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Research

Exploring perceptions to improve the outcomes of a marine protected area

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ABSTRACT. Marine protected areas (MPAs) are widely promoted as effective tools for conserving biodiversity and safeguarding ecosystem services. However, MPA success can be hindered by a lack of legitimacy and low social support because of perceived negative effects on ecosystem services and human well-being. Despite these social challenges, the social dimensions of marine conservation, such as the effects of MPAs on coastal livelihoods and local communities' perceptions of these effects, are often overlooked in conservation initiatives. In this study, we use a mixed methods approach, combining qualitative thematic analysis and quantitative network analysis derived from interviews and focus group discussions, to examine the perceptions of key stakeholder groups about the Litoral Norte MPA in Portugal. Our findings reveal that most stakeholder groups hold more negative than positive views about the governance and management of the MPA. Key concerns include unsatisfactory participation in MPA decisions and perceptions that the MPA fails to deliver positive social and ecological outcomes, such as increased community involvement, fair income distribution, and enhanced fish abundance. Policy makers and managers need to address these negative perceptions to improve conservation governance and management. By considering the stakeholder feedback presented in this study, such as fostering better engagement with the local community and transforming conflicts into opportunities for co-developing new conservation actions with local resource users, policy makers and managers can increase support for Litoral Norte and enhance the social and ecological outcomes of the MPA.

Key Words: *conservation; ecosystem services; environmental management; human well-being; marine governance; marine protected areas; MPA; perceptions; social-ecological systems; social impacts*

INTRODUCTION

Marine conservation often involves designating marine protected areas (MPAs), which have become widespread tools in governing and managing marine environments. Currently, there are over 18,200 MPAs worldwide, covering more than 8% of the world's ocean (UNEP-WCMC and IUCN 2024). And the number and extent of MPAs are expected to increase rapidly because of the agreement reached at the 15th Conference of Parties to the UN Convention on Biological Diversity (COP15). In this international agreement, nearly 200 nations committed to conserving and managing at least 30% of the world's coastal areas and ocean by 2030 (CBD 2022). This global commitment has reinforced the importance of MPAs' role in marine governance and management worldwide.

Reflecting the diverse nature of marine governance, the arrangements for MPAs encompass various models, including co-management, community-based initiatives, and state-led arrangements (Mascia 2004). Within MPAs, often there are variations, ranging from those with no-take zones, where extractive activities are prohibited, to multiple-use protected areas allowing for regulated human activities. The regulations established by MPAs can help them serving various purposes, including biodiversity conservation, enhanced fisheries management, and the protection of ecosystem services, such as the replenishment of fishery stocks and opportunities for tourism (Lester et al. 2009, Cinner et al. 2016, Potts et al. 2014). In this sense, MPAs have the potential to deliver both positive ecological (Lester et al. 2009, Edgar et al. 2014, Rojo et al. 2019) and social outcomes (Mascia et al. 2010, Oldekop et al. 2016, Ban et al. 2019).

However, because MPAs are often established near communities whose livelihoods depend on locally supplied ecosystem services (Jentoft et al. 2012, Mahajan and Daw 2016), MPAs can decrease access to these services by restricting human activities (Pascual et al. 2016). As such, MPAs may involve complex trade-offs in ecosystem service supply, such as enhancing tourism opportunities over fishing activities (Outeiro et al. 2019). Changes in ecosystem service supply following MPA establishment may significantly influence the acceptance or rejection of marine conservation initiatives, depending on how local communities and key stakeholders perceive the social and ecological outcomes of MPAs (Bennett et al. 2019). At the end, the long-term success of MPAs relies on the acceptance and support from local communities and key stakeholders (Pita et al. 2011, Voyer et al. 2015, Yates et al. 2019). In this sense, assessing MPA success requires considering the social dimensions of marine conservation, but these dimensions are often overlooked, especially in protected areas from Europe (Jones et al. 2017, 2020). It is, therefore, crucial to understand the social dimensions of MPAs, especially people's perceptions of changes in ecosystem service supply and related well-being benefits following MPA implementation (Potts et al. 2016).

In the context of our study, perceptions refer to "the way an individual observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome" (Bennett 2016:585). They are subjective interpretations of reality shaped by attitudes, beliefs, values, norms, and motivations (Levine et al. 2015, Bennett 2016). As such, perceptions are heterogeneous, differing among individuals and social groups, influenced by contextual factors, such as social, economic and geographical characteristics, personality traits, and

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access to the ocean and coast (Jefferson et al. 2015, 2021). Although perceptions research is now viewed as crucial to inform marine conservation activities and to improve their outcomes (Gelcich et al. 2014, Potts et al. 2016), the study of perceptions remains limited (Bennett 2016), but research on this topic is growing (Jefferson et al. 2021).

The study of perceptions can help elicit the underlying reasons that explain acceptance or rejection of MPAs (Bennett 2016, Lotze et al. 2018, Brueckner-Irwin et al. 2019). For instance, if MPAs are perceived as providing benefits to local fisheries and ecosystems, social approval of conservation initiatives can be high among fishers (Leleu et al. 2012). Local fishers' support of MPAs can be influenced by perceptions of ecological effectiveness, social impact management, and good governance processes (Bennett et al. 2019). Likewise, other stakeholders, such as tourism operators and non-extractive users, who perceive that MPAs offer both community and environmental benefits tend to support and approve of them (McNeill et al. 2018). Understanding local communities and stakeholders' perceptions can facilitate co-learning, participation, communication, and the integration of valuable insights into conservation practice and policy (Webb et al. 2004, Bennett 2016). Moreover, exploring mismatches of positive and negative perceptions of who manages and who uses local resources may reveal pathways and barriers to MPA success.

To help fill gaps in our understanding of why people support or oppose marine conservation initiatives, and to better incorporate stakeholder insights into conservation practice and policy, we assess how key stakeholders perceive the outcomes of Litoral Norte MPA in Portugal. We selected Litoral Norte MPA as a case study because this is a multiple-use protected area with a dynamic marine social-ecological system that harbors important ecosystems and supports coastal livelihoods. Our focus on this MPA aims to provide policy makers and managers with valuable insights to enhance both the social and ecological outcomes of the area. For this, we ask the following research questions:

- What are the perceptions of key stakeholders about the impact of Litoral Norte MPA on ecosystem services, human well-being, pressures, and trends since its creation?
- What are the opinions of key stakeholders about the governance and management of Litoral Norte MPA?
- Do key stakeholders have suggestions for improving the governance and management of Litoral Norte MPA? If so, what are they?

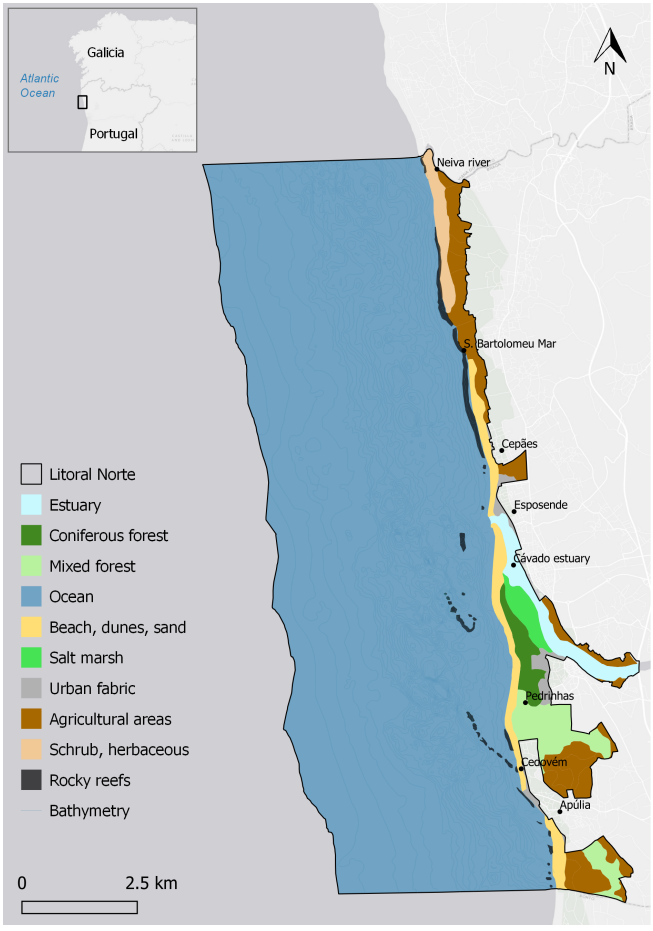
Two related theoretical framings guide our study: social-ecological systems theory, which emphasizes the interconnectedness of humans and ecosystems (Berkes et al. 2000), and the ecosystem services concept, which can be defined as "the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems" (Costanza et al. 2017:3). Following this, we departed from the conceptualization of human well-being for conservation by Breslow et al. (2016), which highlights that people shape and are shaped by ecosystems, and emphasize the importance of healthy and functioning ecosystems for humans to thrive.

METHODS

Study area

Litoral Norte is one of the few MPAs located in the north of Portugal. It is classified as an IUCN category V multiple-use protected area (Fig. 1), covering 8887 hectares, 14% of which are terrestrial and 86% are marine. The MPA partially overlaps with a Nature 2000 Network's Habitats Directive Site, which was designated by the EU to protect important habitats such reefs, mudflats, coastal dunes, salt marshes, and estuaries found in the area. As of 2024, the local marine observatory has identified 132 marine habitats and 2611 species in the MPA, and new species sightings are regularly recorded by the observatory (OMARE 2024a).

Fig. 1. Location of Litoral Norte marine protected area and main land-use types of its coastal fringe (from Garcia Rodrigues et al. 2022, distributed under the CC BY 4.0 license).



The Portuguese government created the Litoral Norte MPA in 2005 by changing the legal status of the area, which had been a protected seascape since 1987 (Regulatory Decree 2005). Since its creation, the MPA has been governed by a steering committee with executive power, as well as an advisory council. The steering committee is chaired by a member of the Portuguese Institute for Nature Conservation, which is responsible for managing the MPA. The advisory council consists of representatives from the

local municipality (Esposende), NGOs, local university, and several governmental entities, such as the Directorate-General for Natural Resources, Safety and Maritime Services, and the Directorate-General for Tourism. The advisory council reviews proposals for management plans and evaluates annual reports of MPA initiatives.

The government defined the main goals of the MPA as conserving biodiversity, enhancing seascape aesthetics, and improving the quality of life and well-being of local communities (Resolution of the Council of Ministers 2008). To achieve these goals, and according to the government's resolution, the MPA initiatives should correct processes that may lead to the degradation of nature, ensure the sustainable exploitation of natural resources, such as fisheries, promote scientific research and environmental education, and ensure that tourism and recreation align with local ecological, aesthetic, and cultural values. Additionally, MPA planning should ensure the active participation of all relevant entities in the management of the MPA in close collaboration with local communities (Regulatory Decree 2005).

The ecosystems of Litoral Norte MPA provide livelihoods for local communities. Fishers and fish vendors rely on locally caught marine organisms such as fish, crustaceans, sea urchins, octopus, squid, gooseneck barnacles, limpets, and mussels (ICNF 2023). Maritime tourism operators depend on the revenue provided by national and international tourists who are attracted to local beaches, estuaries, and seascapes. In addition to beach tourism, the area is becoming increasingly popular among locals and visitors for activities such as surfing, kitesurfing, kayaking, and diving (OMARE 2024b). The popularity of coastal hiking and bird watching is also rising, highlighting the increasing importance of nature tourism in the MPA (ICNF 2014).

Methodological approach

We used a mixed methods approach to gather stakeholders' perceptions, opinions, and suggestions for Litoral Norte MPA. This approach involved conducting semi-structured interviews and focus group discussions, which were analyzed using both qualitative thematic analysis and quantitative network analysis. Although interviews and focus group discussions may yield different information on the same topic (Kaplowitz and Hoehn 2001), they can also generate comparable data (Hicks et al. 2013, Yates et al. 2019). To ensure the collection of comparable data, we used similar question guides for both interviews and focus group discussions (Appendices 1 and 2).

Our mixed methods approach has provided a comprehensive and nuanced understanding of stakeholders' views on the Litoral Norte MPA. This is because interviews, focus group discussions, and network analysis elicit different types of information. Interviews can provide in-depth insights from individual stakeholders, while focus group discussions can reveal collective perspectives and interactions among them. Incorporating network analysis allows us to visually represent relationships among stakeholder perceptions that emerged in our interviews and focus group discussions, helping us to identify and quantify their importance and influence within each network. Employing a mixed methods approach also enables data triangulation (Flick 2018), allowing for cross-validation of our findings by comparing data collected through different methods. This approach enhances the overall robustness of the study.

Data collection

We conducted semi-structured interviews and focus group discussions with key stakeholder groups of the MPA (Table 1). We identified these key stakeholders as those with a professional role in the ongoing governance and management of the MPA, as well as those whose livelihoods rely on the MPA's resources. Therefore, our study included a diverse group of MPA managers, scientists, fishers, fish vendors, and maritime tourism operators. We aimed at ensuring a variety of perspectives within the scope of our study.

Table 1. Number and type of key stakeholders who were interviewed or participated in focus groups discussions. We did semi-structured interviews with all key stakeholder types and organized focus group discussions specifically with local resource users, that is, fishers, fish vendors, and maritime tourism operators.

Stakeholder type	Sector/Group	Data collection method	No. interviewees/ attendees
MPA manager	Institute for Conservation of Nature Environmental municipal councillor	Semi-structured interview	3
Scientist	Marine biology Marine ecology Naval history Underwater archaeology	Semi-structured interview	5
Fisher	Commercial fishers' association Commercial small-scale fisheries	Semi-structured interview	3
Fish vendor	Fish market Street sales	Semi-structured interview	2
Maritime tourism operator	Nautical recreation (kitesurf, surf, diving) Recreational fisheries	Semi-structured interview	4
Fisher	Commercial small-scale fisheries	Focus group discussion	6
Fish vendor	Fish market Street sales	Focus group discussion	3
Maritime tourism operator	Nautical recreation (kitesurf, surf, stand-up paddle, jet skiing, diving)	Focus group discussion	3
Total			29

Our interviews were semi-structured because contrary to more structured approaches they allow for a detailed, in-depth exploration of interviewees' perceptions, motivations, attitudes, and beliefs (Bernard et al. 2016). Our interview guide had 13 open-ended questions with the purpose of eliciting information in three core topics: (1) the social and ecological importance of the MPA, and perceived challenges since its creation; (2) views on MPA governance and management; and (3) suggestions for improving MPA management. Most interviewees provided detailed responses to all three core topics.

Between March and December 2017, we conducted 17 face-to-face, in-depth, semi-structured interviews in Esposende. Before starting each interview, we obtained oral informed consent from the interviewee after explaining the scope and purpose of the study, reminding that consent could be withdrawn at any time and guaranteeing anonymity and confidentiality. Interviews lasted an average of 1 hour and 3 minutes, ranging from 25 minutes to 1 hour and 40 minutes. We used a digital voice recorder to record all interviews for later transcription, resulting in 18 hours of audio recordings.

To recruit interviewees, we contacted known relevant individuals either by email or phone. This approach has resulted in interviews with MPA managers and scientists, following purposive sampling (Goodman 1961). These interviewees provided us additional potential contacts for interviews who were recruited using snowball sampling (Goodman 1961). We stopped searching for further interviewees when we reached data saturation, that is, when we had collected sufficient data and no new themes were emerging from the interviews (Guest et al. 2006).

After doing interviews, we organized three focus groups discussions with MPA resource user groups, that is, fishers, fish vendors, and maritime tourism operators. The aim was to delve deeper into the themes that emerged from our interviews and to facilitate continued stakeholder engagement. This approach allowed us to make the most of the available financial and logistical resources. We chose these stakeholder groups because they were potentially most affected by the establishment of the MPA and relied heavily on locally provided ecosystem services and related benefits for their livelihoods. The objective of the focus group discussions was to elicit the perceptions and opinions of local resource user groups, and to gain a better understanding of their views on the subject.

We organized focus group sessions with three distinct groups of fishers, fish vendors, and maritime tourism operators. We ensured that each group was homogeneous, with members sharing similar backgrounds. This was important for the quality of the group's output because members with similar backgrounds tend to be more open and comfortable with each other (Morgan and Krueger 1997). We did previous interviews with all key stakeholder groups (Table 1), including MPA resource user groups, which allowed us to gain a deeper understanding of the social and ecological issues potentially relevant to each resource user group. Although the topics of the focus group discussions overlapped with those of the interviews, we tailored them for each session to ensure maximum relevance and engagement.

We conducted focus group discussions in February 2018 with three to six participants at the premises of the local commercial fishers' association, which was located near the MPA. We were consistent with our ethical considerations, aligning with the principles outlined for the interviews. On average, the focus groups lasted 1 hour and 41 minutes, with a range of 1 hour and 20 minutes to 2 hours and 16 minutes. We recorded all discussions with both audio and video equipment for later transcription, resulting in 5 hours of footage. Our research team consisted of a facilitator and a note-taker, whose task was to document insights arising from the discussions.

To arrange the focus group discussions, we used a convenience sampling approach and invited fish vendors and maritime tourism operators who were already known to the research team. We also asked these participants to identify other potentially relevant participants, who were then contacted by phone using a snowball sampling approach. For fishers, we had access to a list of individuals working in the area. We selected every fifth person on the list and invited them by phone to participate in the focus group discussion. If the contacted fisher was unavailable, we contacted the next person on the list and followed the same procedure until a fisher was available to join the focus group.

Data analysis

Thematic analysis

We used oTranscribe (Bentley 2013) to transcribe the interviews and focus group discussions, and uploaded the resulting documents to a text analysis software. After reading and becoming familiar with all the transcripts, we applied a thematic analysis approach to code the text (Braun and Clarke 2006). We identified seven main categories that emerged from the data: "ecosystem service," "well-being attribute," "pressure," "trend," "suggestion," "positive opinion on MPA," and "negative opinion on MPA." For instance, we coded "I hold a deep sentimental attachment to this park" as "well-being attribute" (sense of place); "I believe we should establish no-fishing zones" as "suggestion" (create no-take zones); and "The creation of the MPA halted sand extraction in the dunes, protecting them" as "positive opinion on MPA" (dune conservation).

Our categorization of themes was informed by the theoretical framework that guides our study. We drew on social-ecological systems theory (Berkes et al. 2000), the ecosystem services concept (Costanza et al. 2017), and the conceptualization of human well-being for conservation by Breslow et al. (2016). This theoretical framework emphasizes the critical role of well-functioning ecosystems for humans to thrive.

Network analysis

We used a network approach to analyze and visualize the coded themes of the qualitative data generated by the interviews and focus group discussions (Pokorny et al. 2018). This method draws on graph theory and network analysis to quantify and visualize the relationships between codes in transcripts. Each code is represented as a node, and an edge represents a relationship between two codes. This network analysis creates edges based on the chronological order of the codes, such as that code "A" is connected to code "B" if "B" comes after "A" in the transcript.

Our data analysis approach, which has been previously used in education and psychology studies (Bodin 2012, Pokorny et al. 2018), avoids relying on the analyst's interpretation of relationships between codes in a text. Instead, it employs predefined criteria, namely, chronological order, to create networks. This method offers the advantage of increased reproducibility, enabling other researchers to replicate network metrics from the same set of code data (Pokorny et al. 2018).

In our network analysis approach, edges can either be directed or bidirectional, indicating a one-way or two-way relationship between two codes. If two codes are subsequent, the edge is directed, whereas if codes overlap the same portion of transcript

Table 2. Summary of metrics for the networks of fishers, fish vendors, maritime tourism operators, scientists, and managers of the Litoral Norte marine protected area (MPA). Each node represents a unique theme from interviews and/or focus group discussions. Edges connect nodes, indicating relationships. Weighted degree represents node size, reflecting the number and importance of edges. Weighted in-degree represents incoming edges to a node, while weighted out-degree represents outgoing edges. Betweenness is another measure of importance, measuring the number of links a node makes between otherwise unconnected nodes. Diameter is the longest path between two nodes, and path length is the number of edges required to connect two randomly selected nodes. Density indicates the proportion of edges per node compared to the total number of edges.

Network metrics	Fishers	Fish vendors	Maritime tourism operators	Scientists	MPA managers
Nodes	80	29	61	64	60
Edges	256	88	127	120	135
Weighted degree (Avg; SE)	8.91 ± 0.70	6.71 ± 0.88	7.30 ± 0.59	6.60 ± 0.62	7.86 ± 0.85
Weighted in-degree (Avg; SE)	4.46 ± 0.36	3.36 ± 0.48	3.65 ± 0.30	3.30 ± 0.31	3.93 ± 0.42
Weighted out-degree (Avg; SE)	4.46 ± 0.35	3.36 ± 0.46	3.65 ± 0.30	3.30 ± 0.31	3.93 ± 0.44
Betweenness (Avg; SE)	258.48 ± 32.56	86.00 ± 17.05	276.60 ± 31.89	243.25 ± 35.86	185.61 ± 24.65
Diameter	10	12	14	11	13
Path length (Avg)	4.31	4.19	5.69	4.92	4.63
Density	0.029	0.071	0.029	0.029	0.036

text, the edge is bidirectional. Additionally, edges or relationships were assigned weights. We assigned a weight of "1" to codes arising from implicit statements and a weight of "2" to codes signaling explicit assertions. This weighting approach was adapted from the method used by Carley and Palmquist (1992) to weight connections in mental model graphs. To avoid the weighting effect of verbose responses, we removed nodes' self-connections, which refers to connections between the same code.

To determine the relative importance and influence of each node in the graphs, we calculated two measures of centrality: weighted degree and betweenness. Node size in the graphs reflects the node's weighted degree, which considers both the number (degree) and strength (weight) of the edges directed toward and going out of a node (Newman 2010). Similarly, edge thickness is proportional to its weight, representing its relative importance in the graphs. Another measure of importance is betweenness centrality, which indicates the number of links a node makes with other nodes that are otherwise unconnected. If a node connects many important nodes in the network, it has high betweenness centrality and acts as a bridge between them (Newman 2010). In this context, important nodes are those with a high weighted degree.

In addition to measuring the number of nodes and edges, we also calculated the diameter, average path length, and graph density to determine the networks' size. The diameter is the longest path between two nodes, while the average path length is the average number of edges required to connect two randomly selected nodes (Pokorny et al. 2018). The minimum path length value is 0, and the maximum value corresponds to the network's diameter. Network density measures the proportion of edges per node compared to the total number of edges. A highly interconnected network would have a density close to 1, while a sparse network would have a density close to 0 (Pokorny et al. 2018).

For an easier interpretation of the graphs, we used different colors for each of the seven coded themes. All graphs and network metrics were calculated using Gephi 0.9.2. (Bastian et al. 2009). To visualize the graphs, we used the Fruchterman-Reingold algorithm, which is a force-directed layout algorithm (Fruchterman and Reingold 1991).

RESULTS

The coding of interviews and focus group transcripts resulted in 725 themes. We categorized these themes into seven groups: 140 as "ecosystem service," 124 as "well-being attribute," 108 as "pressure," 104 as "negative opinion on MPA," 56 as "positive opinion on MPA," 103 as "trend," and 90 as "suggestion." All these thematic categories were broadly present in the transcripts of both the interviews and the focus group discussions.

Out of all the networks, the fishers' network had the most nodes (hereafter, themes), with a total of 80 (Table 2). Furthermore, this network had the highest average weighted degree, that is, the highest number of edges or connections per theme, with a total of 256 edges. These results indicate that the interviews and focus group discussions with fishers generated the most diverse and interconnected themes compared to other networks.

The networks of maritime tourism operators, scientists, and MPA managers consisted of approximately 60 to 64 nodes that were connected by 120 to 135 edges. Among these networks, the maritime tourism operators' network had the highest average betweenness centrality (276.60), indicating that its interviews and focus group discussions generated themes that connect to a larger number of otherwise unlinked themes in the network. On the other hand, the fish vendors' network had the least number of nodes and edges, but it was the most interconnected because of its lowest average path length and higher density, which means it had less but more frequently occurring joint themes than the other networks. Overall, the five networks were sparsely interconnected, with relatively few edges per node and low density values, suggesting that interviewees discussed a wide range of themes without much overlap.

Perceived ecosystem services and well-being attributes, and how they are changing

Fishers

Interviewed fishers perceived a wide diversity of well-being attributes provided by fishing in the MPA (Fig. 2). "Identity" was the most important well-being attribute in their network, with a weighted degree (wd) of 24 and betweenness (b) of 1111. Fishers strongly associated living off the sea as part of their identity (Fig. 3). For instance, one fisher evoked childhood memories about the first time he went into a boat:

Fig. 2. Relative importance (weighted degree) of all themes associated with ecosystem services (green) and human well-being attributes (orange). Bar plots show themes of the five networks: fishers, fish vendors, maritime tourism operators, scientists, and marine protected area managers.

> *I've been going* [fishing] *a lot since I was little. I used to run away from school to see fishers up there from the wall. When I was eight years old, I threw myself into the water and his father-in-law told my father, 'take the boy, take the boy!' I didn't even know if I could swim ... Then he grabbed me and put me inside the boat and took me to the sea.* [Focus group A - fishers]

The fishers' network showed that "identity" was closely connected to other well-being attributes such as "health," "income," "relaxation," "job," "satisfaction," "freedom," and "happiness." This highlights the intertwined nature of the well-being attributes that fishers derive from the sea and fishing.

In addition to the expected theme of "harvestable fish," the fishers' network showed other themes that represent ecosystem services. These included "estuary nursery grounds" and "habitats and species," which support and regulate ecosystem services. Fishers also recognized the importance of locally provided ecosystem services like "nature tourism," "hiking," and "nautical recreation." Overall, the fishers' network highlighted the multifaceted nature of ecosystem services and well-being attributes perceived by fishers.

Fish vendors

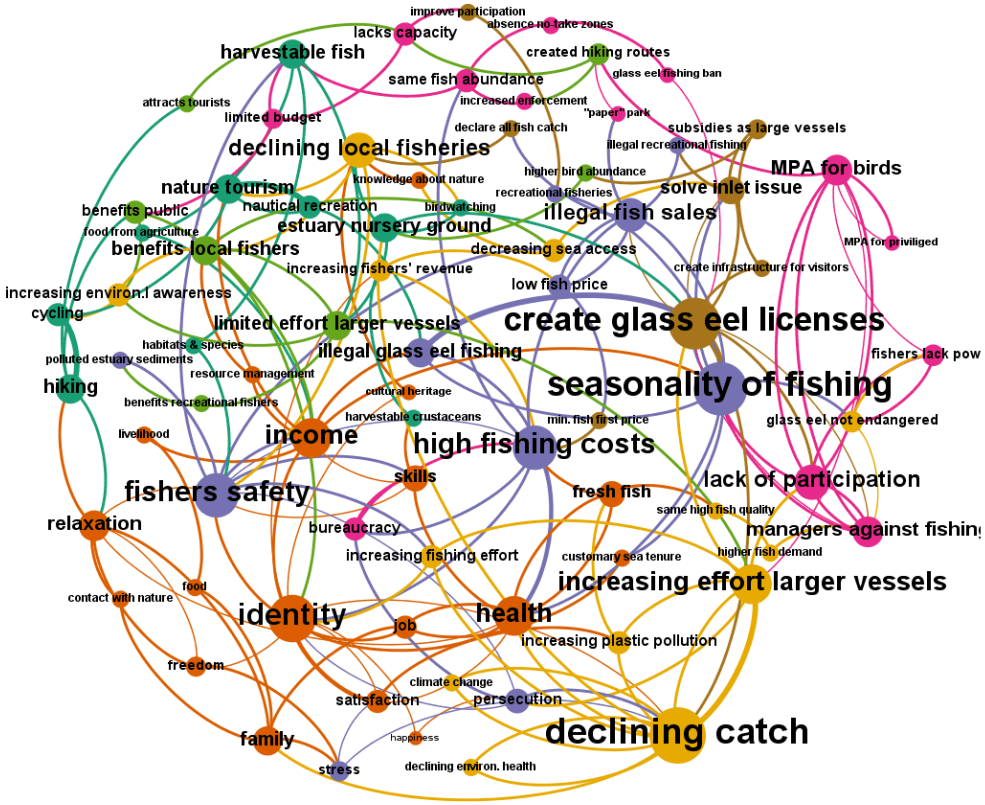
The interviews and focus group discussions with fish vendors generated fewer themes than other groups. However, they shed light on what is important to this group (Fig. 2). Fish vendors emphasized the social aspects of their sales, as evidenced by the importance of the "social relations" theme in their network (wd = 22, b = 364). For fish vendors, social relations are built not only through bonds with regular clients, but also through a sense of camaraderie among their peers, as shown in Fig. 4. To illustrate this, one fish vendor revealed:

> *They* [the clients] *come here and it's a family, it's a joy! If you come here on a Sunday, you'll feel the joy around here ... They are great! Sometimes they do not even come to buy. Sometimes they come just to listen to us, to talk to us.* [Focus group B - fish vendors]

Another fish vendor stated, "We go to the market to sell and, in the market, I help my colleagues. As she well knows, we help each other" [Focus group B - fish vendors].

In addition to "social relations," fish vendors also expressed pride in their "skills," which enable them to select, scale, and fillet high-

Fig. 3. Fishers' network with themes from interviews and focus group discussions. Themes are classified by category: ecosystem services (dark green); human well-being attributes (orange); positive (light green) and negative (pink) opinions of marine protected area (MPA) governance and management; trends (yellow) since MPA creation; pressures (purple) occurring in the area; and suggestions (brown) of MPA management actions.



quality, locally caught fish, and do their job well. They viewed their role not only as providing fresh fish to their customers, but also as contributing to the health and well-being of their community by supplying nutritious food.

Interestingly, in the fish vendors' network, themes related to ecosystem services, such as "harvestable fish" and "seascape aesthetics" were not only interconnected but also linked to the well-being attribute of "social relations." These connections highlight the interdependent relationship between marine ecosystem services and human well-being.

When asked about the main changes in their activities since the creation of the MPA, both fishers and fish vendors reported a decline in fish catch (Fig. 5). During a focus group discussion, one fisher vividly recalled the days when the sea was teeming with fish:

> *I used to fill the boat with seabass, it was every day! ... I know there are days I catch seabass, I can say that I caught them the other day, but what about those days I don't catch? Before, it used to be every time.* [Focus group A - fishers]

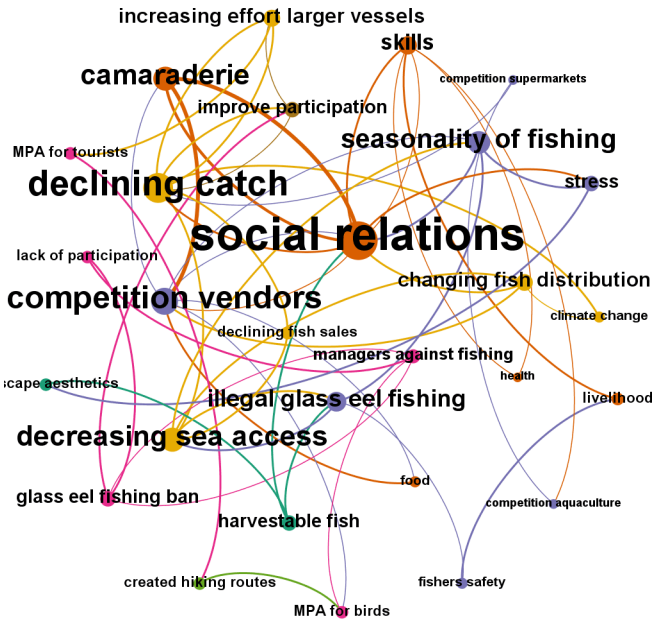
During the fish vendors' focus group session, one participant admitted, "There are less fish than there were a few years ago. There used to be so much more" [Focus group B - fish vendors].

The most prominent theme in the fishers' network was "declining catch" (wd = 30, b = 1108), which is linked to other themes representing trends such as "increasing effort by larger vessels," "increasing fishing effort," "increasing plastic pollution," "declining environmental health," and "climate change." "Declining catch" was also connected to social pressures like "stress" and "persecution" by authorities, as well as to well-being attributes such as "identity," "health," and "family." These interlinkages between trends, pressures, and well-being attributes illustrate the complexity of the negative ecological impacts perceived by local resource users.

Both fishers and fish vendors' networks show that "seasonality of fishing" was a significant theme (wd = 26, b = 1019; wd = 9, b = 100), because rough sea and weather conditions during winter prevent fishers from fishing for several weeks. Some fishers suggested that more time could be spent fishing in the sea if the inlet at the mouth of the Cávado estuary was made safer by dredging and repair because this is the only channel that gives them access to sea. The importance of this theme was further highlighted by its connection to the well-being attributes of "income" and "health," as well as to the need to "solve the inlet issue."

The theme of "seasonality of fishing" was also connected to other social-ecological pressures, such as "illegal glass eel fishing" and "illegal fish sales." Despite being a forbidden activity, glass eel

Fig. 4. Fish vendors' network with themes from interviews and focus group discussions. Themes are classified by category: ecosystem services (dark green); human well-being attributes (orange); positive (light green) and negative (pink) opinions of marine protected area (MPA) governance and management; trends (yellow) since MPA creation; pressures (purple) occurring in the area; and suggestions (brown) of MPA management actions.



fishing in the Cávado estuary is highly profitable because of great demand from Asian markets, providing some fishers with extra income during the winter months when they cannot fish as often. As a result, "seasonality of fishing" was linked to the theme of "create glass eel licenses," which was one of the most important themes in the fishers' network (wd = 27, b = 1108). During a focus group discussion, a fisher suggested that licensing could help prevent illegal fishing and generate tax revenue to improve fishers' pensions and overall well-being:

> *This illegal* [glass eel] *fishing has many intruders, hasn't it? It's known that it goes on from north to south* [of the country]*, and the State could gain from it. There could be a temporary closure that would make it all better. In the end, if we were licensed, it would improve everything. There wouldn't be so many intruders in this fishery. There would be taxes paid by fishers, for the future of them to be better, to improve their pensions and everything. It would be much better for everyone, for everything.* [Focus group A - fishers]

Glass eel fishing is a highly contentious issue in the MPA because of heavy fines and arrests as it involves the IUCN's critically endangered European eel (*Anguilla anguilla*), a protected species. Similar connections related to glass eel fishing were also shown in the fish vendors' network (Fig. 4).

Tourism operators

The most important well-being themes in the tourism operators' network were "sense of place" and "passion for nautical activities" (wd = 20, b = 510; wd = 20, b = 587; Fig. 2). These themes were interconnected and also linked to "environmental education" and "income" (Fig. 6). During a focus groups discussion, one tourism operator explained these linkages by saying:

> *Kitesurfing became a passion, which later became a business, and extended to several other passions for the sea. And we began to diversify our offer. It's not just about income. If it was only for income, I'd do other things. I'd make more money than what I get from what I do here. It's also a passion for the place, for the people, for all this.* [Focus group C - tourism operators]

In the tourism operators' network, "contact with nature" was another important well-being attribute. This theme was not only linked to "staying outdoors," another well-being attribute, but also to several ecosystem service themes such as "kitesurf," "hiking," "paragliding," and "biodiversity." During interviews, tourism operators emphasized the favorable conditions that the estuary and the sea provide for tourism and outdoor recreational activities. For instance, the Cávado estuary was often considered a "unique" place to teach kitesurfing to new practitioners. Tourism operators also highlighted the importance of the coastal waters and the associated "seascape aesthetics" for their nature-related businesses. One operator admitted that they "benefit from having an area with these seascape characteristics." Another stated:

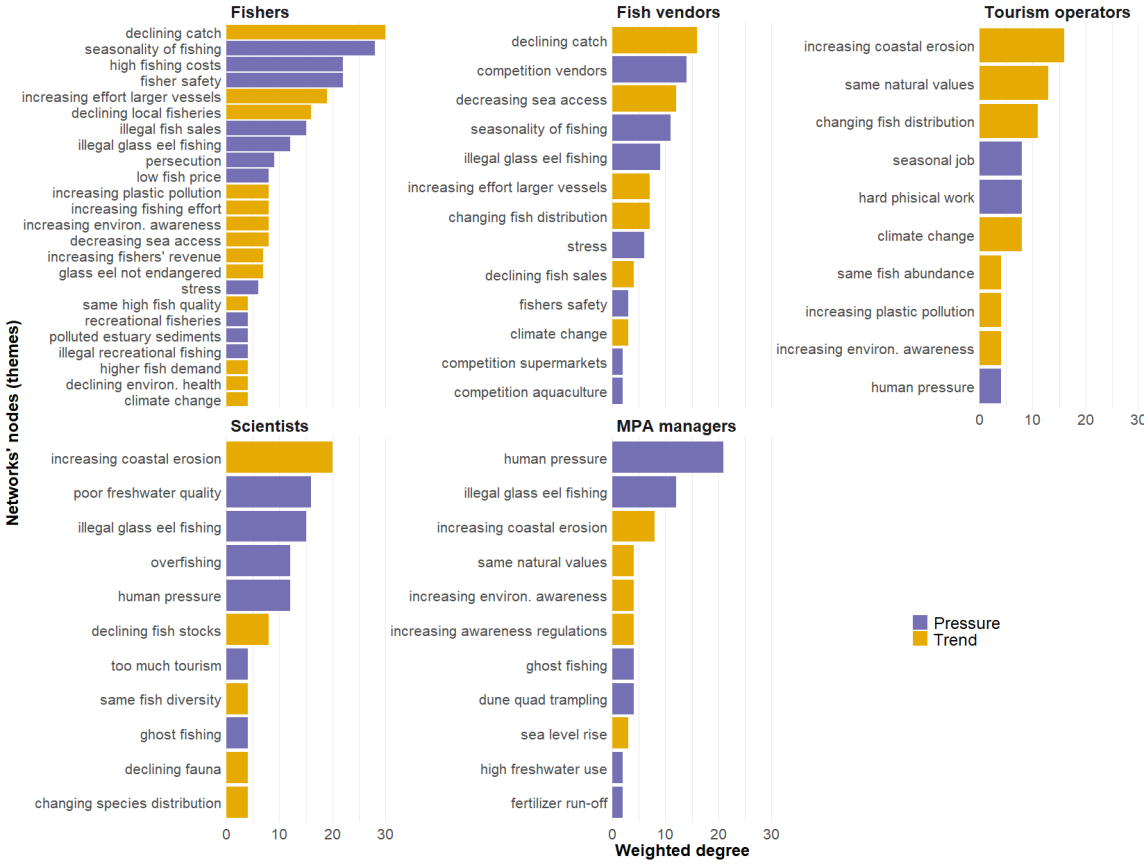
> *Our dives are quite like those of Viana do Castelo* [nearby municipality]*, with the advantage that here it's a bit wilder. One takes a boat trip from the north or the south, and clearly notes that entering this area ... there are fewer houses on the coast. It's emptier. It has a larger natural component.* [Focus group C - tourism operators]

Tourism operators, along with fishers and fish vendors, have noticed changes in the fish populations inside the MPA. In tourism operators' network, the theme "changing fish distribution" was linked not only to "climate change" but also to a theme representing a negative opinion about the MPA, which is "lack of capacity" of MPA management to produce positive outcomes. Some tourism operators perceived "same fish abundance," a theme connected to "diving," reflecting the perception of local recreational divers on the MPA's ineffectiveness in increasing the number of fish.

Scientists

Interviewed scientists had a different focus than fishers, fish vendors, and tourism operators. Their answers elaborated more on the ecosystem services provided in the MPA than on well-being attributes, as shown in their network (Fig. 7). The scientists' network was dominated by interrelated themes representing ecosystem services including "beach tourism," the most important theme (wd = 27, b = 1608), "seascape aesthetics," "birdwatching," "harvestable fish," "nautical recreation," "coastal protection," "biodiversity," "scientific research," and so on.

Fig. 5. Relative importance (weighted degree) of all themes associated with trends (yellow) since the creation of the marine protected area (MPA), and pressures (purple) occurring in the area. Bar plots show themes of the five networks: fishers, fish vendors, tourism operators, scientists, and MPA managers.



Although scientists focused more on ecosystem services, their network also had a few themes representing well-being attributes. These included "income," which is linked to both "beach tourism" and "wilderness"; "health," which is linked to "seascape aesthetics"; and "historical heritage" and "historical shipwrecks," which represent the cultural and historical legacy derived from local maritime history and from knowledge of underwater archaeological sites.

Similar to other groups, scientists also perceived "declining fish stocks," "same fish diversity," "declining fauna," and "changing species distribution" since the creation of the MPA. In their network, "declining fish stocks" was linked to "illegal glass eel fishing," "overfishing," and "ghost fishing," a term that represents lost or abandoned fishing gear at sea that causes continued fish mortality. These linkages show that interviewed scientists associated declining fish stocks with fisheries that occur inside the MPA.

MPA managers

Like scientists, interviewed MPA managers also placed more emphasis on the ecosystem services provided in the MPA than well-being attributes (Fig. 8). Three-quarters of their themes were related to ecosystem services and one-quarter to well-being attributes (Fig. 2). The most important ecosystem services perceived by managers were "beach tourism" and "harvestable fish" (wd = 24, b = 612; wd = 24, b = 586), followed by "nautical recreation" and "biodiversity." These interlinked themes suggest that managers perceived the interconnected nature of ecosystem service provision in the MPA.

Although less important than ecosystem services, MPA managers acknowledged the significance of the well-being benefits provided by the area. They recognized the importance of "sense of place," "quality of life," "knowledge about nature," and "cultural heritage."

"Increasing coastal erosion" was the most important trend in the networks of MPA managers, scientists, and tourism operators (Fig. 5). For managers and scientists, this trend was linked with "human pressure" and "beach tourism." Scientists also associate this trend to themes related to negative opinions about MPA management, such as "poor planning" and "lack of capacity." In contrast, tourism operators connected "increasing coastal erosion" with themes representing suggestions for MPA improvement, such as "solve inlet issue" and "promote environmental education." Coastal erosion is a complex phenomenon in the area, with numerous potential causes and pathways for mitigation, as indicated by the perceptions of interviewees and focus group participants.

Fig. 6. Maritime tourism operators' network with themes from interviews and focus group discussions. Themes are classified by category: ecosystem services (dark green); human well-being attributes (orange); positive (light green) and negative (pink) opinions of marine protected area (MPA) governance and management; trends (yellow) since the creation of the MPA; pressures (purple) occurring in the area; and suggestions (brown) for MPA management actions.

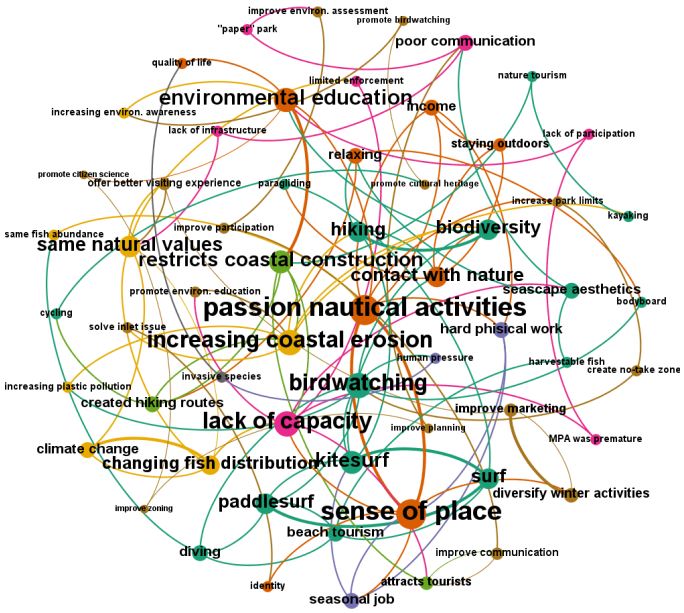
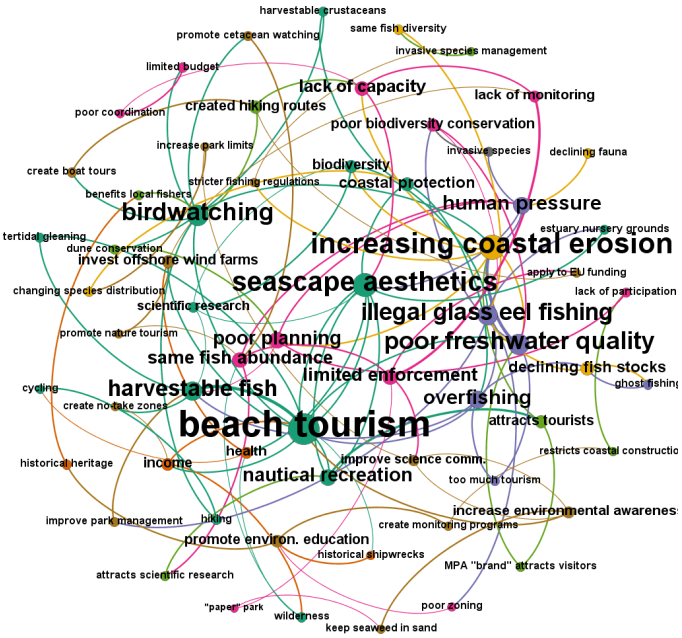


Fig. 7. Scientists' network with themes from interviews and focus group discussions. Themes are classified by category: ecosystem services (dark green); human well-being attributes (orange); positive (light green) and negative (pink) opinions of marine protected area (MPA) governance and management; trends (yellow) since the creation of the MPA; pressures (purple) occurring in the area; and suggestions (brown) for MPA management actions.



Views on MPA governance and management

Our analysis revealed a mismatch between the perceptions of MPA managers and those of the other stakeholder groups. Although managers generated both positive and negative opinions, all other groups produced more themes associated with negative opinions on local MPA governance and management (Fig. 9).

Negative views

The networks of fishers and scientists had the highest number of central themes associated with negative opinions about the MPA. For instance, interviewed fishers reported a "lack of participation" in MPA decisions (wd = 16, b = 295). They said that their voices were not properly heard before the MPA was created and that public hearings organized by MPA managers during the implementation phase were just to comply with formal obligations. One fisher commented:

> *Most people heard what they* [MPA managers] *had to say but that was already written. There was a public consultation but only for a few people and institutions. It was not for the fishers.* [Focus group A - fishers]

In the fishers' network, the theme "lack of participation" was connected to other themes associated with negative opinions such as "MPA for birds," "managers against fishing," and "fishers lack power." Similarly, in the fish vendors' network, "lack of participation" was linked to the theme "managers against fishing."

Both stakeholder groups argued that MPA managers were against fishing inside the MPA and supported the prohibition of fishing in the future. To illustrate this claim, one fisher stated:

> *That's what's going to happen* [prohibition of fishing inside the MPA]*, as far as I'm concerned. If it's not for us, it's going to be for the next generation of fishers.* [Focus group A - fishers]

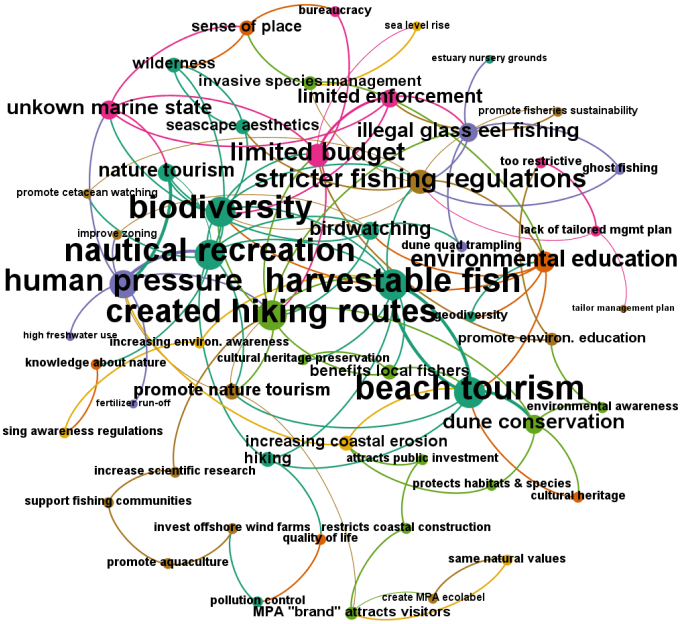
Both scientists and fishers perceived "same fish abundance" inside the MPA compared to before its implementation. This theme was linked to "limited enforcement" in the scientists' network, and to the "absence of no-take zones" in the fishers' network.

Other central themes conveying negative opinions in the scientists' network were "poor planning," which is linked to "lack of participation." Similarly, "lack of capacity" was connected to "lack of monitoring" and "poor coordination." On these topics, one scientist revealed:

> *The* [MPA's] *Advisory Council, for all intents and purposes, needs to provide an evaluation of the annual work plans and activity reports. There were only two meetings over these* [10] *years. Only one work plan and one activity report were analyzed. Both were poor.* [ID 4 - scientist]

The maritime tourism operators' network echoed similar themes as the scientists' network. The central theme conveying a negative opinion was "lack of capacity" (wd = 16, b = 1183), which is linked

Fig. 8. Marine protected area (MPA) managers' network with themes from interviews and focus group discussions. Themes are classified by category: ecosystem services (dark green); human well-being attributes (orange); positive (light green) and negative (pink) opinions of MPA governance and management; trends (yellow) since the creation of the MPA; pressures (purple) occurring in the area; and suggestions (brown) for MPA management actions.



to "limited enforcement" and "MPA was premature." In interviews, tourism operators expressed their dissatisfaction with the lack of a clear plan, vision, and appropriate management by MPA managers. They argued that the MPA is a "paper park" and was created prematurely. To support their claims, they mentioned that managers were still doing a species inventory 10 years after the MPA was created. Additionally, tourism operators criticized the MPA's lack of "presence" in the field and claimed that managers have no clear communication strategy to inform the public about the MPA limits, zoning, and usage restrictions. During a focus group discussion, a tourism operator noted the following:

> *In any nature park out there everything is marked, everything is signposted. There are rules for each space, there are spaces for people to use and how they should use them. Things have been thought out. There's nothing here. There is absolutely nothing.* [Focus group C - tourism operators]

MPA managers also identified a few areas of concern in the MPA's management, with the main issue being "limited budget." This theme was connected to "unknown marine state," "limited enforcement," and "bureaucracy" in their network. To illustrate these connections, one manager revealed:

> *The knowledge that we have* [about the status of marine ecosystems] *is not great ... We have a partnership with the Marine Ecology Forum,* [local association] *which gives us feedback on their diving activities because we do not have a boat to do diving activities.* [ID 2 - MPA manager]

Positive views

Despite the negative opinions expressed by some interviewees and focus group participants about MPA's management, not all views were negative. For instance, all groups referred positively to the coastal hiking routes created in the MPA, with wooden walkways that protect dunes and estuary margins from trampling. Additionally, groups praised the MPA's role in preventing urbanization on the coastline and mentioned positive environmental education activities done by MPA managers.

In addition to the positive aspects mentioned by interviewees and focus group participants, MPA managers highlighted that the MPA "benefits local fishers" and linked this theme to "cultural heritage preservation" and to the ecosystem services "harvestable fish" and "beach tourism." These connections highlight the perceived contributions of fisheries to the local culture, and managers believe that the MPA can increase the supply (harvestable fish) and demand (beach tourism) for fish in the area, benefiting local fishers.

MPA managers and tourism operators both highlighted the MPA's capacity to attract tourists, viewing it as a "brand" in the region. According to them, the MPA is "good for tourism" and beneficial for their nature-related activities. One tourism operator said:

> *I think the best thing that could have happened to Esposende* [the municipality], *namely for tourism operators, was the creation of a natural park.* [Focus group C - tourism operators]

Suggestions for MPA governance and management

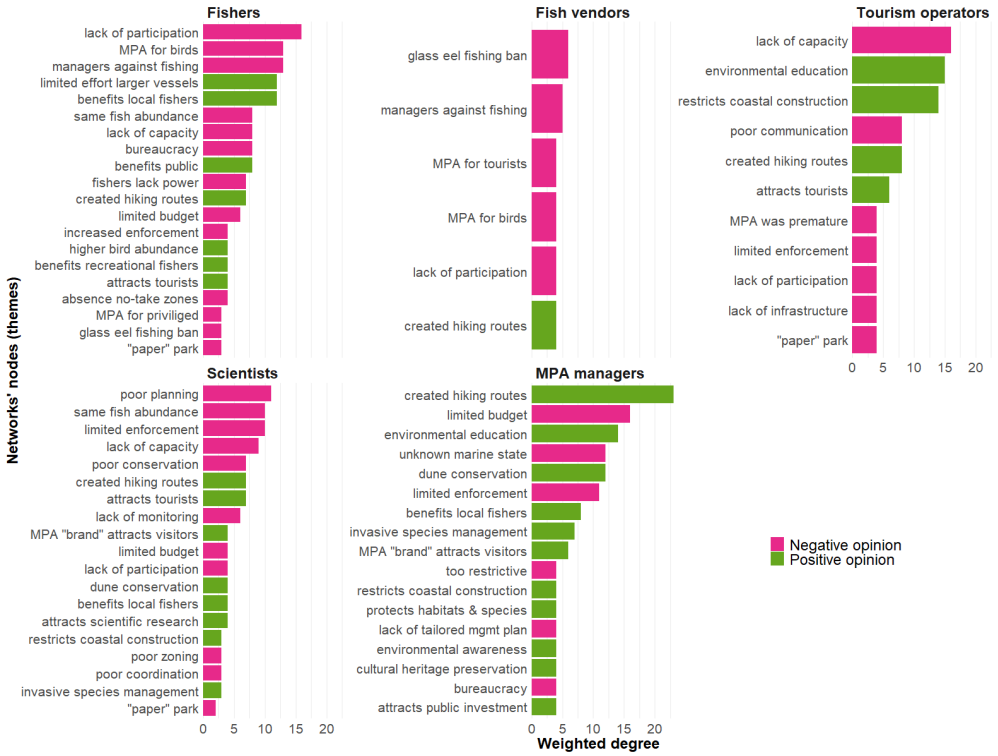
In order to help improve MPA governance and management, we asked stakeholders to provide suggestions based on their perceptions (Fig. 10). However, some of these suggestions contradict one another. For instance, while fishers proposed the "creation of glass eel fishing licenses" (wd = 27, b = 1108), managers and scientists supported "stricter fishing regulations" (wd = 17, b = 560; wd = 3, b = 121). Similarly, while managers suggested "stricter fishing regulations," others called for "support for fishing communities."

Yet, several suggestions shared commonalities among groups. Both fishers and tourism operators claimed that managers should "solve the inlet issue" to improve navigation safety when vessels go out to sea. All local resource users—fishers, fish vendors, and tourism operators—called for improved participation in MPA decisions. To this end, one fish vendor stated:

> *They* [MPA managers] *should arrange meetings with the fishers, should try to understand their side, what is right and what is wrong. Because fishers, in certain things, whether they like it or not, know better than they do.* [Focus group B - fish vendors]

The suggestion to "increase park limits" and "create no-take zones" as a means to improve the MPA was common among tourism operators and scientists. The theme "increase park limits" in the scientists' network was connected to the trend "changing species distribution," indicating that interviewed scientists believed that expanding the MPA's size and implementing stricter regulations could improve the ecological conditions of the area. The theme "create no-take zones" in the scientists' network was connected to "harvestable fish" and "income," suggesting that scientists believed that implementing no-take zones could increase revenue for fisheries by promoting a "spillover" effect.

Fig. 9. Relative importance (weighted degree) of all themes associated with positive (green) and negative (pink) opinions of marine protected area (MPA) governance and management. Bar plots show themes of the five networks: fishers, fish vendors, tourism operators, scientists, and MPA managers.



Improving MPA environmental assessments was a suggestion made by interviewed tourism operators. They argued that MPA managers should focus their efforts on improving baseline scientific knowledge, specifically on the abundance, richness, and status of species in the MPA. Once this information is available, tourism operators claimed that managers should improve planning and zoning according to the MPA's goals for biodiversity conservation.

Tourism operators also suggested that the MPA should increase its presence in the field by installing more and better signposts, as well as increasing the number of staff monitoring and patrolling the area. They proposed that infrastructure should be developed for MPA visitors to enhance their experience and to improve sea-related tourism activities. The group also emphasized the need for improved communication among all MPA stakeholders.

Throughout the interviews, managers argued for multiple uses inside the MPA. Key themes associated with their suggestions included "promote nature tourism," "support fishing communities," "promote aquaculture," "invest in offshore windfarms," "increase scientific research," "promote cetacean watching," and "create MPA ecolabel." These diverse proposals highlight the multifaceted perspectives on the use and conservation strategies within the MPA. Articulating stakeholders' proposals by identifying synergies and explicitly addressing contradictions and trade-offs can pave the way for promising management actions for the MPA.

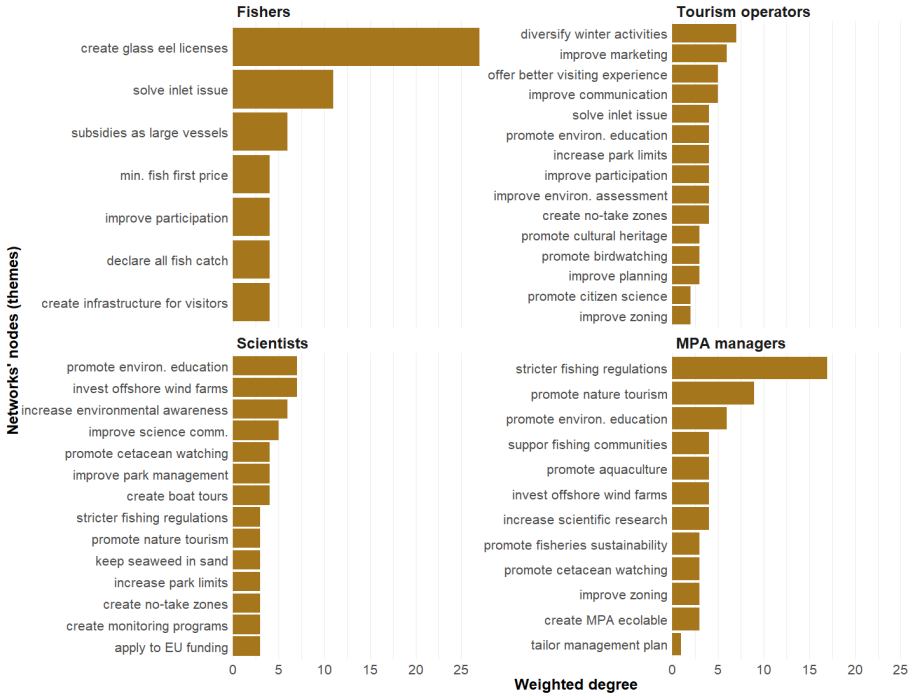
DISCUSSION

MPA success may face barriers due to lack of legitimacy and limited social support driven by perceived negative effects on ecosystem services and human well-being (Leleu et al. 2012, Bennett et al. 2019). Our results indicate a shared perception among local resource users, that is, fishers, fish vendors, and tourism operators, suggesting a decline in important ecosystem services and related human well-being attributes within Litoral Norte MPA. This shared perception contributes to mostly negative views on the governance and management of the MPA. Although our results may not be generalizable because of the relatively limited number of interviews and focus group discussions, they offer valuable insights that reveal pathways and barriers to MPA success. This knowledge can help conservation managers and policy makers in their efforts to improve the social and ecological outcomes of the MPA.

Perceived changes of ecosystem services and well-being attributes

We found that all stakeholder groups recognize ecosystem services and well-being attributes linked to Litoral Norte MPA. Local resource users reported a broader set of well-being attributes tied to ecosystem services, including identity, social relations, and sense of place. This broader perspective among resource users is likely influenced by their higher dependence, closer experience, and deeper relationships with the marine environment (Cárcamo et al. 2014, De Vos et al. 2018). This contrasts with scientists and MPA managers who reported fewer well-being attributes than local resource users, possibly because they do not depend directly on locally provided ecosystem services or belong to social groups

Fig. 10. Relative importance (weighted degree) of all themes associated with stakeholders' suggestions of marine protected area (MPA) management actions. Bar plots show fishers', tourism operators', scientists', and MPA managers' network themes. Results of fish vendors are omitted because their network only had one observation of this category (i.e., "improve participation," with a weighted degree of 6).



whose livelihoods are affected by the MPA (Bennett and Dearden 2014). Nevertheless, it is concerning that important ecosystem services linked to central well-being attributes are perceived to be declining within Litoral Norte.

This is the case of harvestable fish. Fishers and fish vendors perceive a decline in fish catch. They attribute this decline mostly to the increasing fishing effort by large vessels near the limits of the MPA, reduced sea access, rising pollution, and climate change. In contrast, scientists link the perceived decline mostly to overfishing and illegal fishing, while tourism operators associate it with changing fish distribution due to climate change. Addressing these complexities requires comprehensive studies that assess the state of fish populations and the impacts of fishing inside and in the vicinity of the Litoral Norte MPA (Corrales et al. 2020). Despite these different perspectives, the perceived fish catch decline and its underlying causes are connected to central well-being attributes for fishers and fish vendors, including identity, health, income, and social relations, and were also linked to negative themes such as stress and feelings of persecution by local authorities, resulting in negative social impacts (Gollan and Barclay 2020). These perceptions reflect how some fishers and fish vendors view the MPA: a tool against fishing designed for nature conservation and tourism. This raises questions of equity, justice, and power within the MPA because it suggests that the perspectives and needs of certain social groups, in this case fishers and fish vendors who rely on local resources for survival, are not adequately addressed (Bennett et al. 2021).

Nevertheless, perceptions as these held by fishers and fish vendors are common in marine conservation interventions (Mangi and Austen 2008, Bennett and Dearden 2014, Sowman and Sunde 2018, Pita et al. 2020), even when limited impacts of MPAs on fishing are recognized (McNeill et al. 2018). These perceptions may be explained because of a lack of trust and unmet expectations created by MPAs, such as increased catch, higher revenues, and better protection of the ecosystem (Pita et al. 2020). This can help explain fishers' and fish vendors' perceptions about the Litoral Norte MPA. Unchecked, these negative views can hinder the future of the MPA. They can lead to widespread non-compliance with rules and regulations, poaching, and pollution (Francolini et al. 2023). To mitigate these challenges, MPA managers should recognize and explicitly articulate these perceptions into concrete actions aimed at building trust, managing expectations and conflict, enhancing active participation in MPA decisions, and fostering collective deliberation on what matters to whom (McNeill et al. 2018, Bennett et al. 2019). This strategy can ultimately lead to more equitable conservation decisions (Zafra-Calvo et al. 2019).

For scientists, MPA managers, and tourism operators the main (negative) trend in the MPA was increasing coastal erosion. This points to a decline in coastal protection, an important ecosystem service provided by beaches, dunes, and other ecosystems of the coastal fringe (Spalding et al. 2014). The coastal fringe of Litoral Norte, which covers about 14% of the MPA, is undergoing severe erosion, with increasing beach retreat and dune breaching, mostly in winter months. Interviewed managers and scientists associate

increasing coastal erosion in the region with human pressure and beach tourism. Studies conducted in Portugal indicate that increasing urbanization of the coastal zone as well as sea level rise are among the primary causes of sedimentary deficits in the coast, causing negative ecological, social, and economic impacts (Freire et al. 2009, Santos et al. 2014, Almeida and Silva 2021). To address this issue, policy makers and managers can consider implementing coastal risk assessments. Such assessments can identify the most vulnerable areas and aid in prioritizing management actions to halt and prevent coastal erosion (Ferreira et al. 2021).

On the positive side, tourism operators highlighted the significant role of the MPA in providing and safeguarding other ecosystem services such as seascape aesthetics and nautical recreation. These ecosystem services were linked to well-being attributes including sense of place, knowledge about nature, and income. Preserving these benefits requires focused efforts from policies and management actions (Ban et al. 2019). For instance, efforts can be directed toward curbing coastal sprawl to protect seascape aesthetics. And measures can be implemented to ensure that nautical recreation is able to coexist with other maritime uses of the MPA. Positive perceptions such as those reported by tourism operators not only contribute to enhancing local support for marine conservation but are also necessary to ensure the long-term success of the Litoral Norte MPA (Bennett 2016).

Changing perceptions through effective governance and positive outcomes

Our findings reveal a clear mismatch between the opinions of managers on MPA governance and management and those of the other stakeholder groups. Managers tended to hold positive views related with the creation of coastal routes around the MPA, environmental education, and habitat conservation. But fishers, fish vendors, tourism operators, and scientists frequently expressed negative opinions. Their shared negative opinions were related to unsatisfactory participation in MPA decisions, poor community engagement, capacity constraints, and perceived difficulties of the MPA in generating positive social and ecological outcomes. Other studies reported similar findings. For example, Pita et al. (2020) found that fishers' acceptance of an MPA in Portugal did not increase even a decade after its establishment. This lack of acceptance was attributed to a perceived absence of positive ecological outcomes for fisheries, and distrust in the MPA goals and performance because of poor engagement and participation in the consultation processes during its implementation phase. In Western Australia, McNeill et al. (2018) reported that recreational and commercial fishers suffered most of the negative social impacts related with a local MPA, resulting in highly critical attitudes toward the protected area. On the other hand, non-extractive users who perceived broader community and ecological outcomes had mostly positive opinions about the MPA. In our study, fishers and fish vendors perceived the MPA mostly as a threat to their livelihoods and believed it to be incapable of generating positive outcomes. These negative perceptions are likely to persist while fishers and fish vendors view the MPA as not capable of delivering fisheries benefits.

The mismatch between positive views of MPA managers and negative views expressed by the other stakeholder groups raises concerns about the future of Litoral Norte MPA. This discrepancy may lead to low compliance with rules and regulations because of a lack of legitimacy, low social acceptability and support for the MPA (Pita et al. 2011, Voyer et al. 2015, McNeill et al. 2018). But these perceptions may change in the future. Social acceptability and support for conservation can increase through effective governance and the delivery of positive social and ecological outcomes (Leleu et al. 2012, Bennett et al. 2019).

Effective governance requires institutional diversity (Jones et al. 2011). It needs to combine bottom-up approaches, which benefit from detailed local knowledge, with top-down institutions, which are better suited to deal with social-ecological interlinkages across temporal and spatial scales (Cudney-Bueno and Basurto 2009). Bottom-up governance gives resource users and other members of the local community an active role through direct involvement, either as independent decision makers or in partnership with the government. Top-down governance, on the other hand, highlights the role of governments and experts in supplying information, rules, and enforcing regulations, taking advantage of the state's strength and resources (McCay and Jones 2011). The synergy between these approaches enhances institutional diversity, contributing to improved governance (Jones et al. 2011, Winkler et al. 2021).

Attaining positive social outcomes demands understanding stakeholder needs, interests, and aspirations (Daw et al. 2011, Pita et al. 2013). This requires disaggregating their perceptions, as we did here. The disaggregation of perceptions, such as those of fishers, fish vendors, and tourism operators, are valuable to inform participatory processes aimed at enhancing resource users' well-being, paving the way for more inclusive decisions (Jentoft et al. 2012, Di Franco et al. 2016). Increased participation in MPA decisions, as suggested by fishers, fish vendors, and tourism operators in our study, encourages compliance, increases legitimacy of decisions, builds trust, and decreases conflict (Andrade and Rhodes 2012, Villasante et al. 2021). These are positive social outcomes that are within reach.

However, MPA managers should be aware of the drawbacks of participatory processes. These include relatively high time and financial costs (Drakou et al. 2017), and unsatisfactory experiences for participants if they are not properly planned or facilitated (Kusters et al. 2018). Participatory processes, while important for improved decisions, should be complemented by empowering activities that engage stakeholders fully in conservation goals. Such empowering activities can include capacity building initiatives, environmental education activities, and effective and frequent communication between MPA managers, scientists, and local resource users (Pomeroy and Douvere 2008).

Enhanced social acceptability and support for conservation can also result from positive ecological outcomes. These are typically contingent on MPA design, enforcement, staff, and financial capacity (Edgar et al. 2014, Gill et al. 2017). The managers of Litoral Norte MPA acknowledged budget constraints in their work. This has resulted in limited knowledge on the current state of local biodiversity, a lack of staff to develop conservation initiatives, and limited capacity to enforce rules and regulations. Both the national government and municipal authorities have a responsibility to address budget, staff, and enforcement constraints to improve the ecological outcomes of the MPA.

Policy makers should reassess the current MPA design because it may not be suitable for achieving the government's goals for the protected area, including biodiversity conservation, and sustainable fisheries. Scientists, tourism operators, and even fishers have pointed out the absence of no-take zones in the MPA. No-take zones are areas where fishing and other extractive activities are not allowed. With proper inclusion of fishers in decision making (Lopes et al. 2013), they can enhance biodiversity protection and fisheries sustainability, potentially increasing harvestable fish because of a "spillover" effect (Halpern and Warner 2002, Halpern 2003, Edgar et al. 2014). For this, fishing needs to be controlled inside and outside the no-take zone (Lester et al. 2009). Policy makers and MPA managers should consider the designation of no-take zones in the Litoral Norte MPA to enhance biodiversity conservation and promote the sustainability of local fisheries.

Improving MPA management

Articulating stakeholders' perceptions, as we did here, can help identify promising management actions (Adams and Sandbrook 2013, Yates et al. 2019). For instance, fishers have proposed the improvement of conditions for accessing the sea through the estuary inlet. This action could improve safety conditions for fishers, mitigate the illegal glass eel fishing, and provide increased opportunities for marine fishing. Instead of relying on estuary fishing where glass eels are illegally caught, fishers would have greater access to the sea. As such, this management action holds the potential for both positive social and ecological outcomes.

In another recommendation, tourism operators urged MPA managers to intensify local community engagement with the MPA. This involves enhancing conservation outreach, promoting citizen science, and fostering increased communication with the local community. These actions can effectively involve local people in MPA-related activities, strengthening social networks and thus fostering institutional and social trust (Alexander and Armitage 2015). Improved institutional and social trust are crucial factors that can enhance perceived benefits and garner support for conservation initiatives (Jones et al. 2018, Villasante et al. 2021).

Involving the local community and understanding the perceptions and views of stakeholder groups can contribute to better decisions, increased social acceptability, and support for conservation (Yates and Schoeman 2015, Pendred et al. 2016, Jones et al. 2018). For instance, although current Litoral Norte MPA rules and regulations do not impose strict fishing restrictions, allowing fishers to operate inside the MPA, there is a ban on catching the critically endangered glass eel in the Cávado estuary, as previously mentioned. These restrictions have contributed to the lack of support for the MPA from fishers and fish vendors, who are denied access to glass eel fishing, one of their few sources of income during winter months when fishing activities cease because of rough sea and weather conditions. Although fishing a critically endangered species may not align with ethical and conservation considerations, MPA managers should openly and transparently recognize this source of conflict. Viewing this conflict as an opportunity, managers can collaborate with fisher and fish vendors to co-develop alternative sources of income during winter months. By targeting the underlying causes of negative perceptions, MPA managers can enhance social acceptability, garner approval, and secure local support for conservation efforts (Bennett and Dearden 2014).

Limitations

Although studying perceptions can shed light on how conservation initiatives can be improved (Bennett and Dearden 2014, Chaigneau and Brown 2016, Bennett et al. 2019), we acknowledge the limitations associated with the subjective nature of perceptions. According to Bennett (2016), the constructed nature of perceptions means that they may not objectively represent social and ecological outcomes. Additionally, perceptions may be intentionally inaccurate or used to infer causality when counterfactual evidence is lacking. Assessments of stakeholders' perceptions also tend to report more negative outcomes than those that objectively determine outcomes (Ban et al. 2019). This could be related to the identity of those measuring the outcome, that is, stakeholders versus scientists, and because objective and subjective measures capture different aspects of human well-being. Subjective measures are better suited for incommensurable well-being attributes, such as identity or sense of place (Ban et al. 2019, Garcia Rodrigues et al. 2022), while objective measures are commonly applied to material aspects of well-being, such as food security or income (Breslow et al. 2016).

Another limitation of our study is the relatively limited number of interviewed stakeholders from a single MPA in the Global North. Although our findings may not be generalized to other regions and contexts, the rich and insightful data obtained from our interviews and focus group discussions offer valuable insights. We believe our study contributes not only to understanding the social dimensions of Litoral Norte but also provides relevant insights for other MPAs with similar governance and management arrangements.

Future research can expand the scope of this study by targeting additional stakeholder groups, such as NGO representatives and recreational users, to assess their perceptions and views about MPA outcomes. Evaluating the perceptions of these stakeholders can provide further insight into the pathways and barriers to MPA success. As highlighted by Ban et al. (2019), another avenue for future research involves assessing MPA outcomes on a network scale, rather than focusing on single MPAs, given the increasing establishment of MPA networks worldwide, including in Portugal. Moreover, it is crucial to focus on researching effective and desirable co-creation and co-development processes involving local communities, key stakeholder groups and decision makers. In doing so, we can improve our understanding to help develop conservation initiatives that are more legitimate, inclusive, equitable, and just for all.

CONCLUSION

A comprehensive evaluation of the impacts of MPAs on local communities is necessary for effective governance and management. This includes understanding the views of key stakeholder groups, including local resource users. In our study, we examine the perceptions of fishers, fish vendors, maritime tourism operators, scientists, and managers on the Litoral Norte MPA in Portugal. For this, we use a mixed methods approach,

including a qualitative thematic analysis and quantitative network analysis derived from interviews and focus group discussions. Although some stakeholders highlight the role of the MPA in safeguarding some ecosystem services, such as seascape aesthetics, our results also show that most stakeholder groups perceive a decline in other important ecosystem services, including harvestable fish and coastal protection, and a decrease in related human well-being attributes, such as identity, sense of place, and income. These perceived declines in ecosystem services and human well-being attributes within the MPA predominantly result in negative views on the MPA's governance and management.

To improve governance and management, policy makers and conservation managers must address these perceived declines, consider stakeholders' views and recommendations, and work toward improving the social and ecological outcomes of the MPA. To achieve this, stakeholder groups have suggested that decisions within the MPA should aim to enhance local community engagement with the MPA, co-develop with local resource users alternative sources of income for winter months, improve safety conditions to access the sea, and view conflicts as opportunities to co-create new conservation initiatives with local resource users. A closer cooperation between policy makers, conservation managers, scientists, and local resource users can foster increased support for conservation efforts and ultimately lead to positive outcomes for both nature and people.

Author Contributions:

JGR conceived the project and designed the study, collected and analyzed the data, prepared all figures and tables, and wrote the first versions of the manuscript. SV and ISP contributed to the final version of the manuscript and supervised the research project.

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Data Availability:

The network data supporting the findings of this study are available upon request from the corresponding author, JGR. The remaining data are not publicly available because they contain information that could compromise the privacy of research participants. Our data collection and analysis followed the guidelines provided by the European Commission's "Ethics in Social Sciences and Humanities." Ethical approval was not granted to this study because of the absence of a committee for research ethics in our research institutions at the time of data collection and analysis.

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Appendix 1. Interview guide

Part 1. Social and ecological importance of Litoral Norte MPA

1. To begin, could you please elaborate on your current functions/activities within the scope of the Litoral Norte MPA?
2. If you had to describe the Litoral Norte area to someone who is completely unfamiliar with it, how would you do so? What is the current environmental state of the areas you have described?
3. What does the Litoral Norte area represent to you, taking into account its marine and coastal areas, as well as the estuaries of Cávado and Neiva?
4. In your opinion, what are the most important areas within the Litoral Norte MPA, and why do you consider them as such?
5. In your view, which groups of people and activities are most dependent on the natural resources of the Litoral Norte MPA, and how do these activities contribute to the well-being of those involved?

Part 2. Changes since the creation of the MPA and suggestions for improvement

6. Have you noticed any differences in the area since the creation of the MPA in 2005? If so, what are they? If not, why do you think there have been no changes?
7. What are the positive and negative aspects of creating the MPA?
8. In your opinion, who are the main winners and losers of the establishment of the MPA?
9. Do you identify any problems or threats to the MPA (environmental, social, economic, cultural)? If yes, what are they?
10. Are there any conflicts between sectors or groups of people who use the MPA? If yes, what are they?
11. In your opinion, what can be done to solve the problems and conflicts you have identified?

Part 3. Governance and management of the MPA

12. I would like to know your opinion about the governance and management of Litoral Norte MPA. What is your opinion about how the MPA is organized and how decisions are made to manage the MPA?
13. Would you like to add anything else to the answers you have provided here? Is there any topic that we haven't discussed that you consider relevant?

Appendix 2. Focus group discussions guide

Part 1. Introduction

1. To begin, I would like each of you to introduce yourselves. Could you tell us how long you have been living and working in Litoral Norte?
2. Now that we have all introduced ourselves, I would like you to talk about the sea in Litoral Norte. What is this sea like?
3. What is it like to work in sea-related activities? Can you tell us the positive aspects about working in these activities?
4. Are there negative aspects about working here? If so, can you elaborate on them?

Part 2. Wellbeing derived from sea-related activities

5. Now I would like you to think about how you benefit from this area. What does the sea give you and the activities you are involved in that makes you want to continue doing them? You have a few minutes to think and write down the most important things that the sea provides to you and your community. When you're done, we'll discuss your answers.
6. Now I would like you to tell me about the meaning of doing these activities. Do you do it just to receive an income, or do you do it for other reasons as well? In addition to the income you derive from these activities, are there other things that make you enjoy your work? You have a few minutes to write down the most important things that make you enjoy your work. When you're done, we'll discuss your answers.

Part 3. Changes since the creation of the MPA

7. You mentioned that the issues [mentioned before] are very important to you and your activity. Are these issues better or worse than they were 10

years ago [about when the MPA was created]? What has made those issues better/worse?

Part 4. Governance and management of the MPA

8. Now I would like to hear your opinion about Litoral Norte. What do you think about this MPA?
9. If you had the power to change the way the MPA operates, what changes would you make and why?
10. The objective of today's discussion was to learn more about your activities and to understand the effect that the MPA has had on these activities. Is there any topic that we haven't discussed here that we should have talked about?