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Fishers' participation in Small-Scale Fisheries. A structural analysis of the Cabo de Palos-Islas Hormigas MPA, Spain

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1. Introduction

In recent decades, the consideration of the social dimension to deal with natural resources management and conservation has increased notably. This evolution relates to the increasingly applied Complex Social-Ecological Systems paradigm, implying a holistic, systemic and complex vision [1–3]. The interdisciplinary research needed to apply this methodology is still limited and more research is needed because the social aspects of MPAs, including social relationships, management processes and policy dimensions, are more complex than previously acknowledged [4,5]. In the case of small-scale fisheries and MPAs, this perspective allows their analysis in terms of the networks created by stakeholders and the interactions between them, considering their role in decision-making and the type of participation they exercise in management [6–9].

Participation favours an effective collaborative governance process when stakeholders are engaged in decision-making. Many studies have highlighted the advantages of values, the use of local knowledge, increased trust, the legitimacy and social acceptability of environmental management, it promotes social learning, and improves the stakeholders' performance [10–15].

In the European Union context, the engagement of stakeholders in the management of fisheries occupies a central role: “promoting and attaining sustainable use of resources through community participation is a central tenet of the European Union's (EU) 2013 Reform of the Common Fisheries Policy” ([16], p. 268). In the case of Spain, for the management of MPAs, the national administration supports participation, with the

explicit intention of balancing the authority of national and regional governments with bottom-up stakeholders, mainly fishers' organizations [17,18]. Also at regional level, which is relevant for the case study being analysed here, the regional government in Murcia supports stakeholders' participation, explicitly defending the collaboration between national and regional administrations and the benefits of an existing advisory board with representatives from each stakeholder in Cabo de Palos-Islas Hormigas MPA (CPH-MPA).

However, fishers' participation is perceived as scarce in many MPAs, and the administrative authority usually has the power to put their own opinions, perceptions and views above the others [19–24]. It is also common to find MPA studies carried out only considering the information and knowledge from a selective group of experts (technicians, scientists, administration responsible) or even only that of the MPA manager [25,26]. The limitations of this approach do not come from only using the technical information provided by experts but, rather, problems appear when an institutional opinion, valuation or perception is considered as being representative for all the groups that constitute the MPA system, and also when valuable knowledge is not taken into consideration.

Perceptions, defined as “a mode of apprehending reality and experience through the senses, thus enabling discernment of figure, form, language, behaviour, and action” is influencing “opinion, judgment, understanding of a situation or person, meaning of an experience, and how one responds to a situation” and has also great influence in human behaviour ([27], p.6). It is relevant to understand the existing diversity in stakeholders' perceptions, explained by the sociology of knowledge based on the socialisation process through which reality is being internalised [28], in an accurate analysis of a MPA system.

The range of perceptions is related to power, participation, influence and legitimacy in an MPA decision-making process. Perceptions and values condition attitudes and behaviours and, therefore, their diversity has consequences for the effectiveness of an MPA at different levels [29–31]: its management objectives, the well-being and human development of fishers' communities and, at a more general level, conservation and sustainability.

A fundamental aspect in engagement that helps to understand the link between participation and effectiveness, has to do with the communication amongst stakeholders. The stakeholders' perceptions of information exchange are embodied in the MPA institutional system. This is a system acting as the skeleton for the flow of diverse knowledge in a social learning process and as the basis for effective collaboration. What are the structural characteristics of such a system? What are the structural barriers complicating the use of complementary knowledge sources, that could have a positive effect on the outcomes of an adaptive management process?

The objective of this paper is to advance our knowledge of the above two questions, focusing on the identification and analysis of the structural barriers to participation for fishers, as a main stakeholder in MPAs and as major contributor to local wellbeing.

The paper's objective is approached through the analysis of the CPH-MPA case study in Spain. The CPH-MPA is a complex system, with various barriers making participation difficult, where participation is an objective emphasized by the regional and national administrations involved in its management [32]. However, fishermen and their representatives reveal a desire to increase participation in MPA management, perceiving their views as currently not being taken into account. Importantly, the perceptions of an insufficient participation of fishers are also a perception of the whole MPA social system.

This analysis has also enabled the proposal of structural interventions that can be valid for contextually similar small-scale fishery MPAs. The analysis was carried out by applying network analysis to perceptions data from representatives for each stakeholder group involved in the MPA system. Perceptions-based studies applying network analysis, such as this one, provide critical insights into how to identify potential pathways through which participation can be strengthened.

In the following sections the theoretical basis of this research is outlined and the research methods used in this study and analysis are described. The results are then outlined, focusing on the structural barriers associated with several networks embodied in the CPH-MPA social system. The final part comprises the discussion, including recommendations and conclusions, where there is a summary of the paper's key findings.

2. Structural barriers to stakeholders' participation

The participation and engagement of stakeholders in the management of MPAs is supported extensively in the literature [32] as it helps to achieve the objectives established for the MPA [33–36]. Arguments in favour of it refer, mainly, to the diversity of views and values, the provision of local knowledge and the legitimacy of governance, which prepare the ground for more effective implementations and long-term management.

Management evolves efficiently when it improves over time in an adaptive process that maximizes the chances of achieving the stated goals [5,37]. Wilson ([37], p.11) explains 'adaptive and efficient fisheries management' as "a management process that can be improved over time" to emphasize that centralized management is not efficient as it cannot deal with the diversity embedded in the complex MPA system and neither do

managers have enough knowledge about local conditions. Successful management requires appropriate institutions, continuous communication and coordination in a polycentric network where local organizations are involved. Transparency, face-to-face contact and exchange of information increase policy options and foster a continued learning and adaptive process with improved outcomes.

A well designed engagement process, with the effective collaboration of stakeholders, involves them in a collaborative governance process that acts through various complementary mechanisms: enhancing the generation of new knowledge through social learning, integrating important insights, diffusing knowledge and best practices and helping to reach general management objectives with better informed decisions [4]. In a recent editorial, *Nature Climate Change* asserts that this process generates benefits at all levels: for research, by helping to get and manage data; for non-experts, by improving scientific literacy and a perception of valuable contribution; for the MPA management and for the common good, at local and global level, so influencing local development and sustainability [38].

Power dynamics are also affected by this process as participants should perceive that they are given more equal opportunities to contribute, with consequences for equity and legitimacy. In this process, the local socio-economic, cultural and institutional context imposes some conditions that affect, in positive or negative terms, the engagement of stakeholders and its wanted or unwanted outcomes [39]: the existence of a participatory culture, to have previous experience of engagement and the availability of resources. Under unsatisfactory conditions, stakeholders' engagement is vague and not being fostered. Decreasing participation and general dissatisfaction are reflected in an unequal distribution of power, leading to different levels of influence in the management process.

Yet, Reed et al. [39] argue that the value of every participant's contribution should be recognised, everyone should be given an equal opportunity to contribute, even when knowing that conflicts among stakeholders are likely to emerge in the MPA system that require a professional facilitator to mediate.

This is a complex and challenging scenario. The governance process should ensure that the system, made up of actors with different knowledge, interests and perceptions, holds the democratic qualities fitting a multi-actor collaboration context, including transparency of decision-making procedures, legitimacy and accountability, and procedural fairness [4].

In this complex process fishers have a relevant role since they form a main stakeholder group in decision-making in MPAs. However, according to the literature, fishers continue to be marginalised from the management process [19,20] and there seems to be a tendency towards their decreasing participation in decision-making [21–23]. Even in some management contexts, fishers have been referred to as lawless poachers and viewed as an obstacle to sound management [24]. Findings from previous studies have found that fishers are overwhelmingly dissatisfied with this situation, condemning their lack of involvement in management, their exclusion from scientific assessment upon which decisions are made, and the lack of recognition and respect given to their knowledge [33,40–42]. In this respect, participatory governance instruments are claimed to face the little power that they hold [18,43]. Therefore, stakeholder participation is positively valued, but decreasing participation and dissatisfaction have been reported at the same time in a complex socio-ecological context. This is also the situation in the particular case of CPH-MPA, like in other MPAs [32]. If stakeholder participation is agreed to be positive, even necessary for an efficient management in MPAs, and if there is a

revealed desire for more participation, what types of participation should be sought?, What are the barriers that hinder its achievement?

Participation exists in a social network on a spectrum, ranging from passive, where it is a means to collect information to inform decisions or consult, to proactive, where the relevant actors are involved in decisions through a two-way engagement with consequences in equitable outcomes and for the level of influence of stakeholders [23,39]. Hogg et al. [32] propose the following typology, from less to more active stakeholder participation: passivity, communication, consultation, influence and collaboration. A more general typology distinguish the following types of participation: manipulative, informative, consultative, functional, collaborative, delegative and stakeholder rule [44]. A main structural difference between those types of participation bases on the distinction between unilateral, or one-way, communication and two-way communication. The limited participation represented in unilateral communication networks can lead to poorly informed decisions and to a restricted social learning process, due to a reduced range of information inputs and of knowledge exchange [4,39]. Therefore ways to foster two-way communication and involvement have to be sought [4,44,45].

The literature has sought to offer explanations for the limited participation of stakeholders, focusing on:

- Cultural differences, prejudices and stereotypes, and lack of confidence in the administration and science. These barriers can create mismatches between the type of participation fishers and other actors are seeking [18,19,21,23,24,33,40,46,47].
- Social and technical capacities, limited funding and the limited existence and misuse of appropriate information. These barriers cover problems for collaborative

management processes that require particular skills and long-term financial resources to support the process [10,37,48–53].

- Institutional limitations and communication restrictions. These are governance related constraints, also linked to cultural and capacity barriers, including the lack of platforms for collaborative management that would allow for good communication and open dialog, constraining fishers' participation and also contributing to distrust between actors [11,14,20,34,42,54,55].

One of the communication restrictions, referring to the scarcity of platforms for interactive engagement across sectors [55], is directly linked to the structural analysis of participation, but the literature is very scarce in this respect. According to Wilson [37], the existence of structural barriers is limiting the collective learning process necessary for efficient adaptive management. An inappropriate institutional structure avoids the feedback about actors' actions that would allow the gains in scientific and practical knowledge that, in turn, would facilitate learning and adaptation. If there is no effective reciprocal communication, transparency is being damaged, and the exchange of information is scarce. In this situation, structural barriers erode the policy options and undermine the potential for continued learning and adaptation.

An inadequate structure of the collaboration network could reinforce the status quo and damage collaborative outcomes. According to Bodin [4] the exchange of information is the type of tie that can facilitate social learning and its analysis can be approached through stakeholders' perceptions and the study of network structures and processes. Actors linked in the social network represent a wide range of knowledge domains and expertise. The inclusion of all stakeholders ensures the consideration of different educational levels, roles and occupations. Through their social linkages information is

being exchanged, experiences are being shared and stakeholders are engaged in collective deliberation. The final main effect is that a learning process is set in motion. However, an inefficient structure could be acting as a structural barrier, and the learning process could be restrained, as experiences are not being shared and most or key stakeholders are not being engaged in collective deliberation. As a result, only the central actors may be exercising a powerful influence in the network. According to Bodin [4] a centralized network is justified, in terms of effectiveness, only if more collaborative networks, based on mutual trust and willingness to comply, are underlying it. Otherwise, “a network conducive to managing cooperation problems is characterized by actors tending to reciprocate incoming social ties and form triadic structures” ([4], p.3).

Structural barriers and deficient reciprocal linkages can be caused by two types of actors in the network:

- Bridging or brokerage actors. They would occupy a position between many others. The problems appear when these actors are not present and there is no cohesion in the system, or when these actors control exchanges through the power they hold owing to their position.
- Central actors. They have a relatively high number of linkages in the network. They can be a source of structural problems when their leadership skills are questioned, they are not positively perceived by the other stakeholders, they have limited access to resources, or they take advantage of their powerful position to control the exchange of information and to restrict the reciprocity of ties.

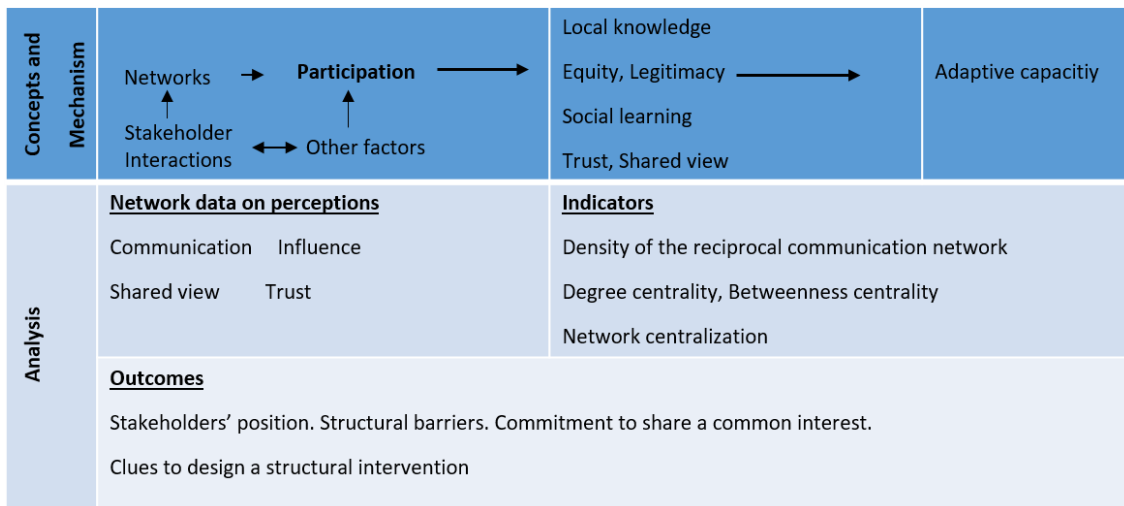


Fig. 1. Methodological framework. Other factors refer to institutional factors, capacities and interests among other relevant issues influencing and being influenced by the interactions among stakeholders and having an effect on participation.

The methodological framework is summarized in Fig. 1, together with a conceptual outline of participation and, in the lower part, the main aspects to be considered in the analysis. It indicates that the position of stakeholders, the identification of structural barriers, and even the potentiality to share a common interest, is revealing information that can be obtained through the study of different networks representing the social system's perceptions of different aspects referring to participation. A social network characterized by reciprocal communication, low centralized influence, the presence of bridging and central stakeholders maintaining cohesion and contributing to a shared view and high trust would foster the social learning process. Also legitimacy, equity and the consideration of local knowledge would be benefited by participation, so aiding a process in which the social systems enjoy an adaptive capacity and advances in efficiency terms. As Bodin [4] asserts, establishing collaborative networks does not guarantee efficiency in decision-making processes. The challenge is to understand the structure of those networks, how they contribute to this efficiency, and to design interventions based on network weaving, acting on direct engagement and establishing collaborative venues

[56–58]. For this analysis, very specific weaving actions, working through brokering and central actors, are also discussed.

3. Materials and Methods

3.1 Study area

Cabo de Palos (pop. ~1200) [59] is a small village in Murcia, Spain, with a strong fishing tradition. The CPH-MPA of fisheries interest (Fig.2.) covers 19.3 km², was established in 1995 by the Spanish and Regional governments, and the fishers were involved in the inception process through the *Cofradía* (BOE no. 161 of July 7 and Decree 15/1995 of 31 March) (BORM no. 92 of April 21, 1995). It is managed at national level by the National Ministry of Agriculture, Food and Environment and at regional level by the Regional Ministry for Agriculture and Water of Murcia. An advisory board was formed to support the management of the MPA and includes representatives from the administration, research organizations and fisheries sector (BORM no. 92 of April 21, 1995). The main conflict is focused in how the rapid growth of the diving sector has been managed. This has resulted in the fishers feeling marginalised from an area specifically protected to promote and sustain the artisanal fishing industry [60]. That advisory board has not acted as a channel to guarantee the participation of fishers and those circumstances could explain the fishers' negative reactions in the early years of the reserve. The objectives of the MPA are described as: the protection, regeneration and development of fishing resources for the maintenance of sustainable fisheries, enabling artisanal fishermen in the area to preserve their traditional way of life and to support other low-impact activities (for example scuba-diving and environmental education) that contribute to economic development.

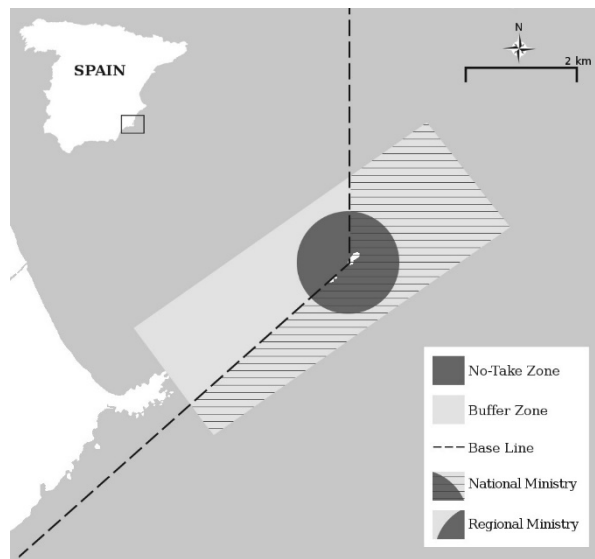


Fig. 2. CPH-MPA. Location, zoning and management responsibilities.

The artisanal fishing fleet is small and like other small-scale fishing fleets in the Mediterranean is in gradual decline [61]. In 1993 there were 14 active vessels, 10 in 2000 when the reserve census was established (BORM no. 92 of April 19, 2000) and 6 at the time of the study. The number of active vessels is lower than the authorized vessels, as established in the census. These 6 vessels provide employment to 13 fulltime fishers and several part-time employees. The artisanal fishers from CPH-MPA belong to the second largest *Cofradía* in the region, Cartagena, with 54 boats (*Cofradías* are fisher guilds “aimed to provide social assistance to their fisher members (...) they had the capacity to regulate fishing activities developed in their coastal area of influence” ([48], p.59). As in other regions, there is a strong tradition of ‘family fishing’ [18]; almost 80% of the fleet in CPH-MPA have familial links. Within the reserve, fishing tackles permitted include trammel nets and long line. CPH-MPA exemplifies a common situation across the Mediterranean as a MPA established by national government to protect fishing interests [48]. Case studies, like the one conducted in this paper, contribute to the requested

collection of data for small-scale fisheries and shed light on the structural processes influencing the effectiveness of management and governance in MPAs.

3.2. Data collection

Social network surveys were conducted between 2013 and 2015. The target population for the material presented were the 18 organizations involved in the governance of the CPH-MPA, identified through a literature review, secondary data sources and exploratory interviews. The groups included government departments, research organisations, fisher groups, non-governmental organisations and other resource users (Appendix). A list of these organizations was presented to each interviewee in generic terms, e.g. universities and municipality, to ensure that the list was manageable and to reduce the potential for non-response through interview fatigue. Single or multiple individuals from each organization were interviewed (n=28 individuals). Where possible, multiple individuals were interviewed for each actor group, as representatives to comment on behalf of an organisation. This study focuses on responses to social network survey questions, based on previous studies, on the sources of information about the MPA, influence, shared views and trust [62,63] (Table 1). The preliminary findings of the social network results were discussed and validated through community meetings held between 2013 and 2014 and with artisanal fishers in July 2015.

Information exchange	Thinking about the list, in the past year, who have you received information about marine resources from?
	Thinking about the list, in the past year, who has received information from you about marine resources and their use?
Shared views	Who on this list shares similar ideas to your group about how to manage the marine environment and marine resources?
Trust	In a hypothetical situation, if your group was unable to attend a meeting about the marine environment or marine resource management, which of these groups would you trust to represent you?
Influence	Which of these groups have influence over decisions regarding marine resources?

Table 1

Overview of questions put to each respondent for the collection of network data.

3.3. Data analysis

To better understand potential constraints it is useful to contrast fishers' self-perception about their engagement with the perceptions held by the whole system. This is particularly relevant in the case of a small-scale fishery studied as a system, because an analysis of self-perceptions would be based on a very limited number of data with a single subjective source. A discussion can rise up leading to the necessity to corroborate or to refute it considering the information coming from the other stakeholders in the system. Network analysis of perception is being applied as an appropriate methodology in this context.

Exchange of information, perceptions on influence, shared views and trust have been analysed as relational data and organised into adjacency matrices to apply network analysis using UCINET [64,65]. The relational data (from questions in Table 1) generated several networks to analyse the CPH-MPA social system from different perspectives. An information exchange network has been built after joining the matrices for sending and receiving information to value the intensity of linkages and to discover the existence of reciprocal ties. In the final matrix there are five values that can be interpreted in terms of absence of communication, one-way or two-way communication (with information

exchange linkages going in just one or both directions) that has been corroborated (the receiver confirms the reception of information that the sender said he sent, or the sender confirms sending the information that the receiver said he received) or not (the receiver does not confirm the reception of information, or the sender does not confirm sending information).

The reciprocity analysed in this way leads to more reliable data, guaranteeing that information is being exchanged and the relationship exists [66]. The information exchange network was reduced using a Maximum-Spanning-Tree (MST) procedure implemented using a Gephi plugin [67]. A MST is a sub network with only one component that connects all nodes with $n-1$ edges throughout the closest nodes [68,69]. This permits an analysis of the fundamental structure of the network, helping to identify and isolate the structural salience in the network [69]. Consequently, the strongest communication pathways, as well as the 'hubs', i.e. actors that have the greatest potential to facilitate communication and information exchange, can be identified.

The results from the information exchange matrices offers very valuable insights for a better understanding of a directed influence matrix, where central and broker actors have also been identified. In both matrices network centralization and density were calculated to assess overall network cohesion. Density describes the ties reported as a proportion of the possible ties within the network and network centralization describes the extent to which perceived influence and information exchange is dominated by a few individuals or spread evenly among actors [7]. Centrality measures were calculated to examine the position of individual actors in the network.

Normalized degree centrality was calculated for the symmetric information exchange network. Applied to directed data, normalized in-degree centrality scores have been used

to assess the perceived distribution of influence in the ‘influence in the decision-making’ network. When measuring the perception held by actors within the network towards others, in-degree provides a useful centrality measure as it specifically describes the prominence of an actor within a network by measuring the degree to which an actor receives ties from other actors in the network [70]. Betweenness centrality was calculated in both matrices (representing the extent to which an actor lies on the paths between others) to assess which actors contribute most to linking the network, and thus have the most potential to encourage the flow of ideas and to build trust [71,72].

Social network analysis has been applied to calculate density and centralization as characteristics referring to the whole system, where high density and low centralization, analysed through the selected networks, imply better conditions to foster social learning and to benefit equity and legitimacy through high participation. Centrality measures allow us to identify stakeholders who give cohesion to the system or hold power, generalize trust or impede a shared view, and thus driving or slowing down an adaptive management. The analysis conducted is based on the mechanisms schematized in Fig. 1 (Section 2), where an overview of the methodological framework is provided.

4. Results

The relational data collected (Table 1) has been used to analyse the CPH-MPA social system through several networks. The network in Fig. 3 illustrates who actors reported exchanging information with. Further research is required to better understand the type and effect of the information being exchanged for decision-making and trust building. However, this network provides an interesting insight into the initial stages of influence (e.g. access, voice and ‘being heard’). In this network the overall density is 0.464. Most of

its links have values 1 and 2, only 17 links have values higher than 2 (density is 0.118), and only 8 have the maximum value (density is 0.055). This last case corresponds strictly with a two-way communication.

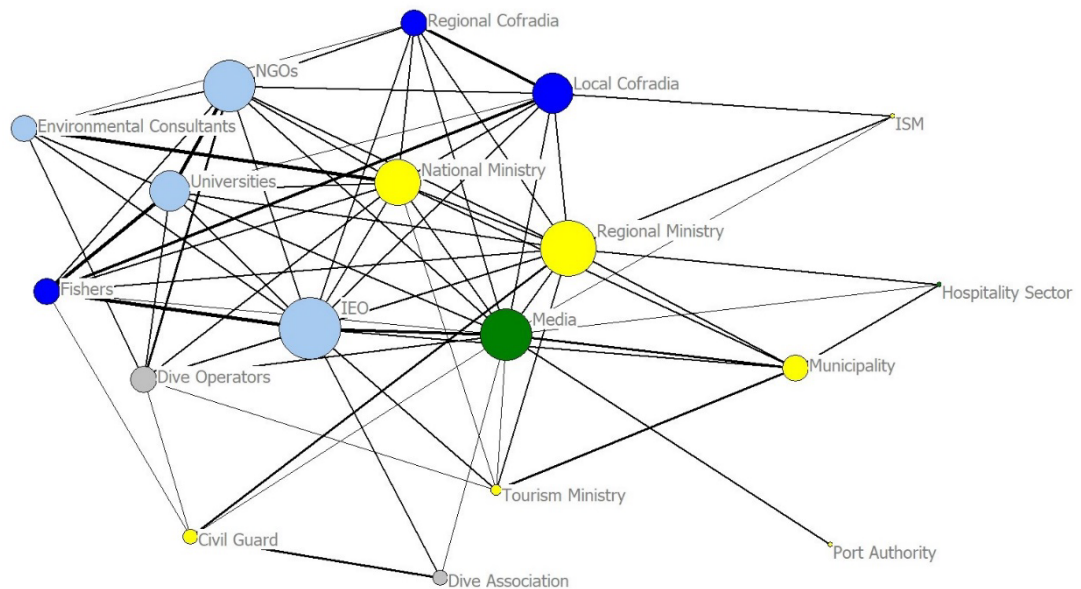


Fig. 3. Network of information exchange. Nodes represent the organizations interviewed. Size of circles indicates degree centrality. Line thickness indicates the level of information exchange (0, 1, 2, 3, 4), for the thickest lines both actors are sending and receiving information, and for the thinnest lines only one actor reported one tie, sending or receiving information. The stakeholders shown in all figures are grouped, and each functional group is distinguished with a specific colour (See Appendix). Density = 0.464; Density GT1 = 0.281; Network centralization GT1 = 41.18%. GT1 refers to values greater than 1, eliminating one-way information exchanges that have not been confirmed.

Even considering the whole network, with all possible ties and including unconfirmed one-way communication, more than half of the possible relationships in this small social and geographical area are absent, showing a notable lack of exchange of information among stakeholders, even at its most elemental level. Also the presence of two-way communication is scarce and restricted to Administration, Fishers, Local *Cofradía*, NGOs, Universities and Environmental Consultants. This network shows heterogeneity and the existence of grouping. There are many stakeholders with few and thin links gathered in the right side. The most central actors with the strongest links are (Table 2): National and

Regional Ministry, IEO, Universities, NGOs and the fisheries sector (Fishers and both *Cofradías*).

Actors	Information Exchange GT1		Influence	
	N-Degree	N-Betweenness	N-Indegree	N-Betweenness
Regional Ministry	58.82	15.33	76.47	34.43
National Ministry	47.06	3.88	52.94	11.91
IEO	64.71	13.46	47.06	10.14
Universities	41.18	1.16	41.18	2.29
NGOs	52.94	3.17	41.18	16.93
Local <i>Cofradía</i>	41.18	1.43	29.41	1.16
Fishers	23.53	0.12	23.53	0.28
Dive Operators	23.53	0.00	23.53	1.10
Tourism Ministry	5.88	0.00	17.65	11.21
Regional <i>Cofradía</i>	23.53	0.00	17.65	2.09
Environmental Con.	23.53	0.00	11.76	5.37
Dive Association	11.76	0.66	11.76	12.04
Municipality	23.53	9.56	11.76	0.00
Media	52.94	6.36	11.76	0.74
Port Authority	0.00	0.00	5.88	0.17
Civil Guard	11.76	0.74	5.88	0.14
ISM	0.00	0.00	5.88	0.31
Hospitality Sector	0.00	0.00	0.00	0.00

Table 2

Centrality scores calculated for exchange of information and influence. Centrality has been calculated from the dichotomized Information Exchange matrix of values GT1. GT1: see note in Fig. 3. The classification of stakeholders is in descending order of N-Indegree for influence. Density = 0.464. Density GT1= 0.281. Network Centralization GT1= 41.18%.

The Regional Ministry has been found to be the most relevant actor in the MST (Fig. 4), when considering the strongest pathways for information exchange. Its central position enables it to act as an information broker, distributing information for the greater good or, conversely, gives it the opportunity to hoard and control information, increasing their influence and power. The National Ministry, at a second level, and the IEO, at a third, also act as brokers. In another group there are the eight organizations with only one edge, that can be considered 'leaves' of this tree: Hospitality Sector, Tourism Ministry, Port Authority, Environmental Consultants, Regional *Cofradía*, ISM, Diver Association and Dive Operators. The MST in Fig. 4 helps to identify the remarkable hierarchy in this network,

with the National and Regional Ministries concentrating information and receiving and sending information to the two main line-motifs through the organizations of the second level (IEO, Environmental Consultants, Local *Cofradía* and Fishers) and from these organizations, the tree opens in other paths to reach the leaves.

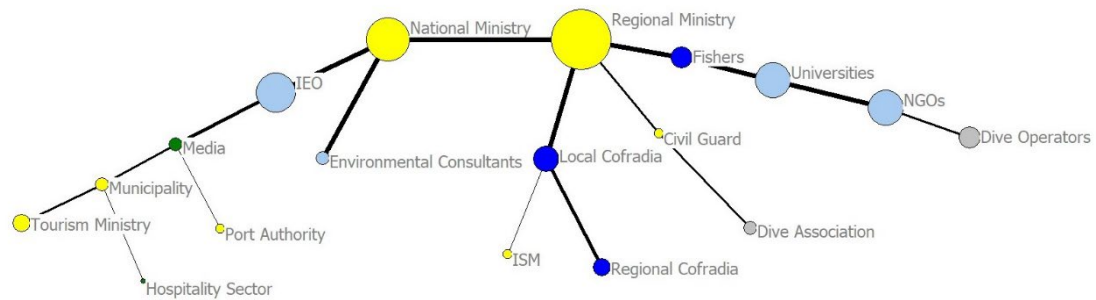


Fig. 4. MST of the Information Exchange Network. The size of circles indicates degree of influence. See note in Fig. 3.

The unequal distribution of power among governance actors is a permanent feature, regardless of the model of participation [48]. In a collaborative management setting the gap between those who perceive themselves as holding less power or as being powerless and not having access to information is reduced [18,40]. One way to delve into whose perception of participation is more accurate is to investigate perceptions of influence. Fig. 5 explores the perceived influence of stakeholder groups on the decision-making process. The low density and high network centralization of this network indicate that influence was perceived to focus around a few particular actors. The stakeholders with the highest in-degree centrality scores were Regional Ministry, National Ministry and IEO (Table 2). These actors were perceived to have the most influence over decisions taken. Fishers and the Regional *Cofradía* were below the average in-degree centrality score

implying that other actors do not consider them to be influential. The Local *Cofradía*, however, was slightly above the average.

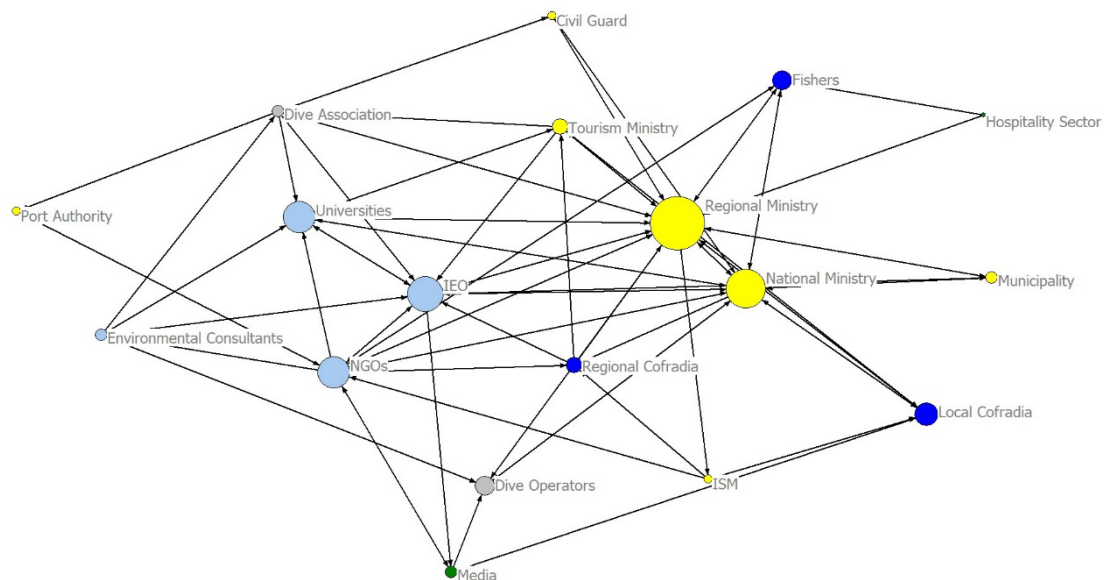


Fig. 5. Social perception network on Influence. Size of circles indicates Indegree Centrality. See the Note in Fig. 3 for the colour of nodes. Density = 0.242. Network Centralization = 55.363%.

These networks, reflecting the social understanding of the different organizations involved in managing the CPH-MPA, helps substantiate two findings from the interview data: 1) the governance system is hierarchical, top-down with government departments taking a central role; 2) fishers' perception of low influence is shared by all other actors in the network. In addition, the networks tell us that the Regional Ministry has the most influence and other user groups have low influence, with the Local *Cofradía* having the most influence of all user groups (Fig. 5).

The network analysis for the CPH-MPA revealed that there are structural barriers restricting a collective learning process. Does the social CPH-MPA system work as a collaborative network? The results from the information exchange and influence analysis leads to a negative answer. But, other basic requirements would include trust and

awareness of a common objective. To know more about this process, Fig. 6 is based on the answers to questions about shared vision and trust, joining both adjacency matrices and considering only reciprocal linkages. The similarities between Figs. 4 and 6 are evident, pointing to the relationship between the frequency and intensity of contacts with the development of shared vision and trust. Two key issues emerge: only seven stakeholders trust and/or share their vision with other actors; and there are two separate components, each of them made by stakeholders belonging to the same functional group. One component is made up of the most central stakeholders identified in the previous analysis on information exchange and influence: Regional and National Ministries, IEO, Universities and NGOs. Local *Cofradía* and Fishers make up the other component. Above all, there is an absence of mutual trust and shared vision between both components, and this is a serious barrier for the stakeholders to be engaged to achieve the common interest.

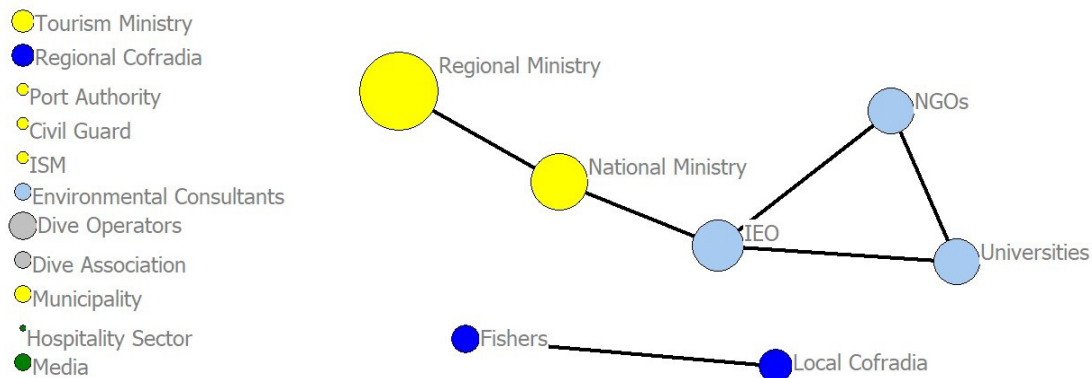


Fig.6. Perceptions network on Shared views and Trust. Only reciprocal relationships of Shared views and Trust are considered. Size of nodes indicates in-degree centrality for influence (Fig. 5). For the colour of nodes see Fig. 3.

5. Discussion and Conclusions

This paper contributes to the growing literature highlighting the role of social networks on natural resource management and, in particular, on small-scale fisheries [6,55,71,73–77]. These research works highlight the contribution of the social dimension and examine networks, like information, knowledge and advice networks, providing resources, facilitating collective action and increasing the fishing success and they also identify groups and influential actors. The present paper adds to this literature by exploring diverse networks to gain a detailed picture of participation which allows us to identify the structural barriers to a more participative management, particularly for fishers. The analysis also reveals the consistency of the information provided by the different networks, with a main role played by the exchange of information to foster trust and form a shared view. The analysis also revealed that the users' self-perception on insufficient participation are also a perception of the whole MPA social system.

It is convenient to enrich the relevant data for the identification of structural barriers in small-scale fisheries, because the analysis is frequently based on biased and very limited information. The network analysis of perceived relations has allowed to compare diverse information sources to get more robust conclusions about the effective participation of actors in decision-making and to identify the structural barriers affecting governance. If collaborative initiatives do not overcome them, the influence of stakeholders in decision-making will be limited, leading to frustration because stakeholders' desires and the expressed objectives of the administration would not be achieved [4].

Spain provides an interesting backdrop to investigate the role of fishers and their participation in fisheries management. In a highly decentralised country, coastal fisheries management combines the centralised actions of the national and regional governments

with the self-organisation of fishermen within *Cofradías*, which act as consultative and cooperation agencies with the government [17,18]. This study reveals that in the CPH-MPA the exchange of information among the stakeholders involved in its social system is insufficient and inadequate to have collaborative processes (Table 2, Fig. 3, Fig. 4). The absence of this basic type of link restricts, or even impedes, the existence of coordination. These missing links could have various causes, like a rational response to information costs or inefficient social and legal arrangements [78]. The information exchange network shows that the two-way linkages are insufficient, preventing levels of participation going beyond informative and consultative participation. Besides the misunderstanding between the Administration and Fishers as to the meaning of participation, the fisheries sector maintains half of the strong communication links, which constitute an opportunity to advance in an adaptive management process and to increase its potential to foster more participation or at, least, feelings of being heard.

Effective management requires ample and deep consideration of the way in which actors are processing information [78]. A first step in this respect would be to understand the social structure allowing for, and also hindering, information exchange. If information is not being exchanged, it cannot be processed. This, in turn, reduces compliance and obstructs the possibilities of having influence in management decisions [79].

A qualitative perception analysis on stakeholders' participation in the CPH-MA had already been conducted in [32] and [44]. Among the lessons learned are the perceived low level of participation amongst stakeholders, that the fisheries sector perceive that they are not influential in the CPH-MPA decision-making process, that most of the barriers covered in the literature are present in CPH-MPA, and specific barriers to stakeholders participation have also been identified: lack of administrative will, lack of

funding, fishers' low status, lack of respect for managers, dispute over science, failure of the fishers' organization to represent fishers and personal and sectoral conflicts. Those perceptions are related to the secondary role of fishers, and other stakeholders, in the reserve's monitoring and management processes. The discomfort caused by the conflict with the diving sector, with a disorderly growth giving rise to a sense of injustice for fishers [60], has also implied opportunities. New communication linkages between both sectors have recently been created and the advisory board has begun to play a more active role. Those results suggest a need to analyse more deeply in order to corroborate self-perceptions on low participation and to shed light on some ambiguities. The network analysis added valuable results allowing to assert that the social cognition about who is influential is consistent with those self-perceptions, because the other actors indicate that the power and influence of this stakeholder group is low (Table 2, Fig. 5). It is therefore questionable for the Administration to maintain its discourse about the effective engagement of fishers. When asked to consider their own level of influence one fisher indicated "no. We are nobody". Another fisher asserted that "there is little dialogue". In contrast the administration suggested that their doors are open: "The fishermen of Cabo de Palos can contact us directly whenever they want, almost daily, and the communication flows". Researchers reinforced this view by saying: "Fishermen have their fishermen guilds, they can convey their problems to their guilds and request a meeting with the relevant politician or technician, every citizen can do that, problem is that they don't do it."(sic)

The CPH-MPA social system perceives that fishers are at the periphery, with their knowledge and knowhow being disregarded. Fishers' themselves reiterated the top-down and centralized nature of communication placing themselves as the last link:

“There’s a chain - the university, the IEO or the ministry decide something and then tell the federation, then they tell the *Cofradía* and then, us.” Being at the end of a formal hierarchical chain of communication leaves fishers vulnerable. This finding agrees with researchers from previous studies who suggested that because small-scale fishing implies small-scale commitment, it usually means small-scale power [24,80]. The administration however, perceived participation and communication channels positively, leaving little incentive for them to increase participation. In this respect, the identification of two components integrated by relationships of reciprocal trust and shared views, one made by the most central stakeholders, is very revealing (Fig. 6).

This study offers recommendations to help overcome the constraints identified and to take advantage of opportunities, in order to strengthen the role of fishers in a more effective CPH-MPA management. The first recommendation is to increase the number of connections in the whole network to facilitate coordination, particularly increasing the connectivity of the fisheries sector in the system. It is necessary to provide a diverse range of formal and informal opportunities for participation, to strengthen the ties between actors, offer opportunities to form new ties, help to build trust and to incorporate diverse and complementary knowledge. It can be argued that working on structural barriers, and fostering contact and information exchange is too time consuming and therefore inconvenient for some actors. However, good planning considering direct (informal face-to-face exchanges, interviews, meetings, telephone), indirect (public events, bulletins, questionnaires) and virtual (virtual encounters, social media, email) contact avoids this problem [55]. The creation, or reinforcement, of different kinds of linkages among stakeholders for the exchange of information would solidify the institutional network.

The structural characteristics of the network can also be monitored over time to ensure that a collaborative network is as effective as possible.

The second recommendation is to improve communication between the Administration and the fisheries sector to agree on the meaning of participation, and on the level of decision-making that the administration is willing to share with the other stakeholders [32]. This will enable the decision-making process to be better shaped and to reduce the disparity between participants' expectations and outcomes. Although the level of participation may not be as high as the fishers may wish, having transparency helps manage expectations and reduce frustrations, so favouring legitimacy.

The third recommendation refers to capacity building for every group involved, improving their training and experience through participatory processes. This would help ensure more equitable participation, so empowering the actors, and increasing the opportunities for communication [32].

The fourth recommendation implies weaving the network. This can be encouraged after knowledge brokers have been identified, such as the IEO and Universities. Specific tools and processes encouraging a two-way dialog should be promoted. For example, the co-production of knowledge and participatory research projects involving fishers and incorporating their knowledge would ensure that research is more in-line with policy needs. In this complex process it may be necessary to have a professional facilitator, who is almost indispensable when there are serious problems, conflicts or personal confrontations.

A final general recommendation is to give much greater consideration to the social dimension in MPA monitoring.

In this study we have illustrated that the relational analysis of perception data offers a unique insight into MPA and fisheries governance, highlighting the tangible role that social networks can play. They can be used as a management and policy tool to foster adaptive management by pinpointing institutions and individuals that could help to strengthen the existing relationships, to promote information flows, and to build trust between the different actors. The adequate training of the involved actors is a key element to make the best use of it (third recommendation).

While the focus of this paper has been to provide information specifically related to the CPH-MPA, the methods applied, lessons learned and recommendations are applicable to other contextually similar fisheries and MPAs. The applied methodology provides a practical way to reveal both structural and contextual constraints to participation and to identify opportunities to strengthen the role of fishers, which is an important requirement for MPAs and fisheries management hoping to adopt more collaborative strategies.

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Ethics statement

Permission to conduct this study was granted by the Ministry of Agriculture, Food, and Environment in Spain and ethics approval was obtained for this study through submission of an ethics assessment to the University of Murcia Ethical Committee. Participants were informed of the aims of the project, how data would be used and how they could access the study results. Researchers obtained verbal consent from participants before conducting interviews. Personal identifying information was replaced with respondent ID numbers to ensure anonymity.

Appendix

Roster of actors involved in CPH-MPA governance system used in the questionnaire. In the Figs., the nodes of every Functional Group (Government, Monitoring Research and Development, Fishers associations and Fishers and Other) have been shown in different colours.

Institution/group	Node abbreviation	Number inter-viewees	Functional Group	Examples or resources provided to CPH-MPA governance network
National Ministry of Agriculture, Food and Environment	National Ministry	2	Government power sharing and enforcement	Policy-making, User rights, Surveillance, Information, Conflict resolution, Technical support, Enforcement, Marine and Social Security
Council of Agriculture and Water of the Region of Murcia	Regional Ministry	1		
Council of Tourism and Culture of the Region of Murcia	Tourism Ministry	2		
Port Authority	Port Authority	1		
Civil Guard	Civil Guard	1		
Social Marine Institute	ISM	1	Monitoring research and development	
Municipality	Municipality	1		
Spanish Oceanographic Institute	IEO	3		
Universities	Universities	2		Monitoring studies, Education, Outreach, Information, Conservation programs, Dissemination, Project funds, Capacity building, Revenue
Environmental Consultants	Environmental Consultants	2		
NGOs	NGOs	3		
Regional Federation <i>Cofradías</i>	Regional <i>Cofradía</i>	1	Fishers associations and Fishers	Political representation, Information, Learning, Financial support
<i>Cofradía</i> de Cartagena	Local <i>Cofradía</i>	1		
Artisanal Fishers	Fishers	2		
Dive Operators	Dive Operators	2	Other resource users	Political representation, Information, Learning, Financial support, Dissemination
Regional Dive Association	Dive Association	1		
Hospitality Sector	Hospitality Sector	1		
The media	Media	1		