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Socioeconomic Impacts of Networks of Marine Protected Areas

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Introduction

Marine ecosystems have been recognized as one of the most important natural resources (Costanza, 1999; Beaumont *et al*., 2007) as they offer a wide range of ecosystem services (Beaumont *et al*., 2007; Atkins *et al*., 2011; Burkhard *et al*., 2011). This makes their conservation and management highly valuable for human well-being.

Marine Protected Areas (MPAs) can enhance fish size and abundance inside their borders across a variety of species, ecosystems and geographic regions (Roberts *et al*., 2001; Lester *et al*., 2009; Gaines *et al*., 2010; Halpern *et al*., 2010; Abbot and Haynie, 2012), as well as economic profit (White *et al*., 2008), with potential positive spillover effects for adjacent fisheries (Russ *et al*., 2004). Marine Protected Areas can also act as a safeguard against uncertain future environmental conditions. Given that the local and regional magnitude of climate change impacts is difficult to project, marine reserves can provide an 'insurance factor' that buffers against some of these unknowns. For example, multiple MPAs in networks can spread the risk of impacts (such as catastrophic storms) that are spatially large relative to individual reserves but small relative to the scale of the network (Allison *et al*., 2003; Game *et al*., 2008; McLeod *et al*., 2009; Gaines *et al*., 2010; Gleason *et al*., 2010). Protecting portions of stocks inside MPAs can buffer losses from management failure (Gell and Roberts, 2003) as well as provide reference areas for assessing climate impacts (Bohnsack, 1998), thus providing especially valuable insight in data-poor settings on stock fluctuations driven by factors other than fishing (Wilson *et al*., 2010).

Given the broad range of ecological and socioeconomic impacts of MPAs, and the need to design and manage MPAs in their socioeconomic context, research is imperative in this area. During the EU-funded

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research project on 'Towards coast to coast networks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential' (CoCoNet), a series of virtual and regular workshops were held between researchers and practitioners to discuss the socioeconomic aspects of marine conservation in the Mediterranean and the Black Seas. The goal of these workshops was to provide a platform for experts from different origins and disciplines to debate specific questions concerning the state and the future of marine conservation in Southern European seas.

The first workshop was held online in December 2012, involving a total of 90 participants. The following areas were discussed: (i) the socioeconomic impacts of MPAs; (ii) methodologies for socioeconomic assessment; (iii) drivers of change; and (iv) future MPA networks and policies. Following a period of follow-up research, a second workshop on MPA network management was conducted in Mallorca (Spain) in October 2014. External experts, stakeholders and policy advocates from the project area (Mediterranean and Black Seas) and additional regional seas were also invited. The workshop focused on (i) establishing MPAs and MPA networks; (ii) managing MPAs and MPA networks; and (iii) monitoring MPAs and MPA networks. Finally, a third online workshop was organized in December 2014, with the objective of combining the existing experience from the socioeconomic analysis of MPAs conducted within the CoCoNet project.

This chapter presents the main findings and lessons learned from these series of scientific exchanges, and provides recommendations for the management of MPAs in the Mediterranean and Black Seas. Special emphasis is given to the socioeconomic aspects of MPAs, as it is now widely recognized that MPAs must be designed to address social and economic considerations as well as conservation goals. We present the state of the art concerning the study of the socioeconomic impacts of MPAs, and present tools for MPA socioeconomic assessments; we then introduce case studies gathered in the workshops from the Mediterranean and the Black Seas; summarize the literature and expert discussions by presenting lessons learned; and conclude with some final remarks.

State of the Art

Socioeconomic Impacts of MPAs

The impacts of establishing MPAs have been widely studied from a biological and conservation point of view, but less evidence exists about socioeconomic impacts. Literature has chiefly focused on the impacts of protected areas on activities such as fisheries and tourism, while other potential positive and/or negative impacts have received less attention.

A vast literature exists concerning the effects of MPAs on fisheries. Research shows that fisheries benefit from MPAs as protected eggs, larvae and adult fish spill over into adjacent fishing grounds, benefiting fishermen and their catches (Claudet and Guidetti, 2010). Thus, fishermen see MPAs as positive initiatives and might become involved in their management. For example, fishermen participating in managing a reserve in Torre Guaceto (Brindisi, Italy), where fishing was allowed in part of the reserve, obtained yields which were consistently about double those obtained from fishing grounds outside the reserve.

Apart from benefits to fisheries, however, MPAs also provide many other benefits. In 2009, a study by Lester *et al.* (2009) reviewed reports from 1224 no-take marine reserves in 29 countries and found documented increases in biomass, species richness and population size within the boundaries of the reserves.

Social sciences have contributed a relatively small but steadily growing body of literature that examines the social and economic implications of MPAs (Sanchirico and Wilen, 2002). In Southern European seas, a seminal paper by Badalamenti *et al.* (2000) remains the main source on the socioeconomic impacts of MPAs on the Mediterranean Sea. More recently, Rossetto *et al.* (2013) presented a synthetic review of the empirical evidence of benefits and costs of MPAs, in order to inform the planning of future protected areas. Pascual *et al.* (2016) updated the Badalamenti *et al.* (2000) analysis and expanded it to the Black Sea as well.

Based on a literature review on socioeconomic impacts of MPAs, together with the input from the workshop participants, Table 6.1 provides a comprehensive list of the different potential positive and negative impacts expected from a protected area, from a user perspective, for each socioeconomic activity. The table captures information from the Black and Mediterranean Seas to elucidate the main positive and negative impacts of activities on users.

Instead of looking at the impacts of economic uses on MPAs, the focus is the other way round: we are trying to understand the implications of MPAs for the society and economy of an area. For this purpose, we recommend ranking impacts according to: (i) the importance of the activity in the region; (ii) the importance of the stakeholder groups in the region; (iii) the socioeconomic context; and (iv) the magnitude of the impact. All these factors are of course related. For example, it emerged from the discussions that mineral extraction may be an activity considerably affected by MPA creation in the Black Sea, more so than commercial fisheries which have severely declined in the last few decades. The importance of recreational impacts in Mediterranean MPAs was highlighted, and regional differences are very relevant for understanding the dynamics.

Tools for MPA Socioeconomic Assessments

We now review some of the main methodologies and conceptual frameworks used for MPA research and management which we find useful for assessing the socioeconomic impacts of MPAs.

Social-Ecological Systems (SES) Approach

Novel conceptual frameworks address marine management from a social-ecological perspective. In her pioneering work, Ostrom (e.g. Ostrom, 2009) identifies a set of variables that affect the likelihood of self-organization in efforts to achieve a sustainable SES, such as cooperation in sustainable fisheries management. From this more holistic social-ecological perspective, marine resources are understood as an intertwined system where ecological and socioeconomic factors interact. Recent work has adopted this framework to investigate fisheries where resource system, resource users, resource units, governance, interactions and outcomes from the systems are analysed in order to understand the system's complexity and address management in a more sustainable way. Leslie *et al.* (2015), for example, apply a SES approach to artisanal fisheries in Baja California. For MPAs, Jones *et al.* (2013) rely on this framework to study in detail governance factors for 20 MPAs worldwide.

However, despite the recent growing body of case studies and recommendations on the benefits of adopting a social-ecological framework for resource management, as well as the potential for MPA design and management, such a framework remains very difficult to apply, whether in fisheries management (Kittinger *et al.*, 2013) or more generally. Further research and additional illustrative case studies are needed to explore the benefits of adopting a SES approach in MPA management.

Table 6.1 Comprehensive list of potential socioeconomic impacts of MPAs.

Type of activity	Sub-types of activity	Potential positive impacts on users	Potential negative impacts on users
Fisheries	Artisanal fisheries (small scale)	Improved catch mix Income and employment increase, for professional and pleasure fisheries and for diving Exclusive access (less competence)	Closure of areas to fisheries If retention rates inside the MPA are high (dispersal ability is low compared to MPA size) there might be no benefit for nearby fisheries
	Commercial fisheries (large scale)	Improved catch mix Increased catch ('spillover effect' and also by 'recruitment effect') Income and employment increase, for professional and pleasure fisheries and for diving Increased biomass (reserve effect) Increased fish size (reserve effect)	Closure of areas to fisheries If retention rates inside the MPA are high (dispersal ability is low compared to MPA size) there might be no benefit for nearby fisheries
	Recreational fisheries	Income and employment increase, for professional and pleasure fisheries and for diving	Closure of areas If retention rates inside the MPA are high (dispersal ability is low compared to MPA size) there might be no benefit for nearby fisheries
Aquaculture	Offshore aquaculture (longlines)	Economic benefits of employment and income	Impacts on local ecosystems?
	Offshore fish-farms	Economic benefits of employment and income	Impacts on local ecosystems?
Navigation and communications	Commercial shipping	Not available	Effect on shipping lanes Increased transport time due to reduced speed limits
	Ports and harbour service area	Not available	Negative effects of anchoring on seabed (e.g. seagrass)
	Communication cables	Not available	Limitation of allocation

Mineral, water and energy resources	Offshore oil/gas platforms, resources extraction, pipelines and cables	Not available	Limitation of extraction and allocation
	Offshore wind-farms	Not available	Limitation of allocation
	Sailing	Not available	Damage to ecosystem from tourist congestion (e.g. anchoring)
	Marine cruising	Increase in marine cruises related to cetacean or seabird sightseeing	Negative effects of anchoring on seabed (e.g. seagrass)
	Diving, snorkelling, nautical activities	Increase in diver visits Income and employment increase, for professional and pleasure fisheries and for diving	Damage to ecosystem from tourist congestion Negative non-consumptive diver impacts on the natural environment Closure of areas
	Cetacean sighting cruising, seabird watching	Increase in demand	Negative effects on cetaceans
Management	MPA management	Economic benefits to scientists and biologists (budget for research, projects, etc.)	Economic cost for public finances: of administration, supervision, monitoring, scientific information policies, prohibitions with financial compensation

Source: First table draft from Pascual (2013), adapted to incorporate comments from participants in the CoCoNet workshops.

Ecosystem Services and Economic Valuation

The Millennium Ecosystem Assessment (MEA) uses a conceptual framework for documenting, analysing and understanding the effects of environmental change on ecosystems and human well-being. It views ecosystems through the lens of the services they provide to society, how these services in turn benefit humanity, and how human actions alter ecosystems and the services they provide (Carpenter *et al.*, 2009).

Assessing ecological processes and resources, in terms of the goods and services they provide, translates the complexity of the environment into a series of functions which can be more readily understood, for example by policy-makers and non-scientists (Beaumont *et al.*, 2007). As a consequence, the focus on ecosystem services has been widely adopted among the scientific and policy communities (Carpenter *et al.*, 2009), including those concerned with marine management and MPAs (Roncin *et al.*, 2008; Fletcher *et al.*, 2011).

Building on the ecosystem services framework, The Economics of Ecosystem Services and Biodiversity (TEEB) has recently applied a more mainstream economic approach to ecosystem services (Costanza *et al.*, 2014). TEEB adopts the MEA framework, but adapts it by including ecosystem functions. Ecosystem functions are defined as a subset of the interactions between structure and processes that underpin the capacity of an ecosystem to provide goods and services. The building blocks of ecosystem functions are the interactions between structure and processes, which may be physical (e.g. water infiltration, sediment movement), chemical (e.g. reduction, oxidation) or biological (e.g. photosynthesis, denitrification), and biodiversity is involved in all of them to varying degrees. Ecosystem services are defined in TEEB as the direct and indirect contributions of ecosystems to human well-being. Identifying and separating ecosystem processes and services avoids the risk of double counting benefits. Figure 6.1 shows the links between functions, services and well-being adopted by TEEB (2012).

Based on TEEB and the MEA frameworks, together with recent work on ecosystem services in the Mediterranean (Sardá, 2013), Table 6.2 summarizes methodologies from the economic literature that can be applied

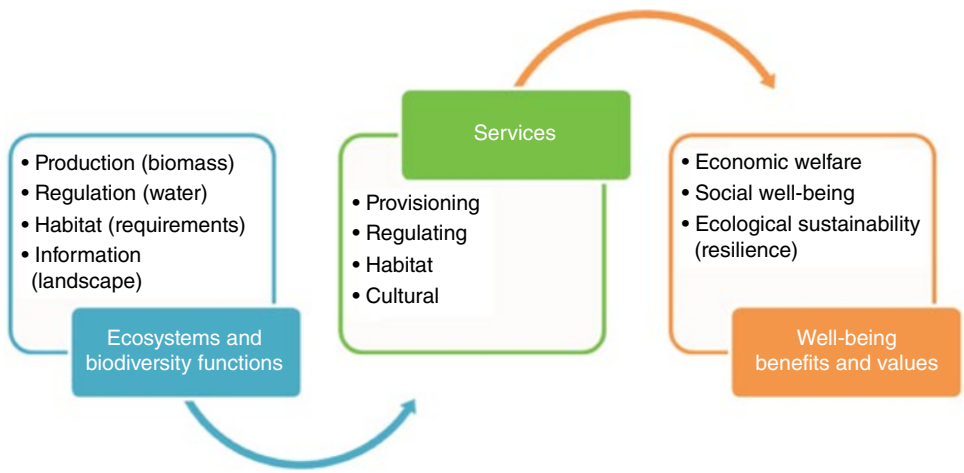

Figure 6.1 Links between functions, services and well-being adopted by The Economics of Ecosystem Services and Biodiversity (TEEB).

Table 6.2 Valuation techniques available for economic valuation of ecosystem services in MPAs.

Value	Function	Ecosystem good or service	Common valuation technique
Use value	*Direct use value:*		
	Provisioning or production services	Production of valuable food and fibre for harvest	NFI, PF, MP
		Pharmaceuticals	NFI, MP
		Raw materials	NFI, MP
	Cultural services	Recreational opportunities	NFI, TC, CV, CE
		Education and scientific knowledge	CV, CE
	Indirect use value:		
	Regulating services	Water quality control	NFI, RC, CV, HP, CE
		Waste treatment	NFI, RC, HP
		Flood control and storm buffering	NFI, RC, AD
		Biological regulation	CE, CV, PF
		Human disease control	NFI
	Supporting services	Climate regulation	RC
		Nutrient cycling	RC
	Option value:		
	Option value	Future benefit for direct and indirect uses	CV, CE
Non-use value	Existence value	Intrinsic value of species, habitat, biodiversity	CV, CE

NFI, Net Factor Income; PF, Production Function; MP, Market Price; TC, Travel Cost; CV, Contingent Valuation; CE, Choice Experiments; RC, Replacement Cost; HP, Hedonic Pricing; AD, Avoided Damage.

under an ecosystem services framework to study the socioeconomic impacts of MPAs and MPA networks. Also included is the type of values the methods can measure. The methods are outlined below:

Net Factor Income (NFI): this method estimates the value of ecosystem services as an input in the production of a marketed good. That is, NFI estimates the value of an ecosystem input as the total surplus between revenues and the costs of other inputs in production. For example, the value of a coral reef in supporting reef-based diving recreation should be calculated as the revenue received from selling diving trips to the reef, minus the labour, equipment and other costs of providing the service (Van Beukering *et al*., 2007).

Production Function (PF): this method estimates the value of a non-market ecosystem product or service by assessing its contribution as an input into the production process or a commercially marketed good. It is different from the NFI method in that it estimates a functional relationship between inputs and outputs. A PF describes the relationship between inputs and outputs in production. This method could be useful when considering aquaculture, for example.

Market Prices (MP): these methodologies use market prices to estimate marginal economic values. This is feasible for those ecosystem goods and services that have a price in existing markets, such as seafood, fish or commercial algae, or revenues from outdoor recreational demand. A major disadvantage of the method is that many environmental goods and services are not traded directly in well-functioning markets and readily observable prices are not available. Additionally, if markets exist but are highly distorted, the available price information will not reflect true social and economic values.

Travel Cost (TC): this method is based on actual consumer or producer behaviour and preferences and values are 'revealed' in complementary or surrogate markets. It employs existing market data to derive the indirect value of nature. An example would be assessing the expenses incurred in visiting an MPA, as an estimate of how much the experience is worth.

Contingent Valuation (CV) and Choice Experiments (CE): these methodologies are used for those services that are not traded in a regular market and therefore have no market price. For such goods and services, usually the individual willingness to pay for a change in the level of provision of the service is estimated. These are the only methods capable of deriving economic values for highly valued species or cultural ecosystem values not related to direct use. This can be done through conducting surveys to collect data about individual preferences in relation to an environmental good. While the CV method asks for willingness to pay for specific changes in environmental quality, the CE method asks respondents to rank attributes of the ecosystem service or to choose among alternative scenarios.

Replacement Cost (RC): this method estimates the value of ecosystem services as the cost of replacing them with alternative goods and services. For example, the value of a wetland that acts as a natural reservoir can be estimated as the cost of constructing and operating an artificial reservoir of a similar capacity.

Hedonic Pricing (HP): this method employs existing market data to derive the indirect value of nature, for example by using property values, on the assumption that the price of a property will indirectly reflect any environmental benefits the property enjoys from an ecosystem service.

Avoided Damage (AD): this method uses the cost of actions taken to avoid damage to the system as a measure of the benefits provided by the ecosystem. For example, if a coastal wetland provides protection from inland flooding, the value of the protection afforded may be estimated by the damage to their properties avoided by local residents and government.

Ecosystem-Based Management

The rapid increase in the size and number of MPAs has been accompanied by a similar increase in implementation of marine ecosystem-based management (EBM) measures. In fisheries, for example, EBM focuses on controlling bycatch, protecting critical habitats, and recognizing predator–prey and other ecological relations, within the framework of traditional population-specific fisheries management (McCay and Jones, 2011). However, although fisheries managers may close some areas to fishing either permanently or temporarily, MPAs are still poorly integrated into ecosystem-based fisheries management (Halpern *et al*., 2010).

One reason for resistance to MPAs as a central component of an ecosystem-based fishery may be that they are a relatively new approach, whereas species-specific fisheries management has a long, if not always successful, history. Moreover, decisions about size, site selection, and disturbance levels

within MPAs are technically difficult, particularly given the relatively high degree of variability and complexity in marine ecosystems (McCay and Jones, 2011). For a detailed review and discussion on EBM see Sardá *et al*. (this volume).

Marine Spatial Planning

Marine Spatial Planning (MSP) allows the creation and establishment of a more rational organization of the use of marine space and the interactions between its uses, to balance demands for development with the need to protect the environment, and to achieve social and economic objectives in an open and transparent way (Douvere, 2008; Schachtner, this volume). Marine Spatial Planning operates at multiple spatial and temporal scales, by considering the three-dimensional nature of the sea, and addressing static and dynamic maritime activities from local to regional scales (Gilbert *et al*., 2015). Designation of MPAs is an integral part of MSP and the achievement of ecosystem-based management (Crowder and Norse, 2008). Therefore, when establishing MPAs it is important to know how the spatial regulation of human activities within MPAs will affect marine users (Cárcamo *et al*., 2014). In MPAs, marine uses may be subject to stringent conditions or even totally excluded depending on the location and type of the MPA. The specific location of the MPA determines how marine uses are positively or negatively impacted.

Marine Spatial Planning allows comprehensive analyses of MPAs and MPA networks, which are spatially explicit. Through MSP, it is possible to identify and quantify human activities surrounding an MPA network, to assess the compatibilities among activities and their environmental impacts. In fact, MPA design and consideration in a marine system is inherent to MSP. For MPA and MPA networks, MSP constitutes a framework that can be applied at multiple scales. For example, marine spatial plans can be conducted at local or regional level (i.e. trans-national), and MSP is expected to have much potential after the implementation of the EU Maritime Spatial Planning Directive (2014/89/EU).

DPSIR and DPSWR Environmental Indicator Frameworks

The DPSIR (Drivers–Pressures–State–Impact–Response) environmental indicator framework is a systems-based approach which captures key relationships between society and the environment (Lewison *et al*., 2016), and is regarded as a philosophy for structuring and communicating policy-relevant research about the environment, for example by the European Environment Agency. Recent work on the DPSIR model has improved the framework to incorporate the welfare component of environmental factors, developed under the KNOWSEAS FP7 project (http://www.msfd.eu/). This improvement involves replacing 'Impact' by 'Welfare' in what is known as the DPSWR framework. In this new framework 'Welfare' is measures of changes (the 'costs') to human welfare as a result of State changes, and it thus provides a conceptual model that is a useful starting point for analysing coupled social and ecological systems (Cooper, 2013).

MPAs in the Mediterranean and Black Seas

We now present the evidence on the socioeconomic impacts of MPA networks gathered during the expert workshops for the Mediterranean and Black Seas. The majority of the works cited are ongoing research documents that participants to the workshop were engaged in, and therefore some are not yet published. Some of the working documents were originally in different languages from the Mediterranean basin and the Black

Sea area, and the workshops allowed beneficial exchange of knowledge about work going on in these areas.

Mediterranean Sea

A literature review was conducted during the workshops to collect case studies relating to MPAs in the Mediterranean Sea, and a total of 15 case studies were shared among participants. Most assessed the effects of MPAs on artisanal and commercial fisheries, with a few looking at recreational impacts. There was a clear dearth of studies of impacts on other ecosystem services that affect society, such as regulation services (e.g. climate, storm protection, salinization, carbon sinks). The studies are briefly described below.

1 Economic valuation of five marine and coastal protected areas in the Mediterranean (Plan Bleu, 2012)

Keywords: cost–benefit analysis, Mediterranean, ecosystem services, tourism, net present value

Summary: The study focuses on the valuation of costs and benefits for Mediterranean MPAs linked to ecosystem services, including professional and non-professional fishing, tourism, boating, diving, and carbon capture. The costs comprise the management body budget and the economic activities within, or related to, the MPAs. The case study areas are: Cap de Creus National Park (Spain), Kuriat Islands (Tunisia), Kaş Kekova (Turkey), Zakynthos National Park (Greece) and Mount Chenoua (Algeria). The analysis employs three scenarios of the potential evolution of MPA management: (i) more protection; (ii) less protection; and (iii) no change in management. As a general result they find that tourism accounts for 90% of the benefits of the MPAs. The balance between tourism and fishing seems to be the key to MPA acceptance. The net present value is highest for scenario (i) (increasing protection). However, the lack of information in some of the areas limited a wider analysis in the Mediterranean Sea, including additional locations. Also, the study produces estimates of costs and benefits from existing MPAs, but it was not possible to isolate the benefits of establishing additional MPAs.

2 Effects of habitat on spillover from marine protected areas into artisanal fisheries (Forcada *et al.*, 2009)

Keywords: MPA, artisanal fisheries, habitat connectivity, spillover, Mediterranean Sea

Summary: This is a case study on the effects of MPAs in artisanal fisheries in three marine reserves in the Mediterranean: Tabarca Marine Reserve (Spain), Carry-le-Rouet Marine Reserve (France) and Cerbère-Banyuls Marine Reserve (France). It finds that the spillover effect is localized to specific sectors and that MPAs provide benefits to artisanal fisheries in this case. The authors conclude that spillover effects are not a universal consequence of siting MPAs in temperate waters and depend on the distribution of habitats inside and around the protected spaces.

3 A review of marine protected areas in the north-western Mediterranean region: Siting, usage, zonation and management (Francour *et al.*, 2001)

Keywords: fishing, spear-fishing, MPA impacts, management, enforcement

Summary: This paper reviews MPAs in the north-western Mediterranean. It finds that semi-protected areas where professional fishing is still allowed clearly demonstrate the negative impact of spear-fishing, and the limited impacts from regulated professional activities in fish assemblages. The authors also conclude that the most important factor underlying whether or not an MPA is successful and beneficial is the presence of dedicated staff.

4 Marine protected areas in the Mediterranean Sea: Objectives, effectiveness and monitoring (Fraschetti *et al.*, 2002)

Keywords: effectiveness, research, reserve effect, environmental impacts

Summary: The authors of this study argue that in the Mediterranean Sea the lack of appropriate sampling designs and a proper set of experimental procedures prevent any scientific demonstration of MPA effectiveness. This lack of suitable data may be a result of several factors: field investigations of sub-tidal marine reserves are generally confounded by intrinsic ecological differences between the sites investigated, both inside and outside reserves; site and reserve replication is absent; or no information about the biota was collected before the reserve was established. As a result, the authors recommend the use of experimental procedures widely used for detecting environmental impacts.

5 Designing a network of marine reserves in the Mediterranean Sea with limited socio-economic data (Giakoumi *et al.*, 2011)

Keywords: MSP, Mediterranean, economic costs, MPAs, Natura 2000

Summary: This study identified priority areas for MPAs using spatial prioritization software in the eastern Mediterranean Sea, using different types of available data from visual census surveys (fish species abundance, presence of various habitat types, and percent coverage of seagrasses and canopy algae). This approach can also be applied even if spatially explicit information is limited, through socioeconomic cost indices taking into account fisheries (including information on the location of ports and areas often inaccessible to fishermen due to high wind exposure) and tourism (on the basis of availability of beds for tourists). The paper examined how the spatial priorities for marine reserves varied using different combinations of these socioeconomic cost metrics, and compared the model outcomes with two non-systematic methods, the Natura 2000 proposed marine reserves and sites that local fishermen proposed for protection. In fact, only a few sites identified in the paper coincided with those recommended as part of Natura 2000 or the fishermen's proposals. This suggests that much more work is needed to harmonize the proposals in the paper with the principles of efficient systematic conservation planning.

6 Spillover from six western Mediterranean marine protected areas: Evidence from artisanal fisheries (Goñi *et al.*, 2008)

Keywords: MPAs, spillover effect, artisanal fisheries, catch analysis

Summary: This study investigated the spillover (or biomass export) around six MPAs in the western Mediterranean based on catch and effort data from artisanal fisheries. The selected MPAs were Cerbère-Banyuls and Carry-le-Rouet in France, and Medes, Cabrera, Tabarca and Cabo de Palos in Spain. The authors found evidence of effort concentration and high fish production near closed areas for all fishing gear analysed. The authors concluded that coastal MPAs can be an effective management tool for artisanal fisheries in the region and that this could be extended to the rest of the western Mediterranean, as the fishing gear studied in this region were typical of the entire basin.

7 Potential of marine reserves to cause community-wide changes beyond their boundaries (Guidetti, 2007)

Keywords: spillover effects, fisheries ecology, economic impacts, Torre Guaceto

Summary: This study looked at the impact of marine reserves on fish ecology and their socioeconomic implications. The case study concerned the Torre Guaceto Marine Reserve (Italy). Results suggested that no-take marine reserves can promote community-wide changes beyond their boundaries. The effects on fishing communities may impact the earnings from fishing as there were shifts of target species and sizes, as well as other factors.

8 Mediterranean marine protected areas: Some prominent traits and promising trends (Harmelin, 2000)

Keywords: artisanal fisheries, Mediterranean, gear regulations

Summary: Small-scale artisanal fishing by trammel nets could persist at moderate level without affecting the spectacular replenishment of fish populations in shallow rocky areas when other fishing methods such as trawling and spear-fishing were controlled or banned. This result has a particular social and cultural interest in the Mediterranean context, considering the slow decline of this traditional fishery. The paper argues for a more active integration of professional fishermen in the preparation of new MPA projects.

9 Gradients of abundance and biomass across reserve boundaries in six Mediterranean marine protected areas: Evidence of fish spillover? (Harmelin-Vivien *et al.*, 2008)

Keywords: spillover effect, fish ecology, MPA impacts, ecological impacts

Summary: Six Mediterranean MPAs were analysed in terms of their impact on fish biomass and abundance. The authors found fish spillover from reserves which was beneficial to local fisheries. This spillover effect occurred mostly at a small spatial scale (hundreds of metres). The existence of regular patterns of negative fish biomass gradients from within MPAs to fished areas was consistent with the hypothesis of processes of adult fish biomass spillover from marine reserves, and could be considered as a general pattern in this Mediterranean region.

10 Biological and socioeconomic implications of recreational boat fishing for the management of fishery resources in the marine reserve of Cap de Creus (NW Mediterranean) (Lloret *et al.*, 2008)

Keywords: tourism, MPAs, management, recreational value, recreational fisheries, angling

Summary: This study looked at recreational fisheries in the marine reserve of Cap de Creus (Spain). It found that recreational fisheries had a large effect on the local economy since the majority of fishermen were visitors on holiday in one of the villages belonging to the park, where most of the expenditure related to angling activities was made.

11 The impact of human recreational activities in marine protected areas: What lessons should be learnt in the Mediterranean Sea? (Milazzo *et al.*, 2002)

Keywords: recreation, MPAs, monitoring, tourism

Summary: The paper reviewed the world-wide impacts of recreational activities on marine communities in MPAs and highlighted the gaps in the relevant available literature. These gaps should be filled in order to facilitate research, monitoring and management of MPAs in the Mediterranean Sea. The study analysed the different recreational activities in MPAs that, when intensive, could modify marine communities at a local scale. More effort should be put into understanding the impact of 'marine-based' activities by assessing the habitats that most attract tourists, quantifying the cause–effect relationship between the biological impact and the amount of recreational activity in the MPAs, and, whenever possible, predicting the future impact of recreational activities on spatial and temporal scales to assist the MPA management process.

12 Integrating conservation and development at the National Marine Park of Alonissos, Northern Sporades, Greece (Oikonomou and Dikou, 2008)

Keywords: Greek MPA, preferences, costs and benefits, stakeholder analysis

Summary: The paper analysed the degree of acceptance of the MPA by local stakeholders through time, after its establishment 13 years earlier. The authors used questionnaires to collect stakeholders' views. They found that different groups had different perceptions of the MPA: for example, fishermen perceived costs due to restrictions while recreational companies reported benefits. The study illustrated the need for stakeholder analysis in order to understand perceptions and heterogeneity in the actors involved with and/or affected by an MPA.

13 Uses of ecosystem services provided by MPAs: How much do they impact the local economy? A southern Europe perspective (Roncin *et al.*, 2008)

Keywords: ecosystem services, socioeconomic impacts, recreation, stakeholder analysis

Summary: The paper reviewed 12 case studies in the Mediterranean looking at the main socioeconomic impacts of MPAs. An assessment was carried out, including stakeholder interviews. A variety of situations were identified in the different MPAs, from MPAs where commercial fishing was the major economic stake, to MPAs where recreational activities had a dominant economic role. The second situation was more typical. However, due to the lack of baseline data, the question of distinguishing the 'reserve effect' from the 'site effect' could only be addressed with the help of survey results concerning perceptions and attitudes of users.

14 Long-term and spillover effects of a marine protected area on an exploited fish community (Stobart *et al.*, 2009)

Keywords: spillover effect, MPAs, fishing, benefits, economic impact

Summary: The study analysed the spillover effect for artisanal fisheries in the Columbretes Islands Marine Reserve (Spain). It concluded that the reserve establishment had had a positive effect on the exploitable fish community and that there was evidence of biomass export to the surrounding fishery.

15 Perspectives of economic effects of fisheries exclusion zones: A Sicilian case study (Whitmarsh *et al.*, 2002)

Keywords: marine reserves, fishery reserve, trawl, artisanal fisheries, spillover effects, impacts

Summary: The paper reported the results of a European project investigating the effects of a trawl ban introduced in the Gulf of Castellammare, north-west Sicily, in 1990. The results indicated that the prohibition on trawling led to stock recovery and improved financial returns for the artisanal fishermen who had been permitted to operate within the restricted area. However, there was evidence that the displacement of trawlers to the outer periphery of the exclusion zone had impacted adversely on artisanal operators located immediately outside the trawl ban area.

Black Sea

A total of 15 case study reports and documents were obtained concerning the Black Sea. While for the Mediterranean Sea, studies on MPA impacts are numerous and cover many different areas of research, for the Black Sea scientific publications are scarce and more information can be found in the grey literature. Four of the documents gathered consisted of general background about the current state of fisheries, biodiversity, environment and transboundary diagnostic analysis of pollution in the Black Sea. The remaining 11 contained various levels of information on MPAs and their socioeconomic impacts. From these, three reports were representative of case study areas and are briefly described here.

1 Danube Delta, Romania and Ukraine

The case study of the Danube Delta, an area located at the boundary of Romania and Ukraine, was analysed in some detail. It was a good example of the geopolitical context problems that arise in some MPAs. The paper on boundaries and margins in the Danube Delta (Van Assche *et al.*, 2008) and the decision of the International Court of Justice on the delimitation of the maritime boundary between the two countries in the Black Sea (Zmeiny Island, ICJ Order 2009) detailed these transboundary problems, while the paper on transformations of knowledge/power and governance of the Danube Delta (Van Assche *et al.*, 2011) considered the potential for citizen participation in environmental governance as a possible means for solving these issues in transboundary areas.

2 Vama Veche, Romania

Some participants of the first workshop provided information on the protection and management of MPAs in Romania. They stated that expanding the European ecological network (Natura 2000) in Romania could lead to conflicts between the marine sites and fishery interests, especially at the Vama Veche – 2 Mai Reserve. In order to solve this conflict, they considered that measures should be taken including: (i) the legal control of demersal fisheries in the Romanian coast; (ii) protection of high economic value fish species by taking strong measures to stop illegal fishing and prohibit fishing at certain times of year; (iii) special protection of spawning grounds; (iv) development of fishing regulations; and (v) education/training of fishermen in the proper recording, handling and release techniques for dolphins accidentally caught in fishing gear. In fact, all these measures exacerbated the situation with local fishermen and the situation was resolved not by consensus but by application of law enforcement.

3 Karkinitsky Bay, Ukraine

A case study of Karkinitsky Bay off north-west Crimea (the largest bay in the Black Sea) concerned the socioeconomic impacts of protecting an area for the recovery of the red alga *Phyllophora crispa*. This alga was once harvested for agar and was an important nursery area for fish, both resources having declined since the 1970s. However, new protection measures to restore these resources have potential impacts for navigation as well as gas and mineral extraction which now take place in the bay. Accordingly, the boundaries of the MPA declared in November 2011 had to be drawn to avoid conflicts with these economic activities instead of following the ideal scientific extent (as would be required under EU legislation).

Lessons Learned for MPAs

Participants in the workshops shared their experiences on the implementation of MPAs and MPA networks in the Mediterranean and Black Seas. A main concern shared by all participants – and one that is also evident in the literature – is the level of effectiveness of the MPAs in these regions. This perception revolved around five main issues: (i) the mismatch between regulations and actual implementation and management performance; (ii) the protection level set; (iii) the simplicity of naturalistic approaches as opposed to socioeconomic-ecosystem (network) approaches; (iv) the importance of stakeholder involvement in governance and management from the early design of MPAs; and (v) the lack of resources (including political will) needed to reduce human pressures.

Mismatch between Regulations and Actual Implementation and Management Performance

The role of an MPA is universally recognized and therefore non-negotiable in its essence. However, participants stated that the implementation of the mechanisms and operations of MPAs is difficult; that there are not enough data; and that our knowledge is limited. Participants agreed with the ideas developed by Colloca *et al.* (2015) on no-take zones for nurseries, and the different effects MPAs can have depending on the way they are designed and managed.

A study by Mabile (2007) was proposed to help understand the implications of designing an MPA system in the context of decentralization, with examples from Italy and Spain. It showed that the legislative intervention for the creation of MPAs is a weak procedure which does not facilitate the necessary responsiveness or permit the rapid creation of new sites. This study also highlighted a second aspect: that MPAs are usually limited essentially to a naturalistic approach, which does not favour the acknowledgement of MPAs as a tool for local people, who also usually have no right of participation.

In most Black Sea countries today there exist many conflicts between national legislation, international commitments affecting MPAs, and decisions made about resources that could be exploited in the protected areas. In Ukraine, for example, following the state's nature protection legislation (Law on the Nature Protected Fund 1992), different levels of various activities, including the extraction and use of mineral and biological resources, were allowed in the Zernov's Phyllophora Field (in the central part of the north-western shelf of the Black Sea) and the Small Phyllophora Field (Karkinitsky Bay). However, a 'real' defence of MPAs in Ukraine only began after the introduction of the National Natural Park designation and the establishment of the Institute for Protection of MPAs. After this, in order to promote the formation of a transboundary networks of MPAs, it became necessary to strengthen the protected status of sites across the whole of Ukraine.

Regarding the law, participants believed that analysis cannot be limited to the legal norms alone, as legal standards are worthless if the administrative machinery for their implementation is not put in place. The effectiveness of laws and regulations should be measured in a 'public policies evaluation'. Especially in developing countries, many laws have only been adopted following international pressure (and EU pressure – for example in technical assistance programmes before the integration of eastern countries, and now under the European Neighbourhood and Partnership Instrument); and even after being adopted they have so far had little application. The evaluation of governance effectiveness is an essential aspect of neo-institutional and social science research, but unfortunately we have very few data on governance effectiveness in the case of strengthening environmental laws at national and international level; on different management plans and best practice; and on the development of optimal action plans.

Protection Level

There are still many questions about the different levels and types of protection. It is not clear that the highest category of protection (IUCN Category I, strict nature reserve; Dudley and Hockings, this volume) could guarantee the conservation of biota and habitat diversity in MPAs. Furthermore, national 'Red Data Books' usually comprise just a list of endangered species and their basic biology and status; they seldom provide recommendations for conservation, or for recovery of species and their habitats.

For both artisanal and recreational fisheries there is literature regarding the potential of 'partial MPAs'. These can have some positive aspects, both economic (e.g. reduction of surveillance costs) and social (e.g. fishermen are allowed to fish on some days).

One of the difficulties noted for designing offshore marine reserves with higher protection levels is the cost of surveillance. Widespread use of electronic monitoring, such as the Automatic Identification System or Global Fishing Watch (http://globalfishingwatch.org/), can contribute to reducing the costs of surveillance.

Naturalistic Approaches versus Socioeconomic-Ecosystem (Network) Approaches

The creation of MPAs in the Mediterranean and Black Seas invariably focuses on narrow biological aspects (e.g. presence of legally protected species, Red List species, attractive underwater seascapes or important resource species). However, for networking MPAs, the focus should be on higher biological community levels: this way MPA networks can protect the functions of ecosystems and not just single species (Boero, this volume).

Furthermore, participants generally agreed that to be effective, there should be legal, socioeconomic and functional MPA typologies, rather than typologies based only on biological criteria (Beal *et al*., this volume). On the other hand, the EU Marine Strategy Framework Directive (2008/56/EC) encourages reaching Good Environmental Status through maintaining biodiversity and does not directly address livelihoods (Braun, this volume).

The inclusion of both natural and anthropogenic aspects is believed to be the most cost-effective way of addressing the socioeconomic impacts that MPAs and MPA networks might create. Ways of achieving this goal include stakeholder participation and methodologies such as multi-criteria analysis (Melià, this volume).

Stakeholder Involvement in Governance and Management from the Early Design of MPAs

A decentralized management model for MPAs is an important aspect of MPA effectiveness. However, cost comparisons should be based on MPAs with similar functions (e.g. no-take sanctuaries, regulating fisheries, recreational MPAs, MPAs with a large pelagic area of scientific importance). For instance, let us compare two examples from the French Mediterranean, namely the marine reserve of Banyuls (close to the Spanish border) and the Côte Bleue fisheries reserve (west of Marseille):

Banyuls-sur-Mer is a public institution area of 600 ha, of which 60 ha are no-take (full reserve). Management costs are estimated at €600 000 per year. It attracts a large amount of tourist activity related to diving and an underwater trail. The bulk of the expenses are monitoring, and it provides the data for a public biological laboratory (the costs of which are not included in the management costs given above).

Côte Bleue is a fishery reserve managed by a small fishermen's organization based on a traditional decentralized model: the *Prud'homies de pêcheurs*. It extends over 10 000 ha with 30 ha of no-take. This reserve was first established to protect the area against fishing trawlers coming from Marseille. The annual monitoring costs are estimated at €150 000, with the monitoring performed by professional fishermen (although they have difficulty with tracking navigation and recording recreational fishing).

These two cases are interesting because: (i) the functions are different – recreation and scientific purposes on the one hand, and responding to fisheries management and protection against larger scale fishing on the other; (ii) the legal framework for management is different: Banyuls has a bureaucratic, scientific and 'fonctionnarisée' administration by the district, while the Côte Bleue is a decentralized, empirical community; and (iii) the cost/area ratio is very high in Banyuls and low in the Côte Bleue. To be effective, therefore, we should have legal, socioeconomic and functional MPA typologies in addition to biological criteria.

A participatory process is needed for the establishment or extension of some MPAs, because without involving interest groups or

specific users and local decision-making, it is likely these small economic structures will disappear.

Researchers with experience as custodians of marine reserves were aware that is very important to strengthen the legal framework. However, they considered that it was just as necessary to involve the stakeholders in the process of the management – to have participatory management. It is essential to take a structured approach that fully involves and engages the key (or primary) stakeholders (i.e. those whose livelihoods directly depend on the area, have ownership of it, or who have a statutory role in managing it). The preparation of a management plan is a good way of doing this, bearing in mind that the process of preparation is as important as the final result. How the management plan finally resolves the conflicts and is implemented depends on the legislation, political will, finance, and scientific and management expertise available.

Lack of Resources (Including Political Will) Needed to Reduce Human Pressures

Marine and coastal biodiversity is under increasing stress from intense human pressures, including rapid coastal population growth and development, over-exploitation of commercial and recreational resources, loss of habitat, and land-based sources of pollution. Marine Protected Areas are probably not the best instrument to address the impact of pollution and perturbations; other policies and institutions – such as urban policies, integrated coastal zone management, industrial policies, and investment in environmental protection measures – are better suited to protect the sea from these. However, the management level at which these policies and instruments are decided might not be sufficient for tackling these problems.

Apart from anthropogenic pressures, MPAs are also subject to the influence of natural environmental factors, making it difficult to separate the influence of environmental and anthropogenic factors when determining the source of effects on an MPA. A good example is the shallow-water Black Sea shelf in Ukraine, where two MPAs exist (the Zernov Phyllophora and the Small Phyllophora fields). These areas are under huge anthropogenic pressures (including freshwater inflow from coastal rice-irrigation schemes, sand and gas extraction, shipping, tourism, fisheries and military activities), whilst also being subject to natural geomorphological processes (such as huge sediment inputs from the Danube, Dniester and Dnepr rivers) that significantly influence benthic and pelagic communities, as well as building new areas of habitat.

Thus, improved research and monitoring techniques, as well as ex-ante analysis, are needed to gain a better understanding of the true scale of human impacts and damage to MPA ecosystems in order to argue for the resources needed to address them.

It has been stated that problems related to MPAs can be solved through targeted legislative instruments that must be strictly applied in protected areas. However, in Romania, for example, there is considerable nature protection legislation but it can easily be ignored, especially due to lack of involvement of local authorities. Furthermore, while a management plan is essential for an MPA, financial resources are also very important to put the conservation measures into practice. We should stimulate the decision processes and decision-makers in order to find those resources.

Concluding Remarks

We have provided an overview of recent trends in socioeconomic research on impacts of MPAs in the Mediterranean and Black Seas. We have collated and presented information provided by expert participants to a series of workshops in the EU

CoCoNet project, together with a review of published literature and unpublished documents provided by the participants. From the discussions in these forums and careful analysis of the materials exchanged, we have distilled some key messages and lessons learned for future MPA management. The main message is to consider the socioeconomic dimension of MPA creation and management in the areas concerned. These impacts will vary in magnitude and effect depending on the area and socioeconomic activity involved, as well as on the MPA purpose(s) and design. We have illustrated how different conceptual frameworks, such as ecosystem services or the social-ecological systems framework, can help to elucidate the complex relationships between the ecological and the social systems. We have also provided a review of the state of the art of current approaches to MPA management, including Marine Spatial Planning, stakeholder analysis, ecosystem-based management, and the DPSIR environmental indicator framework. We have summarized evidence arising from case studies of MPAs in the Mediterranean and Black Seas that resulted from the exchange of materials during the workshops, as a way of illustrating success stories. Finally, we provided a discussion on the main requisites for successful MPA management in these regions.

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