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Marine protected area governance: Prospects for co-management in the European Mediterranean

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Marine protected areas (MPAs) raise serious challenges in terms of their governance. By applying a participatory approach co-management can help in overcoming many of the deficiencies of top-down management processes. Yet, despite benefits of co-management, it is still found to be the exception in the Mediterranean. This paper provides a review of co-management and the prospects for decentralisation in the European Mediterranean. The role of social capital (SC) in co-management is discussed and a framework for SC and participation to attain effective co-management is proposed.

Keywords: marine protected areas; co-management; participation; social capital; governance

1. Introduction

Marine protected areas are the most widely promoted tool and policy solution to address the well-documented problems of marine habitat degradation and overfishing [1]. Recent statistics indicate a quadrupling of marine protected area (MPA) coverage over the last 10 years, with current estimates putting the number of MPAs at almost 7500 worldwide [2]. However, marine environments are highly complex and MPAs are found to vary significantly in their effectiveness, generating considerable controversy over how they should be governed [3–6].

Conventional forms of governance take a mostly 'top-down' approach i.e. management decisions are made by national or regional authorities or other local institutions. Such approaches are limited in their effectiveness since they are characterised by centralisation, bureaucracy, scientific elitism and a sense of public responsibility [7]. The failure of top-down modes of governance to sustainably manage marine resources has called for alternative approaches to be sought. Co-management, which refers to the sharing of management responsibility and authority between the state and stakeholders, has become one of the most advocated alternatives [8]. Co-management is seen as a way to overcome many of the failings of conventional modes of governance as it increases the legitimacy, transparency and accountability of resource management through increased stakeholder participation [9]. However, co-management is also a complex and dynamic process requiring a significant level of participation.

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One way of considering the nature and effectiveness of participatory approaches is through the concept of 'social capital' (SC). Definitions of SC vary but most describe connections between actors and the shared values and other resources that arise from those networks. The SC perspective offers a framework to propose interventions and increase participation that leads to effective co-management.

The review is structured as follows: section two explains the concept of co-management, and section three explores the possibility to move from a top-down mode of governance to co-management in the European Mediterranean. The paper uses examples from fisheries management to illustrate the potential for co-management in MPAs, which strongly reflects the existing literature. However, much of the discussion is also applicable to the management of other natural resources, and will be addressed in our forthcoming publications. In section four the role of SC in co-management is discussed and a framework to enhance participation and SC in MPAs is proposed. In the final discussion section, three recommendations are made to encourage the shift to co-management in the Mediterranean.

2. Marine protected area governance: co-management

Co-management practices applied to natural resources have existed for centuries [9], yet the concept only originated and started gaining popularity in the literature in the 1970s [10]. The emergence of co-management can be deemed as a response to three conceptual shifts in ecology and applied ecology thinking: a switch from a reductionism to a systems view of the world, a shift to include humans in the ecosystem, and acknowledgment of the need to move from an expert-based approach to participatory modes of conservation and management [11–13]. As a consequence, stakeholder participation has become ubiquitous, the literature on co-management is rich, and there is abundant evidence on the introduction of co-management worldwide [14–16].

Jentoft [9] defines co-management to be a 'collaborative and participatory process of regulatory decision-making between representatives of user-groups, government agencies, research institutions, and other stakeholders.' Co-management as a term is widely used and encompasses several possible arrangements that vary in terms of the degree of responsibility and consequent balance of power between top-down and bottom-up elements [3,16,17]. The complexity of these arrangements emphasises the lack of a single clear blueprint for co-management [15].

Co-management advocates refer to both ethical and practical reasons for increased participation in resource management [14]. Those focusing more on the ethical arguments point to the need for people to have the right to a say in decisions that may deeply affect their lives and livelihood [14]; and that participation is seen as a tool for empowerment [18,19] and a method to reinforce self-esteem [20]. More practical reasons put forward for participation in both decision-making and investments are that it strengthens resource users commitments to outcomes [14]; enhances the legitimacy of management [21,22]; promotes transparency and accountability in decision-making [23]; increases SC [24,25]; encourages greater compliance with rules [22]; provides a forum for conflict management [26]; elicits a more extensive knowledge base for decisions [27,28]; and fosters a greater awareness of environmental issues [19,27].

However, some authors point out that co-management cannot solve all marine resource management problems, rather it should be seen as a process within which solutions are likely to emerge [29–31]. Furthermore, given the difficulty in defining co-management there is an inherent risk that the term can be used to label processes and

Table 1. Five degrees of participation, adapted from Luyet *et al*. [32].

Term	Degree of stakeholder participation
Information	Explanation to the stakeholders
Consultation	Presentation to the stakeholders and collection of stakeholder suggestions. Decision-making takes place with or without taking into account stakeholders input.
Collaboration	Presentation to the stakeholders and collection of their suggestions. Decision-making, takes into account stakeholders input.
Co-decision	Cooperation with stakeholders towards an agreement for solution and implementation
Empowerment	Delegation of decision-making power to stakeholders

management strategies which strictly do not include the fundamental aspects of co-management i.e. partnership and power sharing [9]. Pinkerton [10] argues that over the years the term co-management has become so broad that 'it risks losing important aspects of its original thrust.' The use of broad categorisations raises questions as to whether all user participation equals co-management. Luyet *et al*. [32] define five degrees of participation (Table 1). For participation to be authentic it requires the state (and other outside agents) to allow stakeholders the dignity of true partnership [9]. Hara and Nielsen [33] state: 'unless users are genuinely allowed and empowered to participate in the setting of management objectives on equal terms with government, co-management cannot really be considered as a serious institutional innovation.' For co-management to be real, power sharing is essential. Jentoft [30] therefore suggests that co-management requires an element of legal recognition to ensure respect for the boundaries of responsibility within co-management arrangements. However, this view contrasts with that of other authors who posit that co-management represents a less legalistic approach to resource governance [34].

Perhaps the most challenging and contentious design principle for co-management, relates to the issue of representation: who should be eligible to participate, and the degree to which those who claim to have a stake in the resource should have a say in how it is managed [20,24,35]. A stakeholder is defined as 'any individual, group, organization or sector in society that has a clearly identifiable interest in the outcome of a policy or decision-making process' [36]. In practice, the list of stakeholders could therefore be substantial, but given the need for efficient decision-making, participation must be limited [35]. Yet not all stakeholders have an equal stake and consequently, some may have more to lose than others when MPAs are implemented [6]. In fisheries management it is generally accepted that user groups (fishers, fish processors, traders) should be involved in management. The controversial issue put forward by several authors is who else should participate [18,20,24,35]. In reality, who participates is often a matter of power. Those whose lives are most dependent on the resources are often the stakeholders with the least power and therefore marginalised [9]. This inequity must be addressed with the design of truly democratic co-management systems. The framework proposed by Luyet *et al.* [32] for stakeholder participation, goes some way to address this issue by including a step for defining a different degree of involvement for each stakeholder identified. However, the process is not standardised and is extremely subjective. As such more democratic and systematic methods must be designed [32]. Furthermore, participation has been criticised for failing to recognise the complexities found in interactions between communities and the state [9]. States and communities are not homogenous units and often multiple local

interests and multiple governance agencies are at play [31]. Communities are often characterised by social fissures, conflicts, inequities, and power-differentials which can be reinforced by co-management [24]. There is also a suggestion that authentic participation is rarely achieved, but rather participatory mechanisms are manipulated to ensure support for projects, policies and management plans [37]. However, despite these problems participatory processes and co-management in particular still holds much promise when compared to other governance systems [9].

Evidence for co-management success is seen by Bown *et al*. [3] to be a matter of controversy due to the ambiguity and sparseness of relevant information [3,38,39]. This could be blamed on the broad definition and ad-hoc use of the term co-management. For example, Pretty and Smith [40] indicate the term has 'been used to justify the extension of control of the state as well as to build local capacity and self-reliance; it has been used to justify external decisions as well as to devolve power and decision making away from external agencies.' Yet there are several authors who claim that co-management has had positive socio-economic and ecological effects [16,27,41].

According to the literature, the coincidence of several factors helps stimulate a shift towards co-management and determines its success. For example, a resource crisis often acts as a catalyst for communities to engage in co-management [15,26,27]. An external agent or policy entrepreneur is reported by many to help expedite the co-management process, as well as the need for local leaders to set an example and provide the energy and direction needed [19,21,27,42]. A willingness to try new approaches is also likely to be a key determinant of success since a shift to co-management often requires a change in the mind-set of stakeholders and government officials [16,20]. Although this may take some time, such changes are necessary to generate the political will and stakeholder commitment needed to support the co-management process [29], both initially and in the long-term [43]. One of the major lessons learned from the early community-based projects is that the role of the government is crucial to address external disturbances, e.g. market failures, that might otherwise hinder a successful co-management approach. This leads many to claim that co-management should have a legislative basis [5,16,30,44–46]. Others emphasise the need for long term financial support for planning, implementation, coordination, monitoring and enforcement [16,27,42]. Consequently, co-management can take a decade or longer to become established [19,21,23,29,47]. Furthermore, it cannot be considered suitable for every situation [9,19]. In particular, where many of the above factors are not present, co-management may not be feasible [21]. In the following section we explore the possibility for a move away from top-down management in the Mediterranean.

3. The possibility for decentralised governance in the European Mediterranean

3.1 Marine resource management and protection in the European Mediterranean

In general, the protection of natural resources in the European Mediterranean is implemented within the highly centralised and state-controlled EU legal framework [48]. The legal tools under EU law, namely directives and regulations that are of particular interest to resource management in this region, include: the Convention of Biological Diversity (CBD – Barcelona Convention), the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol, 1995); Marine Strategy Framework Directive (MSFD, 2008/56/EC); Natura 2000 network, issued from the Habitats (92/43/EEC) and Bird (79/409/EEC) Directives; the Common Fisheries Policy (CFP,

involved in a reform process); and a recently proposed Integrated Coastal Zone Management Directive (ICZM Memo/13/210) [48–50].

The CFP was created in 1983, and is often criticised for being too top-down, unilateral and remote, with fishers expressing particular dissatisfaction [48,49]. Despite a major reform to the CFP in 2002 (Council Regulation (EC) No 2371/2002), no significant changes were made to its structure, and the promise for increased participation (art.2.c) has been rhetorical rather than real [49]. Proposed changes to the CFP in 2013 promise greater decentralisation through regionalisation. However, regionalisation does not equal co-management, because although decisions are made at a lower bureaucratic level this does not ensure that stakeholders are or will be included [51].

The implementation of the 'Birds' and 'Habitats' Directives have made some progress in biodiversity conservation and spurred the development of an extensive network of terrestrial, coastal and MPAs, commonly known as the Natura 2000 network (including 'Natura 2000 at sea' developed since 2010). The MSFD represents an ecosystem-based approach to marine management and governance, aiming at achieving 'good environmental status'. The MSFD furthers the commitment to designate a network of MPAs across Europe, as Member States are required to implement spatial protection measures that contribute to 'coherent and representative networks of marine protected areas (MPAs)' (Article 13 Programme of Measures) [50]. The most recent proposal (ICZM) takes the form of a draft directive that aims to establish a framework for maritime spatial planning and integrated coastal management in EU member states. Its objective is to promote sustainable marine and coastal development and sustainable use of marine resources. It is suggested that the ICZM directive will further aid the implementation of the already existing marine directives [52]. However, as directives, their implementation and success is reliant upon the legal instruments (e.g. laws, decrees, orders) of the Member States. The current management of the Natura 2000 network is questionable [53] and the continued failure to adequately address resource management, sustainability issues, and fishers' dissatisfaction, with current management strategies in Europe [49], suggests that other modes of governance might be more appropriate for successful fisheries and biodiversity management in the region [44,48].

3.2 Marine protected area co-management: a viable option in the European Mediterranean

MPAs are promoted as a key ecosystem and fisheries management tool, yet their history in the Mediterranean is fairly recent [54]. In the Mediterranean, the term MPA covers a wide variety of arrangements, that can differ as much in their oceanographic and ecological contexts as they do in practical use [55]. In 2012, 668 MPAs were recorded in the Mediterranean, of which 23 have been established since 2008. However, in a study of 80 existing MPAs only half had a management plan and 75% of the Natura 2000 sites had no identified full time manager [53]. These findings question the legitimacy of assigning areas as protected with no management plan. So called 'paper parks', present a high risk of failure and redundancy. In such circumstances, stakeholders can quickly lose faith in the MPA and may stop supporting this management strategy [6]. If the MPA strategy fails to deliver what is promised, communities' trust in management authorities, scientists and NGOs, may be seriously damaged. In this context, developing co-management strategies in the Mediterranean could be a good approach to address the deficit in management plans; increase the legitimacy of management [9,21]; increase transparency and accountability [23]; and crucially, empower resource users through participation [18].

At present the management of MPAs in the European Mediterranean is generally conducted in a top-down manner [35]. For example, in France and Spain, decisions regarding the establishment of MPAs (and fisheries regulations, in general) are made by the national and regional government and comply with EU-level directives [35,54]. Management can also include devolved arrangements with regional authorities or other local institutions (i.e. councils and provinces), as is the case with some MPAs in Italy and Spain [48,54]. There are also a few examples of Mediterranean MPAs that are managed by non-governmental organisations (NGOs), e.g. Ses Negres, and some Spanish MPAs are managed by a combination of national and regional authorities, e.g. Tabarca [54]. User consultation appears to be the norm in many Mediterranean countries [56]. In France, for example, management decisions are based on extensive consultations between the state and organisations that represent the majority of French fishermen [35,48,55]. However, despite consultation being widespread, evidence for real delegation of decision-making power to user groups is virtually non-existent [35,48]. Co-management therefore seems to be the exception rather than the rule in this region [35,48].

A principal problem for MPA management reported in the European Mediterranean arises from conflicts over regulations and restrictions. It is reported that any changes made to regulations are 'almost always opposed by small-scale fishermen' [55]. In response, Francour *et al.* [55] propose that conflict management within any future MPA should be determined by the extent of preliminary consultations with all users of the area to be protected. However, in many instances, conflicts triggered by management are cultural rather than interest driven [9]. The pre-implementation phase of MPA development is clearly crucial to ensuring its acceptance. However stakeholder consultation is generally deemed insufficient and increased efforts are required to encourage authentic participation at every stage of MPA designation to help understand communities' cultural and social values [6,9,57]. Given the extensive list of benefits associated with co-management, such arrangements could go some way to resolving many of the challenges reported for MPA management in the Mediterranean [55], for instance through enabling a smoother dispute settlement process [58], ensuring greater compliance with the rules and reducing the need for extensive surveillance [59].

Examples from outside of the region [16,44] indicate that the involvement of user groups, stakeholders and communities in MPA planning and implementation can help improve and sustain good management practices. Torre Guaceto (Italy, Adriatic Sea) provides an example of successful co-management that demonstrates a strong collaboration between fishermen, MPA staff and scientists, the results of which are improved resource use and higher catches recorded within the MPA [60]. For such partnerships to develop, the existence of relevant institutions and organisations has been found to be highly beneficial [26]. The French and Spanish Mediterranean are interesting in terms of stakeholder participation because of the existence of specific institutions representing fishing communities, e.g. *prud'homies* and *cofradías*.

The *prud'homies* in the French Mediterranean have existed since the fourteenth century, and enforce EU and national laws as well as specific regulations set out by the institutions themselves. As representative bodies covering clearly defined areas, they have the right to issue sanctions to their own members, but not to members of other *prud'homies*. However, the ability to apply local regulations is often undermined by the hierarchical framework and complex legal system, within which the *prud'homies* exist [48], weakening their potential role as institutions within a co-management arrangement.

The Spanish fishing guilds – *cofradías* – are recognised by law [27,48] and therefore offer a more assured form of decentralisation in fisheries and MPA management.

Cofradías are local non-profit corporations with public rights, which represent the interests of the whole fishing sector by acting 'as consultative and cooperative bodies for the administration, undertaking economic, administrative and commercial management tasks and with the ability to cooperate in matters of regulating access to the resources and informing over infractions occurring in their territory' [61,62] *Cofradías* as consultative bodies may propose specific regulations to the administration (e.g. regulations for gears), develop activities of management (such as paperwork for fishers) and also manage the first sale of catches. In the case of *cofradías*, certain tasks are delegated to a lower level and users participate actively in decision-making, including decisions on MPA design and implementation [27,35,62].

The existence of institutions such as *prud'homies and cofradías* in the European Mediterranean should be viewed as a good opportunity to help encourage the shift towards a more decentralised form of governance in this region. *Cofradías* have already played an important role in the implementation of MPAs in Spain [62], for example, La Restinga-Canary Islands [63], Lira- Galicia [27], and L'Estartit, and Medes Islands- Catalonia [64] Furthermore, the successful move towards co-management in the sand eel fishery in Catalonia, initiated by fishermen, and representatives of *cofradías* and fishermen's federations highlights the important role of these institutions and that co-management in the Mediterranean is possible [65]. In France, collaborative working arrangements between the regional authorities and *prud'homies,* such as Corsica and Port Cros National Park [66], can also be used as case studies to highlight that bottom-up forms of management are, and can be viable within the European Mediterranean [48].

Notwithstanding the highly centralised structure of the present system, there are several opportunities for moving towards more participative and convergent approaches in the European Mediterranean. Ostrom *et al*. highlight that institutional diversity is imperative, 'and may be as important as biological diversity for our long-term survival' [67]. This emphasises the need to strengthen and modify existing organisations making them more appropriate to co-management, and encourage the creation of other suitable institutions [48,56]. National policy and institutional reforms will also be required to provide the necessary legislation to make the decentralisation process possible and operational, and to establish functional co-management arrangements between government and stakeholders [48]. However, engaging communities in MPA management takes time and requires extensive social preparation and community organisation even prior to establishment. It is here where the concept of SC can be useful in providing a methodological framework, which can help identify where institutional reform is necessary and encourage a shift to co-management.

4. The role of social capital in MPA co-management

4.1 The concept of social capital

Previous sections have illustrated that authentic participation in natural resource management is rare despite the benefits of increased equity, empowerment, commitment and involvement that develop as a result of such processes [5,22,27,68–70]. It is therefore essential to understand why authentic participation is so hard to achieve, and what factors hinder the use of participatory processes and therefore restrict co-management. From the literature it is clear that two main factors are highly influential: power and resources. Participation entails sharing information, decision-making and responsibilities (including capabilities and financial resources), and ultimately leads to the sharing of power.

Co-management is therefore not necessarily an easy sell. For example, governments may not want to devolve authority, and resource users may not want to take on more responsibility [57]. The implementation of participatory processes requires overcoming a strong resistance to change and is therefore not only a technical matter but is also related to social and psychological aspects. The concept of SC provides an interdisciplinary framework to enable an in-depth assessment of the causes, consequences and policy implications that may limit participation.

Several different definitions of SC can be found in the literature. Putnam [71], describes SC as social networks and reciprocal norms based on trust that vary systematically in time and space. For Woolcock [72], SC refers to norms and networks that facilitate collective action. This means that individuals and institutions can, through their relationships, share information, knowledge, values and material resources, which positively affect results, profits and wellbeing. Ahn and Ostrom [73] define SC as 'a set of prescriptions, values, and relationships created by individuals in the past that can be drawn on in the present and future to facilitate overcoming social dilemmas.' All the authors agree that SC is a resource emerging from the social network, and actors can use it wisely to achieve individual or collective objectives.

SC can help explain how people with rich social relationships feel more satisfied and achieve better results than those who are more isolated [74–78]. Research has found that individuals and households with higher SC and thus greater connectedness have improved social and economic wellbeing [79–87]. At both the community and institutional level the existence of internal and external good quality relationships can enhance efficiency[1]. Literature on natural resource management has emphasised the positive role of SC for sustainability since high SC makes it less likely that community members engage in activities that cause resource and environmental degradation, with positive consequences for sustainability [85,88,89]. SC is recognised to be central to participatory forms of resource management as it increases the likelihood of resource users becoming self-organised and having confidence to invest in collective activities, knowing that others will do so too [85].

Figure 1 illustrates the three features of SC that are particularly important to sustainable development and co-management: connectedness in networks; common rules, norms and sanctions; and relations of trust [85]. Three types of connectedness have been defined: bonding, bridging and linking [72]. Bonding capital exists *within* subgroups, whereas

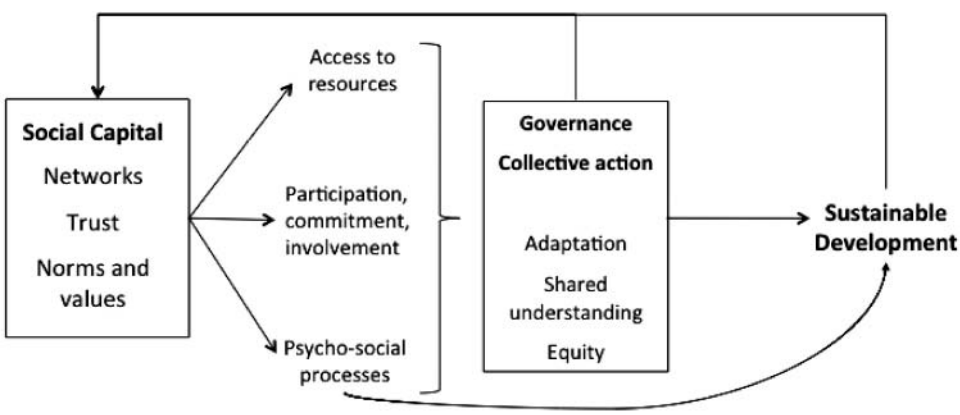

Figure 1. Social capital and its role in co-management and sustainable development.

bridging exists *between* subgroups. Linking is an extension of bridging, involving vertical ties between groups at different hierarchical levels [72]. Common rules, norms and sanctions are recognised drivers of human behaviour and ensure that group interests are complementary with those of individuals [25]. Sanctions ensure those who break rules will be appropriately punished and provide the internal morality of a social system [25,90]. Relations of trust determine the quality of interactions and encourage cooperation as well as reducing transaction costs [85]. These three fundamental features of SC benefit individuals, social groups, institutions and organisations by providing access to resources (e.g. local knowledge, financial resources, information); increasing confidence within the community; facilitating participation; increasing the engagement and involvement of stakeholders in common management; and generating positive psychosocial effects. Evidence suggests that such psychosocial effects can also directly enhance sustainability through reducing conflicts, increasing equity and engendering shared understanding [77,91–93].

Where SC is lacking, it can be developed and modified from both a structural and a cognitive perspective. Improvements to structural SC relate to changes to a network's structure or features, including the rules that govern it [94]. Cognitive SC refers to the shared norms, values, attitudes and beliefs that predispose people towards collective action [94]. Cognitive SC can be improved by building trust and developing norms that help change values and behaviours that reduce conflicts. These modifications can lead to significant institutional and social changes, increasing a society's capability to self-organise and set collective objectives.

Despite the positive benefits it can bring, some aspects of SC can present challenges for co-management. Wilson [95] suggests that co-management arrangements may not be able to rely on shared norms as communities and states are complex and stakeholders often have different backgrounds, interests, world-views, and agendas, which are too different for them to feel committed to the same norms. Wilson [95] therefore suggests that working towards a goal of shared understanding is of much greater importance. Social cohesion can facilitate shared understanding but, for this to happen, rich and varied communication among all stakeholders is essential [95]. Furthermore, sustainable development requires that all involved stakeholders adopt a long term perspective and better understand the complex and dynamic relationships between society and nature [25,26,70,85,89]. In addition, to invest their time in collective activities, people must be convinced that the benefits derived from collective approaches outweigh those derived solely from individual ones [40]. External management agencies must also be convinced that investments to develop SC will produce sufficient benefits to exceed the considerable costs required to establish SC [96].

It is also worth noting that SC can be used in a way that is harmful to some individuals, groups or even the whole community [71]. Several authors have highlighted the possible negative effects of bonding SC, as it can perpetuate counterproductive habits or relationships that are harmful to third parties [97,98]. A community may be well-organised and may have strong institutions and reciprocal mechanisms suggesting high levels of SC, but rather than being based on trust, it could be based on fear and power [99]. Furthermore, associations may encourage conformity, and perpetuate adversity and inequity, enabling certain individuals to get others to act in a way that is only suited to themselves [100]. Awareness of the potential negative aspects of SC is essential and provides an even greater reason to assess SC in order to better understand which forms of social organisation are structurally suited for natural resource management [40].

4.2 A social capital framework for effective MPA co-management

The proposed framework, presented in Figure 2, is structured as a system of steps (outcomes), which employ various techniques (processes/tools). To implement such a system, stakeholders must be identified and SC assessed. Participatory tools must then be chosen and implemented according to the outcomes of step 1. The idea is that SC can be strengthened and harnessed using parallel and varying techniques. Finally, the outcomes from each step must be evaluated. The following sections describe each step of the framework in detail.

Step 1: Analysis of SC

Consideration of SC is imperative for building understanding of the social context since both network structures and features can act to determine the performance and outcome of co-management arrangements [101–105]. An increased understanding of SC and the underlying structural characteristics that determine networks can therefore also improve our awareness of the barriers that potentially prevent collective action and mitigate these risks. It can also facilitate the design and use of appropriate interventions to improve SC (see step 2). Despite this, application of the SC concept to real life examples of natural resource management has been limited. Key issues to consider when conducting SC analysis include timing, which entities to engage with, and measurement techniques.

a. Timing. Early consideration of SC is important in assessing MPA management effectiveness or implementing a new MPA, since early stakeholder interactions can shape

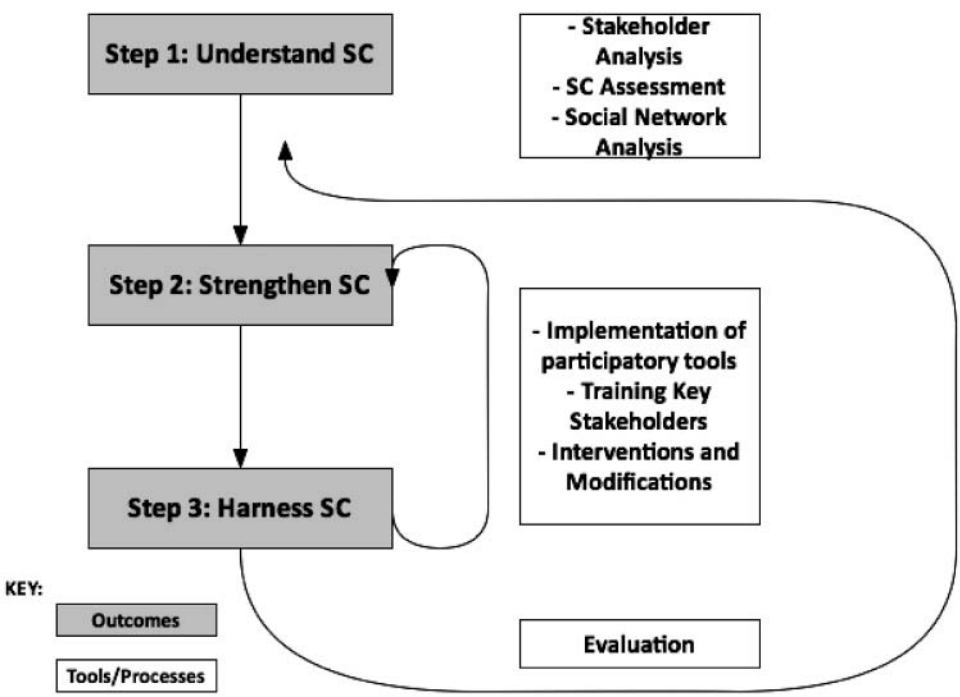

Figure 2. Social capital framework.

subsequent MPA success [6,62]. Case studies have demonstrated that MPA proposals are not only at risk from power struggles between stakeholders but also political issues that extend far beyond the MPA itself. As such, MPAs are not just a technical management measure, but a socio-political enterprise and require in-depth institutional and social analysis prior to implementation [6]. Understanding existing institutions (both formal and informal) avoids contradictions between laws, policies and norms [106], and allows identification of strengths and weaknesses, which must be addressed. It can also identify gaps in the institutional framework that can be filled. Social analysis is needed to understand social bonds, relations of trust, and the incentives, needs and demands of communities.

b. Which entities to engage with. Who initiates the MPA and how the pre-implementation phase is managed is critical as it can have a direct impact on participation and the degree of stakeholder involvement. It can also influence stakeholders' perceptions of the MPA, and consequently their support [62]. Co-management arrangements for MPAs can be initiated and promoted by external agents (e.g. the State, NGOs, scientific institutions) or by the community (e.g. local community groups, local leaders). In general, external agents drive MPA implementation, and the introduction of laws (such as Natura 2000), that require increased protection of marine resources. External agents and community leaders play a key role in co-management arrangements, and their actions have direct consequences on the level of stakeholder commitment to the MPA [6,62]. For example external agents often act as intermediaries between resource users and government and provide logistical support, financial aid, training, knowledge and impartiality [107]. To analyse SC and facilitate participation, the engagement of these external agents and community leaders is required.

A key technique for identifying the entities relevant for analysis of SC is Stakeholder Analysis (SA). Since its inception [108], SA has evolved to become one of the principle participatory techniques used in a wide variety of disciplines [109–111]. In the context of MPA management, the purpose of SA is to identify groups that affect or are affected by the MPA (e.g. fishing sector, tourism sector, public sector, researchers, NGOs, companies, etc.) and 'prioritise these individuals and groups for involvement in the decision-making process' [110]. There are a variety of methods for identifying relevant stakeholders to include in a comprehensive SA [32,110]. This stage is critical as participation relies on the integration of all stakeholders, and the failure to identify some of them may create a bias in subsequent stages. The omission of some stakeholders in an initial SA also opens up the possibility of them appearing at a later stage and possibly having negative impacts on the project [32]. Sound and thorough SA is therefore a central process in authentic participation and co-management.

c. Measurement techniques. One of the primary difficulties with operationalising SC is measuring it. The complexity of SC requires the consideration of diverse aspects and the unit of analysis for SC can vary from the individual [112] to the group or even a whole country [113]. The measurement and effects of SC have been assessed by combining both qualitative and quantitative techniques [114,115]. Jones and Woolcock [115] propose to assess SC at the household or community-level using six dimensions: groups and networks; trust and solidarity; collective action and cooperation; information and communication; social cohesion and inclusion; and empowerment and political action.

In fact, SC can be assessed through a variety of participatory tools and methods with varying degrees of involvement (Table 2), the use of which can positively feedback and reinforce SC. Social Network Analysis (SNA) is one such methodology, which

Table 2. Participation techniques with their degree of involvement, adapted from Luyet *et al*. [32].

Participation technique	Information	Consultation	Collaboration	Co-decision	Empowerment
Newsletter	X				
Reports	X				
Stakeholder Analysis		X			
Presentations, public hearings	X	X	X		
Internet webpage	X	X			
Interviews, questionnaires, surveys	X	X	X		
Field visit and interaction	X	X	X		
Workshop		X	X	X	X
Participatory mapping			X	X	X
Focus groups			X	X	X
Venn diagrams		X		X	
Bridge model				X	X
Citizen jury			X	X	X
Geospatial/decision support system	X		X	X	
Cognitive map	X		X		
Role playing			X	X	X
Multi-criteria analysis			X	X	
Scenario analysis		X	X	X	X
Consensus conference		X	X	X	X

encompasses a range of methods and models and which can be used to measure and study actors in a social network and their relational ties [116,117]. Actors (centrality) and network characteristics (e.g. size, density, modularity, cohesion, structure) can be analysed quantitatively by applying SNA techniques. The information obtained is also useful for SA, as it provides not only the identification of actors and/or groups but also interactions, relational ties and network position. These patterns, referred to as the structural characteristics of a network, effect social processes such as transmission of knowledge and information, consensus-building and power relations [118].

Step 2: Facilitate improvements in the quality of SC

Being social phenomena, SC and social networks are adaptive. This can be advantageous as it allows the stock of SC to be improved and networks to be strengthened and modified to increase their worth. Modifications to SC that encourage effective co-management require the use of diverse techniques that can alter both structural and cognitive aspects of SC. Network intervention 'describes the process of using social network data to accelerate behaviour change or improve organizational performance' [119].

To modify cognitive SC it is necessary to influence perceptions of support, trust, reciprocity and cooperation and, as such, requires a significant degree of time and commitment. Natural capital can be improved in the short term with no real consideration being paid to the community, through the introduction of regulations and economic incentives. These can play an important role in encouraging changes in behaviour. However the failure to modify cognitive SC means people will often revert back to old ways when incentives end or regulations are no longer enforced [40]. In an MPA setting this failure would

have significant consequences for the long-term protection of marine resources [40]. The role of facilitators and leaders is paramount to modify cognitive SC. Facilitators and leaders can drive more frequent contacts between stakeholders by stimulating informal participation within and between organisations and associations [120]. These individuals need to encourage a fair, equal, and transparent process that promotes equity, learning, trust and respect among stakeholders and the administration [121].

Education provides one of the most direct methods for generating SC, because educational institutions at all levels transfer SC through social rules and norms [122]. Learning groups provide a method to increase capacities and accelerate the diffusion of innovations. Evidence has shown that people are particularly receptive to equals and peers [123] hence interactions and relational ties are very important to the learning process [124]. SNA can aid the design of learning groups through the identification of leaders and learning-communities. These leaders play a key role by instilling trust in the knowledge and information shared as they are regarded by learning group participants as both an equal and a trustworthy individual. To facilitate the learning process leaders should be provided with the appropriate training (e.g. on sustainability, opportunities to improve wellbeing, development, etc.) and direct experience and knowledge of successful MPA management, the problems faced, and solutions available.

The changes to cognitive SC can impact structural SC by increasing or changing relational ties (bonding SC), thus altering community cohesion. According to Burt [125] networks rich in SC have more linkages between members (cohesion) and more strategic links with the members of other networks (bridging SC). Participation in learning groups and community exchange experiences (for example fisher-fisher visits to, or from, MPAs with successful co-management) encourage horizontal relationships (bridging SC) and are an important participatory and network intervention strategy. Network interventions can also improve relational ties with institutions at a higher level in the socio-political hierarchy of power, mainly with scientists and the state (linking SC). This can provide direct benefits through increased knowledge and resources as well as encouraging more effective co-management through promoting increased cooperation, cohesion, participation and inclusion [126].

Step 3: Take advantage of SC to facilitate a shift towards MPA co-management

SC can be harnessed in a variety of ways in order to support successful co-management. For instance, SC interventions can be performed using a diverse range of participatory techniques. Those techniques with a higher degree of involvement, and which foster more authentic participation, will have greater influence on SC (Table 2) and be more successful in supporting effective co-management. For example, focus groups are a useful tool to evaluate the results of SC surveys and also help build shared understanding and consensus with regard to challenges faced by a particular area (e.g. threats from climate change and overfishing). Similarly, participatory mapping improves the planning and design of an MPA through community mapping of resources and resource users, and can help to build common understanding amongst stakeholders. Participation, or the lack of it, affects the whole MPA development process and should be encouraged at all phases (pre-implementation, analysis and identification of objectives, design of technical solutions, decision-making, implementation of the management plan and assessment). However, the degree of involvement and choice of participatory techniques should be dependent on the stakeholder, the project context, project phase and resources available, to ensure objectives are met. It must be noted that steps 2 and 3 are complimentary and

should be applied concurrently in order to be mutually reinforcing. Continual assessment and evaluation is necessary to ensure a smooth process and to allow a more adaptive approach to management, in order to overcome many of the failings of conventional management strategies.

5. Discussion and conclusions

It is necessary to take a pragmatic attitude towards co-management. It is not a simple solution and may not work in all situations. Introducing co-management is a complex and fragile process, demanding a large commitment from all involved. Co-management requires an in-depth understanding of SC and a sizeable investment of resources in the initial stages. Often the lack of finances, and appropriate external agents, policy entrepreneurs and local leaders inhibit its implementation. Furthermore, co-management requires specific attitudes and capacities and a significant level of political will, which can take a significant amount of time to develop. There are also risks to participation, such as the entrenchment of social fissures and divides that may jeopardise well-intentioned co-management [9] .

Notwithstanding its problems, co-management is increasingly seen as an alternative approach to resource management challenges that is worth exploring, and plans to encourage further decentralisation in the European Mediterranean should be devised. For co-management to work, it must assume different organisational forms to suit the diverse social, cultural and ecological settings found in this region. Three main elements are required to promote the shift to co-management. Firstly, there is a need to develop increased environmental awareness and encourage greater societal support that demands the development of sustainable management programmes. Secondly, political will at the national level is required and major institutional and legal reforms are recommended to provide the necessary legal support for decentralisation in fisheries management, as has occurred in other parts of the world [44,48]. Thirdly, to achieve effective co-management, it is vital that SC is understood and harnessed.

Communities' rich in SC learn in a more efficient way because they can take advantage of the links they share with other communities and institutions that have more resources and power. As a result these communities are more likely to participate in cooperative projects, such as the co-management of MPAs. This paper has outlined a methodological framework for attaining effective co-management through the analysis and promotion of SC. An in-depth understanding of the SC that exists in communities should be the initial step, allowing for recommended interventions to be made to improve the quality of SC. It is then possible to take advantage of SC to shift towards co-management and sustainable development. The specific interventions discussed in this paper can be used to increase SC, strengthen community organisations and institutions, build capacities and encourage shared understanding of key challenges and possible solutions. If adopted, they could have a significant impact on the development of co-management in the European Mediterranean and elsewhere. In conclusion, co-management offers the best opportunity to achieve effective MPA management but it is a learning process for all and 'ludism: the playful, experimental attitude should guide our efforts' [9].

Note

1. In economic terms, SC is a resource that, along with human capital, physical capital and natural capital, drives development and boosts the efficiency of organisations.

References

[1] A.J. Caveen, T.S. Gray, S.M. Stead, and N.V.C. Polunin, *MPA policy: What lies behind the science?* Mar. Policy. 37 (2013), pp. 3–10.

[2] WDPA, *The World Database on Protected Areas (WDPA)*, (2012). Available at: http://www.wdpa-marine.org

[3] N.K. Bown, T.S. Gray, and S.M. Stead, *Co-management and adaptive co-management: Two modes of governance in a Honduran marine protected area*, Mar. Policy 39 (2013), pp.128–134.

[4] S. Jentoft, T.C. Son, and M. Bjørkan, *Marine protected areas: A governance system analysis*, Hum. Ecol. 35 (2007), pp. 611–622.

[5] P. Jones, W. Qiu, and E.M. De Santo, *Governing marine protected areas–Getting the balance right*, Technical Report. United Nations Environment Programme, 2011.

[6] R. Chuenpagdee, J.J. Pascual-Fernández, E. Szeliánszky, J.L. Alegret, J. Fraga, and S. Jentoft, *Marine protected areas: Re-thinking their inception*, Mar. Policy. 39 (2013), pp. 234–240.

[7] T. Gray, *Participation in Fisheries Governance*, Kluwer Academic Pub, Dordrecht, 2005.

[8] F. Berkes, P.J. George, and R.J. Preston, *Co-management: The evolution of the theory and practice of joint administration of living resources*, in *Second Annual Meeting of IASCP*, University of Manitoba, Winnipeg, Canada, 1991, pp. 35.

[9] S. Jentoft, *Co-management-the way forward*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.

[10] E. Pinkerton, *Toward specificity in complexity: Understanding co-management from a social science perspective*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.

[11] F. Berkes, *Rethinking community-based conservation*, Conserv. Biol. 18 (2004), pp. 621–630.

[12] D. Ludwig, *The era of management is over*, Ecosystems. 4 (2001), pp. 758–764.

[13] G.A. Bradshaw and M. Bekoff, *Ecology and social responsibility: The re-embodiment of science*, Trends Ecol. Evol. 16 (2001), pp. 460–465.

[14] D.C. Wilson, *The community development tradition and fisheries co-management*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.

[15] R.S. Pomeroy, *The government as a partner in co-management*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.

[16] R.S. Pomeroy, P. McConney, and R. Mahon, *Comparative analysis of coastal resource co-management in the Caribbean*, Ocean Coast. Manage. 47 (2004), pp. 429–447.

[17] FAO, *La ordenación pesquera. 4*. Las áreas marinas protegidas y la pesca., 4(null) ed. FAO Orientaciones Técnicas para la Pesca Responsable, 2012.

[18] S. Jentoft, *Fisheries co-management as empowerment*, Mar. Policy. 29 (2005), pp.1–7.

[19] P. McConney, R. Pomeroy, and R. Mahon, *Guidelines for coastal resource comanagement in the Caribbean: Communicating the concepts and conditions that favour success*, Caribbean Coastal Co-Management Guidelines Project Caribbean Conservation Association, Barbados, 2003.

[20] J. Phillipson, *Widening the Net*, Centre for Rural Economy, Newcastle-upon-Tyne, 2002.

[21] B. Beem, *Co-management from the top? The roles of policy entrepreneurs and distributive conflict in developing co-management arrangements*, Mar. Policy. 31 (2007), pp. 540–549.

[22] S. Jentoft, B.J. McCay, and D.C. Wilson, S*ocial theory and fisheries co-management*, Mar. Policy. 22 (1998), pp. 423–436.

[23] J. Kooiman, *Governing as Governance*, Sage, London, 2003.

[24] S. Jentoft, *The community: A missing link of fisheries management*, Mar. Policy. 24 (2000), pp. 53–60.

[25] E. Ostrom and T.K. Ahn, *The meaning of social capital and its link to collective action*, in *The Handbook of Social Capital*, D. Castiglione, J.V. van Deth, and G. Wolleb, eds., Edward Elgar Publishing, Cheltenham, 2010, pp. 17–35.

[26] E. Ostrom, *Governing the Commons*, Cambridge University Press, Cambridge, UK, 1990.

[27] L. Perez de Oliveira, *Fishers as advocates of marine protected areas: A case study from Galicia (NW Spain)*, Mar. Policy (2013) in press.

[28] A. Kendrick and M. Manseau, *Representing traditional knowledge: Resource management and Inuit knowledge of barren-ground caribou*, Soc. Nat. Resour. 21 (2008), pp. 404–418.

[29] R.S. Pomeroy and R. Rivera-Guieb, *Fishery Co-Management*, Cabi Publishing, Wallingford, UK, 2006.
[30] S. Jentoft, *Fisheries co-management: Delegating government responsibility to fishermen's organisations*, Mar. Policy 13 (1989), pp. 137–154.
[31] L. Carlsson and F. Berkes, *Co-management: Concepts and methodological implications*, J. Env. Manage. 75 (2005), pp. 65–76.
[32] V. Luyet, R. Schlaepfer, M.B. Parlange, and A. Buttler, *A framework to implement stakeholder participation in environmental projects*, J. Env. Manage. 111 (2012), pp. 213–219.
[33] M. Hara and J.R. Nielsen, *Experiences with fisheries co-management in Africa*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.
[34] W. Dubbink and M. Van Vliet, *Market regulation versus co-management?* Mar. Policy 20 (1996), pp. 499–516.
[35] K.H. Mikalsen and S. Jentoft, *Participatory practices in fisheries across Europe: Making stakeholders more responsible*, Mar. Policy 32 (2008), pp. 169–177.
[36] FAO, *Indicators for Sustainable Development of Marine Capture Fisheries*, FAO Technical Guidelines for Responsible Fisheries, FAO Rome, 1999.
[37] H. Henkel and R. Stirrat, *Participation as spiritual duty: Empowerment as secular subjection*, in *Participation: The New Tyranny?* Zed Books Ltd, London, 2001.
[38] S. Sen and J. Raakjaer Nielsen, *Fisheries co-management: A comparative analysis*, Mar. Policy 20 (1996), pp. 405–418.
[39] L. Evans, N. Cherrett, and D. Pemsl, *Assessing the impact of fisheries co-management interventions in developing countries: A meta-analysis*, J. Env. Manage. 92 (2011), pp. 1938–1949.
[40] J. Pretty and D. Smith, *Social capital in biodiversity conservation and management*, Conserv. Biol. 18 (2004, pp. 631–638.
[41] S.A. Levin, *Self-organization and the emergence of complexity in ecological systems*, BioScience 55 (2005), pp. 1075–1079.
[42] R.S. Pomeroy, B.M. Katon, and I. Harkes, *Conditions affecting the success of fisheries co-management: Lessons from Asia*, Mar. Policy 25 (2001), pp. 197–208.
[43] R. Plummer and D. Fennell, *Exploring co-management theory: Prospects for sociobiology and reciprocal altruism*, J. Env. Manage. 85 (2007), pp. 944–955.
[44] P. Christie, A. White, and E. Deguit, *Starting point or solution? Community-based marine protected areas in the Philippines*, J. Env. Manage. 66 (2002), pp. 441–454.
[45] D.C. Wilson, M. Ahmed, S.V. Siar, and U. Kanagaratnam, *Cross-scale linkages and adaptive management: Fisheries co-management in Asia*, Mar. Policy 30 (2006), pp. 523–533.
[46] B. Walker, S. Carpenter, J. Anderies, N. Abel, G. Cumming, M. Janssen, L. Lebel, J. Norberg, G.D. Peterson, and R. Pritchard, *Resilience management in social-ecological systems: A working hypothesis for a participatory approach*, Conserv. Ecol. 6 (2002), pp.14.
[47] R.S. Pomeroy and F. Berkes, *Two to tango: The role of government in fisheries co-management*, Mar. Policy 21 (1997), pp. 465–480.
[48] H.O. Arceo, B. Cazalet, P.M. Aliño, and L. Mangialajo, *Moving beyond a top-down fisheries management approach in the northwestern Mediterranean: Some lessons from the Philippines*, Mar. Policy 39 (2013), pp. 29–42.
[49] T. Gray and J. Hatchard, *The 2002 reform of the Common Fisheries Policy's system of governance—rhetoric or reality?* Mar. Policy 27 (2003), pp. 545–554.
[50] W. Qiu and P.J.S. Jones, *The emerging policy landscape for marine spatial planning in Europe*, Mar. Policy 39 (2013), pp. 182–190.
[51] D. Symes, *Reform of the European Union's Common Fisheries Policy: Making fisheries management work*, Fish. Res. 100 (2009), pp. 99–102.
[52] EU, *Coastal Zone Policy*, European Commission, (2013). Available at: http://ec.europa.eu/environment/iczm/prop_iczm.htm
[53] C. Gabrié, E. Lagabrielle, C. Bissery, E. Crochelet, B. Meola, C. Webster, J. Claudet, A. Chassanite, S. Marinesque, P. Robert, and M. Goutx, *The Status of the Marine Protected Areas in the Mediterranean Sea 2012*, MedPAN & CAR/ASP, 2012.
[54] F. Badalamenti, A.A. Ramos, E. Voultsiadou, J.L. Sánchez Lizaso, G. D'Anna, C. Pipitone, J. Mas, J.A. Ruiz Fernandez, D. Whitmarsh, and S. Riggio, *Cultural and socio-economic impacts of Mediterranean marine protected areas*, Env. Conserv. 27 (2000), pp. 110–125.

[55] P. Francour, J.-G. Harmelin, D. Pollard, and S.P. Sartoretto, *A review of marine protected areas in the northwestern Mediterranean region: Siting, usage, zonation and management*, Aquatic Conserv: Mar. Freshw. Ecosyst. 11 (2001), pp. 155–188.
[56] M. Gomei and G. Di Carlo, *Making Marine Protected Areas Work-Lessons Learned in the Mediterranean*, WWF Mediterranean, 2012.
[57] R. Chuenpagdee and S. Jentoft, *Step zero for fisheries co-management: What precedes implementation*, Mar. Policy 31 (2007), pp. 657–668.
[58] M. Nursey-Bray and P. Rist, *Co-management and protected area management: Achieving effective management of a contested site, lessons from the Great Barrier Reef World Heritage Area (GBRWHA)*, Mar. Policy 33 (2009), pp. 118–127.
[59] R.I. Arthur, *Developing, Implementing and Evaluating Policies to Support Fisheries Co-Management*, MRAG Ltd, London, 2005.
[60] P. Guidetti and J. Claudet, *Comanagement practices enhance fisheries in marine protected areas*, Conserv. Biol. 24 (2010), pp. 312–318.
[61] J.J. Pascual-Fernández, *Participative management of artisanal fisheries in the Canary Islands*, in *Europe's Southern Waters: Management issues and practice, D.G. Symes, ed.*, Blackwell Science, Oxford, UK, 1999, pp. 66–77.
[62] S. Jentoft, J.J. Pascual-Fernández, R. de la Cruz Modino, M. Gonzalez-Ramallal, and R. Chuenpagdee, *What stakeholders think about marine protected areas: Case studies from Spain*, Hum. Ecol. 40 (2012), pp. 185–197.
[63] S. Revenga, *Las Reservas Marinas Canarias (España)*, in *Actas de las 1 Jornadas Sobre Reservas Marinas y 1 Reunión De La Red Iberoamericana De Reservas Marinas (RIRM)*, Publicaciones del MAPA, Secretaría Técnica, Madrid, 2003.
[64] A. Ballester-Nolla, *Proyecto para el establecimiento de un Parque - Reserva Submarina en las Islas Medas (Costa Brava, Gerona)*, Inmersión y Ciencia. 3 (2008), pp. 7–33.
[65] GENCAT, *The co-management committee of the Mediterranean sandeel fishing in Catalonia: An example of best practices in the EU*, 20 ed. GenCat, 2013. Available at: http://www20.gencat.cat/
[66] O. Guyader, P. Berthou, C. Koustikopoulos, F. Alban, S. Demaneche, M. Gaspar, R. Eschbaum, E. Fahy, O. Tully, L. Reynal, and A. Albert, *Small-scale coastal fisheries in Europe*. Final report, of the contract No FISH/2005/10. 2007. Available at: http://archimer.ifremer.fr/doc/00000/6348/
[67] E. Ostrom, J. Burger, C.B. Field, and R.B. Norgaard, *Revisiting the commons: Local lessons, global challenges*, Science 284 (1999), pp. 278–282.
[68] C. Cocklin, M. Craw, and I. McAuley, *Marine reserves in New Zealand: Use rights, public attitudes, and social impacts*, Coast. Manage. 26 (1998), pp. 213–231.
[69] NRC, *Marine protected areas: tools for sustaining ocean ecosystems*, National Academy Press, Washington, DC, 2001.
[70] N.L. Gutiérrez, R. Hilborn, and O. Defeo, *Leadership, social capital and incentives promote successful fisheries*, Nature 470 (2011), pp. 386–389.
[71] R.D. Putnam, *Democracies in flux: The evolution of social capital in contemporary society*, Oxford University Press, Oxford, UK, 2002.
[72] M. Woolcock, *The place of social capital in understanding social and economic outcomes*, Can. J. Policy Res. 2, 2001, pp. 225–249.
[73] T.K. Ahn and E. Ostrom, *Social capital and collective action*, in *The Handbook of Social Capital*, D. Castiglione, J.W. van Deth, and G. Wolleb, eds., Oxford University Press, Oxford, UK, 2008.
[74] V. Krebs, *Working in the connected world*, IHRIM Journal (2000), pp. 89–91.
[75] N.A. Christakis and J.H. Fowler, *The collective dynamics of smoking in a large social network*, N. Engl. J. Med. 358 (2008), pp. 2249–2258.
[76] N.A. Christakis and J.H. Fowler, *The spread of obesity in a large social network over 32 years*, N. Engl. J. Med. 357 (2007), pp. 370–379.
[77] J.H. Fowler and N.A. Christakis, *Dynamic spread of happiness in a large social network: Longitudinal analysis over 20 years in the Framingham Heart Study*, BMJ 337 (2008), pp. 2338.
[78] J.T. Cacioppo, J.H. Fowler, and N.A. Christakis, *Alone in the crowd: The structure and spread of loneliness in a large social network*, J. Personality Soc. Psych. 97 (2009), pp. 977–991.

[79] J.F. Helliwell and R.D. Putnam, *Economic growth and social capital in Italy*, East. Econ. J. 21 (1995), pp. 295–307.
[80] G.S. Becker, *Accounting for Tastes*, Cambridge University Press, Cambridge, UK, 1996.
[81] S. Knack, *Trust, assocational life, and economic performance*, in *The Contribution of Human and Social Capital to Sustain Economic Growth and Well-Being*, HRDC and OCED, Ottawa, Canada, 2001, pp. 172–202.
[82] R. La Porta, F. López de Silanes, A. Shleifer, and R. Vishny, *Trust in large organizations*, American Economic Review Papers and Proceedings, NBER Program: CF, 1996.
[83] S. Knack and P. Keefer, *Does social capital have an economic payoff?* NBER Program: CF, 1996.
[84] OECD, *The Well-being of Nations: The Role of Human and Social Capital*, OECD Publishing, Paris, 2001.
[85] J. Pretty, *Social capital and the collective management of resources*, Science 302 (2003), pp. 1912–1914.
[86] M. Semitiel-García, *Social Capital, Networks and Economic Development*, Edward Elgar Publishing, Cheltenham, UK, 2006.
[87] N. Swain, *Social capital and its uses*, Arch. Europ. Sociol. 44 (1999), pp. 185–212.
[88] T. Dietz, E. Ostrom, and P.C. Stern, *The struggle to govern the commons*, Science Magazine 302 (2003), pp. 1907–1912.
[89] E. Ostrom, *A general framework for analyzing sustainability of social-ecological systems*, Science 325 (2009), pp. 419–422.
[90] J.S. Coleman, *Social capital in the creation of human capital*, Am. J. Sociol. 94 (1988), pp. S95–S120.
[91] J.F. Helliwell, *The Contribution of Human and Social Capital to Sustained Economic Growth and Well-being*, HRDC and OCED, Ottawa Canada, 2001.
[92] J.F. Helliwell, *Life satisfaction and quality of development*, NBER Program: IFM, 2008.
[93] J.F. Helliwell and R.D. Putnam, *The social context of well-being*, in *The Science of Well-Being*, Oxford University Press, Oxford, UK, 2005.
[94] A. Krishna, *Active Social Capital*, Columbia University Press, New York, 2002.
[95] D.C. Wilson, *Conflict and scale: A defence of community approaches in fisheries management*, in *The Fisheries Co-Management Experience*, Kluwer Academic Pub, Dordrecht, 2003.
[96] P. Dasgupta and I. Serageldin, *Social capital: A multifaceted perspective*, The World Bank, Washington DC, 2000.
[97] F. Sabatini, *Social capital and the quality of economic development*, Kyklos 61 (2008), pp. 466–499.
[98] M. Stafford, M. De Silva, S. Stansfeld, and M. Marmot, *Neighbourhood social capital and common mental disorder: Testing the link in a general population sample*, Health Place 14 (2008), pp. 394–405.
[99] J. Pretty and H. Ward, *Social capital and the environment*, World Dev. 29 (2001), pp. 209–227.
[100] M. Olson, *The logic of collective action*, Harvard University Press, Cambridge, MA, 1992.
[101] L. Newman and A. Dale, *Network structure, diversity, and proactive resilience building: A response to Tompkins and Adger*, Ecol. Soc. 10 (2005), r2.
[102] Ö. Bodin, *A network perspective on ecosystems, societies and natural resource management*, Department of Systems Ecology, Stockholm University, 2006.
[103] L.G. Carlsson and A.C. Sandström, *Network governance of the commons*, Int. J. Commons 2 (2007), pp. 33–54.
[104] Ö. Bodin and C. Prell (eds.), *Social networks and natural resource management: Uncovering the social fabric of environmental governance*, Cambridge University Press, Cambridge, UK, 2011.
[105] E.L. Tompkins and W.N. Adger, *Does adaptive management of natural resources enhance resilience to climate change?* Ecol. Soc. 9 (2004), pp.10.
[106] K.W. Easter and L. McCann, *Nested institutions and the need to improve international water institutions*, Water Policy 12 (2010), pp. 500–516.
[107] D. Armitage, *Adaptive capacity and community-based natural resource management*, Env. Man. 35 (2005), pp. 703–715.

[108] R.E. Freeman, *Strategic Management: A Stakeholder Approach*, Pitman Publications, Massachusetts, 1984.
[109] J.M. Bryson, *What to do when stakeholders matter*, Publ. Manage. Rev. 6 (2004), pp. 21–53.
[110] M.S. Reed, A. Graves, N. Dandy, H. Posthumus, K. Hubacek, J. Morris, C. Prell, C.H. Quinn, and L.C. Stringer, *Who's in and why? A typology of stakeholder analysis methods for natural resource management*, J. Environ. Manage. 90 (2009), pp. 1933–1949.
[111] F. Ackermann and C. Eden, *Strategic management of stakeholders: Theory and practice*, Long Range Plann. 44 (2011), pp. 179–196.
[112] R.S. Burt, *Structural holes and good ideas*, A. J. Sociol. 110 (2004), pp. 349–399.
[113] R.D. Putnam, *Bowling alone: America's declining social capital*, J. Democ. 6 (1995), pp. 65–78.
[114] S. Franke, *Measurement of social capital*, Reference Document for Public Policy Research, Development, and Evaluation. Policy Research Initiative, Canada, 2005.
[115] V.N. Jones and M. Woolcock, *Using Mixed Methods to Assess Social Capital in Low Income Countries: A Practical Guide*, Brooks World Poverty Institute Working Paper Series, Manchester, 2007.
[116] S. Wasserman and K. Faust, *Social Network Analysis*, Cambridge University Press, Cambridge, UK, 1994.
[117] S.P. Borgatti, A. Mehra, D.J. Brass, and G. Labianca, *Network Analysis in the Social Sciences*, Science 323 (2009), pp. 892–895.
[118] Ö. Bodin and B.I. Crona, *The role of social networks in natural resource governance: What relational patterns make a difference?* Global Environ. Change. 19 (2009), pp. 366–374.
[119] T.W. Valente, *Network interventions*, Science 337 (2012), pp. 49–53.
[120] R. Dasgupta, *Social capital and economic performance: Analytics*, in *Critical Writings in Economic Institutions: Foundations of Social Capital*, E. Ostrom and T.K. Ahn, eds., Edward Elgar Publishing, Cheltenham, 2003.
[121] M.S. Reed, *Stakeholder participation for environmental management: A literature review*, Biol. Conserv. 141 (2008), pp. 2417–2431.
[122] F. Fukuyama, *Social capital, civil society and development*, Third World Q. 22 (2001), pp. 7–20.
[123] K. Morgan, *The learning region: Institutions, innovation and regional renewal*, Reg. Stud. 31 (1997), pp. 491–503.
[124] B.-Å. Lundvall, *National Systems of Innovation*, Pinter, London, 1992.
[125] R.S. Burt, *The network structure of social capital*, in *Research in Organizational Behaviour,* B.M. Staw and R.I. Sutton, eds., JAI Press, 2002.
[126] P. Noguera-Méndez and M. Semitiel- García, *El Capital Social en las comunidades pesqueras de El Vizacaíno*, in *Capital Social*, Género y Desarrollo, Universidad de Murcia, Murcia, Spain, 2008.