastrophes.

The most extreme form of convex relationships is a threshold. In a non-linear systems, small perturbations can become magnified and lead to qualitatively unexpected behaviors at macroscopic levels. Identifying the thresholds, or tipping points, on which one system shifts from the influence of one ecological attractor to another is thus essential for evaluating the impacts of human activities on marine ecosystems. Furthermore, an ecological phase shift is associated with a shift in value. Therefore, unpredictable, putative future phase shifts may make estimation of present value impractical, and present serious problems for management.

For instance, an unexpected consequence of overfishing is that fish could be replaced by jellyfish. This, in turn, will cause a further decrease in fish abundance, since jellyfish feed on fish larvae and their planktonic food. Until recently jellyfish had never been considered in fisheries models (Boero *et al.*, 2008); only now are they starting to receive proper attention (Pauly *et al.*, 2009). What is the threshold leading to the shift from a fish to a jellyfish coastal sea? Is this shift reversible? Are there any management actions that can be implemented to help reverse this shift?

Is it possible to predict the timing and location of thresholds and thus estimate the present value of marine ecosystem services more accurately? In general, it is difficult to detect strong signals of change early enough, and so to develop scientific consensus in time for implementing effective solutions. The quantification of thresholds requires knowing what keeps a system into a more or less predictable domain where changes are mostly fluctuations (e.g. seasonal fluctuations) and not variations (i.e. the emergence of a new attractor, leading to a new condition). But typically the passage from one attractor to another is determined by an episodic, often unpredictable event (Boero *et al.*, 2008). The identification of trends, however, allows for some weak inference about the future.

The concave non-linearity case offers different challenges. We refer here mainly to what is defined in economics as the marginal benefit, and the marginal cost, of preservation. The interrelationship of ecosystem structure, function, and economic value is also of great importance to decision makers who are often concerned with how much natural habitat to “preserve“ and how much to allocate for economic development. In assessing such trade-offs, it is frequently assumed that ecosystem services change linearly with critical habitat variables such as size. This assumption can lead to a misrepresentation of the economic values inherent in the resources; it can overestimate or underestimate the service value, resulting in an “all or nothing“ habitat scenario as the only decision choice. A common reason for invoking such an assumption is that few data exist for examining the marginal losses associated with changes in nonlinear ecological functions, making it difficult to accurately value the changes in ecosystem services in response to incremental changes in habitat characteristics.

An example of misuse of the linearity assumption is provided in this seminal paper of Costanza *et al.* (1997) which attempted to estimate the total value provided by the world’s ecosystem services. This value was estimated at about three trillion USD, three times the world’s GDP at that time. However, the analysis overlooked the non-linearity of the ecological system, assuming that each ecosystem unit is worth the same. Economic analysis would measure the benefits and costs of preservation only at the *margin* and not on *average*. In the case of mangrove preservation in Thailand, it was shown (Barbier *et al.*, 2008) that total preservation results in a net loss to society vs. only partial preservation when devoting the other part to shrimp farming. This is precisely because of the concavity relationship: it turned out that the last units of mangroves were worth less than shrimp fishing while the other units were worth more.

In summary, taking benefits and costs at the margin is more likely to get support from the general public. However, one must be careful not to apply the concavity case when one is in the convex part. To avoid this, a very important challenge for ecologists will be to understand better where the non-linearity actually occurs; that is, where thresholds are. When we will have a better understanding of the issue, valuation studies will be better accepted in the concave range.

3.5 How to evaluate highly complex systems?

In addition to the unpredictability of chaotic dynamics, marine ecologists have to deal with very complex ecosystems composed of thousands of interacting species. The good news is that, while individual species may have chaotic dynamics, food webs have emergent properties that can be predictable and change in understandable ways at the ecosystem level. For instance, prohibition of fishing in a marine reserve causes populations of target species to increase in abundance, but their prey may consequently decrease over time. The relative abundance of different target species will also change with time along a process called ecological succession, and total biomass will often increase, unless an event (e.g., fishing in the reserve) reverses the predictable ecological trajectory. It is very important to understand that, while the abundance of individual species may not be predictable over time, there are emergent properties that can be forecast with more certainty as long as the system remains under the influence of a known attractor. Economic valuation will require that ecologists identify the minimum number of parameters (dimensions of the ecosystem) that can explain the general behavior of the ecosystem and allow for reliable modeling and scenario-building. Linking food web and ecosystem theory with empirical marine ecology will be fundamental to achieve this goal.

3.6 The syndrome of the shifting baselines

Our perception of what is a natural environment changes across generations: we believe that what is natural is what we experienced at an early age, or the first time we visited a place or ecosystem. As humans increasingly degrade the environment, our expectations of what is natural are lowered (Pauly, 1995). Thus, our baseline of what is natural slides across generations. The problem is that baseline shifting affects evaluation of environmental states and changes by scientists as well as by other people, paving the way for lower valuation of marine ecosystems' services.

The effects of shifting baselines can be exacerbated by modern production techniques that alienate end-consumers from marine ecosystems, so that they do not perceive the changes in the environment. For instance, because of economic subsidies and imports of seafood from other seas, Mediterranean populations have not yet realized that fish stocks are plummeting. Society and culture will also shape the perception of the desired state of the environment. The greater environmental awareness in some countries has also reshaped our perception of value of marine life. For instance, when Moby Dick was written, the hunted whale was typically perceived as evil and dangerous; whereas today many readers would consider the whale hunter as cruel.

Certain economic models formulate past consumption as complement to present consumption capturing in that way the effect of shifting baselines on valuation. But how to account for baseline shifting in valuation studies? Does environmental change coincide with variance in valuation across respondents' age (in surveys), knowing that those exploiting a resource are more likely to perceive a change in real time than end-consumers detached from the natural environment?

3.7 Developing a new common toolkit in a fast-changing world

To cope with the new challenges imposed by the complexities of global change, an interdisciplinary approach integrating science, economics and sociology is needed. This new approach includes techniques such as the DP-S-I-R (Driving Pressures-States-Impacts-Response), and increased focus on ecosystem services. The analysis of driving pressures on an ecosystem and their impacts on the environment and on society requires fundamental information both from the ecological and the sociological side. Economics, through the valuation of the ecosystem services involved, provides an important component of this interdisciplinary decision support system.

In this context, an important question is when and where the valuation of ecosystem services fits into existing environmental policies. Whenever possible, environmental impacts should be valued in monetary terms. Where this is not possible, these impacts should be expressed either in quantitative terms or as a mere qualitative assessment of potential impacts.

The joint initiative in regard to the global economic benefits of biodiversity and the costs of ecosystems degradation (European Communities, 2008) proposed a valuation framework as a future policy toolkit for policy-makers and practitioners. Combined with practical guidebooks (DEFRA, 2007), the approach could be as follows:

• **Establish an environmental baseline to examine the causes of biodiversity loss:** ecosystem services are identified and grouped into functional categories (provisioning, regulating, cultural and supporting). A quantitative and/or qualitative assessment of the potential impacts of human activities on ecosystem services requires a rigorous baseline against which to assess putative changes expected from different policy options.

• **Evaluate alternative policies by quantifying the impact of policy options on specific ecosystem services:** this approach is also used on impact assessments and cost-benefit analysis to ensure that decision-makers can make informed decisions on the basis of a systematic analysis of all the implications of various policy choices. While the focus of valuation should be on marginal changes rather than on the "total" value of an ecosystem, it is important to take a broad view of the ecosystem and the spatial scale of possible impacts.

• **Assess the costs and benefits of actions on human welfare:** the analysis will need to assess the effects of changes in the identified ecosystem services. It is important to note that there could be both costs and benefits for human welfare. As some services might be incompatible (e.g. water extraction and groundwater recharge), combining these values would over-estimate the ecosystem services.

• **Consider the distribution of impacts of ecosystem services loss and conservation:** the beneficiaries of ecosystem services are often not the same as those who incur the costs of conservation ('positive externalities'). Mismatches can lead to taking decisions that are right for some people locally, but wrong for others and for society as a whole. In the name of effective and equitable policies, these spatial dimensions should be recognized and corrected with appropriate tools, such as payments for ecosystem services and redistribution to those who actually maintain these services.

4. Governance

The Mediterranean basin is a complex geopolitical system involving 21 countries, which implies several layers of governance with different degrees of overlap. Like ecosystems, local societies are complex: they may be multi-level and include competing groups and different interests by social and ethnic groups, as well as gender and age discrimination. These complex communities are embedded in larger complex systems at national, regional, and global scales, with accelerating changes that influence both property rights dynamics at the local level, the role of traditional governance, and social values. Among others, the case of the tuna fishery in the Mediterranean (Fromentin and Powers, 2005) exemplifies a shift from artisanal to industrial fisheries, and from regional to international actors.

The general shift from subsistence and livelihood use of local resources towards the pursuit of economic growth and international markets created rifts among local communities and also conflicts with the outside world, as the interests of Mediterranean communities have been colliding with the interests of a larger system of resource users. The increase in the spatial scale of resource use increases the heterogeneity of users, inducing commons governance to become multi-scale and multi-jurisdictional.

The functioning of the Mediterranean ecosystem (including humans) is source of debate, making difficult consensual agreement over the future of the region. Scenario-building should be a tool to stimulate dialogue about external pressures and internal dynamics of the sub-region or locality, to help build capacity for resource management. Besides vulnerabilities, the scenario planning should also reveal previously unconsidered opportunities for enhanced learning and collaboration among the many associations and organisations that work in the same area or on the same type of system (e.g., marine protected areas) in each of the Mediterranean sub-regions (see Becker, this volume). Throughout this planning process, economic valuation is likely to contribute to building a common background not only within communities but also between scientists, managers and policy-makers.

Environmental and resource management is a socio-political undertaking (Nadasdy, 2007). At the beginning of the twentieth century, state wildlife management was linked to the expansion of state power and new forms of governance will need to build trust by seriously considering culture and identity. In this context four categories of factors, identified by Folke *et al.* (2003) for building resilience in social-ecological systems are relevant:
(1) learning to live with change and uncertainty: in a changing, non-linear world, accurate forecasts are unlikely;

(2) nurturing diversity as a means of ensuring greater options for renewal and reorganization: diversity, in fact, contains the possibility of unexpressed solutions to unforeseen problems, from rare species to unhorthodox social-economic practices, preadapted to future conditions;
(3) combining knowledge types to enhance learning: for instance the blend of scientific and traditional culture has much to offer;
(4) creating conditions and opportunities for self-organization.

Social dynamics are as difficult to predict as ecological dynamics, due to the diversity of human values, the rapid pace of social change, and the reflexive nature of people (Westley *et al.*, 2002). Cooperation between different populations, organizations, and types of management requires mechanisms for linking social and ecological knowledge, such as the history of coastal uses, with more universal knowledge, such as the dynamics of sediment accretion/erosion cycles (see Scapini, this volume). This requires that stakeholders have some minimal level of trust in one another, and some shared vision of the management issues that they face.

In the Mediterranean, a variety of cross-scale ecological issues, like the spread of invasive species (see Galil, this volume), and a lack of ecological regional management emphasize the need for trusted mechanisms linking local and more general socio-ecological knowledge.

To quote Berkes *et al.* (2007) “Resource management is at a crossroads. Problems are complex, values are in dispute, facts are uncertain, and predictions are possible only in a limited sense. The scientific system that underlies resource management is facing a crisis of confidence in legitimacy and power. Top-down resource management does not work for a multitude of reasons, and the era of expert-knows-best decision making is all but over“. Stakeholders’ values and expectations must be properly identified and communicated to policy makers. Stakeholders are more likely to participate in management if the policies and strategies are generated by their direct contribution. Although participatory management is costly in terms of money and time, this approach is sine-qua-non for fair distribution of cost and benefit of valuation of environmental resources (Tosun, 2006). In complex, adaptive systems, disequilibrium and surprise are the rule, and failure is as instructive as success. “The devil is not just in the details, it’s in the dynamics“ (Westley, 2002).

5. Case studies of Mediterranean ecosystem services valuation

This section presents three case studies exploring the valuation of (1) rocky shore habitats threatened by illegal date-mussel fisheries, (2) coastal ecosystems affected by jellyfish outbreaks, and (3) a charismatic species that has no market value.

5.1 Case study 1 – Destructive date mussel fishery on rocky habitats

This study considers the case of the rocky shore in south-western Apulia (SE Italy), highly impacted by the illegal fishery (prohibited since 1988) of the date-mussel *Lithophaga lithophaga* (Linnaeus, 1758) a mollusk considered a delicacy in many Mediterranean countries. Date-mussels live inside galleries that they bore in the rocks. The only way to collect them is to dismantle the rocks (Fanelli *et al.*, 1994). As a consequence, the biological covering of the marine substrate is eradicated, explaining why this fishery is considered as the most destructive of the entire planet (Dayton *et al.*, 1995). It has been shown that rocky substrates impacted by date-mussel fisheries may remain void of any biological covering for a long time with potential negative effects for fishes using this habitat for shelter, food, nesting and nurseries (Guidetti and Boero, 2004; Guidetti *et al.*, 2003; 2004). Because of the high catch (around 100 kilograms of date-mussels per day) the rate of depletion was two kilometres per year before the ban (Fanelli *et al.*, 1994).

The economic valuation of the rocky shore ecosystem in south-western Apulia should be carried out via the following steps:
1) identifying the ecosystem services provided by the rocky shore;
2) collecting quantitative data on mussel fisheries and on other fisheries lost each year and their market price or economic valuation (via revealed or stated preference techniques);
3) a cost-benefit analysis on a specific proposed policy.

If a protection plan were suggested, a cost-benefit analysis of the plan would show the economic feasibility of the proposal. In this case study the ecosystem services and benefits of the rocky shore in south-western Apulia are identified in Table 3. For each service/benefit, possible economic valuation methods are proposed, and some quantitative data currently available reported. The policy analysis would consider enhanced controls on illegal fishing of date-mussels.

Table 3. Ecosystem services and benefits of the rocky shore in south-western Apulia, Italy. Based on Table 19.2 of the Millennium Ecosystem Assessment (Reid, 2005: chapter 19), modified to avoid double counting of ecosystem services.

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	Fishing date mussels	Prohibition of date mussel fisheries	Quantitative data currently available
Provisioning services					
Food (date-mussel).	Market prices.	Approximated value of date-mussels based on the current price on the 'illegal' market.	+ The current price of date mussels in the illegal market can be used as a proxy for valuation purposes, but cannot be considered as a gain from an economic point of view because it is an illegal market.	- The loss of jobs related to this illegal activity could be taken into account by policy makers to avoid social conflicts.	?40.00/kg
Date mussel-driven tourism.			+ Italians travel to Albania to eat date mussels.	-	
Food (marketed fish).	Market prices.	This is an approximated value of the fish, molluscs, and crustaceans based on their current market price.	- Fish, mollusks, and crustaceans are deprived of their habitats (at various stages of their life cycles) so becoming rarer and less exploitable by fisheries.	+	
Medicines (potential).	Market prices (if any; or substitutes).	This is the price at which the drugs derived by the organisms, or the price of similar drugs, are sold.	- no drugs have been isolated from the organisms that live in the habitats affected by date mussel fisheries, but they might be in the future.	+	Currently no data are available.
Raw materials (sponges).	Market prices.	The market price of commercial sponges.	- Commercial sponges are destroyed.	+	
Regulation services					
Atmospheric and climate regulation (carbon dioxide control) depending on the scale.	Damage cost avoided.	This is the cost of carbon dioxide emissions (the price of carbon) based on the estimated damage because of CO_2 emissions (Pearce *et al.*, 1996; Tol, 2005; Stern, 2006).	- The destruction of biological covering impairs production of oxygen and consumption of carbon dioxide.	+	
Erosion control.	Market prices / damage cost avoided.	This can be either the price of artificial defence protection, if the rock is eroded, or the cost to avoid damages in absence of any coastal protections from the rock.	- Date mussels erode the rock and cause it to collapse; the biological covering retards the process, whereas fisheries accelerate it.	+	

Table 3. Continued

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	Fishing date mussels	Prohibition of date mussel fisheries	Quantitative data currently available
Cultural services Recreation, amenity and aesthetics (for illegal consumers).	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments).		+ These people are happy to find date mussels, and go to places where they can be found. This has a beneficial effect on the local economy, beyond the price paid for the date mussel meal (accounted for in another section). These persons travel to Albania just for this.	- These people are not happy with the ban on date mussels. They go to Albania where date mussels are available with no limitation, which contributes to the destruction of Albanese and Croatian habitats.	
Recreation, amenity and aesthetics for people who value environmental integrity.	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments)	This can be inferred by the cost sustained to travel to the area, or the willingness to pay of individuals to preserve/restore the area.	- Loss of tourists not willing to spend their vacation in a place where nature is being eradicated.	+ The restoration of the environment, if any, will attract sensitive people to environmental integrity (also with the presence of MPA).	
Cultural (possible cultural loss).	Survey of affected community.	People can be asked if they feel this loss and how much they value it.	- The "culture" of eating this dish is lost.	+ A culture of respect of nature is gained.	
Supporting services Nursery (other species not sold in the market).	Stated preference methods; benefit/value transfer.	This is the value people put on the fisheries that are not sold in the market but that have a function as biodiversity. The value can be obtained with a specific study or using previous studies (value transfer).	- Habitat destruction impairs the support provided to species of commercial interest such as fish, crustaceans and molluscs.	+ The stopping of habitat destruction might lead to an improvement in these services, even though full restoration seems difficult to obtain due to the presence of sea urchins which contribute to the persistence of barrens.	
Resilience/stability.	Non-monetary indicators.		- The removal of biological covering leads to barrens that are kept stable due to sea urchin grazing. Even the stopping of the fisheries does not lead to improvement because the barrens are then caused by sea urchin grazing.	+ This positive effect is real if the sea urchins are removed, for instance by allowing the growth of populations of fish that predate on the sea urchins.	

5.2 Case study 2 – Mediterranean coastal ecosystems and the prevention of jellyfish outbreaks damages

Mediterranean countries are facing more extensive and more frequent jellyfish outbreaks (CIESM, 2001). The analysis of possible benefit/loss due to jellyfish outbreaks is done by examining their impacts on coastal ecosystem services (see Table 4). At high densities, jellyfish

Table 4. Impact of jellyfish outbreaks on coastal ecosystem services.

Ecosystem services	Economic Valuation Method	Explanation of the valuation method	With jelly fish outbreaks	Without jelly fish outbreaks
Provisioning services				
Food (sea food).	Market analysis.	This is an approximated value of the fish, molluscs, and crustaceans based on their current market price.	- Diminish and damage seafood availability.	+ Some large species of jellyfish are consumed in SE Asia.
Coastal installations.	Damage cost avoided.	This is the cost to be sustained if jellyfish enter seawater intake pipes in coastal installations.	- Clearing jellyfish from intake pipes; stoppage of seawater cooles power plants.	+
Regulation services				
jellyfish stings.	Cost of illness and loss of earnings.	Costs of medical treatment of jellyfish stings, and earnings lost by patients	- Painful stings, can lead to hospitalization and scarring.	+
Human mortality from jellyfish stings.	Costs of premature mortality as value of statistical life.	This value is subject to estimation.	- Possible but too rare to be of concern.	+
Cultural services				
Recreation, amenity and aesthetics.	Revealed (travel cost) and stated preference methods (contingent valuation, choice experiments).	This can be inferred by the cost sustained to travel to the area, or the willingness to pay of individuals to preserve/restore the area.	- See the text for reference.	+ See the text for reference.
Cultural (perceived loss of beach amenity and cultural symbolism).	Survey of affected communities.	People can be asked if they feel this loss and how much they value it.	- If the jellies are stingers.	+ A potential for attraction.
Supporting services				
Nursery (other species not sold in the market).	Stated preference methods; benefit/value transfer.	Value of the bycatch fisheries that have a function as biodiversity.	- Jellies may cause the depletion of fish populations.	+
Resilience/stability.	Non-monetary indicators.		- The ecosystems may be dominated by dinoflagellates and procaryotes (e.g. bacteria that cause mucilage events).	+

may cause the ecosystem to shift towards states that are usually not considered as positive for humans (Boero *et al.*, 2008). Jellyfish prey on zooplankton, including fish eggs and larvae, and at the same time compete with fish for the same food resources. Large annual jellyfish shoals are vast consumers of zooplankton and, especially in the more oligotrophic parts of the sea, may have dramatic impact on the fisheries. The loss to commercial fisheries stems from predation and competition on the fish stock, prevention of certain modes of fishing (trawling, purse seining) during shoaling periods, difficulties in sorting the catch and damaging it. When the shoals are driven ashore they can clog the seawater cooling systems of power plants, leading even to local interruption of electricity supplies (Galil *et al.*, 1990; 2007). The venomous stinging cells of certain jellyfish species harm humans. The native mauve stinger, *Pelagia noctiluca*, and the Erythrean alien, *Rhopilema nomadica* Galil, 1990, inflict painful stings that may necessitate medical treatment (Galil, this volume), and increase costs of illness and loss of earnings. Jellyfish outbreaks negatively affect tourism and reduce the recreational attractiveness of entire coastlines. Some cultural loss may be involved considering that the locals' traditional recreational use of the beach is replaced by swimming pools or shopping malls.

5.3 Case study 3 – The non-market value of a charismatic species: application to the Mediterranean monk seal

There are quite a few examples of species that have dramatically greater appeal to humans than others. These species are immediately identifiable by name and often have some charismatic or symbolic attributes. They are commonly associated with a particular geographic location or habitat. Because of this association between the species and their habitats, these charismatic species are also sometimes referred to as "flagship" species. For humans, they are the leading representatives of the habitats from which they derive.

Meta-analyses of the willingness to pay for individual species have shown a significant preference for a few charismatic species relative to the vast majority of species. Flagship species are often used as representatives of the general problem of habitat transformation and biodiversity conservation. For example, conservation organizations often focus their appeals for funding around the plight of a particular charismatic species. These species are thus not just highly valued for themselves, but also highly valued as representative of entire ecosystems. In other words, the demand for individual species conservation can be either a complement to or a substitute for the demand for habitat conservation.

A valuation study considered the willingness to pay for the endangered Mediterranean monk seal (*Monachus monachus*) in the island of Lesvos, Greece. In spite of numerous restrictions, regulations and conservation measures imposed by Greek authorities, the seals are killed by inshore fishermen because they damage fishing gear whilst trying to extract fish from fishing nets. The problem can be seen as an example of competition between fishermen and seals for the fish resource.

The mean willingness to pay to help preserve the seals was estimated at 12 Euros but, interestingly, only 5% of this amount was associated with use value (Langford *et al.*, 1998; 2001). The authors of the study are skeptic about the use of their study to help preserve the species, although the positive side of this study is that people express their willingness to pay for a species even though they expect never to get in direct contact with a seal at sea. Another question is whether the conservation of monk seals will help preserve other less charismatic species.

6. Glossary

The workshop participants decided early on to draw a list of terms commonly used in their discussions so as to make sure that both economists and environmental biologists used the same semantic references.

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alien (non-indigenous) species: a species living outside its known natural range, introduced intentionally or unintentionally by humans.

amenity: any tangible or intangible benefits of a property or a place, especially those which increase the attractiveness or value of the good or which contribute to its comfort or convenience.

assets: something possessed by an entity from which future economic benefits may be obtained. Everything owned by a person or company (all tangible and intangible property) that can be converted into cash.

attractor: a set to which a dynamical system evolves after a long enough time. In an ecosystem, an attractor would be the endpoint of ecological succession towards which any state of that ecosystem will evolve to, in the absence of disturbance.

bequest value: the personal or social benefit received by the present generation from leaving a resource for future generations to enjoy or use.

biodiversity: the full range of natural variety and variability within and among living organisms, and the ecological and environmental complexes in which they live; it includes genetic diversity within species, the diversity of species in ecosystems, and the diversity of habitats and ecosystems.

biodiversity asset: a living entity or group of entities that is of (perceived) value to humans.

common and public goods: goods that are non-rival and non-excludable. This means that consumption of the good by one individual does not reduce the amount of the good available for consumption by others; and no one can be effectively excluded from using that good. A public good is one which, if made available to one person, automatically becomes available to all others in the same amount.

carrying capacity: the maximum number of organisms that can be supported in a given area or habitat.

consumer surplus: an estimate of total economic benefits from consuming a good or service. It is measured by the maximum willingness to pay over and above the actual cash cost of consumption.

contingent valuation: a technique used in the valuation of environmental goods, to estimate either the willingness to pay for an improvement in the quantity or quality of some environmental good, or the willingness to accept compensation for the deterioration in environmental provision. It is an analytic survey technique that relies on hypothetical situations to place a monetary value on goods and services.

cost-benefit analysis: a process to assess the desirability of public interventions ex-ante. Benefits and costs are estimated by taking into account both private and external impacts of the intervention.

discount rate: rate at which the future value is discounted to estimate the present value.

ecosystem: the entire biological and physical content of a biotope interacting as an ecological unit (including humans).

ecosystem function: basic ecological processes necessary for the self-maintenance of an ecosystem (such as primary production, nutrient cycling, and decomposition) and all the evolutionary processes contributing to the basic ones (e.g., species interactions).

ecosystem services: the fundamental life-support services provided by ecosystems; the benefits people obtain from ecosystems; these include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth.

endemic species: species native of and restricted to a particular geographical region.

existence value: value from knowledge of continued existence based on moral conviction.

externalities: the impact of one person’s actions on the wellbeing of a bystander (can be positive or negative). A side effect or consequence of industrial or commercial activities that affects other parties without this being reflected in the costs of the goods and or services involved.

goods: any object, service or right that increases utility, directly or indirectly, not to be confused with the adjective “good” as used in a moral or ethical sense. Goods and services are those things produced by human or nature that yield benefits or increase our well being. They may be tangible or intangible.

habitat: the environment on which a given species or ecological community depends for its survival. The environment can be physical (e.g., rocky reefs, marine caves) or created by living organisms (e.g., seagrass meadows, deep coral banks).

instrumental value (or extrinsic value): the value of objects, both physical objects and abstract objects, not as ends-in-themselves but as means of achieving something else.

intrinsic value: the inherent worth of something, independent of its value to anyone or anything else.

invasive species: an alien species whose population has undergone exponential growth and is extending its range.

linearity: attribute of a system in which causes of a given size produce effects of proportional size. Linear systems are predictable, if initial conditions are known.

marginal changes: small incremental adjustments to a plan of action.

marginal cost: the increase in total cost associated with the production of an additional unit of the good produced. Marginal cost = Change in total cost / Change in quantity produced.

marginal damage: the damage caused by an additional unit of disturbance (e.g., pollution).

market failure: a situation in which a market left on its own fails to allocate resources efficiently.

marginal revenue: the contribution to total revenue associated with the production (and selling) of an additional unit of the good produced by the firm. Equals change in total revenue / Change in quantity produced.

maximum sustainable yield: the maximum yield that can be harvested from a renewable resource stock without reducing the size of the stock.

market value: price at which an asset would be traded in a competitive setting.

non linearity: a system whose functioning cannot be modeled as a linear sum of independent variables. Non linear systems are extremely sensitive to initial conditions.

non renewable resources: resource that exists in a fixed amount (stock) in various places in the earth's crust and has the potential for renewal only by geological, physical, and chemical processes taking place over hundreds of millions of years.

opportunity cost: what must be given up to obtain a certain item. It is the second best alternative foregone.

phase: a distinct period in which a given system maintains its features either by remaining stable or by undergoing cyclical changes along a predictable sequence of events (e.g. seasonal cycles).

phase shift: an abrupt transition from one ecological state to another (i.e. from top-predator dominated food web to a gelatinous predator dominated one).

price: the intersection of supply and demand. The amount of money or goods asked for or given in exchange for something else.

private benefits: benefits that are obtained directly by the consumer from its consumption activities or by the producer in its production activities.

private costs: costs that are directly supported by the consumer in its consumption activities or by the producer in its production activities.

property rights: set of rights that ensures/allows the specific use/management of a renewable or a non-renewable resource.

renewable resource: a natural resource that is replenished by natural processes at a rate comparable or faster than its rate of consumption by humans or other users.

scenarios: account or synopsis of a projected course of action, events or situations. Scenarios are widely used to understand different ways in which future events might unfold.

social benefits: all benefits created by a consumption activity or a production activity. Equals private benefit + external benefit.

social costs: all costs involved in a consumption activity or a production activity. Equals private cost plus external cost.

sustainable development: economically viable development that does not result in the degradation of the environment, and loss of resources or native biodiversity; it must not compromise the welfare of future generations for the benefit of present generations.

threshold: the minimum level or value of a stimulus necessary to illicit response.

use value: the value people place on the actual use of an environment.

value: the preferred end-states of existence, which taken together circumscribe human well-being.

willingness to pay: the maximum amount that a buyer will pay for a good.

The economic valuation of marine ecosystems – lessons from the Millenium Ecosystem Assessment

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Abstract

In a democratic system, policy makers have to take the preferences of the citizens into account. Since we live in a world with scarce resources, one is asked to make choices regarding the use and management of these resources. In this context, if policy makers decide to invest in the protection of marine ecosystems, less financial resources will be available for other policy areas, for example national health. Moreover, investing in the protection of marine ecosystems brings along the provision of a wide range of benefits to humans though most are not priced in the existing markets – for example climate regulation and provision of habitat for biodiversity. Given that most human activities are priced in one way or other, in some decision contexts the temptation exists to downplay or ignore these important marine ecosystem benefits on the basis of the non-existence of prices. The simple and simplistic idea in the minds of many policymakers is that a lack of prices is equivalent to a lack of values. Clearly, this is a biased perspective. Against this background, this paper explores the motivation for an economic valuation of this complex resource. The state-of-the-art economic valuation methodologies follow the guidelines proposed by the Millennium Ecosystem Assessment, taking into account the existing scientific knowledge on the functioning of marine ecosystems, marine ecosystem goods and services and its impacts on human welfare. Finally, we critically review some economic valuation studies, arguing that the economic valuation of marine ecosystem services and biodiversity can make sense if and only if important guidelines are observed.

1. Introduction

Natural marine ecosystems require our attention for two reasons. First, they provide a wide range of benefits to humans, ranging from the provision of food to climate regulation, from coastal recreation to habitat conservation. Secondly, human activities have contributed, and still contribute, to an unprecedented strain on marine ecosystems, and the biodiversity they host. Our experience in the field of environmental economics teaches us that many marine ecosystem values cannot be incorporated in conventional market transactions. The question then is how to translate such values into monetary terms. This is a challenging question to be posed to economists. In order to provide an answer to such a question, economists first need to work with marine scientists from other disciplines so as to understand the complexity of the relationships between the functioning of marine ecosystems and their capacity to provide ecosystem goods and services. Economists, at a second stage, proceed with the valuation of these ecosystem goods and services, bearing in mind their impact on human welfare. This valuation is expressed in monetary terms, exploring a wide range of methodologies.

We will articulate the discussion as follows. In Section 2 the notion of marine ecosystems as a source of economic value is discussed, presenting the welfare-theoretical based approach as well the economic valuation methodologies. In Section 3 the Millennium Ecosystem Approach is presented and some economic valuation studies are critically reviewed against this integrated ecological-economic framework. In Section 4 the knowledge shortfall is reviewed, putting forward some suggestions for future research. In Section 5 the conclusions are drawn.

2. Marine ecosystem as a source of economic value

2.1. Motivation for economic valuation: why are economists in this picture?

The economic valuation of environmental assets, in general, and marine ecosystems and biodiversity, in particular, is among the most pressing and challenging issues environmental economics is confronted with (see Sudhkev *et al.*, 2008). One of the main reasons for pursuing economic valuation arises from its potential for benefit-cost-analysis, which is a cornerstone in the evaluation of any policy design. The basic rule of benefit-cost-analysis in decision-making is to approve any potentially worthwhile policy if the benefits of the policy exceed the costs. Therefore, identifying and estimating the economic values of the full range of benefits provided by the marine ecosystems is urgently needed. Major organisations across the world such as the World Bank, the European Commission, the Environmental Protection Agency, and others promote the application of economic value assessments in the policy agenda. Environmental accounting is also recognised as an important steering factor in carrying out an economic valuation of marine ecosystems and biodiversity services. In this context, various efforts have been made to adjust national accounting systems and associated gross national product statistics to take into account the depreciation of environmental assets and the loss of biodiversity. Green accounting is one possible strategy. The underlying idea is to add information on physical flows and stocks of environmental goods and services to the traditional national accounting system – the so-called physical satellite accounts. Against this background, there is an ongoing Integrated Project (EXIOPOL, 2008) that is synthesising and developing comprehensive estimates of the external costs for Europe of a broad set of economic activities, setting up a detailed environmentally extended input-output framework, with links to other socio-economic models, in which as many of these estimates as possible are included. Finally, natural resource damage assessments (NRDAs) have also created a stimulus for the economic valuation of marine ecosystems. The core of a NRDA exercise is to appraise how much society does value the destruction of natural resources. An important benchmark in the history of NRDA was the massive oil spill due to the grounding of the oil tanker Exxon Valdez in Prince William Sound in the northern part of the Gulf of Alaska on March 24, 1989. This was the largest oil spill from a tanker in US history. More than 1,300 km of coastline were affected and almost 23,000 birds were killed (Carson *et al.*, 1992). The natural resource damage resulting from the Exxon Valdez oil spill was estimated at $2.8 billion at the time. For the first time, a governmental decision expressed the legitimacy of non-use values as a component of the total damage value. To date, NRDAs are mainly undertaken in the USA and have not yet become an issue in the European policy agenda because of different legal/institutional arrangements.

2.2. General features of the economic valuation perspective

The economic valuation of marine ecosystem and biodiversity services (MEBs) is based on an instrumental perspective of the value. This means that the value of MEBs is anchored in a human perspective and therefore interpreted as the result of an interaction between those attaching value (humans) and the object of valuation (flows of ecosystem goods and services). In other words, the economic valuation perspective subscribes to an anthropocentric value orientation, thus rejecting the notion of intrinsic values – see Nunes and van den Bergh (2001). Secondly, humans elicit MEBs in terms of their impact on human welfare, including human knowledge, use, experience, and consumption of MEBs. Thirdly, the economic valuation of MEBs has a reductionist approach since it is based on the idea that one is capable of subdividing the total economic value into use value and passive use value, reflecting the different human motivations with respect to the (non)use of biodiversity values. In a conceptual framework, one can define the total value (TV) of the marine ecosystem and biodiversity benefits in terms of the use value (UV) and non-use value (NU). The former can be further divided into direct and indirect use values (DUV and IUV). Direct use values include: (a) marine and coastal recreation benefits; (b) natural and cultured marine species with commercial value; and (c) insurance with respect to potential risks to human health. Indirect use values refer to benefits that relate to the good functioning of the marine ecosystem and the survival of marine living resources, even if these have no direct commercial value. Finally, non-use values of marine quality can be divided into a bequest value (BV) and an existence value (EV). Bequest value refers to the benefit accruing to any individual from the knowledge that future generations might benefit from a sustainable marine ecosystem. Existence value refers to the benefit derived simply from the knowledge that the marine ecosystem is protected without even being used.

Fourthly, economic valuation of MEBs is pursued through explicit changes in the current state of the world. On average, these are described by the use of scenarios, and economists focus on the welfare changes involved. In other words, what is pursued is less an economic valuation of the system (in its current state) than the *changes* of the system. For example, in the field of climate change, one may be willing to assess the total economic value provided by MEBs when moving from an A1 to a B2 storyline scenario. Fifthly, economic valuation of MEBs is a monetary indicator. The reason is that from a theoretical perspective, economists assume that consumers are willing to trade changes in the level of provision of MEBs with variations in their income (e.g. compensation measures or payments for ecosystem services). This means that the economic valuation results can be easily fitted to benefit-cost-analysis, a crucial tool for the design of effective and broadly accepted management policy. Finally, a European review on the economic valuation of ecosystems and biodiversity (TEEB phase 1) points out that most of the economic valuation studies lack a uniform, clear perspective on MEBs as a distinct, univocal resource. Therefore, an integration of the economic valuation exercise within a fully integrated approach such as the one recently proposed by the United Nations, the Millennium Ecosystem Approach, is solicited. This will be considered in detail in Section 3.

2.3. Economic valuation tool box

Various valuation methods are available to give an economic value to environmental benefits. We can distinguish two groups of valuation methods: the direct and indirect or dose response valuation methods – see Table 1.

Table 1. A classification of economic valuation methods.

Revealed preference	Stated preference	Dose response
Travel cost	Contingent valuation	Production cost
Hedonic pricing	Stated choice	Production factor
Averting behaviour		

The dose response methods are similar in that they put a price on environmental commodities without establishing people's preferences for these commodities. The production cost techniques such as the dose response methods rely on the presence of physical input-output relationships. For example, if one intends to estimate the monetary value of the benefits of clean air on human health, one can take into account the relationship between air pollution and the number of visits to physicians and the purchase of drugs. This valuation method results in underestimates as it omits preferences for health, the value of which cannot be easily estimated. Conversely, the direct methods rely on individual preferences. These methods are further divided into revealed preference methods and stated preference methods, depending on the process by which the individuals' preferences are obtained. The group of revealed preference valuation methods consists of three methods: travel cost, hedonic pricing and averting behaviour (see Braden and Kolstad, 1991; Mäler, 1988). The common underlying feature is the dependency on a relationship between a market good and the environmental benefit. For example, when using the travel cost method, researchers estimate the economic value of recreational sites by looking at the costs of the trips made by the visitors to these sites. When using the hedonic price method to estimate the economic value of clean air, researchers examine the analysis of house market prices and surrounding air characteristics. Researchers who use the averting behaviour method try to estimate the economic value of clean air on the basis of expenditures on technological equipments made to avert or mitigate the adverse effects of air pollution.

Whereas economists who use revealed preference valuation methods have to carry out estimation exercises bearing in mind the existent market price data, economists who use stated preference valuation methods have to collect their own data by means of questionnaires, based on constructed markets. The underlying feature is the use of the questionnaire to ask the individuals directly to state their economic values for environmental commodities (Mitchell and Carson, 1989). The use of questionnaires require 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 (Carson *et al.*, 1994; NOAA, 1993). In contrast, revealed preference methods have remained an exclusive valuation tool for economists. Stated preference valuation methods are contingent valuation, contingent ranking, pairwise comparison and allocation games. The respective differences relate to the way in which the economic values are elicited. For example, whereas the contingent valuation method asks respondents to express their preferences for some defined environmental benefit in monetary terms, the contingent ranking method asks the respondent to rank a number of described environmental quality alternatives.

Table 2. Main economic valuation techniques: a summary.

Methodology	Approach	Applications	Data requirements	Limitations
Revealed preference methods				
Production function	Trace impact of change in ecosystem services on produced goods	Any impact that affects produced goods	Change in service: impact on production; net value of produced goods	Data on change in service and consequent impact on production often lacking
Replacement/Avoidance cost	Use cost of replacing the lost good or service	Any loss of goods or services	Extent of loss of goods or services, cost of replacing them	Tends to over-estimate actual value; should be used with extreme caution
Travel Cost Method (TCM)	Derive demand curve from data on actual travel costs	Recreation	Survey to collect monetary and time costs of travel to destination, distance travelled	Limited to recreational benefits; hard to use when trips are to multiple destinations
Hedonic Pricing (HP)	Extract effect of environmental factors on price of goods that include those factors	Air quality, scenic beauty, cultural benefits	Prices and characteristics of goods	Requires vast quantities of data; very sensitive to specification
Stated preference methods				
Contingent Valuation (CV)	Ask respondents directly their WTP for a specified service	Cultural values, Passive use values	Survey that presents scenario and elicits WTP for specified service	Many potential sources of bias in responses; guidelines exist for reliable application
Other methods				
Benefit transfer	Use results obtained in one contest in a different context	Any for which suitable comparison studies are available	Valuation exercises at another, similar site	Can be very inaccurate, as many factors vary even when contexts seem 'similar'; should be used with extreme caution

Source: World Bank (2004) p. 11.

It is important to note that an alternative valuation method, *benefit transfer*, is currently popularised and applicable for any of the ecosystem goods and services in question. The development of benefit transfer technology provides a low cost and less time consuming opportunity for the economic valuation of most of the environmental goods and services. The idea underlying this method is to transfer the biodiversity benefit estimates from original CV studies to the policy site, where no original studies have been done but policy decisions need to be made. However, the validity and accuracy of the estimate results need to be improved. In Table 2, we display all the valuation methods mentioned so far, and list detailed information regarding the respective application fields, data requirements as well as main limitations of each method.

3. An ecosystem service based approach

3.1. The conceptual integrated ecological-economic framework

The Millennium Ecosystem Assessment (MEA, 2005) has fundamentally changed the approach that has characterised natural and social scientists, and has mapped the complex relationships between biodiversity, ecosystem functioning, and human welfare. The MEA distinguishes four broad categories of benefit: provisioning services, cultural services, regulating services and supporting services[1].

Following the MA approach, Beaumont *et al.* (2007) and Balmford *et al.* (2008) identified a range of marine ecosystem goods and services for each category – see Table 3. An accurate, complete and reliable monetary assessment of marine ecosystem benefits also requires the application of specific monetary valuation tools. Bearing in mind both the classification of the economic value component and the respective marine benefits, Table 3 shows the most suitable valuation methodology to be used. As one can see, the travel cost method is the most suitable valuation method for a monetary value assessment of marine quality benefits that relate to the provision of tourism and recreational opportunities. Moreover, stated preference methods can fulfil an important role in the overall assessment of marine quality benefits. Indeed, stated preference methods can be applied to assess the monetary value of most of the types of benefits provided by the protection of marine quality, including both bequest and existence values. Furthermore, these methods have the advantage that marine policies may be valued even if they have not yet been adopted (*ex ante* valuation) or lie outside the current institutional arrangements. Thus, it offers much scope and flexibility for specifying different marine protection, restoration and amelioration programmes. For these reasons particular attention will be paid to the analysis and discussion of stated preference methods, including the stated choice method (SC) and contingent valuation method (CV). In addition, we will also focus on the use of the travel cost (TC) method to assess marine recreational values.

Table 3. Goods and services provided by marine biodiversity: a MEA approach (adapted from Beaumont *et al.* (2007) p. 256; van den Bergh *et al.* (2002); Sudhkev *et al.* (2008); Markandya *et al.* (2008).

MEA Category	Goods or Services	Most suitable valuation method
Provisioning services	Food provision	Aggregate price analysis(1)
	Raw materials	Aggregate price analysis(1)
Regulating services	Gas and climate regulation	Avoidance cost
	Disturbance prevention (food and storm protection)	Aggregate price analysis(1), Avoidance cost
Cultural services	Cultural heritage and identity	Stated preference methods
	Cognitive, educational values	Aggregate price analysis(1)
	Leisure and recreation	Travel cost method
	Bequest and existence values of habitats and species	Stated preference methods
Supporting services	Resilience and resistance (life support)	Production function, Stated preference methods (2)
	Biologically mediated habitat	Production function, Stated preference methods (2)
	Nutrient cycling	Replacement/Avoidance cost, Stated preference methods (2)

(1) market price method;
(2) no clear understanding of the potential of these economic valuation methodologies to fully capture the magnitude of the benefits due to high degree of uncertainty.

SC and CV are survey based valuation techniques that are widely used in the context of environmental valuation (Carson *et al.*, 1992; NOAA, 1993; Hanley *et al.*, 2001). CV is a survey-based approach that directly estimates the preferences for risk reductions in the overall marine ecosystem quality. Therefore, CV gives an immediate monetary estimate of the

[1] Although the prevailing orthodoxy now is to give ecosystem services centre stage and to view biodiversity as valuable when it enhances those services, one should note that not all scientists agree with this perspective. Indeed there is increasing scientific evidence that biodiversity has a more central role and in fact underpins the supply of ecosystem services, even though the issue remains controversial (Balvanera *et al.,* 2006). Positive biodiversity effects have been found on the productivity of many ecosystems – which are crucial to the provision of many services such as food or wood – and on their resilience, e.g. their capacity to respond to disturbances in a constructive way.

willingness to pay (WTP) welfare measure associated with an increase in the marine quality. In short, CV and SC make use of a questionnaire that describes a survey market in which non-market goods can be traded. It is assumed that the values elicited with CV will correspond to those that would emerge on real markets. The contingent market defines the good itself, the institutional context in which it would be provided, and the way it would be financed. Respondents are then asked to express their maximum WTP for a survey-described change in the level of the environmental good. Alternatively, in the SC approach respondents are presented with a set of two or more survey-described alternatives that differ in terms of the respective attributes and attribute levels. The respondents are asked to select the alternative they prefer. Both questionnaires (CV and SC) contain two important elements. The first is a clear description of the environmental good to be valued. The second element is a mechanism for eliciting the WTP of the respondents. CV describes the elicitation process directly with a WTP question, while in SC, individual WTP is inferred from the choice of the described alternatives (or choice sets). Finally, the travel cost method (TC) can be used when the valuation exercise and underlying policy proposals refer exclusively to the recreational use values provided by protection of marine quality. In short, the travel-cost method is a demand-based model used for a recreation site – see Nunes and van den Bergh (2004).

3.2. Valuation studies

From theoretical view point, climate change is expected to have *inter alia* an impact on the thickness of the Arctic sea-ice cover and on the Atlantic meridional overturning circulation. This may be translated *inter alia* into higher surface/water temperatures that, in turn, will strengthen near-surface stratification and decrease the ability of the winter winds to mix the water column (e.g. McClain *et al.*, 2004; Llope *et al.*, 2006). Several coupled ocean-atmosphere models have shown global warming to be accompanied by an increase in vertical stratification (IPCC, 2001). These physical and biological impacts need to be clearly identified and measured – for example by exploring the use of climate scenarios (such as the Arctic Climate Impact Assessment: ACIA 2005, which uses the B2 intermediate scenario describing a world with moderate population growth, economic development and technology change; this scenario predicts a doubling of atmospheric CO_2 after approximately 80 years). Once the physical and biological impacts are mapped and quantified, economists would then proceed with the economic valuation of these impacts, expressed in terms of their significance with regard to (changes in) human welfare.

In Figure 1 one can see that there are two basic levels of analysis that can be used to assess the net cost of impacts of climate change and marine biodiversity effects, namely partial equilibrium analysis and general equilibrium analysis.

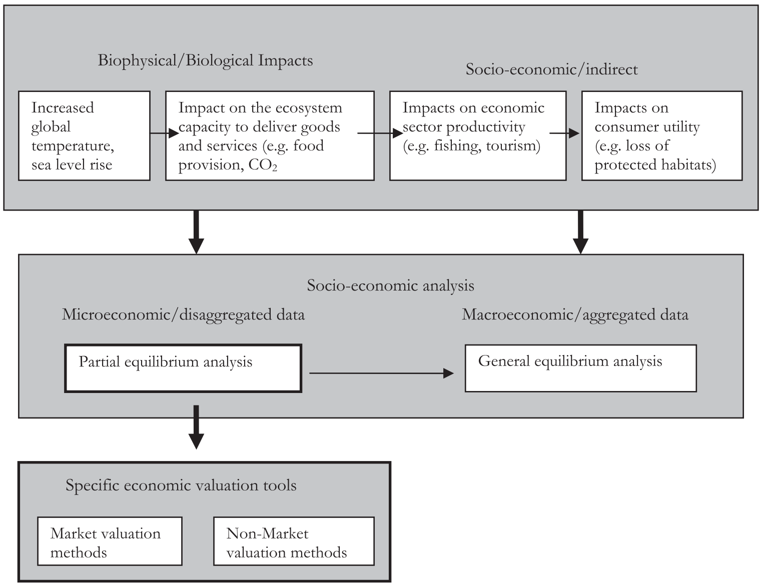

Figure 1. Framework for valuating climate change impacts on the provision of marine ecosystems and services (adapted from: Australian Greenhouse Office report (2004).

Partial equilibrium analysis: here the impacts of climate change, and its implications in terms of the ecosystem provision of EGS, can be examined in terms of its direct effects on a specific, single market, an industrial sector or economic activity (e.g. the local or regional effect of a reduction of the supply EGS on forest recreation activity).

General equilibrium analysis: this method is widely used for studying the indirect economic impacts or economy-wide impacts caused by climate change. Thus, the impacts of climate change can be assessed for a number of markets, economic sectors and respective trade patterns within an entire economy. This analysis considers the interactions among the different economic sectors and suggests that any climate change impact on one specific market will produce indirect impacts on many other markets, thus affecting prices in a wider context.

Alternatively, from the empirical valuation perspective, today we find neither a partial equilibrium nor a general equilibrium application that focuses on the monetary value measurement of the wide range of impacts of climate change on marine ecosystems. A recent review of the economic valuation literature of ecosystems and biodiversity services showed that among the 291 valuation studies submitted to the international call for evidence issued by the European Commission, only four referred to marine and coastal valuation studies (Markandya *et al.*, 2008; Sudhkev *et al.*, 2008) – see Box I.

Box I: Studies of Marine Ecosystem Service in Europe.

1. In the coastal waters of several European countries there is a notable loss of crayfish populations (*A. Pallipes, A. Astacus, A. Torrentium*) due to pollution, habitat loss, overfishing and the introduction of alien species (mainly N. American). Services lost include food (domestic varieties fetch twice the price of non-native varieties), regulating services (trophic effects on prey and predators), recreation and cultural services. Although estimates of the loss have not been made, estimates of the costs of restoration have. They indicate modest costs (around €225,000 per stream over 5 years in France) that would be well below the value of the recovered crayfish populations.
2. Overfishing in the North Sea is a major threat to biodiversity and ecosystem health, and stocks of a number of fish are now under stress. Estimates of the benefits of recovery plans that would increase populations are about €600 million a year. This excludes benefits from fish processing and recreational fisheries.
3. Eutrophication of coastal marine ecosystems in Sweden is well studied. Services lost as a result of eutrophication include provisioning for commercial fishery species and reduced efficiency in regulating services such as cycling and deposit nutrients. In addition there is a loss of cultural services, notably recreation. The value of the loss of regulating services is estimated at €6-€52 million a year for the Stockholm archipelago (for a one metre improvement in summer *Secchi* depth i.e. depth to which water can be seen with the naked eye) while the value of provisioning services is estimated at €6-€8 million a year for the Kattegat and Skagerrak fishery areas. This is based on a reduction in the output of *plaice* juveniles as a result of eutrophication.
4. A marine protection programme that focuses on the prevention of harmful algal blooms along the coastline of the Netherlands, entailing the construction of a ballast water disposal treatment in the Rotterdam harbour and the implementation of a monitoring programme of water quality in the open sea along the North Holland beaches, is valued in the 225 - 326 million Euro range, and includes non-market benefits associated with beach recreation, human health and marine ecosystem impacts.

A further set of recent European market-based studies of the value of marine ecosystem services of relevance to the application of MEA is presented in Box II, which also includes valuation based on stated value approaches (see Beaumont *et al.* (2006) for more information) that estimate the value of various economic activities connected to marine ecosystem biodiversity and, more generally, to conservation. In addition we include Box III that has details on an overview for the Mediterranean and Black Seas – see SESAME (2008) for more information.

Box II: an overview of goods and services provided by UK marine ecosystems.

Food provision: food provision refers to the exploitation of marine plants and animals for human consumption. For instance, Defra sea fisheries statistics 2004 reported a total value of £513 million for the UK fishery industry. However, marine ecosystems have been disturbed by anthropogenic consequences, such as climate change, in terms of reduced provision of commercial fish stocks as well as loss of marine biodiversity. In economic terms, it refers to a decrease in fisheries productivity in association with a negative welfare impact. The magnitude of the welfare loss for this value aspect is underestimated as it considers only market prices.

Raw materials: raw materials refer to the marine organisms extracted for all purposes except human consumption, e.g. pharmaceutical and ornamental uses. This category is highly underestimated due to a lack of data, but it represents considerable market value. For example, figures show that the total value of fishmeal in the UK market in 2004 was £81 million (European Parliament Report, 2004), whereas the estimated total gross income from seaweed was between £349,819 and £583,032.

Gas and climate regulation: marine living organisms balance and maintain the chemical composition of the atmosphere and oceans. As, the monetary magnitude of this value component is rather difficult to obtain by using market valuation methods; an avoidance cost method can be employed so as to estimate the savings due to marine conservation policies. For instance, Beaumont *et al.* (2006) obtained a value estimate ranging between £420 million and £8.7 billion (UK£2004) for the UK territorial waters area.

Disturbance alleviation and prevention: the damage caused by flooding and storm events can be alleviated and prevented by biogenic structures. For instance, the salt marshes attenuate and dissipate wave and tidal energy and thereby substantially reduce the cost of flood defence measures (Morris *et al.*, 2004; Brampton, 1992; and Möller *et al.*, 1996). By using the avoidance cost method, King and Lester (1995) and Beaumont *et al.* (2006) have estimated cost savings from sea defence for the UK waters at between £17 billion and £32 billion. The authors acknowledge that this value estimate is underestimated as only salt marshes were considered.

Cultural heritage and identity: this service of marine ecosystems reflects the cultural value associated with marine biodiversity e.g. for religion, folklore, painting, cultural and spiritual traditions. However, little information is currently available on the cultural benefits of marine biodiversity, although this is believed to be indicative of a lack of documented research, as opposed to a lack of value.

Cognitive values: this value component refers to the economic values of cognitive development in marine science, including education and research. For example, in the UK marine research and application areas involved total funding of about £292 million in 2002, in addition to £24.8 million generated in education and training in marine science (Pugh and Skinner, 2002).

Leisure and recreation: the leisure and recreation service provided by coastal marine biodiversity has significant economic value, including support to the related employment and small businesses. In the UK, the total net value of marine leisure and recreation was estimated to be £11.77 billion in 2002 (Pugh and Skinner, 2002). More specific valuation studies are undertaken for open marine waters, e.g. whale-tourism and seal watching. For example the whale-tourism in West Scotland generated total income at £7.8 million in 1994 (Beaumont *et al.*, 2006).

Bequest and Existence values: this value component captures the non-use value of marine ecosystems. Studies by Hageman (1985) and Loomis and White (1996) estimated an annual average household's willingness to pay for surviving species of sea mammals in the £19 - £46 range per species, depending on the mammal species. By multiplying the unit estimate by the total number of households, the non-use value of marine mammals was estimated between £469 million and £1,136 million in the UK in 2004.

Nutrient cycling value: nutrient cycling has an essential role in terms of alleviating excessive nutrient loading and sustaining the productivity rates of marine species. The economic valuation of this service is rather difficult due to the high degrees of uncertainty about anthropogenic effects. Costanza *et al.* (1997) employed a replacement cost method and estimated the value of marine nutrient cycling in the £0.10 - £0.29 per m^3 range. However, this value estimate should be used with caution.

Biologically mediated habitat: such habitats support a large number of species and have an essential role in marine ecosystem functioning. The loss of these habitats will result in a decline of biodiversity due to a loss of nursery and refuge areas. The valuation of marine biologically mediated habitats is currently missing due to lack of information.

A number of points should be noted about these estimation results:

(1) Estimates of market values are partial and generally not comparable. Sometimes the figures are given as net income, sometimes as gross income. Gains in terms of employment or increased local

economic activity found in some reports are not necessarily economic benefits or they might be only partially (that depends on what alternative employment opportunities exist and what alternative economic activities are possible). With the current state-of-the-art, however, it is possible to carry out proper valuations based on economy-wide impacts of biodiversity loss or conservation and some studies have done this.

(2) In some cases estimates are based on the costs of restoring lost services. Albeit useful, such estimates could be higher or lower than the market value that is lost. Indeed one of the purposes of valuing loss of biodiversity is to see if replacement or restoration is justified. Using the former as a measure of value does not allow you to answer that question.

(3) Underlying the market-based approach are scientific studies linking the estimated impacts on biodiversity to certain causes (e.g. the effect of pests on forests, of forests on air pollution, etc.). We should recognise that there are still many uncertainties regarding these links, which should be reflected in the reported benefits.

(4) The majority of the studies refer to marginal changes in local areas. At the same time there are a few that value the broad scale of services provided globally. The numbers from the latter studies are extremely high.

(5) The purpose of many of the studies was to show that the services provided by nature are significant and either merit protection (where biodiversity is threatened) or merit expansion (where there is potential for it). Estimates of the 'opportunity cost' of coastal habitat, wetlands – i.e. what it would be worth if it were not conserved – are often much lower than the value of the biodiversity services provided if it was conserved.

Box III: overview on valuation studies in the Mediterranean and Black Seas.

Food provision: Knowler *et al.* (1997) developed a bioeconomic model of the Black Sea anchovy fishery and have estimated the benefits of pollution abatement in terms of fisheries revenues at €2.57 million annually in addition to the existing fisheries revenues of €12.57 million in the Black Sea. 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 Venetian Lagoon. Using this information, the authors calculated the welfare improvements associated with a 50% improvement in catch rates to be €3.42 million annually.
Bequest and Existence values: Langford *et al.* (1998) report the results of a contingent valuation survey carried out in Greece to estimate the public's willingness to pay for the conservation of the Mediterranean monk seal (*Monachus monachus*) in the Aegean area. The authors estimate a median willingness to pay of €12.
Leisure and recreation: Machado and Mourato (1998) use contingent valuation to determine the value of a reduction in health risks associated with recreating in polluted marine waters along the Estoril coast, Lisbon. Estimation results show that recreational/amenity use value per visit range from €16 for changing from a bad to a good quality beach to €7 for moving from average to good quality beaches. The mean expected willingness to pay to avoid an episode of gastroenteritis was €8. Brau and Cao (2006) carried out a choice experiment on a sample of tourists at the end of their holiday on the island of Sardinia (Italy) to examine the feasibility of implementing sustainable tourism policies. As far as environmental quality is concerned, it is found to be an important determinant of destination choice. Tourists were willing to pay €40 for proximity of the lodging to the sea, €57 to avoid the risk of overcrowding and €50 for the option of existence of a protected natural area in the surroundings.
Disturbance prevention: Alberini *et al.* (2004) administered a contingent valuation study to elicit willingness to pay for a theoretical project that would improve infrastructure on the island of S. Erasmo (in the Venetian Lagoon) to help control erosion, improve beach quality, refurbish sewage and water pipes, and restore a cultural monument. The value estimates show that the non-use portion of mean willingness to pay is €36, and the values for users and potential users are €56 and €35, respectively.
Nutrient cycling: Jones, Sophoulis and Malesios (2007) conducted a contingent valuation survey to evaluate the benefits deriving from the improvement of the sea water quality around the city of Mitilini, an island located in the Northeast Aegean Sea, resulting from the construction of a Sewage Treatment Plant. Estimation results indicate that the residents of the city were willing to pay € 17 every four months over a period of four years.

3.3. Critical discussion of the valuation studies

Biodiversity is a complex, abstract concept. It can be associated with multiple, widely ranging benefits to human society, most of them still poorly understood. From the economic valuation studies under review it is clear that the few empirical assessments of marine biodiversity and ecosystem values do not provide an unequivocal, unambiguous monetary indicator. In any case, one should always keep in mind that economic valuation of biodiversity values does not pursue total value assessment of biodiversity, but rather of biodiversity changes. Therefore, it is nonsense to try to value extremely large changes in biodiversity, and certainly a waste of time to examine extreme changes like one resulting in a situation in which there is no natural living creature. Economists have assessed the economic value of biodiversity through tradeoffs between money and changes in biodiversity at different levels of life diversity, including genetic, species, ecosystem and functional diversity. Most of the time, there are no market valuation mechanisms that price biodiversity values. Therefore, valuing biodiversity requires the use of special valuation tools. The choice of the valuation tool will, in turn, depend upon the biodiversity value category under consideration. For example, it will be hard to set a contingent valuation survey to elicit the economic value related to changes in ecosystem functions and ecological services that are far removed from human perceptions, such as CO_2 storage or groundwater purification processes. On the contrary, the contingent valuation method is the most appropriate method whenever one focuses on the monetary valuation of biodiversity non-use values. Having said this, we strongly believe that the (neo-classical) economic valuation of biodiversity does make sense. Nevertheless, it is important to mention that economic valuation studies have arrived at an important crossroad. On the one hand, one may opt for combining contingent and non-contingent valuation strategies so as to assess the complexity involved at multiple life organisation levels in more detail. This strategy signals the need for a multidisciplinary approach that seeks a clear perspective on the direct and indirect effects of changes in biodiversity on human welfare. This would contribute to more sturdy economic value estimates that could serve to guide biodiversity policies. On the other hand, researchers can continue to work on creating more sophisticated versions and applications of the non-market valuation methods.

4. Shortfalls in knowledge and suggestions for future research

From the above, and from a review of the valuation literature, we conclude that while methods have been developed and used widely for some environmental values (especially non-market values), there are still several gaps in the literature. Notable among these are the lack of valuation studies and of assessment of economic value. In fact, we would argue that the following issues need to be addressed urgently:

i. to promote the development of valuation studies that focus on the valuation of loss of marine species other than keystone species; marine cultural and spiritual values; and the dynamic aspect of all ecosystems and values – changes over time are at the core of all ecosystems.

ii. equally important, information on the impact of climate change on the European marine and coastal environment is still patchy. Therefore, a greater effort has to be made to gather, store and analyse previously and currently collected marine environmental data (e.g. common open access database and annual pan-European reporting based on national contributions).

Given that there are thousands of ecosystems and sites of importance within the EU, let alone the whole world, it is impossible to conduct individual studies to obtain the relevant information in a timely way. Hence some kind of benefit transfer will be essential if the goal of obtaining national, regional and global estimates of the damages from biodiversity loss in the absence of any action is to be obtained. The same applies, *a fortiori*, to estimating the reductions in such damages when some actions to protect the ecosystems are implemented.

The solution to this problem is that one needs to improve the application of benefit transfer for specific evaluations of ecosystem service benefits. In this context, we need to establish a clear set of guidelines about which kinds of benefit transfer are possible. Such guidelines need to stipulate not only the kind of ecosystem services but the areas and countries where the transfer can be carried out, given the available set of valuation studies. Secondly, further research should be carried out on how 'packages' of ecosystem services may be valued without undertaking whole new studies. Where there is an adding up problem, it may be possible to develop approximations for adding up benefits that can only be transferred individually. Thirdly, where transfer is not possible, we should develop toolkits that can be used to carry out location specific studies. Given the large database of existing studies, these can help simplify and demystify the process of valuation so it can be conducted in a more routine and cheap manner. Finally, an inventory of all major ecosystems should be drawn up and the loss of services expected under different scenarios should be prepared. Some of this is underway for some ecosystems but not for all the important ones.

In any case, one should always keep at the back of one's mind that any economic valuation exercise refers to *an incremental value*. To be useful, the valuation of the service has to be an incremental one. There is little advantage in knowing the total value of an ecosystem unless there is a threat to eliminate it or a policy or reconstruct it in its entirety, which is rarely the case. Yet many valuation studies provide estimates of the total cost of whole systems and there is even one regarding the value of the ecosystems of the whole world (Costanza *et al.*, 1997). Carrying out an incremental analysis (which may entail estimating significant non-marginal changes in ecosystems), however, is not as easy as it might sound. If one is using revealed preference methods, a link has to be established between a change in the environmental attribute and the demand for a visit to a site or the value of a property. If one is carrying out a stated preference analysis the respondent has to understand the nature of the incremental change, which is more difficult than asking for the value of access to a site or use of a particular recreational facility. Finally, any economic valuation exercise needs to address the *multiple services and the 'adding up' problem*. Many ecosystem services that individuals receive are multidimensional and there is an adding up problem. The value attached to one forest area for recreational or other use is not independent of whether another forest nearby is conserved or not. The implication is that studies need to be undertaken allowing for substitution effects, which makes them more specific to a particular application and less capable of being transferred to other applications.

5. Conclusions

This report has critically reviewed the economic valuation of marine ecosystem services and biodiversity. The main message is that the economic valuation of changes in the provision of marine ecosystem services and biodiversity can make sense. This requires, inter alia, that a clear ecosystem services approach is chosen, that a concrete scenario is formulated, that changes are within certain boundaries, and that the particular perspective on biodiversity value is made explicit. So far, relatively few valuation studies have met these requirements. As a matter of fact, most studies lack a uniform, clear perspective on marine ecosystem services and biodiversity as a distinct, unequivocal concept. Against this background, the Millennium Ecosystem Assessment is now recognised as a key reference for the economics of ecosystems and biodiversity. However, to date, we have insufficient knowledge about, for example, how the functioning of ecosystems relates to the production of ecosystem goods and services and what the underlying role of biological diversity is within this complex relationship. For this reason alone it is very difficult, if not factually impossible, to assess the total economic value of marine ecosystems. Even if we admit that a value could be placed on a set of goods and services represented by all marine ecosystems, and keeping in mind that at present scientists still do not have sufficient knowledge to map and calculate the full range of ecosystem goods and services (across all the different types of world ecosystems), we would be still unable to answer the question "What is the role of biodiversity in this picture?" To answer this question, we would also have to include: (a) the role of genetic variation within species across populations and its impact on the provision of ecosystem goods and services, (b) the role of the variety of interrelationships that exist between species in different ecosystems on the provision of ecosystem goods and services, and (c) the role of functions among ecosystems on the overall level of provision of ecosystem goods and services. Without any doubt, a full monetary assessment would be impossible or subject to much debate. All in all, the available economic valuation, estimates should be considered at best as a lower bound to an unknown value of biodiversity, and always contingent upon the available scientific information and the global socio-economic context.

Is economic valuation of natural Mediterranean marine ecosystems providing the correct signal for policy makers?

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Abstract

Mediterranean marine protected areas (MPAs) are very diverse in their intrinsic, jurisdictional, management and enforcement features (Mabile and Piante, 2005). They offer a wide array of situations, ranging from relatively large multiple-use marine areas with active management and strong social interactions, to small sanctuaries that are theoretically totally closed to any human activity.

There are several types of impact analyses that might be undertaken to examine potential impacts from marine reserves, and these are differentiated by the reach and scope of their coverage.

The most comprehensive kind of economic impact analysis (but also the most data intensive) is a full *cost/benefit* analysis. A comprehensive cost/benefit analysis of economic impacts of an MPA system would attempt to monetize all of the benefits produced and all of the costs generated by all affected parties over all relevant time periods. These would include the costs (current and future) incurred by current commercial, recreational and other users that were removed from existing grounds as the MPA network was adopted. These policy costs would be stacked up against new benefits (current and future) associated with reserves, including any commercial and recreational spillover benefits from dispersal from the MPA. In addition, other benefits from MPA creation such as ecosystem services, tourism, diving, educational benefits, insurance benefits, and existence values would be measured. Often cost/benefit studies summarize results in a monetary metric called *net economic benefit*, represented by the sum of gross values of the goods and services that are produced by a system, less the costs of producing those goods and services. Net economic benefits are often confined to primary effects associated with the first round of impacts on existing users.

However, *Cost/Benefit* analysis has its own weaknesses. One of them is the uncertainty as to what people are really responding to when asked about their Willingness to Pay (WTP).

In my presentation I will raise the issue of how we can interpret results from *Cost/Benefit* analysis and in which cases a supplementary study should be performed.

1. Introduction

The purpose of declaring a protected area is, as its name suggests, protecting a specified region from certain human impacts (Sanchirico *et al.*, 2002). That is, to maintain its natural characteristics. There are several factors that protected areas should be protecting from. Most are associated with some form of exploitation (fisheries, harvesting, etc.) or some form of commercial development (roads, housing, shopping malls and commercial tourism).

MPAs are protected areas in the Ocean or shores which are regulated more rigidly than elsewhere (Baht, 2003). This is done especially to achieve certain conservation goals such as to protect living organisms and their habitat. Another goal is to regulate some commercial activity such as fishery harvest that would be managed inefficiently under a free access management (Hanneson, 2002).
Economics deals with choice between alternatives. In the case of MPAs, there are two sets of choices or questions:
1) Should we construct MPAs?
2) What would be the most suitable way of constructing, managing, operating and financing them?
One research direction deals with the ecological aspects of MPAs, considering mainly the benefits created by establishing MPAs. The other direction deals with the process itself by which an MPA is developed and implemented, and the policy and economic issues associated with it (Spergel and Moye, 2004). One major distinction between these two research directions is that the first one deals with the benefit of MPAs while the second takes it one step ahead to deal with opposition to MPAs.
The need to deal with opposition to MPAs raises an important question as to why there would be any opposition if MPAs produce only benefits. The answer is that, as in any other human activity, implementation of MPAs produces not only benefits but also costs. The problem of benefits and costs gets more difficult because they do not appear uniformly; some individuals may be net beneficiaries while others may be net losers. Another complication is that benefits and costs usually appear at different points in time.
The importance of addressing MPAs is thus not only collecting factual information about technical matters. No less important is the human side dealing with various connections among ocean users, coastal communities, tax payers and conservationists.
There are different sorts of economic analysis that might take place. They range from traditional profit analysis of commercial activities, through optimization of marine fishery through bio-economic modelling, and up to cost-benefit analysis which includes non-market valuation (Becker and Choresh, 2006).

Non-Market valuation is of specific importance in analyzing decisions with respect to MPAs. Research shows that MPAs can increase biodiversity and allow a marine ecosystem to return closer to its “natural” state. Non-extractive users may value these changes to the marine ecosystem. For example, designating a special marine area, like a park or sanctuary, to protect biodiversity may increase its usefulness; such an area could be used for diving and photography. Improving the health of the ocean may also appeal to individuals who might never intend to use the area, but who value its existence nonetheless. If an MPA does attract new visitors, this can lead to additional jobs, income, and tax revenues for the local community. It is even possible that potential increases in revenue from tourism could offset potential losses due to lower commercial or recreational catches because of the closure.

Unless it can be proved that MPAs do not generate benefits that are at least as high as the costs incurred in carrying them, the management plan which is based on wrong cost-benefit analysis will not be sustainable. But insuring that benefits exceed costs is not sufficient for a successful management scheme. It should also be guaranteed that sufficient finance is available in order to carry out those conservation efforts.

2. Steps in conducting an economic analysis

The followings are the major steps that an economic analysis should follow (Becker and Choresh, 2006):
1) Identify the economic benefits in preserving the MPA – This step is needed in order to understand how an MPA can enhance economic activities and social values. It is important in order to later compare those benefits to the costs. It is also important in order to understand how to finance the desired activities - by governmental taxes, entrance fees, etc.
2) Identify the economic costs associated with preserving the MPA – This step is important because it helps distinguish between direct (maintaining the area) and indirect (lost development opportunities) costs. This separation is helpful in understanding where objections might arise and also to relate generation of revenues to sustainable management of the site.

3) Valuation of benefits and costs – This step is important for making a crucial decision about preserving the site on economic ground. The major purpose is to put all benefits and costs on the same footing. Since only parts of the values are expressed in monetary terms through their market value, we should think about ways to express values in monetary terms for the other services.
There are two main approaches to value those services - through nearby operating markets and through hypothetical ones. The first approach considers substitute markets (nearby) to the missing one. Therefore it is also called an indirect approach, or a revealed preference approach. Those can include substitute goods (to corals for example) or fuel and lost time (when deciding to visit a certain MPA). Hypothetical markets use surveys as their way of valuing the goods or services in question. Therefore it is called a direct approach, or a revealed preference approach, since people state their preference regarding the good or service in question. This method is the only one which can be used in order to obtain from people their value of the site, even though they do not intend to visit it. However, this method is also the most controversial one because it relies on a hypothetical basis.
Measuring costs can also be done in other ways. The most straightforward one is the accounting approach. Just add all those costs that are associated with well known out-of-pocket values: operation and maintenance costs for example. However, other costs can not be estimated in such a way. Measuring the cost of coral reef deterioration, beach restoration, etc., should be estimated by other means. For example, by the replacement cost approach. That is, what will it cost to provide the same service by the next available mean?
4) Distribution of benefits and costs – This step is important in order to identify gainers and losers. Without that it will be hard to plan a sustainable management strategy in order to compensate the losers and so move towards a more equitable distribution of net benefits from an efficient management point of view.
5) Identify economic incentives to generate revenues – This step is important because sometimes a good economic analysis is stalled due to lack of a complement program as to how to finance the cost needed to protect the site.

3. Different costs and benefits

In planning a comprehensive policy and management plan, the following costs and benefits need to be considered (adapted from Cesar, 2002).

3.1. Costs

Opportunity costs (loss of potential earnings):
- Short-term fishery revenues;
- Revenues from activities forbidden in the MPA, such as coral mining, shell extraction and blast fishing;
- Large-scale tourism and resort development;
- Industrial and infrastructure development.

Direct costs:
- Establishment costs;
- Administration costs;
- Employment costs;
- Monitoring and enforcement costs.

Indirect costs (possible compensation payments to those adversely affected by the decision to establish the reserve):
- Fishermen and processors in the short-term;
- Alternative employment packages;
- Infrastructure costs of increasing tourism;
- Displaced communities, if relocated.

3.2. Benefits

Fishery enhancement:
- After some time lags, the results of protection include larger, more valuable and variable fish species within the reserve, with transfer of benefits to fishing areas through adult spill over and larval export;

- Habitat protection increases production in reserves;
- Stock protection reduces the likelihood of fishery collapse.

Tourism and recreation:

- Better opportunities for tourism and recreation are a major objective of many protected areas (Becker and Lavee, in press);
- Enhancement of fish stocks in reserves and the associated habitat protection increase the appeal for tourism. This creates employment opportunities directly linked to the reserve (e.g. tour guides, wardens) and could stimulate a multiplier effect through the local economy (e.g. hotels, restaurants, infrastructure, taxi services, etc.).

Biodiversity conservation:

- Reserve protection leads to the recovery of exploited species in reserves, increased species diversity and improvements in habitat. These changes are expected to lead to greater resilience of populations to environmental perturbations, reducing the likelihood of local extinctions (Giraud *et al.*, 1999; Hall *et al.*, 2002; Langford *et al.*, 1998).

Ecosystem services:

- Other than fishing, protection of reefs provides protection against storms and coastal erosion, and increases assimilative capacity for pollutants.

Health services:

- There are potential gains from pharmaceutical bio prospecting – future discoveries of important medicinal components.

4. Benefit-Cost Analysis

The benefits and costs of MPAs can be systematically identified and described. However, a precise calculation of the expected net benefits obtained by expressing all benefits and costs in dollar terms is often not feasible. Like other public investments, the potential benefits of MPAs will often be realized at some future date, whereas many of the costs are incurred immediately, implying that closing off areas results in an inter-temporal tradeoff, perhaps even across generations. Many recent calls for MPAs have cited potentially large economic returns from ecotourism activities and conservation values associated with biodiversity preservation. However, Benefit-Cost Analysis has several shortcomings. Two of them are the equity and limitation in non-market valuation.

4.1 Equity and fairness concerns

Every public investment has equity or fairness implications and MPAs are no exception.

Equity issues among the stakeholders in the process can easily arise because MPAs will most likely affect user groups disproportionately.

Not surprisingly, distributional effects are very important in the political realm of decision making. Commercial and recreational fishermen often fear they will bear the costs of closing areas but will not be the recipients of the benefits. Such a change in the distribution of benefits and costs – real or perceived – is inevitably the subject of considerable dispute. Better understanding of the benefits and costs may reveal ways to compensate the losers and allow the MPA proposal to go forward. Otherwise, one might reasonably expect political intervention aimed at restricting management options.

4.2 Limitations to valuation

Valuation is a useful tool for marine protected area management because it highlights a range of costs and benefits which have in the past often been ignored by planners, policymakers and decision-makers. Valuation techniques however only provide tools which help to make better and more informed decisions about marine protected area management − they are not ends in themselves, and have a number of shortcomings and weaknesses.

There are a number of methodological issues and limitations which should always be borne in mind when carrying out marine valuation:

- Marine valuation is usually, of necessity, *partial*. Most quantified estimates of the economic benefit of marine goods and services focus only on selected components of their value. They should be taken as a minimum estimate of the total economic value of marine ecosystems.
- The *reality of values* is sometimes limited. They are rarely "real" values and often do not exist in terms of concrete prices and income. Rather than definitive or binding figures, most values should

be seen as indicative estimates which present a guide to what marine protected areas may be worth, for use in planning, decisions and policy. It is always important to make explicit the hypotheses, suppositions and assumptions which have been used in the course of marine valuation.

- The value of marine protected areas is *unequally distributed* between people and over time. Most valuation techniques do not take account of this differentiation or variability. Different people have different perceptions of the value of marine resources and ecosystems, and these may vary at different times. Economic valuation is usually based on a particular person's or group's conception of what a particular marine good or service is worth at a specific point in time. It is not necessarily universally valid, or might be extrapolated between different groups, areas, and species or over time.
- The loss of marine resources and ecosystems can have *irreversible effects* including the complete collapse of human livelihoods, the permanent loss of consumption and production possibilities or the total extinction of wild species. The full risk or ultimate implications of these losses, or how the loss of one species or habitat may affect other resources or activities in the future, is not known. The final or knock-on effects of marine ecosystem degradation can never be fully quantified or reflected in economic valuation.
- Some marine benefits will always be *unquantifiable and immeasurable* because the necessary scientific, technical or economic data are not available. Other aspects of marine valuation which relate to human life or religious and cultural values involve ethical considerations, especially when they are used to argue that specific activities or particular people's needs are more desirable or important than others. It is impossible to value marine protected areas fully, and in some cases it should not even be attempted.

5. SUMMARY

In this short paper I have tried to summarize the pathway in which decisions should be made with regard to MPA siting. It was shown that MPAs have two kinds of benefits. One is associated with a market value. The other should be estimated by non-market valuation techniques. The latter is the most important and also controversial one since it can easily alter the sign of the Benefit-Cost test. Non-market valuation methods should be used but also should be recognized for their limitations. A necessary step is to understand in which way the final result is biased. For example, if the result is a lower bound for the true value while the Benefit-Cost is positive, we can be sure that the project is worthwhile taking.

Another point that should be considered is how to connect between the non-market value and the financial requirement to make the plan a sustainable one. For example, a non-market value can be significant and suggest siting of MPA. This might be involved in losses (in real money) for other users. A possible way to turn this proposal to a sustainable one is to find a way to convert benefits (in virtual currency) to money (in real currency) and compensate the losers.

The price of change: the economic impacts of alien species and jellyfish outbreaks in the Mediterranean Sea

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Abstract

The economic impacts of invasive alien species and jellyfish outbreaks in the Mediterranean are reviewed. Some Erythrean aliens have been exploited commercially almost as soon as they entered the Levant and today they form an important part of the region's fishery resources. Other Erythrean aliens are noxius and venomous and pose severe health hazards and economic losses. In the western and central basins of the Mediterranean indigenous jellyfish outbreaks have detrimental impacts on fishery resources and ecosystem functioning, cause health hazards and costly damages to tourism. Multiple anthropogenic stressors destabilize and disrupt the native Mediterranean littoral ecosystem. Virtually every anthropogenic activity harms the sea in some degree. Those activities represent market failures because consumers do not pay for the current and future costs of their actions – in effect grazing on the Mediterranean commons. We need to correct this failure by ensuring that society is confronted with a market price for harming the sea.

Introduction

Coastal marine systems are among the most ecologically and socio-economically vital. Marine habitats from the intertidal to the continental shelf break are estimated to provide valuable ecosystem goods (e.g. food and raw materials) and services (e.g. disturbance regulation and nutrient cycling). But those marine ecosystems, along with the goods and services they provide, are threatened by multiple anthropogenic stressors – pollution, eutrophication, destruction and fragmentation of habitats, overfishing, introduction of alien species and climate change. These stressors, which are only a fraction of the magnitude of predicted changes in the coming centuries, have already triggered significant responses in the Mediterranean Sea. As these changes continue, we risk serious degradation of marine and coastal ecosystems, with far-reaching consequences for human health and welfare.

Evidence is accumulating that some recent changes in biodiversity patterns in the Mediterranean littoral are linked to direct drivers such as climate change and invasive species (Bianchi and Morri, 2003; Galil, 2007; 2008a,b). By the middle of the century, climate change and invasive species may be the dominant direct drivers of biodiversity loss and increased risk of extinction for many species, especially those already at risk due to low population numbers, restricted or patchy habitats, and limited climatic ranges. Both processes – global warming and the influx of thermophilic aliens – may impact the already teetering fisheries, mariculture, and tourism through proliferation of alien parasitic, noxious and poisonous species, displacement of commercially-important native species,

or through alteration of the food web and by causing phase shift in coastal ecosystems and changing seascape patterns.
Invasive alien species are increasingly seen by scientists and policy makers as a major threat: “Invasions … are now widely recognized as one of the most significant components of global change, with far reaching and often harmful effects on biodiversity“ (<www.eupolitix.com>). The “Jakarta Mandate on Marine and Coastal Biological Diversity“, adopted by the Parties to the “Convention on Biological Diversity” (CBD), cites “invasion of exotic species“ as one of the five main categories of the anthropogenic impact on marine and coastal biota (<www.biodiv.org>). Marine invasions are recognized as imperiling global “biodiversity, marine industries (including fishing and tourism) and human health“ (Bax *et al.*, 2003). Alien macrophytes, invertebrates and fish – nearly 600 species have been recorded thus far – are prominent in a number of Mediterranean coastal habitats (Galil, 2008b). In this paper, the reports on the economic impacts of invasive alien species and jellyfish outbreaks in the Mediterranean are reviewed.

Invasive alien species

Some Erythrean aliens have been exploited commercially almost as soon as they entered the Levant and their economic importance have been long acknowledged: “... les passages définitifs de ces espèces à travers la totalité du Canal présentent un résultat *économique* [sic] également très important..... pour les marchés palestiniens et syriens, un appoint non négligeable et particulièrement intéressant, par consequent, pour l’ensemble des populations de ces deux Pays“ (Gruvel, 1936: 228, 229).

An early Erythrean invader, the swimming crab *Portunus pelagicus* was on sale already by the early 1900s in the fish market of Haifa (Fox, 1924; Calman, 1927); during the British Mandate the fishermen of Haifa and Acre sold 20 tons of the crab annually (Perlmutter, 1956). By mid-century the Erythrean fishes were an important part of the Levantine fisheries. Insofar as the Israeli fishing grounds were concerned, the bulk of the trawler catch from 1950 to 1955 was comprised of three species – the native red bream *Pagellus erythrinus* (Linnaeus, 1758), the hake *Merluccius merluccius*, and the Erythrean yellow striped mullet *Upeneus moluccensis*. The latter were fished commercially in the early 1940s only along the southern coast of Israel. By 1946-1947 they were found all along the coast (Gottlieb, 1957), and by the late 1940s constituted an estimated 10-15% of the total mullid catch (Wirszubski, 1953). In 1955 Israeli fishermen noticed greater numbers of the yellow striped mullet, and data assembled by the Sea Fisheries Research Station, Haifa, indicated that their percentage in the mullid catch rose to 20%, and to over 83% in early 1956 (Oren, 1957a,b), so as to be considered “the most important commercial fish in the Israel trawl catches“ (Gottlieb, 1957: 20). Since the total mullid catch had remained constant, the yellow striped mullet had in the early 1950s “almost completely replaced the Mediterranean species, the red mullet, *Mullus barbatus* in the trawl catch” (Perlmutter, 1956: 4). In 1955, another Erythrean alien, the lizardfish *Saurida undosquamis* became an important part of the trawl catch (Oren, 1957b). In 1953 it was first recorded from the Mediterranean coast of Israel (Ben Tuvia, 1953a,b) as much rarer than the native Mediterranean lizardfish *Synodus saurus* (Linnaeus, 1758). Within two years commercial catches increased steadily: in November and December 1955, 22 and 27.5 tons respectively were taken, swelling to 40 and 46.8 tons in January and February 1956 respectively, to a total of 266.5 tons for 1956 – that is, 20% of the total annual trawl catch (Oren, 1957a,b). The sudden increase in the populations of the lizardfish, the yellow striped mullet, the red soldierfish, and Erythrean penaeids was attributed to a rise of 1-1.5ºC in sea temperature during the winter months of 1955 (Ben Yami, 1955; Chervinsky, 1959).

Examination of the Israeli fisheries statistics since the mid 1980s underscores the growing prominence of the Erythrean aliens. The Erythrean conch, *Conomurex persicus* Swainson, 1821, and on occasion the Erythrean spiny oyster, are served in seafood restaurants in Israel. Erythrean penaeid prawns make up most of the shrimp catches along the SE Levantine coasts. The Erythrean prawns, in particular *Marsupenaeus japonicus* (Bate, 1888) *Metapenaeus monoceros* (Fabricius, 1798) and *Penaeus semisulcatus* de Haan, 1844, are highly prized. Beginning in the 1970s a shrimp fishery developed off the Sinai coast, and since the mid 1980s off the Israeli coast where a small fleet of coastal “mini“ trawlers has specialized in shrimping, bringing in a quarter of the total trawl catch volume and a third of the trawl gross income (Pisanty and Grofit, 1991; Snovsky and Shapiro, 1999). Off the southeastern coast of Turkey the Erythrean prawns *M. japonicus* and *Penaeus semisulcatus* are the most important species in the landings (Duruer *et al.*, 2008), together with four other Erythrean decapod crustaceans. In southern Lebanon Erythrean aliens constitute 37% in weight of the total landings of the artisanal fishery (Carpentieri *et al.*, 2008). Nearly half of the trawl catches along the Israeli coast consist of Erythrean fish (Golani and Ben Tuvia, 1995). The dominant fishes in the inshore fisheries (trammel-netting and hook-and-lining) are the rabbit fish *Siganus rivulatus* and *S. luridus*, the obtuse barracuda *Sphyraena chrysotaenia* Klunzinger, 1884, and the Erythrean jack, *Alepes djedaba* (Forsskål, 1775). The above species, together with *Sillago sihama* (Forsskål, 1775) and *Scomeromorus commerson*, two species that underwent population explosion in the early 1980s, are common in purse-seine landings. The annual catch of the Erythrean lizardfish which reached 400 tons in 1960 soon after its arrival (see above), declined to 100 tons in the mid 1960s, but has since increased, and catch fluctuations are correlated with CPUE. Catch statistics for mullids do not distinguish between the natives, *M. barbatus* and *M. surmuletus* Linnaeus, 1758, and the Erythrean aliens *Upeneus moluccensis* and *U. pori*, but a study of the frequency of the latter in trawl catches conducted in the mid 1980s showed they formed 87% of the mullid catch off the coast of Israel at depths of 20 m, and 50% at 55 m, whereas the native mullids are more abundant in deeper waters (Golani and Ben Tuvia, 1995). The percentage of the Erythrean mullids in the total mullid catch has been increasing steadily, from 30% in 1980, 42% in 1984, to 47% in 1989 (Golani and Ben Tuvia, 1995). Similarly, catch statistics of sphyraenids do not separate the Red Sea obtuse barracuda from the native Mediterranean species *S. sphyraena* (Linnaeus, 1758) and *S. viridensis* Cuvier, 1829. However, examination of the landed catch showed that the Erythrean barracuda had outnumbered the native sphyraenids in inshore trawl and purse-seine catches (Grofit, 1987). In addition, two of the four species of Erythrean clupeids that established populations in the Levant – *Dussumieria elopsoides* Bleeker, 1849, and *Herklotsichthys punctatus* (Rüppell, 1837) – are of importance in the inshore-pelagic fishery. The increasing exploitation of Erythrean aliens meant the shifting of the trawling grounds nearshore since their densest populations occur at depths up to 50 m. Between 1980 and 1986 the Israeli trawlers doubled their activity (measured as fishing hours) in shallow waters (Pisanty and Grofit, 1991). The shoreward displacement of the fishing grounds coupled with the inexorable gain of Erythrean aliens raise the ratio of alien to native taxa in the Levantine trawl landings.

But together with the commercially exploitable species, the Erythrean invasion swept ashore the scyphozoan jellyfish, *Rhopilema nomadica* Galil, 1990. Each summer since the mid 1980s huge swarms of the Erythrean jellyfish have appeared along the Levantine coast. These planktotrophic swarms, some stretching 100 km long, must play havoc with the limited resources of this oligotrophic sea, and when the shoals draw nearer shore, they adversely affect tourism, fisheries and coastal installations. As early as the summer of 1987 severe jellyfish envenomations requiring hospitalization had been reported in the medical literature: 30 patients, mainly children, suffering various degrees of painful injuries to different parts of their bodies were treated that summer in the emergency ward of the Soroka Medical Center Beersheva, Israel, alone (Benmeir *et al.*, 1990). The annual swarming brings each year reports of envenomation victims suffering burning sensation, eurythema, papulovesicular and urticaria-like eruptions that may last weeks and even months after the event (Silfen *et al.*, 2003; Yoffe and Baruchin, 2004; Sendovski *et al.*, 2005). Local municipalities report a decrease in holiday makers frequenting the beaches because of the public's concern over the painful stings inflicted by the jellyfish. The local newspapers and TV news report during the summer months the presence of jellyfish along the beaches. Coastal trawling and purse-seine fishing are disrupted for the duration of the swarming due to net clogging and inability to sort yield "It is not uncommon that fishermen, especially purse seines, discard entire hauls due to the overwhelming presence of poisonous medusae in their nets" (Golani and Ben Tuvia, 1995: 287). Jellyfish-blocked water intake pipes pose a threat to the cooling systems of port-bound vessels and coastal power plants: in the summer of 2001 Israel Electric removed tons of jellyfish from its seawater intake pipes at its two largest power plants, at estimated costs of 50,000 US$ (M. Cohen, pers. comm.).

The recent spread of the silver stripe blaasop *Lagocephalus sceleratus* (Gmelin, 1789), and the striped catfish *Plotosus lineatus* (Thunberg, 1787) pose severe health hazards. The blaasop's internal organs, and in particular the gonads during the spawning season, contain a strong paralytic neurotoxin. In the Suez City, on the Red Sea, eight fatalities from tetrodoxin poisoning associated with eating the fish have been described recently (Zaki, 2004). Several cases of poisoning were reported from Israel, but none proved fatal (Eisenman *et al.*, 2008). Injuries caused by the barbed and venomous first dorsal spine and pectoral spines of the striped catfish may produce pain levels requiring hospitalization – injuries have been reported by local professional and amateur fishermen.

MASSIVE JELLYFISH OUTBREAKS

Periodic increases of indigenous jellyfish outbreaks have long been noted in the Mediterranean: the penultimate bloom of *Pelagia noctiluca* lasting a decade (1976-1986) (UNEP, 1991; CIESM, 2001). Studies of the phenomenon suggested that various anthropogenic perturbations – eutrophication, overfishing, global warming and the increase of man-made marine hard substrates – may have contributed to the proliferation of jellyfish populations in recent decades (Goy *et al.*, 1989; CIESM, 2001). Jellyfish are both predators and competitors of fishery resources, and outbreaks are often accompanied by a decline in fishery resources. Modelling has suggested that the increased competition for zooplankton during a jellyfish outbreak may possibly lead to a negative impact upon small pelagic fish and their predators, and result in disruption of the pelagic trophic pathway and a reduction in pelagic fishery resources (Jiang *et al.*, 2008). Boero *et al.* (2008) recently proposed that the removal of top predators and the formation of oligotrophic temperature-stable watermasses may cause the suppression of the high energy fish and mammal-dominated food web and the re-emergence of medusozoan-dominated food web. Though experts agree that jellyfish outbreaks have detrimental impacts on fishery resources and ecosystem functioning, no data are available on the cost to fisheries of jellyfish outbreaks in the Mediterranean.

Whatever the cause, the recurrent massive jellyfish outbreaks that have appeared along the shores of the Mediterranean have been amply documented as causing health hazards and costly damages to tourism.

Back in 2006, 21,000 people had been stung by *Pelagia noctiluca* on the beaches of Catalonia, 11,571 people were attended by health authorities in Valencia, while on a single day in August, 400 bathers were treated at a beach in Málaga (The Daily Telegraph, 9 August 2006; <www.iberianature.com>). Some of the country's most popular holiday destinations are affected including the Costa del Sol, Costa Blanca and the Balearic Islands. The warm salty lagoons near the fashionable Murcian resort of La Manga, Mar Menor, are so infested with *Cortylorhiza tuberculata*, that 1,000 tonnes had to be carted away. In Italy that year, large groups of jellyfish have appeared at beaches in the northern region of Liguria, at resorts around the Sicilian city of Messina and in parts of the Adriatic Sea near Trieste.

In the summer of 2007 The Associated Press reported that at least 30,000 people had been stung by jellyfish off Spain. The Sunday Times (June 24, 2007) reported that from the Costa del Sol to the French Riviera, an infestation of jellyfish was forcing seaside resorts to set up defences, repel the invaders and protect the tourist industry. Spain has launched a national "jellyfish plan" to tackle the menace. The numbers of lifeguards and first aid staff have been increased, and a leaflet created to warn tourists of the danger (<www.environmentalgraffiti.com/ecology/>, 8 August 2007). The Environmental Ministry has organised a network of recruits among fishermen and pleasure craft operators to inform the coastguard of jellyfish sightings as well as a "spotter plane". More than a dozen boats normally used for scooping up rubbish at sea will be deployed to suck jellyfish into their holds. The city of Cannes on the Côte d'Azur, shoveled over 11 million tons of jellyfish off its beaches and invested nearly $50,000 in floaters and netting to create jellyfish-free zones the size of Olympic swimming pools at two of its most popular beaches (<www.travelmole.com>, 26 June 2007; <www.time.com>, 21 July 2008). Fearful of the effect on the tourist trade, Monaco too installed booms and nets on several beaches. Marine biologists disdain the use of fixed nets or barriers around swimming areas as the waves could amputate the tentacles of an ensnared jellyfish and carry the venom-filled extremities toward swimmers. Stray tentacles and even dead jellyfish can still be dangerous. In Antibes, a 30ft catamaran which has been described as a "jellyfish hoover" patrolled the coastline, ready to suck up any jellyfish.

This past summer was no better. As thousands of tourists headed to the Mediterranean, beaches were plagued by jellyfish, whose burning stings have sent holiday-makers shorewards. Schools of jellyfish flooded the northern shores of Greece. The jellyfish were observed on the beaches of the Chalkidiki, Pieria, Kavala and Xanthi areas, as well as in the northern part of the Aegean Sea, near the islands of Limnos and Agios Efstratios (<www.BalkanTravellers.com>). French emergency services received more than 500 calls in a single day along a 10-mile stretch of coast from Nice to Cannes (<www.independent.co.uk/environment/nature/>, 24 July 2008). As well as the Côte d'Azur, the coast of Liguria on the west coast of Italy, the Costa Smeralda in Sardinia, parts of the Adriatic coast of Italy, and much of the southern coastline of Spain have been hit. Prodded by Spain's mighty tourist industry, the environmental authorities are expected to support major anti-jellyfish measures from year-round monitoring to jellyfish hunting boats, though the Environmental minister, Cristina Narbona, admitted that even with preventive measures in place "we cannot guarantee in any way the complete absence of these organisms in bathing areas" (<www.independent.co.uk/environment/nature/>, 16 February 2008), and may have to resort to closing beaches.

This is the eighth consecutive year that ever larger populations of jellyfish have appeared off the coasts of Spain, France, Italy and Greece - a trend, experts say, that may or may not reverse itself- and may reflect a regime shift resulting from domination of jellyfish over rivals in the food chain (<www.time.com>, 21 July 2008).

Conclusion

Multiple anthropogenic stressors – pollution, eutrophication, destruction and fragmentation of habitats, fisheries overexploitation, rising temperatures – are implicated in a web of linkages that cause the decline in the richness and diversity of the native Mediterranean littoral ecosystem, destabilize and disrupt its communities.

The economics of the ecosystem change in the Mediterranean is straightforward. Virtually every activity in the peri-Mediterranean littoral and in the sea itself harms the sea in some degree. Those activities represent economic and social consequences not accounted for by the workings of the market. They are market failures because consumers do not pay for the current and future costs of their actions. Economic participants – governments, producers, consumers – need to face realistic prices for harming the sea if their decisions about consumption, investment, and innovation are to be appropriate. Raising the price of "harm" has the primary purpose of providing strong incentives to reduce it. Those who harm the sea are enjoying an economic subsidy – in effect, grazing on the Mediterranean commons and not paying for the costs of their activities. We need to correct this failure by ensuring that society is confronted with a market price for harming the sea.

The value of coastal and marine ecosystems in the Mediterranean will depend on how well we manage them

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Abstract

Coastal and marine ecosystems are considered as natural assets that require good governance and management for allowing their maintenance and adaptation to a rapidly changing environment. Management of natural resources, from the coast to deep waters, is mostly depending on social values which are expressed through political, social, and economic systems. The management of such a complex socio-ecosystem should always be based on an overall vision, approaching problems with multiple objectives in an adaptive manner. The combination of the OECD driving forces-pressure-impact-response (DPSIR) model with the Millennium Ecosystem Assessment typology of ecosystem services may help in building up that vision. Because ecosystem's status evolves through non-linear dynamics and succession of thresholds in a continuous adaptive cycle, the functions linking human and natural systems evolve as well and are highly uncertain. In such a complexity, hence uncertainty, the main issue is about improving coastal governance where skilled self-organized communities and strong committed local governments are considered as the pillars of local development, provided they develop their own knowledge base of the state and changes of ecosystems and resources at stake. Giving a value starts with the knowledge of what is at stake.

1. Introduction

By definition, a "natural asset" is something that is linked to some use, and any use implies a management. The first question is then how well are we managing the natural assets that are coastal and marine ecosystems.

From global studies like the Millennium Ecosystem Assessment we know that we are not doing that well. The management of natural resources, which includes coastal habitats as well as deep waters, derives from our social values. For example, resource management and protection laws are a reflection of a given society's desire to accomplish certain goals, such as protection of critical species.

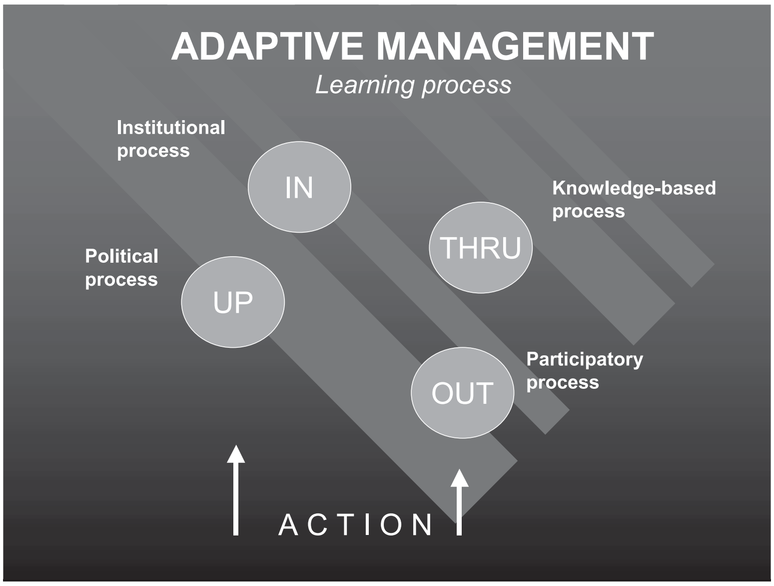
But then the question may be asked about who exactly is pursuing these goals and pushing for enacting protection laws? At local level, "society" is made among others of local residents, local elites, government personnel and agency personnel, with their respective level of participation in decision-making, programme implementation, interest in benefits and evaluation of actions' effectiveness.

The development approach to community participation places its primary emphasis on the building of a community's capacity for ongoing development. One crucial aspect of the developmental approach is thus the creation of a participatory decision-making process within a defined territory, which starts with the smallest administrative unit including local decision-makers. Capacity building creates a process through which a community and local decision-makers can "co-manage" the resources at stake and continue to do their own development.

The problem is that involvement of community users in the management of the resource they exploit (e.g. small-scale fisheries) is in many cases limited to consultation on implementation issues. In the public debate on fisheries management, the issue of sharing knowledge is often translated into the need to disseminate research results to fishermen, with the underlying understanding that everybody in the management process shares the same basic paradigm, and that some actors just know better than others within this paradigm. However, the issue is far more complex, as the public debate also frequently indicates: actually, there are different understandings at stake and these differences must be understood as a first step to a shared understanding. Fisheries science and fishermen observe and interpret the sea on different scales. Fisheries science is still based on the overall "stock" concept while fishermen are concerned with local abundance. Their participation to effective resources management will thus depend on their capacity to co-develop with researchers and use "accepted" indicators that are relevant to management.

2. Adaptive management

The manager is dealing with dynamic, non-linear and therefore complex ecosystems in a world increasingly characterized by rapid transformations. Rather than *managing* such systems, management appears to be about maintaining commitment to competencies or core values, emergent pattern recognition (expertise), and openness to diversity, change, and new information (Gunderson and Holling, 2002).

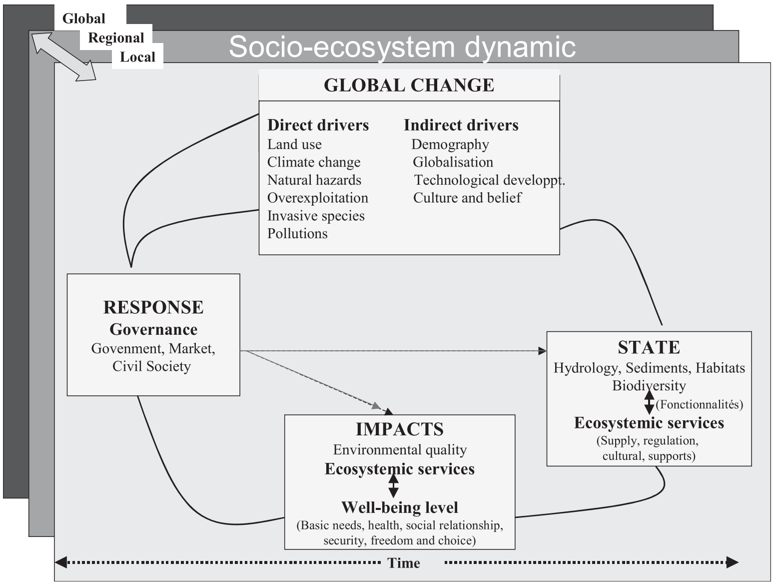


Practically, managing complexity means "never taking action with just one objective in mind" (Westley, 2002). Most problems should be approached with multiple objectives, more particularly in regard to commitment to a scientific approach (managing *through*), commitment to involve external groups or stakeholders in management processes and decisions (managing *out*), the need to also manage position and influence within one's own division or organisation (managing *in*), and the need to take into account the larger political context in which the actions take place (managing *up*).

The effective manager is like a juggler throwing up the four balls simultaneously. In action, the trick is to keep the eye on these four balls and keep a peripheral vision to keep ready to adjust or to take advantage of changing context provided that, in adaptive management, failure is as instructive as success. As an example, turning a disaster like the 2004 Tsunami (Indian Ocean) into an opportunity was part of the strategy of many field organisations in Thailand including a 5-year project devoted to coastal habitats and resources management (CHARM) in the South of Thailand. All in all, the manager must keep the vision to better adapt to the sociological-ecosystem dynamics.

3. The socio-ecosystem dynamics

The state of ecosystems changes in response to the stress imposed by global changes, and human societies adjust their behaviour affecting ecosystems in response to perceived changes in these systems. These society-nature interactions are often represented as driving forces-pressure-state-impact-response (DPSIR) indicators as originally created by the Organisation for Economic Co-operation and Development. It is often assumed that the impact will increase with the intensity of use but sometimes an ecosystem may seem untouched by increasing stress until it suddenly collapses to another state when certain thresholds values are passed. One example of such non-linear change is provided by the collapse of the Newfoundland cod fishery. After decades of increased fish landings and declining fish stocks, the fishery collapsed abruptly in 1992. Even after a 10-year moratorium, fish stocks had not recovered and it is thought this is because of permanent changes that occurred when the fishery collapsed (Defra, 2007).



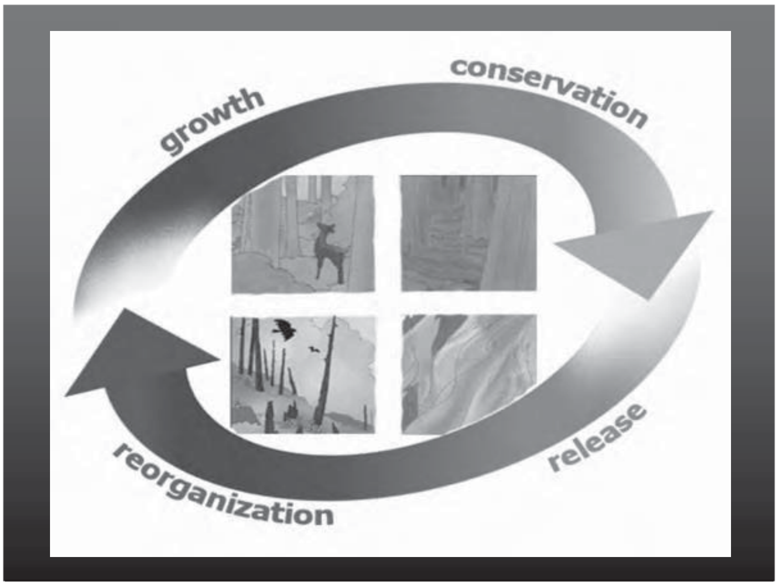
It was to improve the understanding of these interdependencies that the Millennium Ecosystem Assessment (MEA, 2005) was launched in June 2001 in order to inform governments, NGOs, scientists and the general public about ecosystem changes and their effect on human well-being. Recognized as a “substantial evidence base for policy-making”(Defra, 2007), the MEA set out a typology of ecosystem services under four broad headings: provisioning, regulating, cultural and supporting services.

Combining the DPSIR and MEA logical frameworks, one can appreciate more readily that:

- biodiversity underpins all ecosystem services, biodiversity is also considered to have insurance value by providing resilience in the face of current or future shocks to ecosystems and the services provided (Defra, 2007);
- therefore, the state of the system will be found in a better understanding of existing functionalities between the state of biodiversity and the level of ecosystem services; and,
- the measurement of impacts will mainly result in looking at the interactions between ecosystem services change and human well-being level;
- in the end, the application to policy appraisal is voluntarily focusing on ecosystem services contribution to human welfare –an anthropocentric view– that leads to valuing changes in ecosystem services, i.e. the value to human welfare;
- there is not one response but a “cocktail” of responses coming from the three main governance mechanisms: the Government, the market and the civil society mechanisms.

4. Adaptive management / adaptive ecosystems

Mediterranean forest fires provide an example of a system that undergoes adaptive cycles. Fires occur in cycles that are characterized by gradual changes and abrupt transitions. Those transitions occur following disturbances in this case fire is the disturbance whatever the cause. Forest ecosystems develop gradually in a process of succession. Forest succession usually begins with bare ground that is colonized by fast growing grasses and shrubs. Early succession or opportunistic species are selected for fast growth and rapid reproduction, which corresponds to the 'growth' phase of the adaptive cycle.

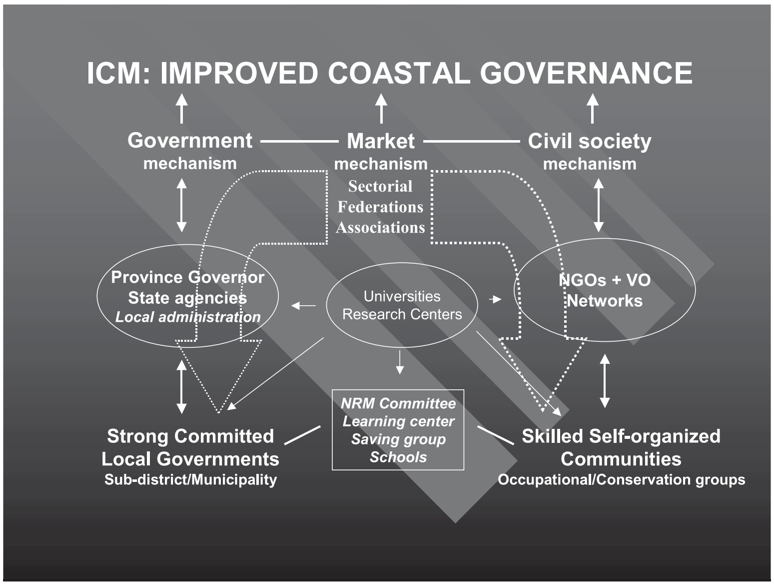


Over time scales of decades to centuries, the system matures as the overall biomass increases. Doing so, the energy captured by that system goes into maintaining the accumulated structure, but as a result the system loses some flexibility and capacity to adapt and respond to change. The system does not keep on growing indefinitely, but tends to reach limits or a state in which it is actually slowly changing. The 'conservation phase' of the adaptive cycle is when the system approaches a steady state or its maximum carrying capacity.
Once there is sufficient fuel combined with dry conditions and a spark, fires can destroy all or part of the existing forest structure. This is the 'release' phase, also called 'creative destruction', followed by a reorganization of the system depending on the 'seed bank' in forest soil (supporting services).
In other types of systems, various forms of capital (e.g., natural capital, financial capital, infrastructure, human capital such as education, and social capacity such as trust and networks) that are built up during the growth and conservation phase, are critical in determining the system's resilience and adaptability. The beginning phase sets the stage for subsequent succession and development phase (ResilienceAlliance, 2007).

This adaptive cycle shows that in a complex evolving world, the functions linking human and natural systems evolve and are highly uncertain. Efforts to freeze or restore to a static, pristine state, or to establish a fixed condition are inadequate whatever the nature of the motive, i.e. conserving nature, exploiting a resource, sustaining recreation, or facilitating development.
The problem is even more complex when a rapid succession of dramatic events does not even give the time to the system to reorganize itself as might be the case for coral reefs and their bleaching as a consequence of sea surface temperature rise.

5. Improving coastal governance

Improved coastal governance towards Integrated Coastal Management (ICM) depends on government, market and civil society mechanisms. At local level, it is conditioned by both skilled self-organized communities and strong committed local governments with negotiation and planning (e.g. Natural Resources Management Committee), learning (e.g. Learning centre) and financial (e.g. saving group and microcredit) facilitating platforms. The awareness and contribution of the Education sector (schools) is considered as crucial for today and tomorrow. The upscaling process operates through the provincial or regional governance level and volunteer organisations supported by government agencies and NGO networks. As a driving force, the market mechanism calls for Public-Private partnership agreements. Knowledge centres (universities, research centres) got committed in the governance process through reliable knowledge transfers to users and decision-makers.



Such is the scheme experimented by a 5-year project on coastal habitats and resources management (CHARM, 2007) in Thailand. It is underpinned by five main attributes as follows: (1) Participation of stakeholders; (2) Partnership between stakeholders; (3) Integrated approaches and methods including full utilization of the knowledge base in the resource system; (4) Learning and adaptation through appropriate institutional arrangements; and (5) Building capacity at all levels.

Participation –International experience demonstrates that projects are sustained only where there are constituencies that are active advocates for improved resources management. A coastal management project like CHARM seeks to carefully design mechanisms to assure that participants at national, provincial and local levels participate in each phase of the co-management process. Under the provincial and sub-district administrations, community organizations should become focal points for conflict mediation and implementation of "pragmatic co-management activities" that test new approaches to habitat and resource management at a pilot scale.

Partnerships - Forging mutually beneficial partnerships among institutions, communities, NGOs, and with donors should be a central feature of the project activities at every level. In the case of the CHARM project, the Financing Agreement that governs the relationship between the Royal Thai Government and the European Commission is designed and may be seen as a partnership. At central government level, a Project Steering Committee is a partnership among the government agencies and professional organisations with major roles in coastal management. The project management unit itself is working in partnership with public agencies and NGOs for community consultation and organization, promotion of alternative livelihoods, and financial management capacity.

Integrated approaches and methods – The integration in coastal management is what makes the difference from traditional sectoral projects that address only fragments of the whole picture. The integration is multidimensional:

- integration of science with policies, with a strong emphasis on the social and political process and the belief that research and technical tools (permits, zoning, impact assessment, etc.) are of little value if the institutional and societal context in which they are introduced is not yet capable of making the changes in values and behaviour that such tools require;
- integration between bottom-up and top-down approaches to resource management;
- integration between large- and small-scale management, and between short- and long-term time scales;
- integration among sectors and disciplines, expressed through institutional arrangements at all levels of governance allowing to appropriate response and management processes, functions, dynamics and changes in a fashion that contributes to ecosystem resilience with the interdisciplinary contribution of the academic and research institutions.

Learning and adaptation – Feedback should be central to the implementation of any project activities. Techniques and mechanisms have to be developed to encourage the open exchange of ideas and experience and foster learning both internally, among the project staff, and externally, with stakeholders and with the public at large. Drafting and dissemination of manuals and guidelines represent an important support to integrated management extension and replication.

Building capacity – The priority should first be given to building a core group of professionals that can sustain a coherent integrated management process into the future. This concerns individuals with adequate training and experience within government at national, provincial and local level, universities, NGOs and communities in the different sites. The 'learning-by-doing' approach will be bolstered by formal training along with exchange visits within the country and with other countries. Besides local stakeholders, building a critical mass of mid-level professionals from government and non-government bodies also helps in facilitating coastal management development, implementation and scaling up.

6. Coastal and marine ecosystems as natural assets

Building and/or maintaining sustainability and resilience in resource systems requires a suitable knowledge base of the state and changes of ecosystems at stake. It is important that resource management (1) implement suitable means to monitor the resource system, acquire knowledge accordingly, and report on its status to all concerned, and (2) make full use of all available sources of information, and properly assess knowledge requirements and gaps.

Going back to the coastal governance scheme, there are among others two important groups of stakeholders to be considered: local government officers and community members.

At a rather large scale like a province or a bay, a coastal environmental profile provides a comprehensive review of the state of the environment in that area. Within well-defined management units, the profile gives information on the bio-geophysical characteristics, resource-use patterns, socioeconomic setting, status of the coastal and marine environment and legal and institutional arrangements. It ends up with a quality status report, a vulnerability mapping atlas (with its geographical information system), and an Environmental Vulnerability Index as a ratio between the natural habitats sensitivity (resilience) and the assessment of the level of risks to which they are exposed. This tool is made to be then incorporated into local governments information unit, usually mainly at provincial level where the appropriate infrastructure and skills are available.

Since this information on existing coastal and marine natural assets at rather large scale does not give the expected information at community resource scale, it is necessary to develop a complementary approach involving community users.

Community-based monitoring (CBM) is designed to empower local communities in monitoring their local environment and resources, and to use this information in a structured way for decision making so as to improve sustainability of their resources and livelihoods. The CBM approach is intended to be implemented in a long-term, sustainable way by communities. Support from local governments and NGO facilitates this process. CBM is centered on the community themselves, through activities such as school involvement in youth camps and curricula design, and involvement from local NGOs. However, it is improved with support from relevant governing and supporting institutions such as the local government administration.

The basic framework of the CBM developed by the project has three levels: (1) Quality of life (e.g. health and disease, economy, personal stress); (2) Production (e.g. catch of key biomass resources, e.g. crabs, species loss, decreased size); (3) Ecosystem (e.g. loss of habitat, loss of functional use such as water quality).

Linked to each of these levels are sets of indicators which inform the target population about the status of the three interlocking aspects. This fundamental linkage between multi-level indicators and the needs of the target community is a core aspect of CBM. Selection of the specific suite of indicators is from expert knowledge and secondary information. This set of indicators was then more widely discussed to provide a consensus on a suitable suite of indicators to be used in the survey. This provisional suite of indicators was discussed with the local government representatives prior to the resources survey, to ensure their cultural appropriateness and local relevance.

7. Conclusion

The new forms of coastal management initiatives put a strong emphasis on the governance process and the well-being of people. Their main goals can be generalized as to: (1) improve the governance process that is supported by and benefits communities and nations; (2) improve the economy, health and social well-being of people who depend upon coastal resources; and, (3) improve environmental quality to maintain biodiversity hence ecosystem services.

Here, “governance” can be defined as the process by which policies, laws and institutions address the issues of concern to a society; governance establishes the fundamental goals, institutional processes and structures that are the basis of planning and decision-making (see Olsen, 2003).

In an increasingly crowded and interconnected global society, it is the ability to integrate across what is known and what is done that is most critical. This integration must occur at many scales and across many different bodies of knowledge. The integration of knowledge of how ecosystems function and respond to human activities is central. Ecosystems must be defined as complex adaptive systems that include human beings as one of their components. The other priority for integration lies in developing nested systems of governance that link natural assets assessment to planning and decision-making at the scale of the community and simultaneously at the higher levels of governance up to the nation and the planet. Such an approach recognizes that biodiversity is a crucially important feature that underpins the state of economic services, together with cultural diversity, another condition to the long-term health of a planet that remains friendly to human beings.

Shortcomings and potential advances in valuation of Mediterranean ecosystems

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Abstract

The aim of the paper is to critically assess the state-of-the art of the current economic valuation methods and to place it into the context of Mediterranean ecosystem. There are shortcomings in many steps of the valuation process starting from cost-benefit analysis in general, over psychological and sociological obstacles. These shortcomings can be partially tackled by applying group valuation methods. Still very serious problem of endogeneous preferences and baseline shifting remain which indicates that objective and human-independent methods are needed.

Cost-benefit analysis

Economic valuation of natural resources is a crucial part of cost-benefit analysis. As the purpose of cost-benefit analysis is efficient allocation of resources (Boardman *et al.*, 2000) it is used when market does not work well[1]. Ideally, cost-benefit analysis provides complete information about social costs and benefits. However, information available by valuation is partial, referring just to some of the links in the chain (Millenium Ecosystem Assessment, 2005: 128). The outputs of valuation are used by relevant authorities for decision-making. Hence incorrect valuation may lead to improper decisions and, ultimately, to government failure.

Before focusing discussion on environmental valuation it is useful to summarize the steps of cost-benefit analysis in the following Table:

Table: cost-benefits analysis.

STEPS	SHORTCOMINGS
1. determination of alternative projects	- limited number of alternatives
2. consideration of local, national and global dimensions of alternatives	- impossibility of capturing all the costs and benefits by the analysis - ignoring spillovers and complementarities effects
3. choosing the measure of impact and verifiable indicators	- indicators used by locals are usually difficult to verify by the broader community
4. quantitative prediction of the impacts	- hard realization
5. monetarizing all the impacts	- controversial
6. discounting of costs and benefits	- problem of choosing a correct discount rate
7. comparison of net present values	- “lowest values”
8. sensitivity analysis	

Source: Boardman *et al.*, 2000: 2.

[1] This is called *market failure* and is characterized by violation of basic assumptions of perfect competition.

When the local, national and global dimensions of alternatives are considered, it is impossible to take all the costs and benefits into account, so that spillovers and complementarities effects are usually ignored. In fact, direct costs and benefits are easier to understand and capture. Indirect effects, which can cause spillovers and externalities, can have large share in total costs and benefits, but they are not taken into account because they are hard to identify and measure. When it is necessary to choose the measures of impact and verifiable indicators, mainstream specialists have to reach a common agreement. Once "objective" information about ecosystem is obtained, the valuation process is still faced with sociological and psychological problems. Boardman *et al.* (2000) claim that if nobody is ready to pay for saving service of some natural resource their willingness to pay for that service is zero. This can be very misleading if the service is a kind of public good. The methods that do not "attach the price" are effective analysis and multigoal analysis. The valuation process is related to reducing information. However, *relevant* information needs to be transmitted to the policy-maker.

When the net present values are computed, the project with the largest net present value should be selected. Here problem may arise if the lowest values (lower bound) of the alternatives are obtained for each alternative. It is known that their real social net-benefits are above the lowest bound but we do not know by how much. Hence there can be two excluding but socially valuable projects: one improves equality; the other improves the ecosystem. Choosing the project with the highest lower bound may be wrong because both projects have unknown but higher social benefits.

Concepts of value

For economists value is a fair or proper equivalent in money[2] or commodities. Philosophers distinguish intrinsic and instrumental value. Economic value is usually associated with instrumental value (something is valuable if it serves for increasing "pleasure" or decreasing "pain"), while ecologists' definition of value is similar to intrinsic value. There are different definitions of value in economic theory. The basic distinction is between subjective and objective value. Objective measure is based on the quantity of inputs. So, Marxists measure the value in labour units while there are suggestions to express value (prices) in energy units (Roma, 2006). Subjective value depends on how much "pleasure" (benefits) and "pain" (costs) something causes to individual. As marginal utility usually decreases with additional unit consumed, scarce resources should be valued more.

Development of social norms related to ecosystem may be the result of accumulated experience from the past[3]. This approach shows that even non-economic kind of values can result from ecosystem services scarcity and ways of improved management. Furthermore, not just material needs, but also social, cultural and spiritual values should be captured by the concept of economic value.

Economic valuation techniques

There are two broad groups of environmental valuation techniques: stated preference techniques and revealed preference techniques. Both classes of methods are based on preferences. In order to draw any sensible conclusion from preference mapping one needs to assume that they are well-behaved (complete, transitive and continuous) and that they exist. In case of stated-preference techniques, individuals state how much they value certain objects. This can be quite vague because individuals do not have to bear real consequence for such statements. Thus they will usually overvalue all the goods because they do not have to pay them. It is difficult to conclude about relative value. However, state-preference techniques are the only methods for revelation of passive use value (value of potential use). Therefore, Champ *et al.* (2003: 47) suggest to apply revealed

[2] Equivalent in money is a sum of money that would have an equivalent effect on the welfare or utility of individuals.

[3] Evolutionary game theory.

preference techniques where observable market behavior can be used to infer about marginal values of non-market goods. These methods require identification of links between non-market goods and some subset of market goods.

Findings of experimental economics

Economic valuation of environment is debatable as an adequate approach. A better understanding of preference formation and decision-making processes could help in choosing a proper valuation method. We can face the problem like Condorcet paradox where after obtaining the lists of costs and benefits we cannot compare them, or the problems where market outcomes are not the result of rational behavior.

Experimental and other empirical findings show that individuals do not behave as Homo economicus. Zendehdel *et al.* (2008: 254) criticise the usage of monetary scales for ranking because individuals are usually not able to express their valuation in monetary terms. Individuals are cognitively bounded so that they can simultaneously take around seven items into account. Also, preferences depend on the context so that loss is evaluated more than gain (prospect theory). Preferences over outcomes depend on the process for obtaining those outcomes (process-regarding preferences) or on how it is experienced by the others (other regarding preferences). Also, individuals may valuate a good which helps them to distinguish from the others (positional goods). As positional goods environmental goods, which are usually public, would have no value because they are used by all equally.

Studies about herding behavior show that individuals tend to follow the behavior of the majority even when they see that the other alternative is more plausible. Environmental valuation may well be biased by this effect: market behavior can be the result of herding, so that revealed preference techniques can yield misleading results.

Furthermore, many individuals are risk-averse and may evaluate more highly the alternative which has the same expected value but is less volatile.

A very interesting finding by environmental economists in the 1970s was that there was a difference between willingness to pay and willingness to accept, or buyer-seller gap. This gap is explained in different ways: profit maximization, endowment effect[4] or action error (fear from acting, in favor of status quo). These findings imply that ownership matters, i.e. the valuation of resource depends on who owns it.

The discount rate is used in cost-benefit analysis in order to calculate a present value of costs and benefits. Experimental findings show that discount rate is not constant as it depend on emotions: when deciding, people are guided not just by self-control (mental effort), but also by automatic processes (surviving). Thus, delayed consequences may matter just to the degree that they are immediate and benefits and costs far in the future are poorly evaluated. One may wonder what are the consequences of such discounting on valuation of long-term impacts.

Also the costs of good production may influence individual willingness to pay, possibly as it guards against the feeling of being cheated (Vatn, 2004: 9).

Fror (2008) refers to the rich literature which opposes cognitive psychology and behavioural economics to the assumption of rational agents, and suggests guidelines for designing CVM (contingent valuation method) studies that are able to take the different natures of information processing by CVM respondents into account. Two cognitive processing models were distinguished: intuitive-experimental and analytical-rational (Fror, 2008: 579). These factors explained part of the variation of stated WTP (willingness to pay). Therefore, the authors suggest applying routinely this kind of test to measure the effect of bounded rational information processing on the contingent valuation method interviews.

The problems mentioned above affect the reliability of both stated and revealed preference techniques. However, the suggestion is not to abandon these techniques but to improve them by combining them with more objective methods of valuation (e.g. energy loss).

[4] Findings show that endowment effect is significant when the value of the object is risky (uncertain).

MEDITERRANEAN ECOSYSTEM AS A PUBLIC GOOD

When Adam Smith in 1776 suggested a limited role of the State, he was assuming that individuals governed by the invisible hand (market), for satisfying their individual interest would automatically optimize the social net benefits. However, this can be true if there are no externalities. Externalities are costs and benefits which are caused by the actions of an individual (entity), but are enjoyed or suffered by the other individual(s) (entities(s)). Opposite to what was believed decades ago, the widespread opinion today is that almost every transaction is characterized by significant externalities. The problem is that the market players do not take them into account and make decisions which may be efficient for them but not socially.

The purpose of economic valuation of public projects is to capture all the externalities and enable socially efficient decision-making. However, one still may question if the same kind of shortcomings which where present in market decision-making (market price) are still present in economic valuation of non-market goods. In the following we are going to use the concepts of public good and common property resources presented in the box.

Box: Public goods and Common Property Resources.

Public Good	**Common Property Resource**
non-excludable non-rival	non-excludable rival
$\mathbf{u_j = be_j + c\gamma - \delta(e_j)}$ e_j – effort of individual j $\gamma(\sum e_k)$ – total public good $\delta(e_j)$ – disutility of effort	$\mathbf{u_j = s(e_j)\gamma - \delta(e_j)}$ $s(e_j)$ – individual share in usage of the resource $\gamma(\sum e_k)$ – total public good $\delta(e_j)$ – disutility of effort
b=0 and c>0 → pure public good b>0 and c>0 → impure public good b>0 and c=0 → private good b=0 and c<0 → pure public bad	

Source: Bowles, 2004.

We can find many examples related to the Mediterranean Sea where the concepts of public goods (and bads) and common property resources may be applied. Over-fishing, sewage, oil transportation and beach conservation are some of them. Let us consider an example at the national level. More than twenty states share the coastline on the Mediterranean Sea. One of the nations makes huge efforts (high δ) to protect its coastal zone. Still these efforts do not bring successful benefits for that country (increased but still low γ) because the other nations do not make any effort.

On one hand individuals do not take into account the costs or benefits their actions cause to the others. On the other hand, individuals can use the public good even without contributing to it by some effort. This may affect valuation. Firstly, such goods are undervalued because of taking into account just own benefits. Secondly, in case of common property goods, knowing that one can not exclude free-riders forms a belief that the others will not contribute anything. Thus, participants will undervaluate the project. The mechanisms that foster cooperation like trust can help valuation of environmental resources properly.

Environmental protection implies paying for some environmental service, although that service may have properties of the public good. I.e. it can be simultaneously used by many users. Revealed-preference techniques are used in order to reconstruct a map of preference. They exploit information about market behavior (equilibrium prices, choices) in order to conclude about individual map of preferences. However, when deciding, individuals do not take into account their effects on the others (social costs and benefits) and feedbacks. So, the market equilibrium is not based on calculation of total costs and benefits.

The preference ordering reflected in the market is a result of strategic behavior and beliefs about the behavior of others. It is illustrated by the Prisoner dilemma game which offers two possible strategies: cooperate or defect. Based on expectations about the behavior of the other individual, one creates preference ordering over strategies. The result is defection of both players. Yet cooperative outcome is the most appreciated but impossible to reach due to distrust. Vatn (2004: 9) points out that distribution of costs may also influence the success of non-market valuation process. The point is that in certain situations "the payoffs of the game" are not known. The market shows us the equilibrium but not the whole game. Creation of trust changes preference ordering and can reveal the information about all the payoffs of the game.

Resolving the prisoner dilemma is one of the arguments for applying group valuation methods (participatory approaches). Participatory approaches may be useful for the Mediterranean zone because of the high variety of nations and variety of different types of "users" (stakeholders).

GROUP VALUATION METHODS

In the previous section we focused on the problem of trust and cooperation and we see the importance of the group valuation methods as the mechanisms for creation of trust. However, most of authors focus on the problem of information transmission of the problem itself.

Christie *et al.* (2005: 305) claim that stated preference methods communicate relevant information about biodiversity to respondents only with difficulty, and hence, it is unlike that the respondents have well-developed preference. That is the reason for the undervaluation of keystone species and the overvaluation of charismatic species (Christie *et al.*, 2005: 307). Also, it was noticed that respondents usually do not distinguish the value of a species from the value of diversity. The social context of state preference interview usually is unusual for economic decision-making (Macmillan *et al.*, 2002: 50). So, this can intimidate some respondents to the extent that their answers may not reflect their actual preferences. E.g. some interviewees may opt for a "quick escape strategy" such as "yeah-saying" or "protesting" to terminate the interview quickly. Other may ask for more time to consider their preferences. So, the suggested alternative is citizens juries that could even come up with monetary estimates of natural resource.

Market stall approach is an attempt to combine the desirable features of group techniques (citizens jury) with particular requirements of cost-benefit analysis, with primary intention of producing WTP estimates. Christie *et al.* (2005: 305) reported a study where two meetings, with WTP in both, were conducted.

Alvarez-Farizo *et al.* (2007) undertake a market stall with three sessions. In each session the participants filed in the questionnaire of choice experiment. The questionnaire was the same but the participants become more informed about the case over time and in the third session they were asked to answer the questions based on what would be the best for the community and the environment overall and to make these choices collectively. The coefficients of regressions did not vary significantly between the sessions. The test of coefficient difference was also undertaken for two subgroups: self-interested participants (with commercial and business interest) and non self-interested participants. The coefficients were statistically different from session to session for non self-interested participants. Deliberative workshops procedures may decrease heterogeneity of opinions and enable maturation of preferences (Alvarez-Farizo *et al.*, 2008: 8-9).

WELFARE, HAPPINESS AND BASELINE SHIFTING

Cost-benefit analysis is used in policy making with the aim to increase social wellbeing or welfare. Usual measure of wellbeing is GDP as its proxy. In fact, a positive cross-sectional correlation between GDP and a subjective wellbeing (happiness) was detected. However, the data of US show that over time happiness decreases and GDP increases.

Example of happiness paradox:

↑ demand for health (safety goods, medicine, gym) →↑ working hours →↓ individual environmental friendly behavior (walking, waste selection, responsible consumption) →↓ environmental quality →↓ health →↑ demand for health

Individuals who already have invested in private goods for protection against a decrease in public goods will value the increase in public goods less because they already own the private substitute for the public good. If this mechanism is at work, then one can question if economic valuation can give sensible results. In the Mediterranean zone there are plenty of uses. As a result “ecosystem tends to weight little”.

Vatn (2004: 2) studies implications of rationality concept on environmental valuation. He emphasizes social aspects and processes. He claims that the problem is that neoclassical economics follows methodological individualism. That implies that rationality is individualist and that agents act independently on the social context. But, Vatn (2004: 4) claims that both knowledge and preferences are social construct. What is considered as rational is not uniform across contexts, but defined by the institutions and roles that apply. Therefore, it is not just that economic processes are result of preference; they also shape preferences.

We can conclude that because of rapid environmental changes, the same environment is not known to two subsequent generations. Hence, there is a baseline shifting due to: (1) environmental changes, (2) cultural changes (system of values) – e.g. mass media affect the preferences, (3) socio-technological changes (way of satisfying the needs) – e.g. urbanization isolated us physically from the nature.

Conclusion

Because of coordination problem and communication of the knowledge, relatively more emphasis needs to be placed on setting common values during a valuation process. Objective valuation methods would be a welcome alternative.

It is suggested to undertake valuation of Mediterranean Sea systematically. Valuation surveys can be done at the sites with similar characteristics, but over the whole Mediterranean. Two classes of surveys should be done, for small coastal communities and for populations from urbanized areas. Common value method can be used for the first and revealed preference techniques for the second group.

Price and value, alternatives to biodiversity conservation (in the seas)

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LAND VS SEA

We are terrestrial animals and our view of the world is biased by our biology. The surface of the earth is 70% water, and the most important ecological processes take place in the world ocean, from the origin of climate to the cycle of water.

Terrestrial environments are characterized by long-lived primary producers (trees and grasses); they are the main components of the biological landscape and their turnover is rather slow. Animals do not play a structural role in terrestrial environments, they play, however, important functional roles, from herbivory to pollination. The bulk of herbivory is carried out by insects, and only in a few places (e.g. Subsaharian Africa) animals can be perceived (even from planes). On land, furthermore, we derive most of our resources from artificially reared organisms. No terrestrial animal species is a source of goods as wild populations, and most plants are cultivated (besides the trees cut off in forests to obtain wood). These features, and many others, lead us to consider "equilibrium" and "stability" as positive attributes of ecosystems and communities.

Marine environments are radically different from terrestrial ones. These differences are crucial also when valuing biodiversity and its management. Some marine primary producers are long-lived (e.g. seagrasses), but the bulk of primary production is carried out by microscopic unicellular algae (the phytoplankton) with rapid turnover. Phytoplankton blooms, in fact, occur after the rainy season, when nutrients are fully available in the water and sunlight is more available too. These pulses of production sustain the rest of the food web which, in its turn, also goes in pulses. First with pulses of herbivorous zooplankton, followed by pulses of carnivorous zooplankton, these being the basis for nektonic life. Except at shallow depth (the first dozens of meters), the sea bottom is not characterized by the presence of primary producers, and animals are the main formers of landscape. In the water column, furthermore, the landscape is either empty (for our perception) or dominated by animals.

If the paradigms and vision of terrestrial domains are transferred to marine habitats, the expectations and the valuations become invariably biased by a distorted perspective.

ECOLOGICAL ECONOMICS

The main goal of ecological economics is to convince politicians, and the public at large, that biodiversity has a value and that, for this reason, it is to be preserved. The goal had been identified by many other environmentalists, but the novelty of ecological economics was to translate of value into price. The price tag is proposed for two items that we derive from biodiversity (and from ecosystems at large): goods and services. Goods are materials of any kind, used for food or for medicine or any other purpose. These items do have an explicit price, since they can be bought for a given sum of money. We are used to pay for them, and they can be privately used. Services are immaterial, but do have a value anyway. A service is, for instance, the consumption of carbon dioxide and the production of oxygen, or the beauty of a place (which attracts tourism). We know that these things have a value but, not having a price, they were not accountable. Stating that something is very valuable but not giving it a price, in a way can be perceived as if the "important" thing is not accountable. After transforming value into price, nature becomes accountable. Services, however, do not have a direct price and they cannot become private. Oxygen is vital for our survival, but it cannot become private and cannot be sold. We can estimate its value, but nobody will ever sell oxygen (or sunlight), one hopes, and so the price is just conventional. There are treaties that regulate the price of the balance between carbon consumption and carbon emission, but not all nations have agreed to sign them. Goods do have an explicit price, services do have an implicit price.

From value to price

The idea of transforming value into price was very simple, and probably derived from insurance policies. Insurances put a price tag on everything, since their aim is to provide monetary rewards in case some insured item becomes lost or deteriorated. Even life does have a monetary value for insurances. This aspect is rather tricky. If a successful dentist is killed in a car accident, his "value" will be much higher than that of, let's say, a shepherd. The insurance will pay more for the dentist than for the shepherd. Their lives do not have the same price. Does this mean that they have different values? Ethics should teach us that the answer is no: a human life, in principle, should be priceless, and anyway its value should be independent from age, colour of the skin, job, and bank account. In theory, every jurisdiction is based on these principles, but they are seldom applied in real situations. All men are equal, but some of them are more equal than others.

The price of nature

The same situation is true for species, habitats, and ecosystems. Of course one might reinforce own statements about the necessity of conservation by arguing that the destruction of a given ecological item (species, habitat, etc.) might lead to the loss of a certain monetary value. This price is calculated on the basis of the goods and services deriving from that item. For the first time, since ecological economics became popular, politicians had an instrument to measure in an accountable way the losses due to poor conservation, or to deliberate destruction.

Usually, these evaluations are not used to calculate GDP, otherwise the development of many rising economies would not so irresistible results, since environmental losses deriving from economic growth (externalities) might exceed the gains. The risk of these exercises, however, is that if the monetary gain exceeds the calculated loss stemming from the evaluation of what is going to be destroyed, then destruction might become economically advantageous. This outcome is contrary to any ethics.

The pros and cons of valuation

The shortcomings of evaluating biodiversity are manifold, besides the ethical problem of doing so. Many species are unknown, and we cannot evaluate the unknown. The roles of most known species are unknown, so we cannot give a proper valuation of their services and even of the possible goods that we might derive from them, either directly or indirectly.

Just as with humans, who should be all equal (but are not), also species might suffer of discrimination. In valuing species, for instance, in principle one might argue that if a species is the only representative of a genus, and of a family (the taxonomic hierarchies are nested into each other) it should deserve greater concern than a species that has other co-generic species. The first one, in fact, represents a species, a genus and a family and bears great originality, whereas the second represents only one species, since other species are referred to the same genus. This, just as happens with humans, is true only in principle. If the species representing a genus and a family is inconspicuous (such as the hydrozoan *Tricyclusa singularis*) and the species representing only itself is the monk seal, then it would be very difficult to accept that a tiny invertebrate is more important, from a conservation point of view, than a large mammal. Charismatic species are given great emotional and even monetary value: all agree that air breathing marine vertebrates deserve the greatest attention. Most people agree that large fish are important and must be preserved. The perception of these values are often based on a very subjective criterion: beauty. Beautiful environments (one for all: coral reefs) and beautiful species (one for all: whales) deserve conservation priorities. The rest almost does not exist. Nobody cares about marine bacteria, and phytoplankton, not to speak about worms, or jellyfish. Very few species of marine invertebrates are charismatic enough to enter any red list. The action of compiling a red list divides organisms in two main categories: when we identify the species that deserve protection, we identify by default those who do not deserve it, or that deserve it with a lower priority. Those which deserve protection are given a great value, whereas the rest is given a much lower price, if any. The psychological attitude towards these categories is leading to incomplete appreciation of what merits protection.

Some species are priced because they really have a price (e.g. tuna), whereas other species usually do not have a price but they are given such a high value that their price (in case of destruction) might become very high (e.g. white people, and whales). Priority in conservation due to higher value might be labelled in another way: discrimination in conservation.

PRIORITIES

Of course, in a case of emergency, one should have priorities. In the battlefield, for instance, medical doctors divide wounded soldiers into several categories and take decisions about who to cure first. The soldiers with the worst wounds require lots of care and have little or no chances of survival. Curing them would lead other soldiers with less serious wounds, but in need of immediate care, to almost certain death. Then there are soldiers whose wounds can wait. Doctors do not waste their time with the first category, they concentrate on the second one, and then pass to the third. Unless a general is wound.

Is it better, if a choice is to be made, to invest resources to maintain old inviduals that provide neither goods nor services, or to maintain young individuals with a high potential of providing goods and services? Again, we operate in a discriminatory way. We spend more resources to cure old people in developed countries than to cure children in developing countries, making choices that are against any logic aimed at the survival of our species.

SAVE THE BACTERIA!

Paradoxically, the very basis of ecosystem functioning is provided by bacteria, but there is little concern about them. Ecosystems can continue to function without whales, but they would collapse without bacteria. Bacteria might be endangered, for instance, by the widespread use of antibiotics, both to cure humans (they arrive at the sea through sewage) and to cure aquacultured fish (they are directly thrown in the sea). These antibiotics act on marine bacteria and might represent a negative pressure on them, modifying their activities. Bacteria are essential to the recycling of matter. They decompose dead organisms and the mineralization of their components leads to the nutrients that are used by primary producers (plants and phytoplankton). Without bacteria ecosystems stop functioning. Maybe, with different bacteria, ecosystems would function in a different way. If we were not emotionally driven, we would give deserve more concern to bacteria than to air breathing marine vertebrates.

BASELINES ARE SHIFTING

When reconstructing a phylogeny (the schematic representation of biological evolution via the origin of sister species and higher taxa), the relationships among taxa are inferred by comparing them with an outgroup, a taxon that is not related to the group of concern and that polarizes the ensuing trees. The species that share more characters with the outgroup are at the base of the tree; those that share less characters and have original characters, unshared with other species, are considered as more derived and occupy a different position in the tree. According to the chosen outgroup, the trees come out different.

A similar concept has been developed in ecology by stating that our perception of the world (baseline) changes with time and that a person who experiences a given portion of history takes that as its standard, whereas a person that experiences another portion of history has another standard. Baselines do shift. If we are to state what is a desired state of the environment, thus, we must consider the standard that we refer to. And according to different standards, the expectations change, just as phylogenetic trees change as outgroups are changed.

One conclusion of this short outline is that we often give values (and prices) that are based more on emotional than on rational drivers.
We imply that biodiversity is very important and connect it to ecosystem functioning, but then our measure of ecosystem functioning is often based on the performance of bacteria (e.g. the efficiency of biogeochemical cycles) so that biodiversity becomes irrelevant. Evaluations based on poor understanding might fail their noble intent and might eventually lead to skepticism, once their application is proven wrong.

Valuing coastal and marine ecosystem services

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ABSTRACT

The analysis of coastal and marine ecosystems is a complex issue. The paper suggests that the policy analysis undertaken to appraise an environmental project, policy or programme, should be supported by an ecosystem services approach for the valuation of ecosystem services and benefits. The use of such an approach for coastal and marine Mediterranean ecosystems is examined. Although constrained by uncertainties surrounding scale and spatial issues, and the nonlinearity and thresholds problem, a valuation of the Mediterranean Sea benefits can be undertaken. This can form an important component of a decision support system guided by sustainability objectives.

1. INTRODUCTION

Some 70% of Earth's surface is covered by marine ecosystems, such as oceans, intertidal estuaries, salt marshes, coral reefs, and coastal waters. Such diverse marine habitats provide hospitality for many species as well as services which result in numerous human welfare benefits e.g. food, recreation and transportation opportunities. These habitats, and related plant and animal species, are under threat from a number of pressures including climate change. Although marine ecosystems are able to cope with natural climate variability, the effects of an accelerated climate variation due to anthropogenic factors are uncertain (Kennedy *et al.*, 2002). Possible impacts from changes in climate such as temperature rises and changes in precipitation include: sea level rise; eutrophication risks due to increased nutrient fluxes from heavy precipitation and runoff from land; loss of coastal wetlands and increased flood and erosion risk. The consequences of environmental change on this scale are difficult to predict. A major concern is the intensification of ongoing pressures on the marine environment such as: globalised economic activity, land-use change, environmental pollution, and over-fishing.

Given the pleasant climate, tourists are attracted by the Mediterranean coasts. While tourism has proved to be a major driver of economic development, it is causing environmental degradation through a consequential extensive built environment multiplier effect. A sustainable development strategy should provide some solutions to enable simultaneous economic development of the area and the conservation of the coastal and marine ecosystems of the Mediterranean Sea.

In this paper we present an 'ecosystem services approach' for the valuation of the Mediterranean coastal and marine ecosystem services benefits, which can offer an important component of a decision support system guided by sustainability objectives.

2. Ecosystem services and benefits

2.1 Definition

Several definitions for ecosystem services are provided in the literature (Daily, 1997; Costanza *et al.*, 1997; Boyd and Banzhaf, 2007). The generic definition of ecosystem services developed by the Millennium Ecosystem Assessment (MEA) in 2005 states that "ecosystem services are the benefits people obtain from ecosystems" and subdivides them into *supporting*, *regulating*, *provisioning* and *cultural* services. Building on this platform it has been argued that when the focus is on national accounting (Boyd and Banzhaf, 2007), landscape management (Wallace, 2007), or as in our example below, valuation of service benefits (Fisher *et al.*, 2008), further elaboration is required for actual choice-making involving human welfare.

For economic valuation purposes, the definition proposed by Fisher *et al.* (2008) clarifies the distinction between ecosystem services and benefits: *ecosystem services are the aspects of ecosystems utilised (actively or passively) to produce human well-being*. They see ecosystem services as being the link between ecosystems and things that humans benefit from, not the benefits themselves. The focus is on the benefits that humans receive from the ecosystem. Ecosystem services include ecosystem organisation or structure (the ecosystem classes) as well as ecosystem processes and functions (the way in which the ecosystem operates). The outcome (ecosystem benefit) measures changes in human welfare. In other words, ecosystem services are the ecological phenomena, and the benefit is the realisation of the direct impact on human welfare. Benefits are typically generated by ecosystem services in combination with other forms of capital like people, knowledge, or equipment (Fisher *et al.*, 2008). As an example, pollination is an ecosystem service since it is an ecological phenomenon that is utilised (indirectly) by humans to enjoy certain food benefit (Fisher and Turner, 2008). In the definition of Fisher *et al.* (2008) the key feature is the separation of ecosystem processes and functions into intermediate and final services, with the latter yielding welfare benefits (see Figure 1).

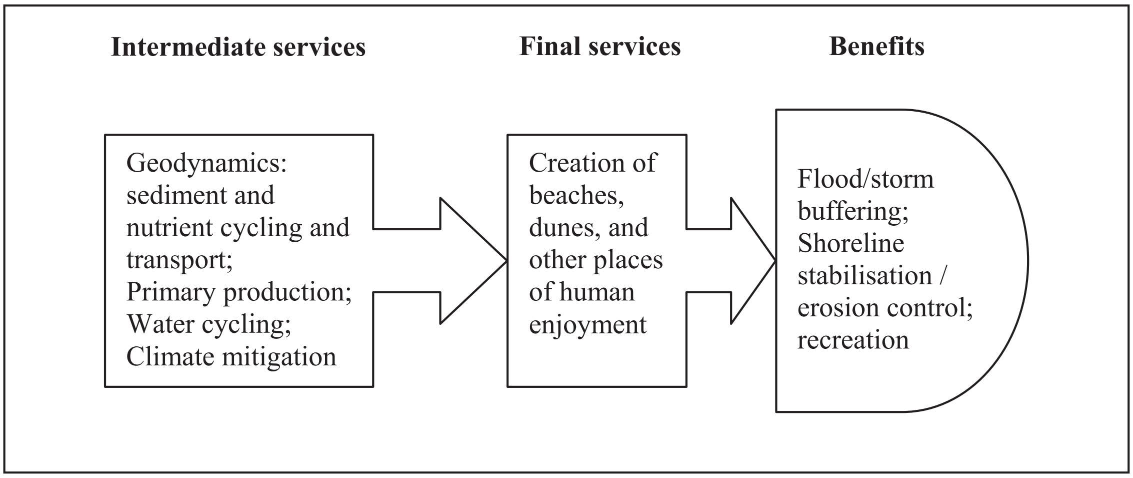

Figure 1. Example of relationships among representative intermediate services, final services and benefits (adapted from Fisher and Turner, 2008).

Due to the complexity of ecosystems and their processes a range of relationships are present and the delineation between intermediate services, final services and benefits is not strict. Services are often a function of the beneficiary's perspective.

In the case of economic valuation, if the ecosystem services as defined in the MEA were to be individually valued and incorporated into a cost-benefit analysis, there is a risk that they could be double counted because the intermediate services are by default included in the value of the final service. Following the definition of Fisher *et al.* (2008), only the benefits generated by the final services can be aggregated, reducing the possibility of double counting.

The assessment of services and values should be conducted in a sequential way. The generation of services, and the enjoyment of benefits, is spatially conditioned; therefore a key step in any evaluation process must be the setting of the ecosystems in their appropriate contexts. The valuation process must also be restricted to marginal gains/losses as well as avoiding double counting. It should note any non-linearity between change in ecosystem services and habitat variables such as size of area and possible threshold effects. Failure to account for these limitations may lead to under/over estimated economic values and unnecessarily polarised cost-benefit decision choices (Turner, 2007; Barbier *et al.*, 2008).

2.2 Coastal and marine ecosystem services and benefits

Mediterranean coastal waters and ecosystems encompass rocky, sandy and muddy shores, estuaries, salt marshes, and are intimately connected to the open sea.

Figure 2 shows the ecosystem services provided by the Mediterranean Sea. The ecosystems are sub-divided in two classes: Mediterranean open sea and Mediterranean coastal areas, including estuaries and salt marshes. The Figure highlights the intermediate and final services involved in the creation of benefits for humans and the valuation techniques that could be used to estimate each benefit in monetary terms.

ECOSYSTEM CLASSES →	INTERMEDIATE SERVICES →	FINAL SERVICES →	BENEFITS →	ECONOMIC VALUATION METHODS
Specific characteristics of the coastal-marine ecosystem as determined by locational factors and structures of the area	A service that comes from other factors than the ecosystem itself (ecosystem processes)	The result of the ecosystem process (ecosystem functions)	The benefits of the ecosystem for humans	Economic methods to value the ecosystem benefits
Mediterranean open sea	• Primary production • Climate mitigation	• Regulation of water flow and quality • Habitat for many aquatic species	• Carbon dioxide control • Biodiversity maintenance • Amenity and recreation • Water ways (transportation)	• Damage cost avoided • Survey-based techniques contingent valuation (CV)/ choice experiment (CE) • Survey-based techniques CV/CE • Market prices
Mediterranean coastal areas / estuaries and salt marshes	• Geodynamics: sediment and nutrient cycling and transport • Primary production • Water cycling • Climate mitigation	• Creation of beaches, dunes and other places of human enjoyment • Sediments, nutrients, contaminants retention/storage • Biomass export • Regulation of water flow and quality • Carbon sequestration • Maintenance of fish nurseries and refuges • Habitat for migratory and other species • Biodiversity maintenance	• Flood/storm buffering • Shoreline stabilisation / erosion control • Carbon storage • Fish production • Ecosystem stability/resilience • Amenity and recreation provision • Cultural / heritage conservation	• Market prices / damage cost avoided • Market prices / damage cost avoided • Damage cost avoided • Production function, market prices, survey-based techniques CV/ CE • Survey-based techniques CV/CE • Travel cost, hedonic pricing, Survey-based techniques CV/CE • Survey-based techniques CV/CE

Figure 2. Classification of the Mediterranean Sea ecosystem services and valuation methods of related benefits.

The open waters of the Mediterranean Sea provide processes such as primary production and climate mitigation that lead to final services like regulation of water flow and quality, and habitat for many aquatic species. Resulting benefits are the control of carbon dioxide emissions, biodiversity maintenance and ecosystem stability, amenity and recreation, and transportation. Mediterranean coastal areas, including estuaries and salt marshes, provide services related to geodynamics, with, for example, the cycling and transport of sediments and nutrients. These processes create beaches, dunes and other places for human enjoyment and protection. In coastal areas sediments, nutrients and contaminants are retained and/or stored, carbon sequestrated, and the water flow and quality regulated. These areas not only preserve fish nurseries and refuges, but are also habitats for migratory and other species. Given these services, Mediterranean coastal ecosystems provide benefits such as flood/storm buffering, erosion control, carbon storage, and fish production. Biodiversity, amenity and recreation benefits are supplied, and cultural values preserved.

Given the multi-faced nature of benefits associated with the Mediterranean Sea there is a need for a usable typology of the associated social, economic, and cultural values. When considering environmental values, in terms of *use* and *non-use* (or *passive*) *values*, economists have generally settled for a taxonomy (Figure 3), the components of which add up to the total economic value (TEV) (Turner *et al.*, 2008).

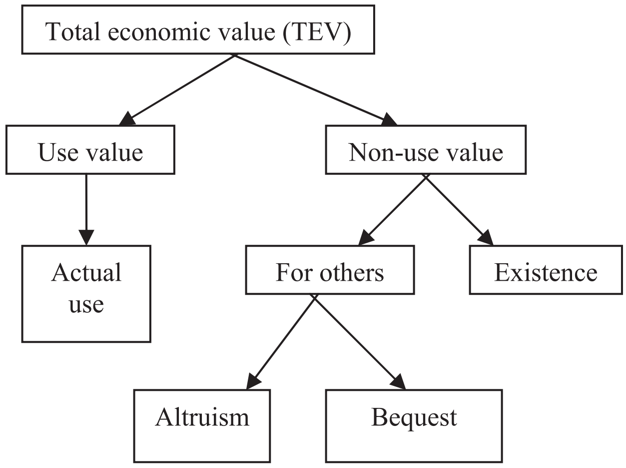

Figure 3. Total Economic Value (adapted from Bateman *et al.,* 2002).

Use values relate to *actual use* of the good in question (for example, a visit to sandy beaches in the Mediterranean), planned use or possible use. Possible uses are important because people may be willing to pay to maintain a good in existence in order to preserve the *option* of using it in the future. Non-uses refer to willingness to pay to maintain some good in existence even though there is no actual, planned or possible use. Among the non-use values a different kind of satisfaction leading to different passive values arises: we talk of *existence values* if the individual has satisfaction in maintaining in existence a resource; *altruistic value* might arise when the individual is concerned the resource in question should be available to others in the current generation; if the altruistic concern is about the possibility for the next and future generations to make use of the resource in question, we talk of *bequest value*. The notion of *intrinsic value* on the other hand refers to assigning values to things ‘in themselves’ rather than because those things serve some human-oriented end. Intrinsic value might be attached to all things, living or otherwise, but not in a monetary way (Bateman *et al.*, 2002).

Each of these benefits can be valued with different economic techniques, each yielding a different degree of precision. They range from market analysis and the damage cost avoided method for *use* values to revealed and stated preference techniques to estimate *use* and *non-use* values, as well as the existence value of some benefits. The true economic value of the ecosystem services is given by the expressed *willingness to pay* (WTP) for those services because that valuation incorporates the expenditure of the individual for the service (the market price of the service) plus the consumer surplus (that is the amount that the individual is willing to pay for that service over and above the market price of the same service) (Bateman *et al.*, 2002). To measure the individual WTP two main techniques can be applied: revealed preferences (RP) and stated preferences (SP). Where market prices of outputs and inputs are available, a proxy value[1] can be assumed. Alternatively, *replacement or substitute costs* can be assessed, which refer to potential expenditures if the ecosystem service was lost and a perfect substitute was possible. In some contexts the *damage cost avoided*, which is represented by the costs that would be incurred if the ecosystem service was not present (e.g. flood prevention and carbon storage) can be used as a proxy value. Finally, the gross value added (GVA), which represents the contribution of the service to the regional or national economic

[1] For a complete analysis of different valuation methods, see Turner *et al.,* 2001.

activity, can be calculated, as a proxy value measure, in cases where a given service and its benefit is locally a significant source of income and/or employment (e.g. tourism).

The last column in Figure 2 shows the valuation categories for each ecosystem benefit identified for the Mediterranean Sea. It appears that the same benefit can be estimated with different valuation methods but that their results are not equivalent. For this reason values estimated with different methodologies cannot always be meaningfully added together in order to provide some aggregate value of the 'total' ecosystem service benefit value.

An example of the application of the ecosystem services-based valuation approach applied to a coastal management policy issue (coastal realignment strategy) in the Humber estuary (UK) can be found in Andrews *et al*. (2006). Complementary economic valuation analysis is reported in Turner *et al.* (2007).

3. Policy analysis

The policy issue under investigation will be composed of a complex mixture of environmental and socio-political driving processes, of consequent environmental state changes which then impact on the provision of ecosystem goods and services and human welfare. The distribution of the welfare gains and losses in society, together with existing policy measures and networks will influence policy response strategies. The economic analysis seeks to evaluate the social welfare gains and losses involved from an economic efficiency perspective, tempered by relevant distributional equity considerations, other precautionary environmental standards and regional economic constraints (most often focused on 'local' employment and economic multiplier impacts which can result in cultural and community losses or gains). The initial analytical step, which is to decide on whether a full cost-benefit analysis seeking to determine net economic benefits from a project, or policy of coastal or marine intervention, or a more constrained cost-effectiveness analysis is required, is summarised in Figure 4. In the latter context, a range of options are usually ranked on the basis of the monetisation of costs incurred to see which yields the desired outcome, for example the achievement of a given water quality status, at the least cost to society. Cost-benefit analysis ranks the alternatives on the basis of the sum of fully monetised net present values of costs and benefits offering the optimal (most efficient) choice. An alternative or supplementary approach, multicriteria analysis, could be deployed whereby the alternatives are ranked on the basis of an explicit set

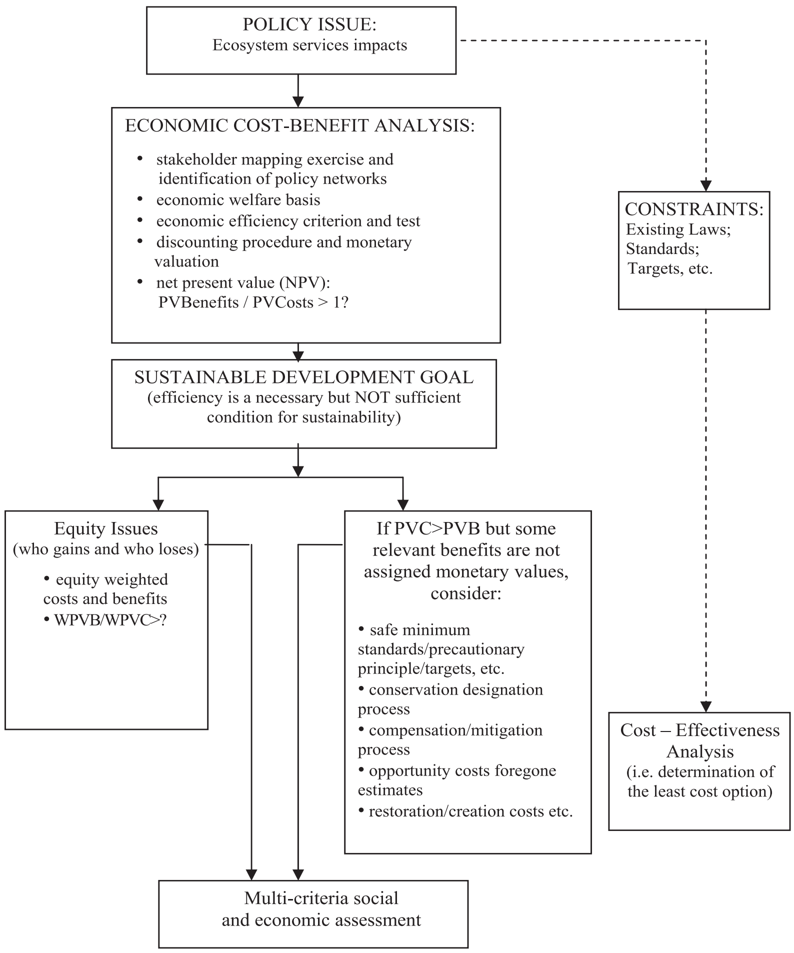

Figure 4. The initial analytical step to decide whether a cost-benefit analysis or a cost-effectiveness approach is required to appraise a project, policy or programme.

of choice criteria and weighted preferences of involved stakeholders, offering qualitative and quantitative solutions to complex choice problems (Skourtos *et al.*, 2005).

Considering the case of coastal zone ecosystems, the policy response interventions following the initial analysis (qualitative and/or quantitative) will usually fall into a number of costs and benefits categories: mitigation of pollution and resource overexploitation problems; enhancement of coastal zone ecosystem goods and services; preservation of unique coastal ecosystems.

4. Ecosystem valuation difficulties

The benefits of intervention in the coastal zone are best discerned if they are related to baseline conditions, i.e. coastal area A at time T_0. The condition of the coastal resources (ecosystems and their services provision) at T_0 reflects the effects of various human activities and of natural events over past time to T_0. A range of environmental change scenarios can be introduced in order to test for different impacts and response options in comparison to baseline conditions (Brower and Turner, 1998).

Thus the initial and vital step in any evaluation exercise is to take due note of the fact that ecosystem services provision and benefits enjoyment is a spatially explicit process. There is a firm requirement to set the ecosystem under investigation in its proper spatial, socio-economic, and politico-cultural context. Secondly, when it comes to valuation data, it is 'marginal' values that are required, rather than aggregated global values which do not fit easily into economic cost-benefit appraisal systems and methods. Because of the uncertainties surrounding threshold effects, judging what is and what is not 'marginal' change in not straightforward.

A further complication arises due to non-linearity between changes in ecosystem services and their critical habitat variables (such as the size of an area), which in turn may lead to non-linear economic benefits. Considering that few data exist for examining the marginal losses associated with changes in nonlinear functions, in assessing such trade-offs, it is typically assumed that linearity exists between the variables considered. However, Barbier *et al.* (2008) show that for some coastal habitats, such as mangroves, salt marshes, seagrass beds, nearshore coral reefs, and sand dunes, nonlinear relationships exist between habitat area and measurements of the ecosystem function of wave attenuation. In economics terms, nonlinearity means that small losses for example in fringe mangroves may not cause the economic benefits of storm buffering provided by mangroves to fall drastically. But this finding is further conditioned by the spatial location context and local circumstances. A similar nonlinearity was found in the study of UK estuaries (Andrews *et al.*, 2006; Turner *et al.*, 2007; Luisetti *et al.*, 2008). In the latter example, it was found that under managed realignment (setting back sea defences and recreating salt marshes) it was not always the case that net economic benefit increased as the size of the recreated area increased. Other factors such as local topography influenced defence capital costs and potential maintenance cost savings benefits. In choice experiments also linearity between attributes and utility is typically assumed. The results show that, instead, there is a point at which the benefits of more salt marsh areas are judged to be negligible, by the survey respondents.

Beyond the 'marginality' problem it is also important to identify sources of 'double counting' in any valuation study. The full range of complementary and competitive services must be distinguished before any aggregated valuation is completed. The supporting ecosystem service, nutrient cycling, for example, will result in a series of outcomes and a range of services/goods of value to humans, e.g. cleaner water for drinking, cleaner water which yields better quality recreation, etc. The economic values relate to the end products, drinking water and recreation, and not to nutrient cycling, *per se*.

Further, in order to estimate benefits given limited funds and a relatively short time period for research, it may be possible to transfer data from other existing studies as a rough guide to appropriate values. This procedure, known as 'benefits transfer', is fraught with problems and a strict protocol is under development and review (Wilson and Hoehn, 2006). Finally, the benefits valuation methods and the cost-based valuation networks cannot be aggregated in any simplistic way without breaching economic theory principles.

5. Regional economic impacts and 'indirect or 'secondary' benefits

The benefits categories illustrated in the preceding sections do not include so-called 'indirect' of 'secondary' benefits provided by coastal resources and related management measures to the regional economy. These 'secondary benefits' may be of such significance and magnitude that important regional income multiplier effects may be generated. Benefits therefore stem from "second round" effects of coastal management measures applied to produce benefits in terms of mitigation and enhancement use values, together with preservation use. The context for the analysis and estimation is the regional economy, as the direct economic benefits result in additional economic activities in the region. The resulting regional income/employment effects are quantified through the use of regional input-output and multiplier models. Input/output analysis is based on a matrix that registers flows simultaneously by origin and by destination. The inputs represent the suppliers, and the outputs represent the users. Those matrices represent a regional, or better a national, approach to double entry bookkeeping. This analysis instrument is not able to capture environmental measures with a small economic impact, but is only relevant for activities having a wide economic impact such as the implementation of environmental policies targeting a whole sector. Nevertheless, I/O analysis could also be relevant for a package of several policy options, each having a relatively small impact, but whose sum results in a large impact on the regional/national economy.

6. Conclusions

The complexity of the analysis of ecosystems and services provision in the Mediterranean Sea can be mitigated through the use of an ecosystem services approach. The MEA definition of ecosystem services has been further elaborated for the purpose of economic valuation reducing the possibilities of double counting of ecosystem benefits. Thus, although constrained by uncertainties surrounding scale and spatial issues, and the nonlinearity and thresholds problem, a valuation of the Mediterranean Sea benefits can be undertaken.

An ecosystem services approach facilitates policy analysis so as to identify the more appropriate policy response to a given specific environmental issue through the definition of the ecosystem services, and consequent benefits. With this approach it is possible to deal with the classification of direct (primary) and indirect (secondary) benefits as well as the choice between CBA and cost-effectiveness to assess a specific project or policy.

Towards sustainable fisheries environment – the case of Egypt vs competitors

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Abstract

Egypt's marine and coastal zones as well as sustainable development initiatives have become of high concern. Egypt faces a challenge due to high competition with neighboring countries that have greater efficiency in harvesting methods, which sometimes lead to over-fishing and environmental degradation.

The paper proposes that the solution between nations does not lie in "Coase Theorem". The valid solution would be in determining taxes, setting wealth-based policies or sustainable harvesting quota, that could be transferable, where the aggregate of all quotas would reflect the most efficient catch level. It is therefore vital to develop more effective fisheries management frameworks in order to ensure the conservation of fisheries and fish species. Pursuing policies must therefore be based not on increasing fish catches through technology, expanding fishing effort but on wealth based policies and Individual Transferable Quotas which would seek to maximize economic rents.

Introduction

Fisheries are a natural capital which represents a prospective source of sustainable wealth. The wealth from fisheries can be utilized for direct benefits such as fish production, source of employment in the fisheries sector, and food. It can also be used for indirect benefits such as generation of economic surplus and investment opportunities.

There are two levels of problems with fisheries management - one is the failure of each country to manage stocks within its own territorial waters, the other a collective failure of managing fish stocks in international waters. In both cases, the waters do not have ownership and the fish are mobile. In open access, the country (or the individual) has no incentive to limit the harvest, since leaving behind an extra unit of fish will not guarantee that someone else would not catch it in the future. In that respect, the open access system leads to the rise of various problems: how fisheries should be efficiently managed between nations? What is the optimum level of fishing relative to preserving further supply? And what leads to over-fishing, and the extinction of certain fish species?

1. Marine fisheries in the Mediterranean

The use of fish stocks entails careful management in order to achieve a sustainable flow of benefits over time. This section presents the main types of failures that the marine fisheries environment faces due to inefficient practices.

1.1. Market failure

A market failure is a technical term that can be defined as the conditions under which the free market does not generate optimal welfare (Sterner, 2003: 2). This relates to the weak legal framework around the issue of common property in the Mediterranean Sea. Property rights are a fundamental base for fisheries management. Property Rights are the rights[1], restrictions and privileges regarding the use of a given commodity. Rights should present the proper incentives for stakeholders under an appropriate legal system to avoid the 'race to fish' and ensure a sustainable stream of benefits from fisheries in the future.

When a fisherman decides whether or not to take his boat to sea, he takes into account his private costs and benefits to evaluate the profitability of his decision. However, he does not take into account that there will be less fish available for other fishermen (current and future) (Markandya *et al.*, 2002: 170). With open access regimes, property rights are not clearly identified or if defined, not well enforced. Accordingly, there are no incentives to efficiently use the commodity. Fisheries in the open seas are nowadays under severe pressure as they are overexploited biologically and economically.

Coase Theorem is a mean to reach an agreement between countries with distinct needs and priorities. In the case of initial distribution of rights, the parties involved can always reach a good agreement in which everyone is better off and the outcome reached is efficient (Mankiw, 2007: 211). However, it is not always easy to reach an efficient outcome if the markets do not function effectively. In that respect, in order to achieve such an approach, it is vital to create a legal basis for fisheries management and property rights at the national level which would form an essential basis for development and enforcement as well as enabling the environmental aspect.

1.2. Policy failure

Market failure is usually supplemented by policy failure. The ecosystem is complex and dynamic. Moreover, defining property rights is incomplete. At times conflicts occur due to claims between the different communities and/or other societies. Over-fishing is facilitated in the absence of clear property rights and due to the high costs of. In case of over-fishing, restricting fishing efforts leads to severe conflicts that arise concerning who has the right to continue fishing.

Defining fishing quotas or rights is highly required especially when conflicts arise between local fisheries and the expansion of aquaculture. Certain regulations such as zoning bring about involved stakeholders to cautiously monitor the local fisheries, research, support local awareness and capacity building.

Policy failures take place when pursuing policies based on increasing fish catches through technology and expanding fishing effort. It is thus important to set wealth based policies or specify Individual transferable quotas, with clear definition of property rights (Sterner, 2003: 374).

1.3. Institutional failure

The institutional context of fishing access and the framework of regulations affect the performance of the fisheries management system. However, the process of institutional development is a long term, gradual process that requires the participation of the majority of stakeholders and effective leadership.

The fisheries management authority should be established within an institutional context to insure monitoring, surveillance and enforcement by state regulatory bodies. To avoid institutional failure, institutional development for wealth-based effective fisheries should therefore be a priority action.

Institutional change should also try to expand Individual fisheries quotas (IFQs), that enable the holder of the quota to a specific catch of fish, and Individual transferable quota (ITQs) that can be bought and sold. The ITQ operates by charging harvesters a price for each unit of the stock

[1] "A 'right' refers to the capacity to assert a claim and have others respect it; a right is more easily enforced if it is clearly defined, cost-effective to defend and backed-up by an effective legal framework (Dasgupta, 2007)".

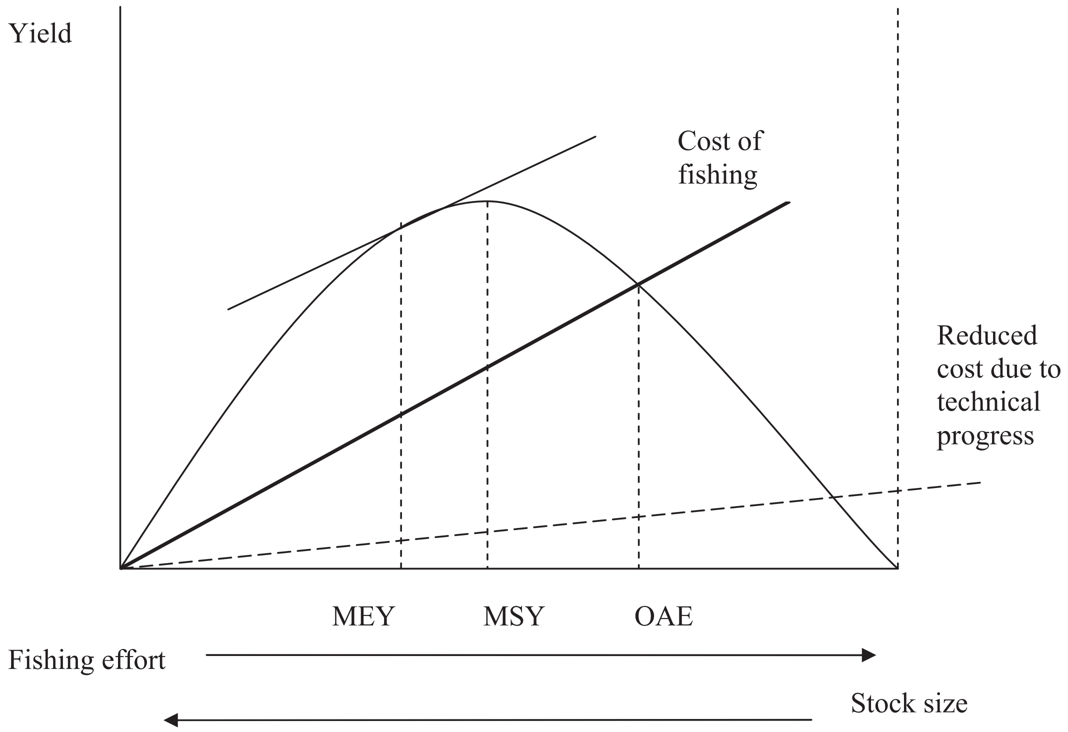
captured. One could charge the price directly, without the ITQ device, by imposing a fee or tax on fish landings. The aggregate of all quotas would be equal to the most efficient catch level. Policy economists proposed this long ago, but were ignored for political and equity reasons (DFID, 2006).

2. ECONOMIC ASPECTS OF FISHERIES

Fisheries are classically common property resources to which property rights are usually poorly defined or non-existent. Fisheries without efficient property rights are usually unsustainable (especially in situations where there is a general failure to restrict access).

This gives rise to a number of questions – how should fisheries be managed optimally between nations. Or in other words, what is the optimum level of fishing effort relative to maintaining stocks? What leads to over-fishing, and even extinction of fish species?

One very well known bioeconomic model is the single species fishery (see Figure 1).



Source: Sterner, 2003. From left to right: Maximum Economic Yield (MEY), Maximum Sustainable Yield (MSY), Open Access Equilibrium (OAE).

Figure 1. Growth rate of the fish stock and sustainable harvest levels.

If the fishery is managed by a sole owner, the amount of harvest will depend on the fishing effort, which can be measured in terms of number of vessel-years, technology and fishing hours or similar units. It is assumed that for a given level of fishing effort, there is a corresponding population stock of the fish species. The efficient harvesting point in a fishing industry is where net benefits are maximized[2].

Maximum Sustainable Yield (MSY) may not be an appropriate target since the costs of fishing would normally rise with the increasing scarcity. Thus, a stock higher than that indicated at MSY specifies roughly the same yield at much lower level of cost. This would lead to a net profit equivalent to the difference between harvest and costs, if a zero discount rate is assumed. This optimal policy is called the Maximum Economic Yield (MEY) (Sterner, 2003: 37).

[2] The condition for maximizing profits will be that marginal revenue from a unit of effort equals marginal cost.

Moving to the left away from the maximum biological sustained yield (biological efficiency) will maximize economic rents or wealth; Maximum Economic Yield is the most economically efficient. In contrast, in the case of open access, Equilibrium (OAE) will be both economically and biologically inefficient. Increased competition in pursuit of available rent will drive average return from investment to zero (investment inefficiency). This theoretically explains why harvesting in the common property case are economically, biologically, and investment inefficient.

This above model is useful as an instructive model only. For empirical work it is not appropriate because real fisheries are much more complex than what the model reflects.

Modifications to this model have later taken place. For instance, the growth rate of the stock can nonlinearly vary with the size of the stock, as in $(dN/dt)/N = g(K-N)/K$[3]. It is also possible to have a more complex model for the growth rate, with discrete time, with harvest and growth in diverse seasons, and also with different age or size groups. Some values of the parameter demonstrate that over-fishing would lead to extinction. This would take place in the case of fish stocks if they drop below a certain critical limit. In that respect, it is obvious that the conclusions that can be derived for the policies of local fishing practices are not the same as those from the original Gordon-Schaefer model (1954).

Even those who strongly believe in the market affirm that policymaking is highly vital in the fishing sector. Unfortunately, many of the adopted policies are not the proper ones, such as giving subsidies to the fishermen to support their purchase of more fishing equipments and tools while catches are declining. This will only accelerate the depletion of the stocks and therefore adds policy failure to market failure. Moreover, technical progress reduces the marginal cost of fishing efforts and accordingly, profitability increases. However, this would lead to the problem of bringing the open access equilibrium close to the extinction equilibrium. In that respect, policies have been designed to stop utilizing various technologies. From an efficiency oriented viewpoint, the optimal policy would be using new technologies while reduced fishing effort so as to reach a point equivalent to the Maximum Economic Yield. Further, the fisherman causes externalities to the other fishermen. Decreasing stocks increase the costs of fishing and lower future catches. Obviously setting the optimal policy is not a simple process.

Fishing efforts can be decreased if taxing policies are implemented. After all fisheries are a capital that is subject to scarcity and accordingly a tax should be set. However, in such case the direct beneficiaries from the fishing sector would be worse off. Taxes are not welcome by the fishermen because the rent they would achieve will be reduced. For this reason, individual transferable fishing quotas (ITQs) have become the major tool for fishing policy. ITQs give a scarcity indication but still give the fishermen the ability of keeping the rent (Sterner, 2003).

The ITQ approach requires choosing a target catch. Regulation is supposed to avoid the depletion of the available stocks from a purely biological aspect. This goal is usually approached through limiting fishing to only a certain period of the year, prohibiting the use of specific effective fishing techniques or tools, and restricting the number of fishing boats allowed to operate. Despite difficulties with poor enforcement or bypassing of the regulations, common property resource management and ITQs, can be considered promising instruments that would offer suitable trade offs among efficiency, monitoring costs, and social acceptance in most cases.

3. Learning experiences

What should be done? What lessons does international experience in fisheries development provide? Knowledge concerning best practices in fisheries development and management is growing, based on international experience.

While many fisheries management systems are not performing well, still, there are examples of success stories. In Namibia, fisheries contribution to GDP increased from 4% in 1990 to 10.1% in 1998. There rights based fisheries management system is used, which led to high resource rent

[3] dN /dt is the population growth rate and g is the rate of growth when no restriction is imposed. When K (carrying capacity) is infinite, ordinary growth is exponential, but when N is very close to K, growth is zero.

generation and fish exports reaching US$300 million per year. Resource rent covered management costs and even made a net contribution to national treasury.

In Mauritania, 20% of the Central Government expenditure is financed by fishing. The expected annual rent generation from these fisheries is estimated at US$100 million per year.

The Journal Science has conducted a survey for 121 fisheries worldwide. The study demonstrated that when setting fixed shares of fishery, overfishing is less likely. Many countries have pioneered in the conception of catch shares such as New Zealand, Australia and the United States.

In New Zealand, Individual Fishing Quotas, industry initiative, and institutional change led to expanding IFQs, cost-effective fisheries management and research. In 1986, IFQs were referred to as ITQs.

It appears that the most successful results on the global level took place through the introduction of individual transferable quotas (ITQs) such that the aggregate of all quotas equals the most efficient catch level.

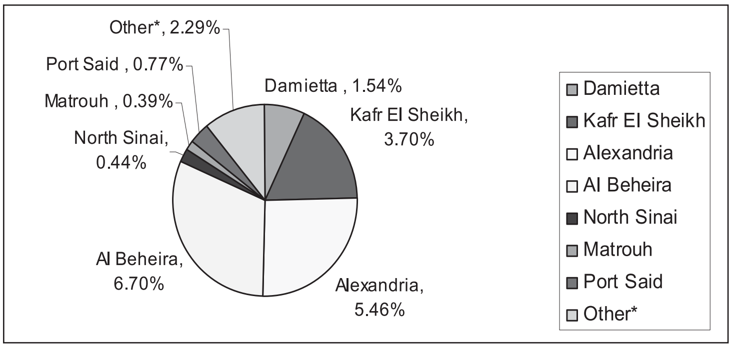
Individual fishing quotas (IFQs), harvest cooperatives, and other limited access privilege programs (LAPPs) have shown results in more precise control of harvests, less bycatch, fewer negative impacts on habitat, better economic performance and improved safety. These programs have substantially reduced the negative environmental impacts of fishing, while allowing fishermen the flexibility to improve their profitability and safety dramatically (DFID, World Bank and FAO, 2007).

The economic successes of commercial fisheries under IFQs during the past twenty years (Sharp, 2005) is best demonstrated in the New Zealand case. Furthermore, the switch to a wealth-based fisheries management (WBFM) approach has been very beneficial in disengaging the value of the fish resources and in contributing significantly to economic growth, resource sustainability and the improvement of livelihoods is shown by the Namibia and Mauritania cases (DFID, World Bank and FAO, 2007). Still, there are many challenges to address. These include excessive fishing pressure on some stocks, a lack of effective fisheries management systems, a lack of capacity in the fisheries administration and research sectors, and a lack of infrastructure and access to country markets.

4. Marine and coastal zones in the Egyptian Mediterranean

The length of the Egyptian coasts are approximately 3,000 km of which 1,150 km extend along the Mediterranean Sea from Saloum in the west, to Rafah in the east, and 1,850 km covering Egyptian Red Sea coasts at the main Red Sea basin (1,200 km) and the Gulfs of Suez and Aqaba (approximately 650 km).

Egypt has eleven coastal governorates bordering the Egyptian coasts. In specific, along the Mediterranean coastal area, the landing sites from west to east are the as follows: Matrouh, Alexandria, Behera, Kafr Al Sheikh, Damietta, Port Said and North Sinai (<http://fao.org/fishery/countrysector/FI-CP_EG/en>). The coastal regions in Egypt are of strategic significance. Figure 2 shows that 21.9% of Egypt's population lives in coastal zones due to the availability of natural resources and raw materials. The coastal zones are also vital routes for maritime transportation and trade in addition to being notable touristic areas.



* Other includes Suez, 0.70%, Al Ismaileya, 1.23%, South Sinai, 0.09% and Red Sea, 0.27%.
Source: Ministry of State for Environmental Affairs (2006). "Egypt State of the Environment Report 2005."

Figure 2. The population distribution of the coastal governorates in Egypt (percentage of the total population).

4.1. Sector characteristics

According to 2004 statistics, Egypt's overall fish production is approximately 875,990 tons, of which 13.3% (116,500 tons) originates from the sea. Table 1 shows in details Egypt's Fish catches from the Mediterranean Sea, which accounts for 8% of Egypt's overall fish production.

Table 1. Egypt's fish production from marine fisheries in the Mediterranean Sea (2003).

Location	Production (tons)
Mediterranean Sea	
Matrouh and Salloum	379
Alexandria	4,560
Abu-Quir	672
Al-Maadeya	12,154
Rasheed	5,000
Borollos	1,517
Ezbet El borg	17,900
Port Said	13,400
Al Arish	4,042

Source: Ministry of State for Environmental Affairs (2006).
"Egypt State of the Environment Report 2005."

Statistics indicates that the number of fishing boats registered until 2004 were almost 6,000, of which 3,954 are self-driven by engines of capacity less than 100 horsepower and most of them are less than 10 meters long. The remaining fishing boats are sailboats or rowboats. The number of officially licensed fishermen is estimated at 27,550, but it is assumed that the number of non-licensed fishermen is a multiple of this figure. Modern mechanized trawlers of capacity over 500 horsepower engines represent only 3% of the Egyptian fishing fleet (Ministry of State for Environmental Affairs, 2006: 89).

Fishing is generally a family business with simple production techniques. Most of these families have only limited education and apply traditional techniques that were inherited from past generations (<http://fao.org/fishery/countrysector/FI-CP_EG/en>).

Methods and fishing techniques differ according to location. In The Mediterranean Sea, fishermen use deep trawlers, long and gill nets. This is in addition to a number of traditional shore-side fishing systems in which they use small thrower nets and small woven strings. The Mediterranean Sea provides more than 30 types of fish, most importantly are Sardines, Anchovies, Bouri, Denies, Barbouny, as well as other kinds of carnivores fish such as the Sepia, Sea Bass, Qarous and Miass. On the other hand, the production of migrating fish is very limited since the Egyptian fishing fleet cannot make use of the economic territorial zone, and focuses only on the continental shelf zone. Carnivorous fish such as the Sea Bass and the Sho'our represent a large portion of fish production.

Although information on the value of fisheries is limited, fish production valuably contributes to food supply. It is also a vital source of income for over 65,000 fishermen and other full time employed people in related activities (estimated at 300,000- 400,000 persons).

Egypt is characterized by having a large fish stock, which can be a great opportunity for development if existing fishing activities is enhanced through effective management, and technology transfer. Expansion of inland fisheries and aquaculture for securing improved food and increasing employment is ongoing. Aquaculture is currently the main source of fish supply in Egypt, accounting for almost 51% of the total fish production). Still, the expansion in aquaculture is controversial and the extent of pressures on the marine system is not yet examined.

The main goal of the Government of Egypt is to augment the catch of fish from its present level of 772,000 tones to reach 1,362,000 tones in 2012 and encourage the exportation as well as increase domestic consumption of fisheries products. Moreover, the government aims at introducing new technologies and enhancing the fishing fleet via fisheries cooperatives and soft loans

(<http://fao.orgfishery/ countrysector / FI-CP_EG/en>). But is it reasonable to increase the fishing fleet? Time series data are not available. This poor knowledge about the stock variability, growth rates, migration, etc. hinders proper assessment of the situation.

Having shown the actual and potential significance of the fisheries sector, the current and future development require assistance and support for investing in the private sector, having an efficient fisheries administration and research system, and enhancing the infrastructure of the landing sites. Also, there is a vital need for new policies for fisheries in alignment with an appropriate legal system as well as access to foreign markets for fish trade.

4.2. Problems threatening coastal and marine environment in the Egyptian Mediterranean

Coastal zones are exposed to many impacts due to various development activities and diverse pollution sources.

Table 2 shows that the governorates are most suffering from the degradation of coastal zones are Alexandria and Suez. The governorates least suffering are Marsa-Matrouh and South Sinai. There are diverse priorities regarding the problems that are faced by coastal zone governorates. Still, the major challenge faced by the coastal Mediterranean governorates is the change what is taking place on their coastlines.

The changing coastline is the main problem facing the governorates located on the Mediterranean Sea. Next come pollution problems as the second major challenge, then sanitary drainage and solid waste management problems (Ministry of State for Environmental Affairs, 2006: 83 - 86).

Table 2. Causes of deterioration of the coastal environment in the Mediterranean Sea (2005).

	Sanitary drainage	Solid waste	Air pollution	Chemical & oil	Nutrient salts	Change of shore shape	Overall indicator
Mediterranean Sea	**2**	**2**	**2**	**2**	**2**	**3**	
1. Marsa Matrouh	1	2	1	1	1	2	1
2. Alexandria	3	3	3	3	3	3	3
3. Al Beheira	2	2	2	2	2	3	2
4. Kafr El Sheikh	2	3	2	1	2	2	2
5. Damietta	2	2	1	3	2	3	2
6. Port Said	3	2	2	3	2	3	2
7. North Sinai	2	1	1	2	1	3	2

1 = Low 2 = Medium 3 = High

Source: Ministry of State for Environmental Affairs (2006). "Egypt State of the Environment Report 2005."

5. Conclusion and recommendations

Egypt has a large and productive fish stock which represents a major opportunity to contribute to the growth of the economy. It is believed that underexploited stocks of fish may generate additional benefits beyond the direct-use benefits (food, employment, incomes) which are currently available.

Although the goal of the Government of Egypt is to augment the catch of fish and enhance the fishing fleet, the poor knowledge about the resource deters proper assessment of the situation. Emphasis on the physical weight of fish caught (a production oriented policy can contribute to overexploitation exceeding natural limits in the long-run) is not the solution to efficient harvesting.

A lot of factors come into play, most of them characterizing marine fisheries failure: Market failure (especially with weak legal frameworks and property rights); Policy failure (pursuing policies based on increasing fish catches through technology, expanding fishing effort, etc, rather than wealth-based policies which would seek to maximize economic rents); and Institutional failure (weak monitoring, surveillance, enforcement by state regulatory bodies). In the fisheries sector, the market generally fails without regulations because the basic requisite of resource ownership is not present. Sometimes the policies adopted are not suitable and therefore add policy failure to market failure. Common property resource management and ITQs are very promising tools that may provide the correct trade offs among efficiency, monitoring costs, and social acceptance in most cases.

Experiences, shows that certain policies were successful such as property rights and fishing quotas. Bioeconomic theory and practice suggest that rights-based catch shares can grant individual incentives for sustainable harvest that would be less likely to deteriorate. Egypt can therefore draw from the above experiences to assist its future fisheries policy development as shown in the examples of New Zealand, and Australia.

The Individual Transferable Quota (ITQ) is the most important regulatory innovation proposed by economists. It operates by transforming a fishery wide restriction on catch into quantitative harvest rights that can be bought or sold. One such right entitles its owner to harvest, for example, one ton of a particular species of fish in a designated area during a specified period of time (it has been applied already in Egypt). Fisheries utilizing ITQs generally experience greater returns for harvesters, and no nation adopting the ITQ approach has subsequently abandoned it.

Beaches as ecosystems – relationship between their socioeconomic and ecological value

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ABSTRACT

Throughout the Mediterranean coasts we generally do not find totally natural or anthropogenic coastal habitats, but a continuum between natural and anthropic (adapted to human uses) beaches, in a dynamic relationship that can be temporary or irreversibly biased in dependency on human activities and development. Therefore any values we attribute to beach habitats are contingent, related to the context, users and development, which are derived from the past history. Since 1998, in the framework of three successive projects [1] we have analyzed a number of diverse coastal ecosystems on both northern and southern Mediterranean coasts, integrating different disciplines – geography, ecology and socioeconomics – to provide scientific baselines for an ecologically some management of those systems. This paper reports some of the lessons learnt regarding the natural and socioeconomic values of beach habitats: a) the health and the sustainability of beach ecosystems depend on their dynamics; b) pressures on and changes of ecosystems should be considered in both time and space scales; c) influences on beach ecosystems may derive from events outside of and even far from the area under management; d) the sociocultural and socioeconomic setting of an area controls its development and the sustainability of any management.

1. INTRODUCTION – THE GENERAL CONTEXT

Mediterranean coasts have been the setting of mankind history for millennia and still represent the most important places of the development as well as socioeconomic and political relationships of diverse countries (Di Nolfo, 2006). A diversity of cultures and habitats characterizes the region (Braudel, 1985) despite a general tendency towards homogenization caused by trades and, more recently, activities linked to tourism and leisure (Löfgren, 2001). Coastal habitats around the Mediterranean are ecologically diverse, culturally relevant and often beautiful. There natural and cultural heritage can hardly be distinguished from each other, natural diversity occurring as a rule together with historical remains (e.g., Oueslati, 2006) and cultural diversity (Matvejevi , 1987). However beaches *per se* are rarely considered relevant for conservation, and have more the status of limits/links between higher ranking systems, such as the Mediterranean Sea (obviously worth of conservation for the common benefit of all the countries bordering it, as stressed by the Barcelona Convention), and the terrestrial natural and cultural riches, belonging to each country. Coastal erosion is generally addressed as an issue challenging inland goods and management

[1] Projects MECO-IC18-CT98-0270; MEDCORE-ICA3-10003 and WADI-IC2005-015226.

options are chosen to stabilize coastlines with little consideration for beach ecosystems (Defeo *et al.*, 2008; CIESM, 2002).

In the ecosystem services' perspective, beaches provide several services of high importance for human welfare and health, including production of food (fish, sea food, baits) and fibres (from the dune plants), similarly to many other ecosystems. In particular, the service of ecologically linking the marine and terrestrial habitats cannot be offered by any other system (McLachlan and Brown, 2006). Beaches will ever exist between the land and the sea, but will they ever represent living ecosystems and ecotones?

2. Coastal reserves and protection of coastal areas and beach habitats

Only recently, have managers considered the need of protecting beaches. The concept of "natural environment worth of protection" was first applied to land environments such as forests and mountains (e.g., in Italy the first national parks were established in mountain environments), later on to wetlands for their rich biodiversity, while coasts were considered as places for settlings, infrastructures and agriculture. Dunes with their typical vegetation belong more to the terrestrial than to the marine domain and are managed as such, despite their strict links with sandy beaches forming the beach-dune unique system. However their status of "natural forests" is rarely understood. Dunes are often considered as sedimentary buffers for beaches (McLachlan and Brown, 2006), and management efforts are made to stabilize and reconstruct dunes, generally using fast-growing plant species (Nordstrom, 2000). This is the case for many beach environments around the Mediterranean. In the framework of three successive EU funded projects (MECO-IC18-CT98-0270; MEDCORE-ICA3-10003 and WADI-IC2005-015226) we have analysed a number of coastal areas representative of the diversity around the Mediterranean.

In Tuscany (Italy), the establishment of Maremma Regional Park has favoured the conservation in the salt marshes behind the beach of an endemic species, the flowering plant *Limonium etruscum*, in the past diffused on the Italian coasts and now limited to that only locality. However, the protection of endemic species is clearly not rentable for the park management, and activities like the introduction of conspicuous mammals and raptors as well as the building of infrastructures for visitors and the management of the littoral for bathing tourism have priority in the management plans of the Park (Scapini and Nardi, 2007). These activities may severely impact the beach-dune system and the endemic plant cited above. The Park was established in 1972 to preserve traditional agriculture and cattle breeding, as well as the natural biodiversity in the coastal mountains (a fossil island) and wetlands (the remains of a wider coastal lake). The socioeconomic importance of this reserve can be easily estimated from the number of visitors and development of agro-tourism small enterprises in the vicinity. Nevertheless pressures are currently put to develop the marina further as an extra attraction and a project has been proposed of beach nourishment inside the Park to increase the bathing area by stopping beach erosion at the river mouth. There will be a trade-off between the development of the marina and the search of wilderness by a high percentage of tourists. However, an advertising of the Mediterranean beach-dune wilderness is rarely made. In the imagination of tourists a dune covered by green grass with visiting birds, white sandy beach with palm trees and transparent blue water is highly desirable, something which they would never find in the real case. On the contrary, the natural dune vegetation has many spiny plants flowering in the spring only; the sparse fore-dune plants are rather perceived as disturbing as well as the small animals feeding on them; wrack is felt as disgusting, although it represents an ecologically key element (Colombini and Chelazzi, 2003; Dugan *et al.*, 2003).

In Spain, in the Alicante province as elsewhere on the Mediterranean coast, a wide, almost complete exploitation of the dunes has occurred for constructions and urbanisation to develop international tourism. Nevertheless some remaining natural or semi-natural corridors still exist, where an endemic coleopteran species, new to science, has been recently described and named *Paratriodonta alicantinus*. The local name given to this species has made possible the advertising of dunes as natural habitats in the local schools and newspapers, so managers are now more ready to protect these remaining dunes and their vegetation (Cantarino, pers. comm.).

Countries on the southern coasts of Mediterranean, like Tunisia and Morocco, are establishing protected areas on their rapidly developing coasts. This is a great opportunity that in the long term will represent a benefit for the whole Mediterranean region. However, there is a trade-off between socioeconomic development and the protection of natural and cultural heritage, as well as between the economic development and social needs. The countries on the northern coast have already experienced these effects and trade-offs. It would be highly desirable that the good and bad lessons learnt were communicated to the partner countries and taken into account to avoid major mismanagement.

In Italy, there are several sparse and relatively small coastal reserves aimed at protecting particular cultural and natural goods. They are locally managed (on the provincial and regional levels) and not linked to each other. Recently a large marine protected area has been established in the Toscano Archipelago. However, the links among areas subject to different levels of protection are complex and this marine natural park is more or less fragmented. This makes protection not only difficult, but also ineffective (see CIESM, 1999), as stressful factors affecting non protected habitats nearby, may negatively affect also the protected areas (Innamorati, pers. comm.). In this case, as in other similar cases of management decided on a national level, the impact is felt at the lower local level by the community living on the resource (Henocque, this volume).

3. Coastal urbanisation, tourism and development

Coasts are a continuum all around the Mediterranean and important ecosystems represent crossroads beyond national borders. The fact that the Mediterranean Sea is a common good of all countries sharing it has been assimilated since the Barcelona Convention (1976; 1995). However beaches are still considered local goods, in most cases managed on a sectoral basis (Conrad and Cassar, 2007).

Governments favour urban development, which implies a high turnover of money (often multinational large enterprises invest in these activities – the gain thus stays outside the managed area), and tend to disregard the needs of local population linked to activities like fisheries and traditional sustenance agriculture. Both the latter activities have pollution impacts on coastal marine waters, but in the long term the negative impacts of urbanisation to the natural habitats are much stronger. Moreover, the socioeconomic costs which the local population incurs in case of a rapid development are rarely taken into account.

In Egypt decreasing fish catches and increasing poverty have been observed in the population of fishermen living around the Lake Maryuit, related to the industrial and urban development of the city of Alexandria (Abdrabo, 2006; 2007). The economic value of the urban (houses and infrastructures) investments is not comparable to that of the activities and living around the lake, but the stakeholders are not the same, urban citizens in one case, fishermen and (non regulated) immigrants in the other. Also the sectors are different, industrial and subsistence activities.

The traditional exploitation of beach ecosystems around the Mediterranean includes the collection of medicinal herbs, dune plants to make basket, worms to be used as baits, seagrass *(Posidonia)* leaves to stuff mattresses, intertidal fish and molluscs for consumption or artisanal selling, as well as the pasturage on the dunes by sheep and cattle. Also the open space of a beach is socially very important to the local population to meet, play football and recover boats and nets. All these activities do not represent relevant threats to the ecosystems and the benefits are valuable for the local population in the short term. The biological and cultural diversity preserved in this way could be of high value for the Mediterranean region as a whole in the long term.

The absence of infrastructures for fishing activities was highlighted as a priority problem in our interviews of the representative of fishermen in northern Morocco. However, the development of infrastructures in that region has started with the construction of the new international harbour of Tangier and will be also implemented through a coastal highway from Tangier to Algeria. This trend of a national-international development beyond the local needs is the rule and is occurring at a fast and unpredictable speed all around the Mediterranean.

Littoral roads, railways and highways have accompanied and in many cases anticipated the development of coastal areas, both on southern and northern Mediterranean shores. However, the environmental impacts of these infrastructures are rarely completely considered. A road may represent a barrier to the flow of surface waters in case of extreme meteorological events (heavy rainfalls), thus causing floods in the littoral plain. Such an event did recently (2007) happen in northern Tunisia, caused by the highway Tunis-Bizerte; not only houses were damaged on the coast by the flood but several people died for the sudden accident, which could have been predicted from the geomorphologic characteristics of the area. Roads (as well as other water managements, e.g. dams) may also block the flow of river sediments to the sea and cause or increase beach erosion. The latter event affects the coastline in the medium-long term. This has been experienced in many places along Italian coasts as well as in Malta (e.g., at Mellieha Bay) where the bathing resorts, separated by a road from the back dune-marsh systems would disappear without an artificial beach nourishment . In the case of infrastructures like roads, those who gain benefits are generally far, both in space and time, from those who are severely affected by the construction.

It has become clear that no human intervention or socioeconomic development is harmless to the very sensitive fragile coastal ecosystems (Schlacher *et al.*, 2008). Constructions are burgeoning along the Mediterranean coasts and most southern Mediterranean countries are encouraging this development without considering eventual negative effects on beach ecosystems, such as those already experienced in many European countries at different tempos (e.g., Italy, France and Spain). The fragility of international tourism as an economic source and its eventual non-sustainability are also not taken into account (Tosun, this volume). We should be mindful of the case of Lebanon, one of the richest bathing resorts in the Mediterranean some decades ago, and now hardly visited by international tourists.

In developed countries beaches *per se* are considered valuable only as marinas or leisure places. However they have become economically important only recently, namely after the Second World War, and have experienced the whole cycle described by Butler (1980) for a tourist area: exploration, involvement, development, consolidation, stagnation and decline/rejuvenation (Scapini, 2002). The novel *Those Barren Leaves* by Aldous Huxley (1925) describes a very poor, underdeveloped coastal wetland in Tuscany, the “maremma”, where the population was threatened by malaria and famine. This same place is now one of the richest and most developed bathing resorts on Mediterranean coasts. Any square meter of beach is highly valuable and there is a need to consolidate the coastline to protect the bathing resorts against coastal erosion. Also natural reserves have been established in the former marsh area that may represent an insurance in view of an eventual rejuvenation of the resort, adding the value provided by the natural heritage. The need of protecting wetlands against invasion by the sea has induced the local administration to extend the interventions of beach nourishment and groynes building to the natural park, despite the high cost of the project and the apparent contradiction between natural protection and engineering measures (Fanini *et al.*, 2007; 2009).

The Mediterranean coast of Morocco has experienced a rapid development since the Sixties; there different types of tourism can be compared. International bathing tourism requires hotels of high standard, touristic villages with facilities (e.g., golf, tennis, etc.) as well as infrastructures. For this reason international tourism has been developed on the Atlantic coast of Morocco, while the lack of infrastructures in the northern coast has limited the resorts to national and local visitors. Holiday houses are now bourgeoning on the northern coast, with an anarchic growth that severely threatens the remains of the beach-dune system (Scapini, 2002; Bayed and Scapini, 2005; Oueslati, 2006). However, the pressure of domestic tourism is limited to July and August, favouring the recovery of the beach ecosystems during the other seasons, particularly in the sectors of the beach where camping and temporary wooden constructions are used (Fanini *et al.*, 2006). Ecotourism would be a less harmful option than bathing tourism for these coastal ecosystems.

Seasonality is an issue in beach tourism that is strictly linked to climate and meteorological events. Ecotourism (e.g., tracking, visiting natural sites) limits its pressure to specific weather conditions and hours of the day, but it extends the season with respect to bathing tourism, as people prefer to visit natural parks during spring and autumn (Fanini *et al.*, 2005). Planners should take seasonal relationships into account when calculating costs and benefits of tourism infrastructures.

4. The issue of sea level rise and coastal erosion

Coastal erosion is considered an issue by local managers when terrestrial goods have to be protected, such as settlements, historical remains and natural habitats. Projects of hard and soft engineering (groynes building and beach nourishment) have been undertaken locally to protect these goods or to develop bathing tourism. As a general rule, managers and decision makers feel that people are threatened by changes and consider the stabilization of the environment as their mandate. A stable beach is thus a valuable beach. This is an economic way of thinking, far from an ecologically oriented one. All ecosystems, and beaches in particular, are dynamic, open systems, naturally changing due to periodic (e.g., day and night, tides and seasons) and non-periodic factors (e.g., storms, climatic changes). Such dynamisms are essential for the conservation of beach ecosystems, as these depend on the supply of soft sediments from outside (the sea currents and the rivers), buffered by the sandy dunes backing the beach (Nordstrom, 2000; McLachlan and Brown, 2006). Beach organisms are well adapted to these changes and depend on them (Scapini *et al.*, 2005; Scapini, 2006). Any human intervention acting against these natural dynamics may have dramatic effects on the ecosystems.

Around Mediterranean shores, dead beach ecosystems are increasing in extension and number with respect to healthy ones. So beaches are more and more perceived as dead places, thus justifying management interventions to stabilize and flatten beaches in order to increase their surface. The concept of biodiversity generally helps ecologists give a value to habitats. In the case of most beaches this is hardly applicable because they are almost dead as ecosystems. We have compared biodiversity indexes of several sandy beaches around the Mediterranean and found that losses of biodiversity at various levels from genes to populations and communities can be proposed as early warning indicators of changes (Scapini, 2002; Bayed and Scapini, 2005).

Sea level may rise for several reasons, such as tectonic movements, climate change effects and management actions landwards (e.g., extraction of underground water and gas). We have to be prepared to changes affecting the coastlines. Attempts to block the retreat of a coastline will be useless in the long term and may be harmful to the beach ecosystems in the short-medium term (Speybroek *et al.*, 2006). Adaptive strategies, such as retreating from the shoreline in case of sea level rise, would appear to be more effective in the long term (Schlacher *et al.*, 2008).

5. Conclusion

We have stressed the development trends of coastal environments and the threats thereof to the beach ecosystems, more than the economic value of the latter. The issue is that the two sets of economic values (of infrastructures and ecosystems) are non- comparable in the short term. Therefore the sustainability of the system as a whole, considering both the natural and social components, has to be taken into account in the valuation. This was highlighted in various ways during the course of the Workshop discussions (see Executive Summary, this volume). While both the economic valuation and the development of management plans can be considered technical issues, the perception of the various stakeholders is a critical point in the decision making process. The valuation process of natural common goods and ecosystem services is also fraught with uncertainty (see Pavlinovic, this volume). This may weaken the position of ecologists with respect to engineers in environmental managers. Ecosystems are complex systems and as such are difficult to manage. Also the ecosystems' response to human actions in the long term is highly unpredictable, except for resilient ecosystems. This is apparently not the case for a closed sea like the Mediterranean (Galil, this volume). Also the response of the society to changes is unpredictable, but the response of the society can be oriented using appropriate adaptive methods of governance (Henocque, this volume). Only a responsible response of the society in general and the local population in particular would ensure the sustainability of the complex Mediterranean system in the long term.

Barriers to Sustainable Coastal Tourism Development: reflection from Turkey

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Abstract

This paper examines the main barriers to sustainable coastal tourism development (SCTD) in the Mediterranean Basin with special references to Turkey. At the risk of over generalization these barriers are classified under three headings; over concentration of tourism development on the coast, over urbanization of the coastline and various environmental implications of tourism for sustainable coastal development. The main policy recommendations include: re-locating tourism development through product and market diversification; widening environmental awareness and protection; adopting a more contemporary pro-active planning approach; and decentralization of public administration of tourism development. Unless Turkey takes a step to ensure implementation of existing regulation regarding environmental protection objectively, by ignoring clientelistic relationship, achieving sustainable coastal tourism development will be put at a great risk.

Introduction

Turkey with her 8,000 kilometer coastline extending along the Black Sea, the Sea of Marmara, the Aegean Sea, and the Mediterranean Sea has a unique position connecting Europe and Asia, geographically, socially, culturally as well as ecologically. The country proposes a rich natural, cultural and living culture, along with high quality built tourist facilities and low price level, which attract international tourists (Tosun and Fyall, 2005). This strong supply side of the tourism industry attracted the attention of the Turkish government, international organizations, and multinational companies including international tour operators. In the 1980s the civilian government gave the highest priority to the tourism industry as a tool to achieve the export-led economic growth strategy recommended by the World Bank and International Monetary Fund. While the government and international donor agencies aimed to solve macro-economic problems such as badly needed foreign currency earnings for financing industrialization and high numbers of youth unemployment through the development of the tourism industry, the international tour operators have aimed to maximize their profit by opening just another country as a cheap tourist destination in the Mediterranean Basin.

Consequently, through the efforts of these stakeholders Turkey experienced a rapid growth in tourism volume and value in the last 25 years (see Table 1). Tourism revenues grew very fast, from $US 7.7 million in 1963, to US$ 18.5 billion in 2007.

Table 1. Tourist arrivals and receipts in Turkey, 1970-2006.

Year	Number of arrivals ('000)	Receipts (million USD)	Year	No. of establishments	No. of beds
1963	200.0	7.7	1970	292	28,354
1970	724.2	51.6	1973	337	38,528
1973	1,341.5	171.5	1974	400	40,895
1974	1,110.2	193.7	1975	421	44,957
1975	1,540.9	200.9	1982	569	62,372
1982	1,391.7	370.3	1983	611	65,934
1983	1,625.7	411.1	1984	642	68,266
1984	2,117.0	840.0	1985	689	85,995
1990	5,389.3	3,225.0	1987	834	106,214
1994	8,000.0	4,700	1989	1,102	146,086
1997	9,689.0	7,000	1990	1,260	173,227
1998	9,752.0	8,300	1991	1,404	200,678
1999	7,487.0	5,203	1992	1,498	219,940
2000	10,428.0	7,636	2000	1,824	325,168
2001	11,619.9	8,090	2001	1,998	368,819
2002	13,256.0	8,473	2002	2,124	396,148
2003	14,029.5	9,676	2003	2,240	420,697
2004	17,516.9	12,124	2004	2,357	454,290
2005	21,124.8	13,929	2005	2,412	483,330
2006	19,819.8	16,900	2006	2,475	508,632
2007	23,340.9	18,487	2007	2,514	532,262

Source: Ministry of Culture and Tourism (2007a;b); TYD (Association of Turkish Tourism Investors) (2007).

The tourism growth initiatives in Turkey were initiated under a socio-economic and political crisis in the 1980s. The Tourism Encouragement Law No. 2634 enacted in 1982 gave generous fiscal, monetary and bureaucratic incentives, in particular to the large scale tourism investments in the coastal areas of the country. As a result Turkey has been very successful in her tourism growth strategy in terms of volume (international tourist arrivals and bed capacity) and value (international tourist receipts) within a relatively short period. However, such a development took place without a contemporary planning approach compatible with principles of sustainable development. As a result, various socio-economic and environmental problems have emerged due to the rapid and unplanned touristic growth.

1. Over concentration of tourism development on the coast

Tourism regions, tourism zones and tourism centers were determined according to the criteria established by the Encouragement of Tourism Law No. 2634. The logic behind the criteria was the ability of these locations to attract maximum numbers of tourists, who would bring in maximum foreign currency earnings–the most critical need for an economy in crisis. The central government gave priority to large-scale tourism investment projects, which targeted mass tourism, in allocating generous monetary and other incentives to meet its short-term policy objectives. However, most of the pre-determined tourism regions, centers and zones were in already relatively developed coastal regions (see Figure 1). As the Association of Turkish Travel Agencies (TURSAB) noted,

> "a coastal strip from Balikesir provincial border, up to the end of Antalya province which included Izmir, Ku adası, Bodrum, Marmaris and the other popular destinations of today was declared priority region to concentrate both public and private investments, then tourism-oriented physical planning works were initiated by the Ministry of Tourism, in co-ordination with the Ministry of Reconstruction and Resettlement, to fill the gap between development plans which had no spatial dimension and the implementation projects". (Duzgunoglu and Karabulut, 1999: 12)

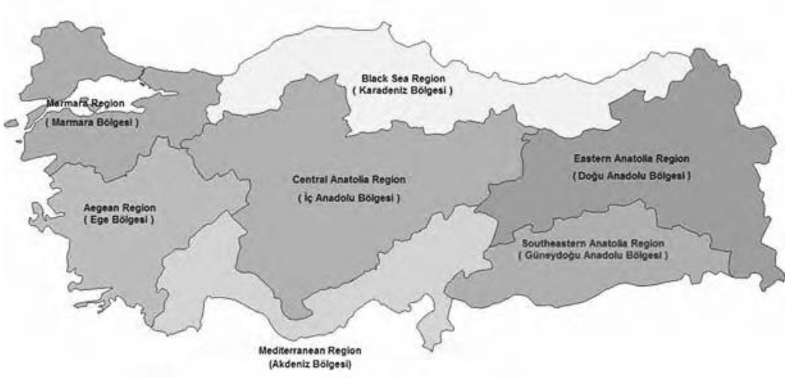

Figure 1. Map of regions in Turkey.

The relevant figures about Turkish tourism further support the above contention and show that tourism development has concentrated on the coastal strip of Turkey in both terms of space and time. On average between 1996 and 2006, 90 percent of international tourists in Turkey visited the coastal regions, spending around 94 percent of their country's total visitor nights in these regions. The average length of stay was also relatively larger in these coastal regions than in non-coastal regions (i.e. central Anatolia, eastern Anatolia and southeast Anatolia) (see Table 2). Between 2000 and 2006 on average around 88 percent of tourism operations took place in the Marmara, Aegean and Mediterranean coastal regions–which today concentrate over 83 percent of travel agencies and tour operators. Further the concentration of tourist activity in relatively developed regions is affected by the regional distribution of airports at international standards. Evidently, vast majority of airports of international standards, found mostly in coastal regions: on average between 2004 and 2006, 50 percent of landing and departing charter flights used airports in the Mediterranean region, 24 percent in the Aegean region and 20 percent in the Marmara region. This trend is also observed in other Mediterranean countries such as the Morocco and Tunisia (Oppermann, 1993). Ultimately, the low mobility levels of tourists within destination countries limits the diffusion of economic benefits, and increases their concentration in primary coastal tourist destinations where the economic and political centres of the destination countries are usually located.

Table 2. Number of international tourist arrivals and nights spent by regions, 1996-2006.

	1996			2003			2006		
R	Arrivals %	Nights spent %	ALS	Arrivals %	Nights spent %	ALS	Arrivals %	Nights spent %	ALS
A	2530900 0.27	11077200 0.31	4.38	2301633 0.19	10097751 0.21	4.4	2219118 0.24	10097751 0.21	4.4
M	3332782 0.36	7175868 0.20	2.15	3078329 0.25	6621802 0.14	2.2	2038173 0.22	6621802 0.14	2.2
Md	2649613 0.28	16233604 0.45	6.13	5751154 0.48	28463452 0.61	4.9	4129834 0.45	28463452 0.61	4.9
Ca	735440 0.08	1404036 0.04	1.91	595518 0.05	2964300 0.06	1.9	471757 0.05	2964300 0.06	1.9
Bs	114206 0.01	160708 0.004	1.41	81893 0.006	141431 0.003	1.7	66150 0.007	141431 0.003	1.7
Ea	63360 0.007	88379 0.002	1.39	43688 0.003	88786 0.001	2.0	37214 0.004	88786 0.001	2.0
Se	16898 0.002	27401 0.0008	1.62	44356 0.003	70235 0.001	1.6	29210 0.003	70235 0.001	1.6
Gt	**9443199** 100	**36167196** 100	**2.71**	**11896571** 100	**46640460** 100	**2.67**	**8991456** 100	**46640460** 100	**2.67**

R= Regions; A=Aegean Region; M=Marmara Region; Md=Mediterranean Region; Ca=Central Anatolia; Bs=Black Sea; Ea=Eastern Anatolia; Se=South-east Anatolia; Gt=General Total; ALS=Average Length of Stay.
Sources: derived from Ministry of Culture and Tourism (1996 - 2007).

Recent statistical figures indicate that on average some 54 percent of international tourist arrivals occur between June and September (see Table 3). This marked seasonality of tourism in coastal regions of Turkey poses additional challenges.

Considering the spatial and seasonal concentration of tourism development on Turkish coasts, it appears that much of the impacts of tourism on the environment have emerged due to the concentration over short periods of mass-tourism facilities in pre-determined areas. Spreading tourism demand to time and space is necessary. The Turkish experience suggests that the development of tourism can be biased towards the uneven distribution of natural and cultural resources/attractions. That is to say, the development and promotion of alternative forms of tourism such as eco-tourism, special interest tourism and farm tourism are necessary to reduce the spatial and seasonal concentration of tourism development.

Table 3. Monthly Distribution of Tourist Arrivals to Turkey, 2000-2006 (numbers in bold indicate percent values).

Month	2000	2001	2002	2003	2004	2005	2006	Average
%	333915	359320	306597	363983	533694	700469	667337	384758.8
Jan	**3,20**	**3,09**	**2,31**	**2,59**	**3,04**	**3,31**	**3,36**	**2.98**
	354487	404653	426405	481252	607854	696 643	626565	437257.6
Feb	**3,39**	**3,48**	**3,21**	**3,43**	**3,47**	**3,29**	**3,16**	3.34
	435158	547365	675 687	499 663	784 107	107348	921892	454432.7
March	**4,17**	**4,71**	**5,09**	**3,56**	**4,47**	**5,24**	**4,65**	**4.55**
	721128	884805	852 930	669 288	1104270	1348264	1372 922	825259.5
April	**6,91**	**7,61**	**6,43**	**4,77**	**6,30**	**6,38**	**6,92**	**6.47**
	986 376	1231562	1325752	1146309	1799130	2302389	1918809	1259090.4
May	**9,45**	**10,59**	**10,00**	**8,17**	**10,27**	**10,89**	**9,68**	**9.86**
	1079 148	1387 955	1457615	1510 951	1898435	2402912	2368 628	1439341.6
June	**10,34**	**11,94**	**10,99**	**10,76**	**10,83**	**11,37**	**11,95**	**11.7**
	1525 718	1776821	1897112	2130949	2 591140	3180802	3109 727	1935255.5
July	**14,63**	**15,29**	**14,31**	**15,18**	**14,79**	**15,15**	**15,68**	**15.0**
	1419 244	1601331	1900120	2 275055	2 492794	2861141	2905817	1852114.5
Aug.	**13,60**	**13,78**	**14,33**	**16,21**	**14,23**	**13,54**	**14,66**	**14.34**
	1368 538	1440365	1770566	1874329	2 125025	2502123	2267146	1629260.5
Sept.	**13,12**	**12,39**	**13,35**	**13,35**	**12,13**	**11,84**	**11,43**	**12.51**
	1178 481	1065825	1420386	1657726	1842277	2108398	1713916	1359054.4
Oct.	**11,30**	**9,17**	**10,71**	**11,81**	**10,51**	**9,98**	**8,64**	**10.30**
	602 396	520962	662985	776 181	948 815	1052561	1020106	672804.2
Nov.	**5,77**	**4,48**	**5,00**	**5,53**	**5,41**	**4,98**	**5,14**	**5.18**
	423564	398005	559873	643872	789367	861836	926968	544134.4
Dec.	**4,06**	**3,42**	**4,22**	**4,58**	**4,50**	**4,07**	**4,67**	**4.21**
Total	10428153	11618969	13256028	1402958	1751698	2112486	1981983	
%	**100**	**100**	**100**	**100**	**100**	**100**	**100**	

Sources: derived from Ministry of Tourism (2000, 2003, 2007).

2. Over urbanization of the coastline

As noted, tourism development in Turkey has been superficially rapid. The generous fiscal and monetary incentives provided to tourism entrepreneurs (in the 1980s) and the vast influx of international tour operators and accommodation providers, combined with the absence of a proper tourism development plan, lack of experience and expertise, and a myopic mission of increasing supply capacity, have together contributed to a considerable number of environmental problems. For example, by neglecting construction regulation, ribbon buildings have been established along the coast of the Mediterranean, Aegean and Marmara Seas. Often out of scale and style with the local surroundings, such developments in Turkey are in danger of being unsustainable in the longer term. As noted earlier (Tosun, 2001), in the absence of proper urban and land management planning many coastal towns has attracted attentions of tourism investors and second home owners. In particular, ribbon buildings along the coastal band and roads built parallel and too close to coastlines have taken place, which may represent bad land management and mal-urbanization. Towns such as Ku adası and Alanya (see Figure 2) can be given as an example in this regard.

Convery and Flanagan (1992: 147) that "the failure to incorporate adequately environmental considerations in the architectural designs of hotels, restaurants, and entertainment facilities can lead to consequences which are both environmentally and economically unprofitable".

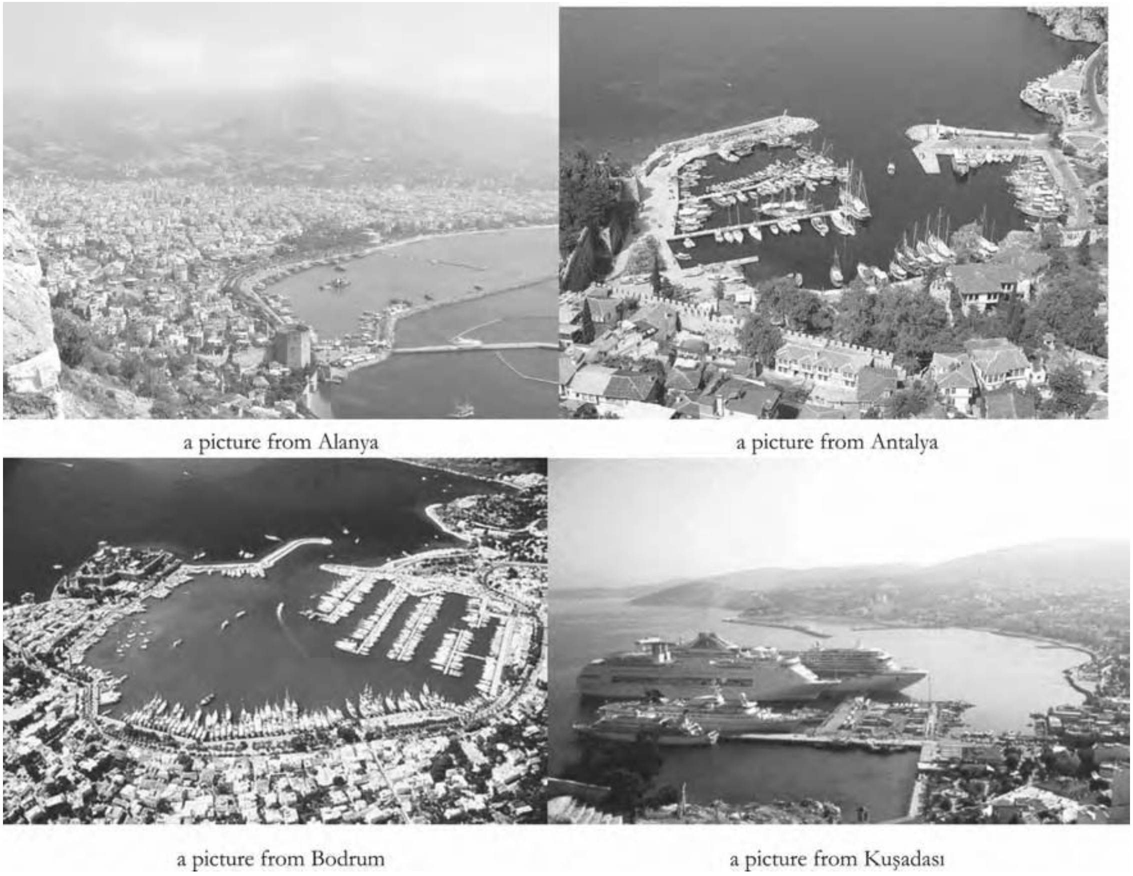

Figure 2. Representative photographs of four coastal Turkish cities largely devoted to tourism.

The analysis of relevant official documents, relevant literature and personal observations of the author suggest that mal-urbanization in popular local tourist destinations in Turkey took place during the 1980s and 1990s along the coast of the Mediterranean, Aegean and Marmara Seas (see Tosun, 2000; 2001). There appear to be three main reasons for this mal-urbanization. The first is the rapid tourism development due to the generous fiscal and monetary incentives provided to tourism entrepreneurs by the government, plus the influences of the international tour operators and donor agencies such as the World Bank and International Monetary Fund. The second is the over concentration of tourism development in space and time alongside with lack of legislative tools and regulations in regard to urban planning. The third is the absence of a proper tourism development plan, lack of experience and expertise, and a myopic mission of increasing supply capacity of the national tourism industry (see Brotherton *et al.*, 1994; Tosun and Jenkins, 1996; Tosun and Timothy, 2001).

Consequently, large scale and unplanned rapid tourism growth have brought negative impacts on urban areas with rich cultural and historical heritage. New buildings, roads, pavements and high quality street furniture have already changed the original setting of many small coastal towns designated exclusively for tourism (see Tosun, 1998).

3. Environmental Implications of Tourism for Coastal Development

Components of natural, man-made, socio-economic and cultural environments are attractors for different types of tourism development. The quality of these environmental components will determine profitability of tourism investment in the short, medium and long term. It may not be possible to say one category of environment is less important than the others or vice versa, as all categories of the environment are inter-dependent and inter-related: a change in one category of environment will influence the other categories. Once the components of environment utilized for tourism investment are changed or degraded, then it is not easy or possible to bring the natural quality back since it takes often centuries to return to a mature, self-regulating system. For example, it is not possible to bring the flora and fauna back after destroying fertile agricultural soils to accommodate tourist facilities.

Evidently, in the absence of contemporary tourism planning approach, the spatial and seasonal concentration of tourism development has caused much pollution in many Mediterranean countries. This has already created an irreversible damage to various components of environment, which badly affect the profitability of tourism establishments and investments. Although little work has been conducted in Turkey on this problem (Tosun, 2001), Turkey has experienced, albeit to varying degrees, the full repertoire of tourism impacts:

3.1 Visual pollution

As implied, Turkey has failed to incorporate adequately environmental considerations in the architectural designs of hotels, restaurants, and entertainment facilities. Such a failure has led to visual and architectural pollution alongside coastal strip of the Mediterranean and Aegean seas. Moreover, many brightly colored caravans and tents installed haphazardly in poorly designed camping areas also destroy scenic views and prospects. Sporadic development of ‘summer’ or ‘second homes’ in or near popular tourist destinations also raise concern: while only in use for two to three months each year, the phenomenon of *bungalow blight* has already altered the panorama of some of Turkey’s most scenic areas. Litter is another major problem. The rubbish and litter left carelessly by tourists not only creates visual impairment of the quality of the natural environment, but also impacts on the agricultural industry negatively.

3.2 Water pollution

Rapid mass tourism development has overloaded local sewage treatment and disposal infrastructure. In coastal Turkey, ‘environmental pollution has become an important problem at these popular local tourist destinations due to the lack of measures to cope with the generation of new or increased waste residues. Sewage disposal systems were installed solely according to local residents’ (Tosun, 2001: 95). The carrying capacity of sewage disposal systems has been exceeded due to the rapid increase in the number of hotels and construction of second homes across Turkey.

3.3 Yacht tourism and water pollution

Apparently, beaches and seas have been used for various purposes in the context of leisure activities. In particular, boating, yachting, and water sport, such as jet skis, scuba-diving, etc. may seriously affect marine bio-diversity.

There are 21 yacht harbours that obtained a tourism operation license, of which 10 obtained a tourism investment license from the Ministry of Culture and Tourism (MCT, 2007). Fourteen of 21 yacht harbours have blue flag. The others (around 30 %) seem not to have environmental-friendly management systems. In this regard it is reported that “yacht tourism has also created considerable water pollution at some local tourist destinations on the coastal areas. For example, yachts have polluted seawater around the yacht port in Ku adası by discharging dirty water into the sea without any pre-treatment. Solid wastes such as cans and bottle, etc. are thrown into the sea from yachts in the area”. (Tosun, 2001: 295)

3.4 Air pollution

Tourists traveling by car, ship, train, bus, or airplane, and the burning of fossil fuels to provide heating and power for tourist facilities, all contribute to air pollution. It should be recognized that although various environmental impacts of tourism such as visual and water pollution are generally localized and restricted to a relatively small, well-defined areas, this is not the case for air quality. Both the airline and the tourism industries must be seen to be concerned for the natural environment by taking measures to reduce emissions to the atmosphere.

3.5 Impacts of tourism on other natural resources

The use of hardwood tree species in the building and decoration of luxury tourist facilities and of building insulation materials made with ozone-depleting chlorofluorocarbons have global environmental implications. Another natural resource which has been over-utilized by tourism facilities is fresh water. Mass tourism development has taken place on the coastal parts of Turkey which have relatively dry climates and where fresh-water supplies are scarce. In this regard, Hamele (1988) reports that in the Mediterranean Basin, while the hospitality industry can use 400 liters of water per customer per day, the local people may only consume a maximum of 70 liters per person per day. Moreover, certain recreation facilities such as golfing necessitate a significant amount of fresh-water for maintaining the course at the required standard (Tananone, 1991). The over-utilization of hardwood trees and water supply by tourists and tourism facilities may suggest that tourism is exerting an unsustainable drain on renewable supplies including losses of greenery.

3.6 Biodiversity versus coastal tourism development

Tourism development inevitably can disrupt and even destroy the ecological balance of an area which may have taken thousands of years to evolve into a mature, self-regulating, stable system. Few detailed analyses exist of water pollution caused by mass tourism development and its impacts on local people and tourists in Turkey, but there is much scientific evidence showing that water pollution from untreated or partially treated sewage effluent can have profound implications for marine life and also for human health. Sewage pollution can alter the ecological balance of an area, often resulting in a marked decline in species diversity, by reducing dissolved oxygen in water and sediments, by increasing water turbidity, and by promoting accelerated eutrophication. Further, coastal tourism development in Turkey threatens biodiversity in two other ways. These are:

- Loss of flora and fertile agricultural lands due to the construction of tourism facilities: it is known that large numbers of hotels and second homes have been built in coastal areas in Turkey by destroying olive and citrus gardens, thus destroying the livelihoods of many agricultural workers.
- Loss of marine species caused by tourism facilities: as noted earlier, boating, yachting, water sport such jet skis and scuba-diving, and sewage disposal of tourist facilities seriously impact marine biodiversity. Moreover, tourist developments on beaches coupled with lighting and noise from tourist facilities have negatively influenced the populations of *Caretta caretta* and *Chelonia mydas*, two species of sea turtle, along parts of the Mediterranean Sea.

4. Recommendations

4.1 Valuing natural assets and cultural values

Economic valuation is done under some assumptions. Hotel rooms, food, beverage, etc., have a price tag and value, which is not the case for natural assets. Since natural and cultural assets are considered and utilized as if they have no value, they are used by tourists and tourism facilities as free of charge at the expense of pollution and/or degradation.

There is need for fair distribution of cost and benefit of tourism development and financing sustainable development. For example, “an ecosystem asset tax” could be taken from hotels, restaurant, bars, etc. to compensate for natural assets and cultural values used as direct or indirect input for tourism product. The income generated through ecosystem asset tax could be used for financing activities arranged for preservation and protection of ecosystem assets.

4.2 Reconsidering valuation approach of natural assets

Although tourists pay for meal, hotel room, etc., they do not pay for the clean sea, beaches, nice view, authentic local culture, etc. On may argue that in a holiday package all of these are taken into account and that price level are determined accordingly. This may be true, but the price is paid directly to tourism operators. So, environment and local community do not get direct benefit from payment made by the users although their products (natural assets and local culture) are consumed and thus degraded. Thus, the pricing or valuation system/approach should be re-considered to distribute cost and benefits of tourism development in fair manner. It is not right to attract more tourists by lowering the price level. Such a marketing strategy benefits only tourists as consumers and investors, but not local community and ecosystem. In this regard, it is suggested that environmental and community taxes may be taken directly or indirectly from the end users to finance environmental protection and enhance the relevant local community.

4.3 Re-locating tourism development through product and market diversification

Lowering touristic price levels and increasing advertising has brought about the problem of concentration of tourism demand in time and space, which seems to be the root of many setbacks on the front of sustainable tourism development. Thus, product and market diversification should be adopted as a destination growth strategy for achieving sustainable tourism.

4.4 Widening environmental awareness and protection

In the words of Beeton (2006) "tourism is like fire. It can cook your meals or burn your house down". If Turkey wishes to use tourism for cooking her meals, there is an urgent need for greater environmental awareness and protection. This could be achieved by providing more training and education about environmental issues and by enforcing stricter environmental regulation and code.

Creating environmental awareness: in order to give priority to environmental concerns in tourism development, the design and implementation of training programs for environmental awareness is vital. These should target appropriate local authority employees, private sector representatives and members of NGOs. Appropriate information and interpretation should be published and provided for tourists to inform them about the fragile nature of the country's historic and natural assets (see Tosun *et al.*, 2006).

Enforcing strict environmental regulation and code: strict environmental regulations should be developed and enforced to protect unique and fragile natural resources, and cultural heritage. These measures should be free of misinterpretation and misuse. Through booklets, signboard and newsletters tourists can be informed how these fragile resources can be easily damaged. Tourist guides should be educated about environmental issues. Most importantly, there should be control to implement these environmental codes by empowering local government, nongovernmental organizations and local communities (see Tosun and Fyall, 2005).

4.5 Re-regulating water consumption

In the Mediterranean Basin, while 400 liters of water are consumed per tourist per day, the local people may only consume a maximum of 70 liters per person per day. Fresh water usage should be regulated. For example, only shower may be installed in hotel rooms, not bath. Alternatively, certain amount of water may be allocated per customer per day, and beyond this limit extra charges may be put in effect.

4.6 Adopting a more contemporary pro-active planning approach

A new approach to planning is needed, which should involve flexible, continuous, comprehensive, integrative, participatory and system planning models. To Tosun and Jenkins (1998), these planning approaches are not necessarily exclusive, rather overlapping but at no time one planning approach alone will be sufficient. Thus, it is recommended that countries in the Mediterranean Basin should develop an appropriate method of planning by using the right mix and proportion of components of the contemporary approach, taking into consideration their own social, cultural, political, economic and environmental conditions.

4.7 Decentralization of public administration of tourism development

It is observed that one of the major causes of unsustainable tourism development is the over-centralization of the public administration system of tourism. In this regard, it may be said that without re-structuring the public administration system in Turkey, it would be very difficult to promote and manage tourism development in a sustainable manner. Municipalities have difficulty in serving foreign tourists, second-home owners and permanent residents simultaneously because their budgets are based on the number of permanent residents, excluding second-home owners and tourists. When large numbers of tourists and second-home owners come and visit popular local tourist destinations during peak season, the service demands on these local municipalities go well beyond their capacities. This suggests that without strong local planning authority and the involvement of local communities in the planning process it will be very difficult to achieve sustainable tourism development.