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**Abstract**

Global conservation policy requires the scaling up of effectively and equitably managed networks of MPAs. While progress has been made on spatial coverage of MPAs, the fundamental aspects of effectiveness and equity may be falling short. Past research has focused on MPA management effectiveness, but less attention has been given to social equity in MPAs. Equity is important as MPAs are often created in areas of the marine and coastal environment where local communities exist and that small-scale fishers (SSF) use for their livelihoods. Social equity is comprised of recognitional, procedural and distributional dimensions. This study assessed the perceptions of SSF regarding these three dimensions of equity using quantitative surveys across 11 MPAs in 6 countries in the Mediterranean Sea. We developed composite scores for recognitional, procedural, and distributional equity, as well as a combined social equity score. Descriptive results showed that SSF perceptions were slightly skewed toward the positive for all social equity scores. We employed models to understand the relationship of MPA, country, and SSF demographics and characteristics with perceptions of equity. Mixed effects models showed that MPAs were the most consistent and significant predictor of perceptions of social equity. Fishers' age also had a significant negative effect on perceptions of recognitional equity and relative wealth and number of livelihoods had a significant positive effect on perceptions of distributional equity. This paper presents a novel method for using stakeholder perceptions to examine social equity that might be adapted and applied to marine and terrestrial conservation initiatives elsewhere.



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| **Keywords** | Social equity; marine protected areas; protected area management; environmental governance; small-scale fisheries; conservation social science |



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Equity, MPAs & SSF in Med Sea - Highlights.docx [Highlights]

Equity, MPAs & SSF in Med Sea - Title Page.docx [Title Page (with Author Details)]

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Figure1.jpg [Figure]

Figure2.jpg [Figure]

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Equity, MPAs & SSF in Med Sea - Supplementary Materials.docx [Supporting File]

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There are no linked research data sets for this submission. The following reason is given:
The data that has been used is confidential

Nathan J. Bennett
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July 29, 2019

Dear Editorial Board of Biological Conservation

**Re: Manuscript submission to Biological Conservation**

Please accept this letter and attached documents as a manuscript submission to Biological Conservation for the article titled: *Social equity and marine protected areas: Perceptions of small-scale fishermen in the Mediterranean Sea.*

Global conservation policy requires the scaling up of effectively and equitably managed networks of MPAs. While progress has been made on spatial coverage of MPAs, the fundamental aspects of effectiveness and equity may be falling short. This paper focuses on social equity in marine protected areas. This study assessed the perceptions of SSF regarding equity using surveys in 11 MPAs in the Mediterranean Sea. This paper presents a novel method for using stakeholder perceptions to examine social equity in conservation that might be applied elsewhere.

This is to attest that:

- The work is all original research carried out by the authors.
- All authors agree with the contents of the manuscript and its submission to the journal.
- This article is part of a larger research project with multiple parts and collaborators. This aspect of the research project has not been published elsewhere.
- The manuscript is not being considered for publication elsewhere while it is being considered for publication in this journal.
- Any research in the paper not carried out by the authors is fully acknowledged in the manuscript.
- All sources of funding are acknowledged in the manuscript.
- All appropriate ethics and other approvals were obtained for the research.

We trust that this information will allow you to process this manuscript. If you have any questions regarding the details of this submission, please do not hesitate to contact me at the above address or via telephone (236-886-6572) or email (nathan.bennett@ubc.ca).

Sincerely,

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## Highlights

- Global conservation policy requires the scaling up of effectively and equitably managed networks of MPAs.
- While progress has been made on spatial coverage of MPAs, the fundamental aspects of effectiveness and equity may be falling short.
- Social equity is comprised of recognitional, procedural and distributional dimensions.
- This study assessed the perceptions of SSF regarding equity using surveys in 11 MPAs in the Mediterranean Sea.
- This paper presents a novel method for using stakeholder perceptions to examine social equity in conservation.

# Title Page

## Social equity and marine protected areas: Perceptions of small-scale fishermen in the Mediterranean Sea

**Journal:** Biological Conservation

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# Main Manuscript

## Social equity and marine protected areas: Perceptions of small-scale fishermen in the Mediterranean Sea

**Abstract:** Global conservation policy requires the scaling up of effectively and equitably managed networks of MPAs. While progress has been made on spatial coverage of MPAs, the fundamental aspects of effectiveness and equity may be falling short. Past research has focused on MPA management effectiveness, but less attention has been given to social equity in MPAs. Equity is important as MPAs are often created in areas of the marine and coastal environment where local communities exist and that small-scale fishers (SSF) use for their livelihoods. Social equity is comprised of recognitional, procedural and distributional dimensions. This study assessed the perceptions of SSF regarding these three dimensions of equity using quantitative surveys across 11 MPAs in 6 countries in the Mediterranean Sea. We developed composite scores for recognitional, procedural, and distributional equity, as well as a combined social equity score. Descriptive results showed that SSF perceptions were slightly skewed toward the positive for all social equity scores. We employed models to understand the relationship of MPA, country, and SSF demographics and characteristics with perceptions of equity. Mixed effects models showed that MPAs were the most consistent and significant predictor of perceptions of social equity. Fishers' age also had a significant negative effect on perceptions of recognitional equity and relative wealth and number of livelihoods had a significant positive effect on perceptions of distributional equity. This paper presents a novel method for using stakeholder perceptions to examine social equity that might be adapted and applied to marine and terrestrial conservation initiatives elsewhere.

**Keywords:** Social equity; marine protected areas; protected area management; environmental governance; small-scale fisheries; conservation social science

## 1 Introduction

### 1.1 Background

Protected areas around the world are often created in locations where local people and resource-users live and work. In the past, it was common to create both terrestrial and marine protected areas without inclusion or consideration of local people's needs, livelihoods and perspectives (Bennett et al., 2017; Dearden and Bennett, 2016). Indeed, many conservation initiatives purposefully excluded local people from decision-making and displaced them from areas critical to their livelihoods (Agrawal and Redford, 2009; Brockington and Igoe, 2006; Sandlos, 2011). The rationale for this separation of humans from nature was that this was needed to achieve environmental protection objectives. Despite the fact that conservation of the environment has the potential to produce positive outcomes for the long term prosperity and well-being of local communities (Ban et al., 2019; IUCN, 2005; Leisher et al., 2007; Naidoo et al., 2019), exclusionary conservation practices have also produced a number of well-documented negative impacts for local people (Sowman and Sunde, 2018; West et al., 2006; West and Brockington, 2006). In recent years, however, conservation policy and practice has sought a more balanced and equitable approach to reconcile the relationship between protected areas and local people (Augustine and Dearden, 2014; Borrini et al., 2004; Bray and Velazquez, 2009; Lele et al., 2010; Lockwood, 2010).

Marine protected areas (MPA) policies and practice have followed this trajectory from strict exclusion towards consideration and inclusion of local people and stakeholders (Christie et al., 2017; De Santo et al., 2011; Freeman et al., 2018; Gurney et al., 2015; Hill et al., 2016; Jones, 2009; Micheli and Niccolini, 2013). MPAs are a spatial tool employed worldwide for marine conservation and fisheries management (Day et al., 2012; Kelleher and Kenchington, 1992). However, they are often created in marine and coastal areas that are historically used and relied on by small-scale fishermen (SSF), fisherwomen and indigenous peoples (Ban and Frid, 2018; Di Franco et al., 2016; Guénette et al., 2008; Kleiber et al., 2018). This spatial overlap has led many researchers and practitioners to argue that the rights, needs, and livelihoods of local people and indigenous communities must be taken into account in the planning and management of MPAs (Bennett et al., 2017; Charles et al., 2016a). Furthermore, signatories to the Convention on Biological Diversity (CBD) have agreed to create networks of MPA in 10% of the oceans by 2020 that are both "effectively" and "equitably" managed. While progress has been made on spatial coverage, with more than 6.97% of the global oceans and 16.03% of territorial waters covered in MPAs (Álvarez-Romero et al., 2018), the achievement of equally important qualitative elements of "effectiveness" and "equity" may be falling short (De Santo, 2013a; Spalding et al., 2016).

## 1.2 Social equity in conservation

While there has been growing attention to the topic of MPA management effectiveness (Fox et al., 2014; Gill et al., 2017; Pomeroy et al., 2004; Scianna et al., 2019), substantially less research effort has gone into understanding social equity in MPAs. Several notable exceptions include: research by Jones (2009) examining the perspectives of fishermen on the social equity implications of no-take MPAs in England; an examination of the impacts of the Marianas Trench Marine National Monument on access for traditional indigenous communities (Richmond and Kotowicz, 2015); a study on MPAs in Japan and the Solomon Islands that emphasizes the importance of considering the perspectives of stakeholders in achieving equity (Hill et al., 2016); and several papers on balancing distributional equity with conservation in MPA network reserve planning (Gurney et al., 2015; Halpern et al., 2013; Kockel et al., 2019). Though not explicitly focused on social equity, numerous studies have also touched on other closely related topics in the context of MPAs, including research on human well-being and benefits (Ban et al., 2019; Gjertsen, 2005; Mahajan and Daw, 2016), participation and co-management in governance (Bennett et al., 2017; Cormier-Salem, 2014; Gaymer et al., 2014; Hogg et al., 2017), rights (Ban and Frid, 2018; Mascia and Claus, 2009), justice (De Santo, 2013b; Gustavsson et al., 2014), livelihoods (Bennett and Dearden, 2014; Charles et al., 2016a; Cinner et al., 2014), and social impacts (Gill et al., 2019; Mascia et al., 2010; Sowman and Sunde, 2018). There has also been a recent surge in publications on social equity in relation to terrestrial protected area and conservation more broadly (Dawson et al., 2018; Friedman et al., 2018, 2018; McDermott et al., 2013; Moreaux et al., 2018; Pascual et al., 2014; Schreckenberg et al., 2016; Sikor et al., 2014; Zafra-Calvo et al., 2019, 2017).

In sum, this literature points to three dimensions of social equity that need to be considered in conservation: recognitional, procedural and distributional equity. In this paper, we build on the definitions proposed in the literature (McDermott et al., 2013; Pascual et al., 2014; Schreckenberg et al., 2016; Zafra-Calvo et al., 2019) to define the three dimensions as follows:

- Recognitional equity – Acknowledgement and representation of the rights, cultures and identities, values and visions, knowledge systems and livelihoods of local groups in conservation planning and management.
- Procedural equity – Inclusive and effective participation of all relevant actors and groups in rule and decision-making for conservation policies and programs.

- Distributional equity – The fair distribution of benefits and burdens between different groups, including current and future generations, of the outcomes of conservation actions.

Zafra-Calvo et al. (2017) also developed a set of indicators (further discussed below) to be applied to measure each of the three dimensions of equity, and subsequently applied these indicators to a global study of 225 protected areas using a survey of individual representatives of community-based organizations (CBOs), non-governmental organizations (NGOs), governments, academics, and protected areas management. Results from this global study were aggregated for both terrestrial and marine protected areas. Furthermore, those surveyed in this study were primarily not those who relied on the resource for their livelihood.

### 1.3 Objectives and overview

This study contributes to the research on social equity in MPAs through examining the perspectives of local resource users. In particular, we used a quantitative survey to explore the perceptions of SSF of social equity in 11 MPAs from 6 countries across the northern Mediterranean Sea. Here we analyze SSF perceptions of recognitional, procedural, and distributional equity and compare how perceptions of equity differ across MPAs, countries and between SSF with different characteristics.

## 2 Methods

### 2.1 Research Context and Site Descriptions

The Mediterranean Sea is an enclosed sea with a surface area of approximately 2.5 million km$^2$. Three continents - Europe, Asia and Africa – lie to the north, east and south and it is surrounded by 20 countries and contains 2 island nations. The coastline is highly populated, dotted with large cities and small-villages, and used for a variety of purposes, including fishing, shipping, tourism, aquaculture, and other forms of intense development therefore rendering this region vulnerable to a multitude of threats (Micheli et al., 2013). This region is well acknowledged for its ecological and fisheries values (Azzurro et al., 2019; Coll et al., 2010; FAO, 2016; Giakoumi et al., 2013). Approximately 85% of fish stocks are harvested at biologically unsustainable levels, which has also led to declines in total catches from around 2 million tons in the 1980s to 787,000 tonnes in 2013 (FAO, 2016). It is estimated that there are 92,700 fishing boats in the Mediterranean and Black Sea, of which small-scale fishers account for ~80% (FAO, 2016). Due to the large number of countries surrounding the Mediterranean Sea, there are a suite of different fisheries management and marine conservation measures and frameworks, including an extensive network of marine protected areas (MPAs). In 2016, this included a total of 1,231 MPAs covering 7.14% of the Mediterranean Sea (MedPAN, 2016). However, their average size is relatively small (~5km$^2$) and only 0.04% of the area is covered with MPAs that are no-take or fully protected (PISCO and UNS, 2016). Most no-take MPAs are very small - almost half are between 0.01 and 1 km$^2$ (Di Franco et al., 2018).

We conducted research in the following MPAs: Cabo de Palos (Spain), Es Freus (Spain), Cap Roux (France), Côte Bleue (France), Bonifacio (France), Portofino (Italy), Egadi Islands (Italy), Torre Guaceto (Italy), Strunjan (Slovenia), Telašćica (Croatia) and Zakynthos (Greece) (Figure 1). The MPAs varied quite significantly in age since establishment (i.e., 1983-2003), size (90-76,000ha), and percentage no take area (2 -100% of the total MPA). In all cases, SSF lived in communities within or near the MPAs – and their numbers ranged from 5-40 according to local key informants (Table 1).


*Figure 1 – Map of case studies sites*

*Table* 1 *– Information about the selected marine protected areas, small-scale fishermen (SSF) and interview sample.*

| ***MPA Name*** | ***Designation*** | ***Established (year)*** | ***Age of MPA (years)*** | ***Total Area (ha)*** | ***Total No Take area (ha) (% of total)*** | ***Estimated # of SSF in each site*** | ***# of surveys (%) (Total n=149)*** |
|---|---|---|---|---|---|---|---|
| Cabo de Palos (Spain) | Marine Reserve | 1995 | 22 | 1931 | 270 (14.0) | 19 | 17 (89) |
| Es Freus (Spain) | Marine Reserve | 1999 | 18 | 15000 | 407 (2.7) | 18 | 12 (66) |
| Cap Roux (France) | Cantonnement de Pêche | 2003 | 14 | 445 | 445 (100) | 30 | 14 (46) |
| Côte Bleue (France) | Marine Park | 1983 | 35 | 9995 | 295 (3.0) | 27 | 17 (63) |
| Bonifacio (France) | Natural Reserve | 1999 | 18 | 76000 | 4000 (5.3) | 38 | 13 (34) |
| Portofino (Italy) | MPA | 1999 | 18 | 346 | 19 (5.5) | 22 | 15 (68) |
| Egadi Islands (Italy) | MPA | 1991 | 26 | 54000 | 1097 (2.0) | 40 | 21 (52) |
| Torre Guaceto (Italy) | MPA | 2001 | 16 | 2100 | 322 (15.3) | 5 | 5 (100) |
| Strunjan (Slovenia) | Landscape Park | 1990 | 27 | 90 | 33 (36.7) | 10 | 9 (90) |
| Telašćica (Croatia) | Nature Park | 1988 | 29 | 7000 | 141 (2.0) | 7 | 7 (100) |
| Zakynthos (Greece) | National Marine Park | 1999 | 18 | 8330 | 800 (9.6) | 35 | 19 (54) |

## 2.2 Survey and Sampling Methods

We developed and implemented a quantitative survey of small-scale fishermen in 11 Mediterranean MPAs. The survey focused on a broad set of questions related to the demographics (e.g., gender, age, education, location, origin, people in household) and characteristics (e.g., income from fisheries, diversification, dependence) of small-scale fishermen (**Error! Reference source not found.**), as well as perceptions of social equity and MPA management. Our use of perceptions of small-scale fishermen to evaluate levels of social equity is consistent with the idea that people will have different notions about what constitutes fair and acceptable (Bennett, 2016; Zafra-Calvo et al., 2019).

In this paper, we are focusing on a subset of survey questions and results related to social equity, which focused on recognitional, procedural, and distributional dimensions (see details in Table 2 and **Error! Reference source not found.**). In developing the survey items, we drew substantially from the indicators developed by Zafra-Calvo et al. (2017) while making significant modifications to the questions and developing some of our own indicators for additional attributes as explained below. For recognitional equity, we asked about the extent to which the cultural identity, rights, and traditional knowledge of SSF were taken into account in MPA management – and added an indicator related to consideration of SSF livelihoods. For procedural equity, we queried SSF perceptions of levels of participation, transparency, access to justice, accountability, and consultation and consent (i.e., Free, Prior and Informed Consent) – as well as developing new indicators related to communication of scientific information (i.e., "informed"), trust and legitimacy. For distributional equity, we developed a set of indicators related to the perceived social impacts of the MPA on different aspects of well-being – including income, livelihoods, food security, knowledge and education, community well-being, connection to nature, fish abundance and perceptions of fairness (in distribution of benefits) (Biedenweg et al., 2016; Breslow et al., 2016; Kaplan-Hallam and Bennett, 2018; Weeratunge et al., 2014). Responses to survey items were on different scales, ranging from 2-point to 5-point scales.

*Table 2 – Survey topics and questions related to recognitional, procedural an distributional equity (Note: All survey responses have been converted to the following symbols: ++=Very positive/+=Somewhat positive/N=Neutral/-=Somewhat negative/--=Very negative; See further details in **Error! Reference source not found.**)*

| Category | Attribute | Survey Questions | Potential Responses |
|---|---|---|---|
| Recognitional Equity | Rights | The rights of small-scale fishers are taken into account in MPA planning and management. | 5 point scale (--/-/N/+/++) |
| | Livelihoods | The MPA management aligns with the livelihood needs of small-scale fishers. | 5 point scale (--/-/N/+/++) |
| | Traditional Knowledge | The traditional knowledge of local small-scale fishers is documented and included in the MPA management | 5 point scale (--/-/N/+/++) |
| | Culture | The MPA acknowledges and celebrates the unique culture and practices of small-scale fishers. | 5 point scale (--/-/N/+/++) |
| Procedural Equity | Informed | Is there research and scientific information available (from the MPA management) about the marine environment and status of fisheries? | 5 point scale (--/-/N/+/++) |
| | Transparency | Is information about how MPA decisions are made and the reasons for MPA management decisions readily available? | 5 point scale (--/-/N/+/++) |
| | Participation | How much participation is there of small-scale fishermen in MPA decision-making and management activities? | 4 point scale (--/-/+/++) |
| | Consultation & consent | Which of the following statement describes the way that MPA management decisions are made with regards to consultation and consent? | 4 point scale (--/-/N/+/++) |
| | Accountability | When issues arise for small-scale fishers related to the management of the marine protected area you know with whom and how to communicate? | 2 point scale (-/+) |
| | Access to justice | Are there mechanisms to address disagreements or conflicts that arise between small-scale fishers and MPA management? | 4 point scale (--/-/+/++) |
| | Trust | How would you classify the level of trust between small-scale | 4 point scale (--/-/+/++) |

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| | | fisher's and MPA management? | |
| | Legitimacy | Please read the following statements and rate your level of satisfaction: The overall management activities for the MPA | 5 point scale (--/-/N/+/++) |
| Distributional Equity | Impacts on income | What do you think has been the impact of the MPA on your income? | 3 point scale (-/N/+) |
| | Impacts on livelihoods | How do you think the MPA has impacted your livelihood? | 4 point scale (--/-/+/++) |
| | Impacts on food security | In your opinion, how does the MPA impact the ability of small-scale fishers from the village to access and harvest fish for household consumption? | 3 point scale (-/N/+) |
| | Impacts on knowledge and education | Please, indicate how the MPA affects the following aspects of the village: The knowledge of education of children or adults in the village about the marine environment | 5 point scale (--/-/N/+/++) |
| | Impacts on community social well-being | Please, indicate how the MPA affects the following aspects of the village: Community activities and the overall sense of social well-being of people in the village | 5 point scale (--/-/N/+/++) |
| | Impacts on cultural connection to nature | Please, indicate how the MPA affects the following aspects of the village: The connection between people in the village and the local marine environment | 5 point scale (--/-/N/+/++) |
| | Impacts on fish abundance | In your opinion, the MPA is: decreasing/neither decreasing or increasing/increasing the number of fish | 3 point scale (-/N/+) |
| | Perceptions of fairness | How do you view the fairness of the overall impacts and benefits of the MPA? | 3 point scale (-/N/+) |

## 2.3 Data Analysis

All data analysis was completed in R Version 3.4.4 (R Core Team, 2018). First, we calculated descriptive statistics for all survey items focused on SSF demographics and characteristics, as well as for individual items related to the three categories of social equity.

Second, we created composite scores for each of the three categories of social equity using the individual indicators (see Table 2). Before composing scores, the dataset was treated to deal with missing values. Although the number of NAs in the dataset was low (3.6%), composite scores could not be computed for a given questionnaire when one of the composing items was a missing value. Therefore, NA correction was done to avoid discarding a number of questionnaires in score computation. Specifically, we used the mice package in R (van Buuren and Groothuis-Oudshoorn, 2010) that creates multiple imputations (replacement values) for multivariate missing data. The method is based on Fully Conditional Specification, where each incomplete variable is imputed by a separate model (van Buuren, 2007). Once missing variables were imputed, for each category of equity (recognitional, procedural and distributional) the composite score was calculated by firstly normalizing to 0-2 all individual items composing the score as they were previously on different scales. Normalized items were then summed up and the resulting sum normalized again to 0-10 so that each category of social equity was on the same scale. Before summing the single items, internal coherence of the items in each scale was checked using Chronbach's alpha co-efficient. No issue with internal coherence was highlighted for any of the 3 composite scores created (always >0.7). We also merged the 3 scores (recognitional, procedural and distributional) to create a combined equity score. This was done through summing the three composite equity scores, and then normalizing this new combined equity score on a scale of 0-10. We ran basic descriptive statistics to characterize the composition of all four equity scores.

Third, we ran single-factor models to test the relationship between each of the four composite equity scores and MPA, country, and demographics and characteristics of SSF. Single factor analysis was implemented as a way to assess large-scale patterns for each single predictor. Given the substantial absence of information about social equity in the context of MPAs and SSF, this preliminary approach was chosen to highlight eventual regional trends over the study domain. Specifically, MPA, country and

fishers' origin were used as factors in one-way ANOVAs. The number of years living in the village was treated as a continuous variable in a linear regression. All other predictors (namely: fishers' age, education, number of people in the household, relative wealth, percentage of incomes deriving from SSF, number of livelihoods, number of nights per week eating fish and fishery diversification) were ordinal. Thus, ANOVAs for factors with ordered levels were used (Gertheiss, 2014).

Finally, we used linear mixed effect models to test the predictive power of all predictors (i.e., MPA, country, origin, number of years living in the village, age, education, number of people in the household, relative wealth, percentage of incomes deriving from SSF, number of livelihoods, number of nights per week eating fish and fishery diversification) at the same time against each composite social equity score. In the linear mixed effect models (implementing the function lmer in the lme4 package R (Bates et al., 2015), MPA and country were considered random factors, while all other predictors were treated as fixed. Kenward-Roger F-test was implemented to test factor significance (Kenward and Roger, 1997). Pseudo-$R^2$ was used to calculate conditional and marginal coefficient of determination for the models and determining the proportion of variability explained by random and fixed components (Nakagawa et al., 2017).

## 3 Results

### 3.1 Sample and characteristics of small-scale fishers

Our sample consisted of 149 small-scale fishermen who lived within or near the 11 MPAs. The sample for each MPA ranged from 5 to 21, or roughly 34.2-100% of SSF in each area (based on information provided in each area by key informants). Many fishermen were in older age brackets, with 48.9% (n=72) older than 50 and only 6.8% (n=10) between 20-30 years of age. Most (72.3%; n=107) had completed only elementary or middle school. In terms of economic reliance on fisheries, for 39.9% (n=57) all of their income came from fisheries, while for 29.4% (n=42) it was more than half, and for 30.8% (n=44) it was less than half. Only 31.5% (n=45) reported that being a small-scale fisherman enables them to have a good quality of life, while 24.5% felt that "it can be challenging" and 44.1% said they are "just barely able" to make enough to live a good quality of life. Survey participants most often had 1 (53.3%; n=73) or 2 (39.4%; n=54) distinct livelihoods; however, fisheries portfolios were often quite diverse with those surveyed participating in an average of 2.8 distinct fisheries. Further details regarding the sample can be found in **Error! Reference source not found.**.

### 3.2 Perceptions of individual items related to social equity

The descriptive analysis of the individual items related to social equity showed varied results across social equity categories (see Figure 2 and **Error! Reference source not found.**). All of the indicators related to recognitional equity (i.e., culture, traditional knowledge, livelihoods, and rights) were slightly more slanted towards positive perceptions, but there was also a considerable spread from negative to positive evaluations. Different procedural indicators showed dissimilar results – with perceptions of legitimacy, voice and conflict management being balanced between positive and negative views, perceptions of accountability and consultation being slightly more positive, perceptions of trust and accountability being highly skewed towards the positive perceptions, and perceptions of communications of scientific information being slightly skewed towards the negative. Several indicators related to distributional equity were evaluated quite neutrally by participants – in particular for perceptions of impacts on incomes (64% neutral), food security (65% neutral), and impacts on community social well-being (49% neutral). Other distributional equity indicators showed different

results – with perceptions of impacts on knowledge and education being evaluated quite positively overall, perceptions of impacts on fish abundance, cultural connections to nature and livelihoods being skewed slightly towards the positive, and perceptions of fairness of impacts skewed slightly to the negative.

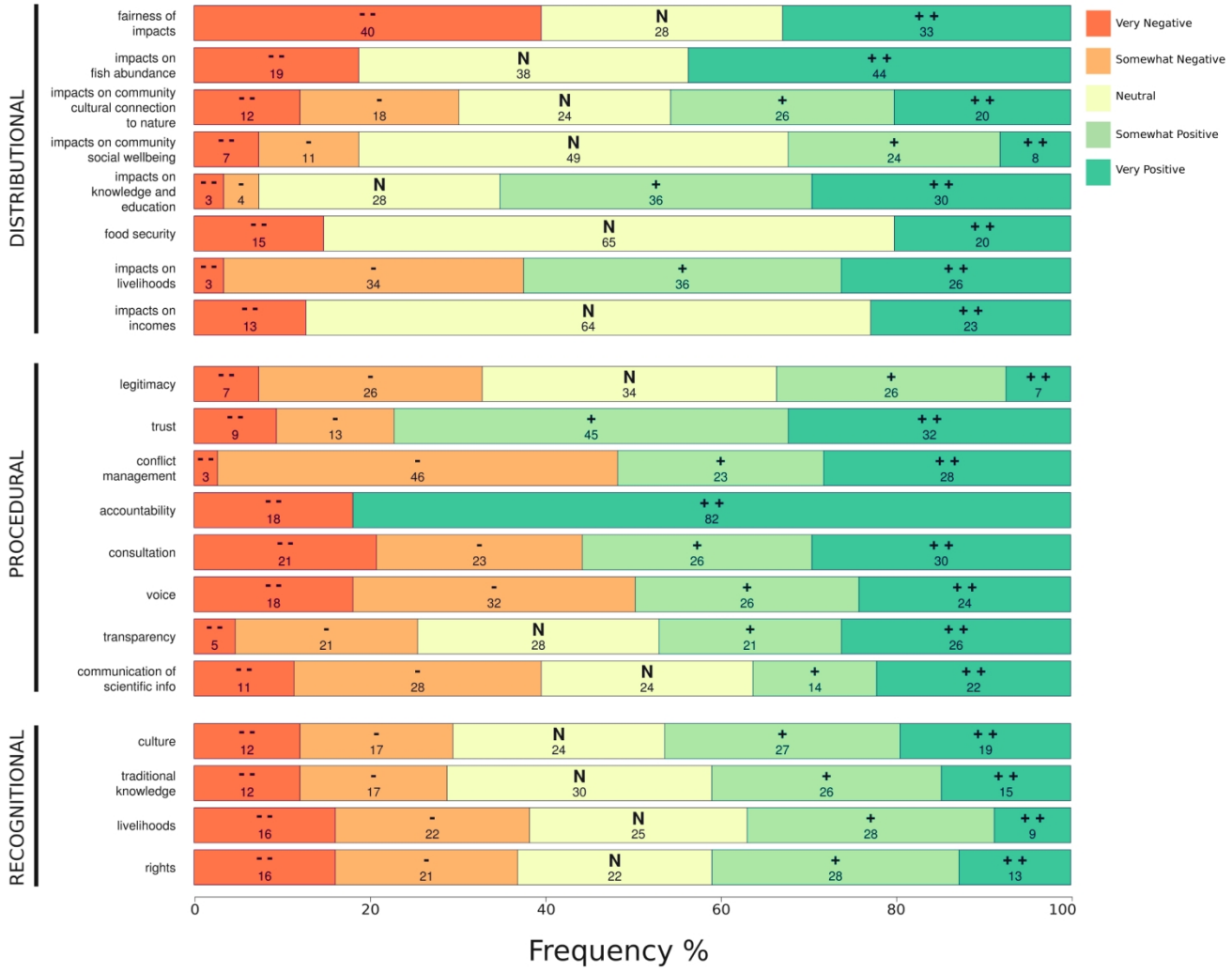


*Figure 2 – Stacked bar charts showing frequency distributions for all individual indicators of social equity, organized by recognitional, procedural, and distributional categories. For ease of communication, all survey responses have been converted to the following symbols: ++=Very positive/+=Somewhat positive/N=Neutral/-=Somewhat negative/--=Very negative (See Table 2 and* ***Error! Reference source not found.****). Numbers inside the bars indicate percentages. (Further details are provided in* ***Error! Reference source not found.****)*

## 3.3 Composite social equity scores

Descriptive analysis showed that the distributions of all composite social equity scores were slightly more positive than negative (Figure 3a and **Error! Reference source not found.**). The mean and standard deviations for each was as follows: recognitional equity (Mean = 5.19, sd = 2.7), procedural equity (Mean = 5.38, sd = 2.51), distributional equity (Mean = 5.48, sd = 2.26), and combined social equity (Mean = 5.34, sd = 2.21). When we re-categorized the scores into 5 categories,

ranging from very negative through to very positive, recognitional equity showed the largest variation with the least number of participants falling into the neutral category (n=32, %=21.48) and simultaneously the most positive and negative results (Figure 3b). For the combined social equity score, 37.58% of survey participants (n=56) fell within the neutral range, while 35.57% (n=53) were positive or very positive, and 26.84% (n=40) were negative or very negative.

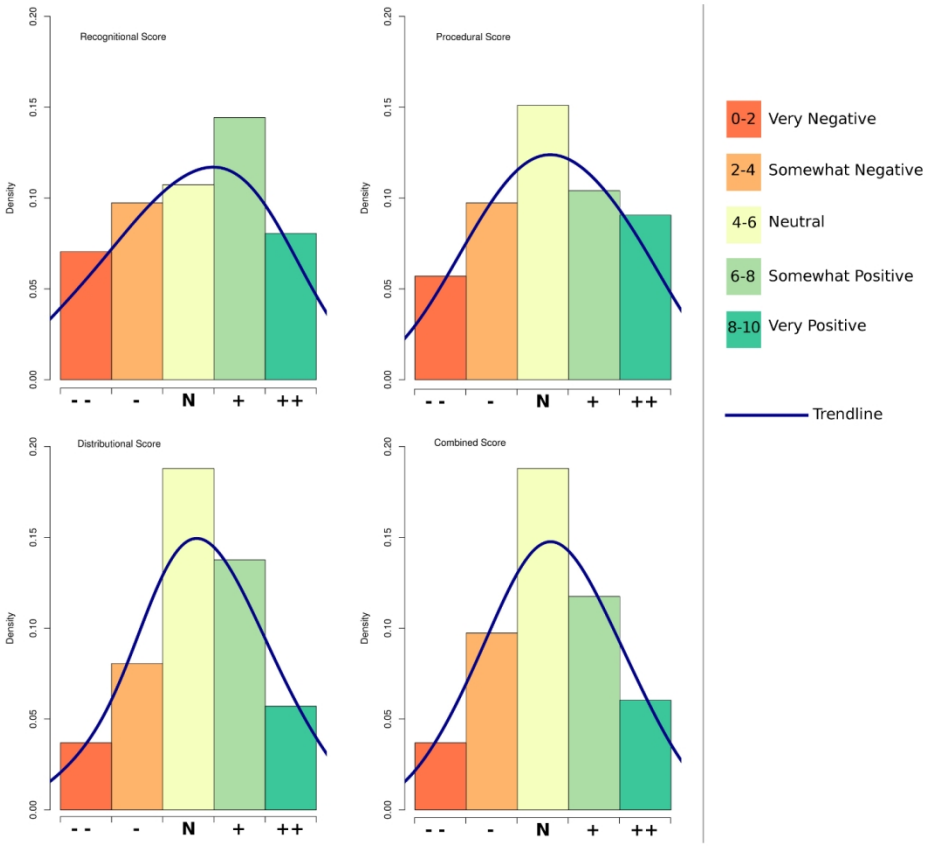


*Figure 3 - Frequency distribution of recognitional, procedural, distributional and combined equity scores. The blue lines represent smooth density estimates (Further details are provided in* ***Error! Reference source not found.****).*

## 3.4 Single-factor models for MPA, country, and social equity scores

One-way ANOVAs showed statistically significant differences among MPAs for the mean scores of all composite equity scores (Figure 4 and **Error! Reference source not found.**). The highest values of recognitional equity were recorded in Torre Guaceto 9.06 ± 0.16 (mean ± se) and Côte Bleue (8.05 ± 0.34) while the lowest scores were in Cabo de Palos (3.2 ± 0.63) and Zakynthos (3.65 ± 0.47). The same pattern of high scores was recorded for the procedural, recognitional, distributional and combined equity scores. For distributional equity the lowest mean value was recorded for Egadi (2.42 ± 0.39). Finally, for the combined equity score, low mean values were recorded for Cabo de Palos, Zakynthos and Egadi.

Single-factor models (ANOVAs) also showed significant differences, for all of the equity scores, between countries (Table 3 & **Error! Reference source not found.**). Overall, France and Slovenia were almost always associated with the highest mean scores, while Spain and Greece were associated with the

lowest scores. Slovenia and Italy had variable rankings depending on the score considered (**Error! Reference source not found.**).

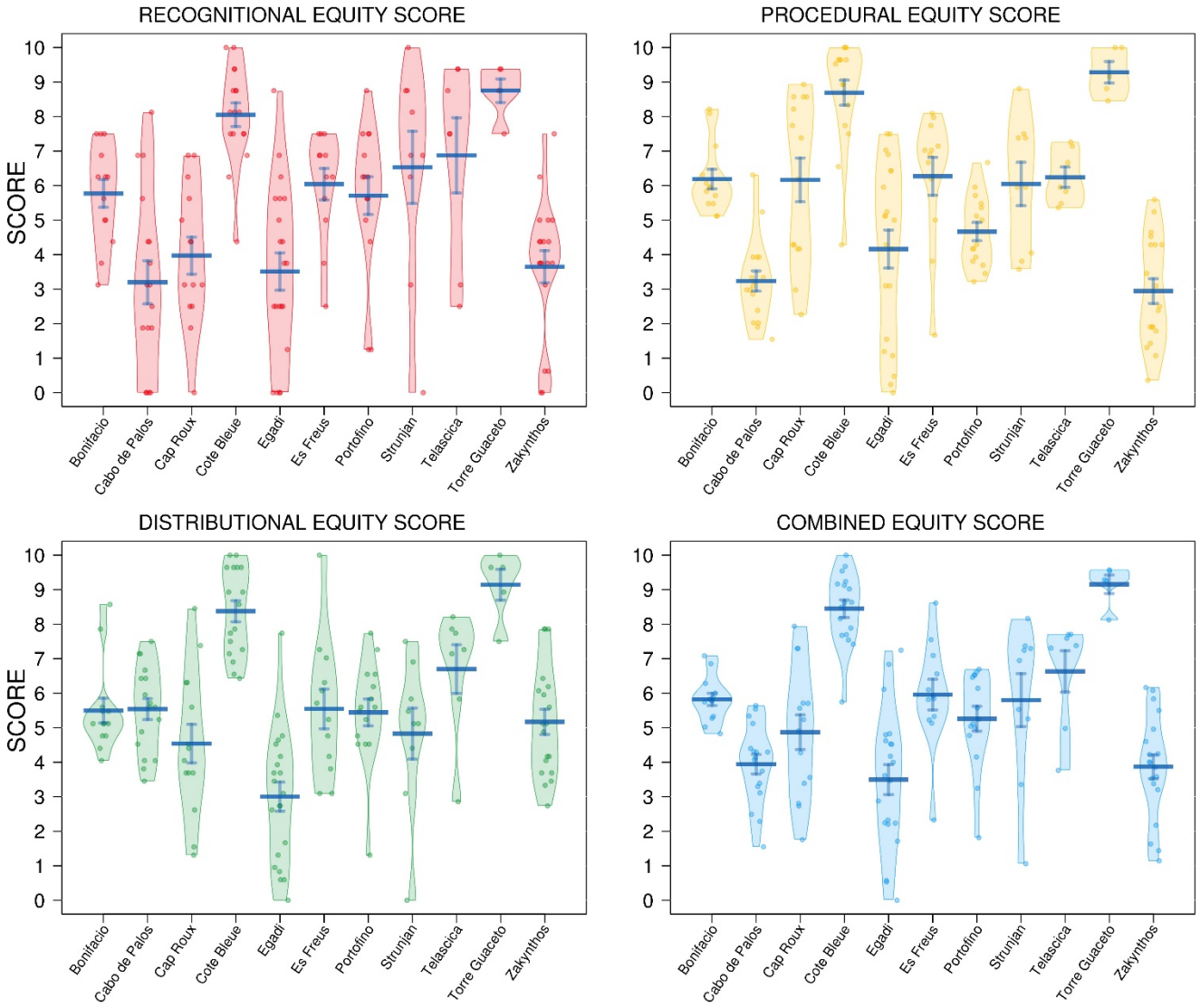


*Figure 4 - Pirate plots of composite social equity scores separated by marine protected area. Blue horizontal and vertical bars represent means and standard errors respectively.*

## 3.5 Single-factor models for SSF characteristic and social equity scores

For single-factor models, recognitional equity was negatively and significantly related with the proportion of SSF households incomes coming from fishing (i.e., as the proportion of income from fishing increased the distributional equity score decreased) and with the number of different gears used by fishers. Meanwhile, the recognitional equity score was positively and significantly related with higher levels of education. The same relationship with education was found also for procedural equity. Procedural equity was also significantly and negatively related with the number of people in a fisherman's household, the number of different gears used by a SSF, and the level of dependence on the seafood they catch for food. For distributional equity, the score was significantly and positively related

with SSF perceptions of relative wealth, i.e. fishers who felt they earned enough money to have a good life quality had higher values for distributional equity. Finally, the combined equity score was significantly and positively related with education, while negatively related with fishery diversification.

*Table 3 – Summary of results from univariate models of relationship between predictors and composite social equity scores. (Notes: The symbols ↗(+) or ↘(-) indicates the direction of the relationship for fixed factors with ordinal levels. Significance levels: ns=non-significant, .<0.1, *=p<0.05, **=p<0.01, ***=p<0.001)*

| **Predictors** | **Recognitional Equity Score (0-10)** | **Procedural Equity Score (0-10)** | **Distributional Equity Score (0-10)** | **Combined Equity Score (0-10)** |
|---|---|---|---|---|
| Associated MPA (ANOVA) | *** | *** | *** | *** |
| Associated country (ANOVA) | ** | *** | * | *** |
| Age (Ordered ANOVA) | ↘ ns | ↗ ns | ↘ ns | ↘ ns |
| Education (Ordered ANOVA) | ↗ * | ↗ * | ↗ ns | ↗ * |
| People in household (Ordered ANOVA) | ↘ ns | ↘ * | ↘ ns | ↘ ns |
| Years in village (linear regression) | ↘ ns | ↘ ns | ↘ ns | ↘ ns |
| Origin (ANOVA) | Ns | Ns | Ns | Ns |
| Relative wealth (Ordered ANOVA) | ↗ ns | ↗ ns | ↗ ** | ↗ ns |
| Percent income from fishing (Ordered ANOVA) | ↘ * | ↘ ns | ↗ ns | ↘ ns |
| Livelihood Multiplicity (Ordered ANOVA) | ↗ ns | ↘ ns | ↗ ns | ↘ ns |
| Fisheries Diversification (Ordered ANOVA) | ↘ * | ↘ * | ↘ ns | ↘ * |
| Dependence on fish for food (Ordered ANOVA) | ↘ ns | ↘ ** | ↗ ns | ↘ ns |

## 3.6 Mixed Effects Models

The linear mixed effect models showed a statistical effect of MPAs on all of the composite social equity scores, while country was not significant for all equity scores (Table 4). For each social equity score, variability in the data was mainly explained by the random component (i.e., MPA), with marginal $Rm^2$ (i.e. the variance explained by the fixed component) ranging between 0.12 and 0.22, and the conditional $Rm^2$ (variance explained by the entire model) ranging between 0.64 and 0.72 (specifically: Rm 0.22 – Rc 0.66 for the Recognitional equity score; Rm 0.12 – Rc 0.64 for the Procedural score; Rm 0.20 – Rc 0.69 for the Distributional score and Rm 0.13 – Rc 0.72 for the Combined score). Significant effects of some fixed components were also apparent. Age showed a significant effect ($p<0.01$) on the recognitional equity score, which decreased with increasing age (Figure 5a). This pattern was consistent among all MPAs, except for Torre Guaceto where respondents all belonged to the same age group. A similar pattern, although only marginally significant ($p<0.1$), was highlighted for age with distributional

and combined equity scores. Significant relationships ($p<0.05$) were also found between increasing levels of relative wealth (consistent across the MPAs) and the number of livelihoods and the distributional equity score (Figure 5b & c).

*Table 4 – Results of mixed effects models showing only remaining components that were significant. (Notes: Significance of fixed predictors resulting from F-test on the linear mixed models are as follows: .<0.1, *=p<0.05, **=p<0.01, ***=p<0.001; "neg" and "pos" indicates negative or positive trends.)*

| | Random component | | | | | Fixed component | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SCORE** | Predictor | Chisq | pvalue | Sig | $Rc^2$ | Predictor | df | Ftest | pvalue | Sig | Trend | $Rm^2$ |
| Recognitional | MPA | 33.96 | <0.0001 | *** | 0.66 | Age | 4 | 3.36 | 0.012 | * | neg | 0.22 |
| Procedural | MPA | 30.95 | <0.0001 | *** | 0.64 | | | | | | | 0.12 |
| Distributional | MPA | 46.06 | <0.0001 | *** | 0.69 | Years in village | 1 | 3.288 | 0.072 | . | pos | 0.2 |
| | | | | | | Relative wealth | 2 | 4.119 | <0.05 | * | pos | |
| | | | | | | Number of livelihoods | 2 | 3.542 | <0.05 | * | pos | |
| | | | | | | Fishery diversification | 5 | 1.905 | 0.099 | . | neg | |
| | | | | | | Age | 4 | 2.081 | 0.088 | . | neg | |
| Combined | MPA | 53.26 | 2.91E-13 | *** | 0.72 | Age | 4 | 2.102 | 0.085 | . | neg | 0.13 |

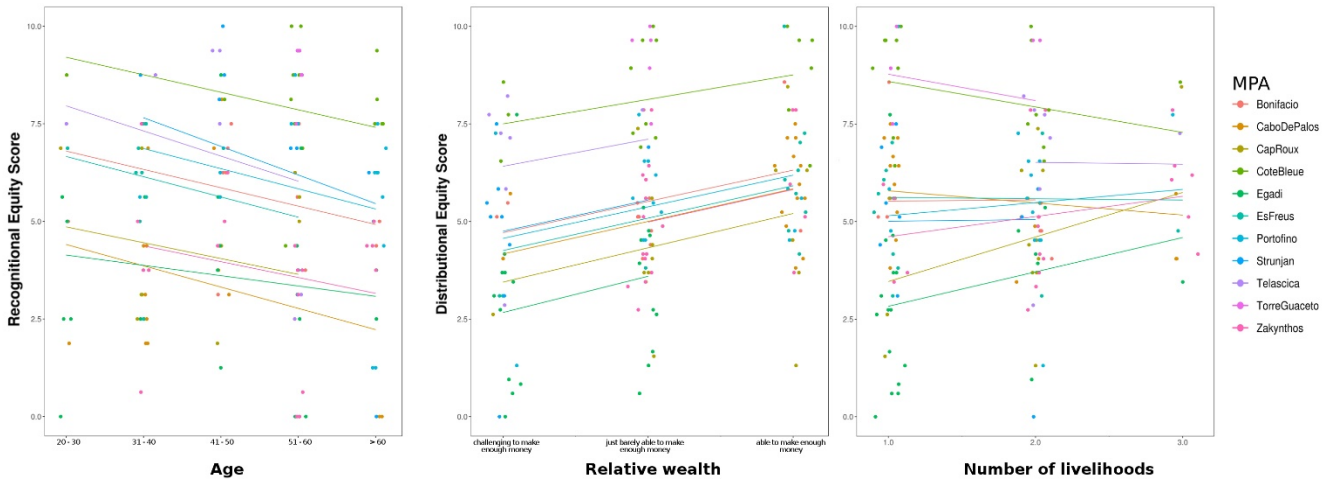


*Figure 5 – Visualization of models where both MPA (represented by colored lines) and fixed components (on bottom) remained significant at $p<0.05$ or greater. Original (dots) and predicted values by lme (lines) of: (left panel or a) recognitional equity score with increasing fishers' age and by MPA. Predicted values for Torre Guaceto not reported as not computed (all fishers belong to the same age class); (central panel or b) distributional equity score with increasing fishers' relative wealth and by MPA; (right panel – c) distributional equity score with increasing fishers' number of livelihoods and by MPA. Jittering added on the x-axis for better visualization.*

## 4 Discussion

This paper builds on a growing literature and body of research on social equity in conservation (Dawson et al., 2018; Friedman et al., 2018, 2018; Gill et al., 2019; Kockel et al., 2019; McDermott et

al., 2013; Moreaux et al., 2018; Pascual et al., 2014; Schreckenberg et al., 2016; Sikor et al., 2014; Zafra-Calvo et al., 2019, 2017). In particular, we present the results of a quantitative survey of SSF perceptions of social equity in 11 MPAs across 6 countries in the Mediterranean Sea. The novelty of this research is that it is the first study to take an explicitly quantitative approach to the study and analysis of social equity using the perceptions of stakeholders. It is also the first paper that specifically focuses on social equity in MPAs.

In summary, our results showed significant variability in how different individual indicators of social equity are perceived. Descriptive analysis demonstrated that perceptions were slightly more positive than negative for recognitional, procedural, distributional, and combined social equity scores. One-way models showed significant differences between MPAs and countries and perceptions of social equity. Overall, significant positive relationships were found between education and recognitional, procedural and combined equity and relative wealth and distribuitonal equity. Signficant negative relationships were also found between: the number of people in a household and procedural equity; percent income from fishing and recognitional equity; fisheries diversification and recognitional, procedural and combined equity; and, dependence on fish for food and procedural equity. Finally, in mixed effects models, MPAs remained significant for all categories of social equity while only age had a significant negative effect on perceptions of recognitional equity and only relative wealth and number of livelihoods had a significant positive effect on perceptions of distributional equity.

Our results point towards several implications for conservation management. First, while we expected to find more significant effects of different SSF demographics and characteristics (e.g., dependence on fisheries, relative wealth, etc.) on perceptions of social equity, overall MPA was always a significant predictor of differences in perceptions of social equity. This finding suggests that perhaps the best level at which to evaluate social equity and identify management actions to improve social equity is at each site. Thus, in sites where perceptions of procedural equity are found to be lower, management actions might be taken to improve transparency, participation in decision making or communication (Dawson et al., 2018; Lockwood, 2010). In MPAs where SSF have lower perceptions of distributional equity, management actions might be identified and taken to mitigate or compensate for negative social impacts or communicate evidence of the benefits of MPAs (Kaplan-Hallam and Bennett, 2018). Second, increasing age was associated with worsening perceptions of recognitional equity and combined equity. Negative feelings regarding recognitional equity among older fishers may be relics, or memories, of the manner in which MPAs were originally implemented or past management actions. Younger generations of SSF may also share MPA core values. Either way, MPA managers might consider taking additional actions to further re-build relationships and trust with older generations of SSF through taking actions to recognize their rights, culture, knowledge and livelihoods in MPA management (Young et al., 2016). Third, higher relative wealth and more diverse livelihoods led to improved perceptions of distributional equity. This result is not surprising – and confirms that programs to provide diversified and alternative livelihoods are justified management interventions for conservation (Charles et al., 2016b; Chen and Chang, 2017; Cillari et al., 2012; Wright et al., 2016).

For those pursuing further work on these topics, we recommend some developments and improvements to our approach and avenues for future research. First, we would recommend that future research on this topic move beyond SSF to focus on multiple stakeholder groups to compare and contrast perceptions of equity. Second, further refinement of some indicators is recommended – as well as the addition of new indicators as social equity theory and practice continues to develop (Dawson et al., 2018; Friedman et al., 2018; Zafra-Calvo et al., 2019, 2017). For example, in the distribution section, we would recommend adding an indicator related to the presence or absence of mitigation, compensation, and restitution mechanisms to help balance harms and benefits of conservation (Bennett et al., 2017).

Finally, there are numerous useful directions for future research and analysis related to social equity – for example, examining the relationships (e.g., trade-offs and synergies) between different dimensions of equity, comparing perceptions of equity and observed measures of social equity, and understanding the contextual, managerial (e.g., staff and budget capacity, presence of a management plan) or governance factors leading to positive or negative perceptions of equity. The last line of inquiry might draw insights from previous research on MPAs features (e.g. design, management and governance) that are significant predictors of MPA effectiveness in delivering ecological and social benefits (Ban et al., 2019, 2017; Di Franco et al., 2016; Edgar et al., 2014; Gill et al., 2017). Accomplishing some of these research recommendations would require a much larger number of case study sites.

## 5 Conclusion

The language of Aichi Target 11 requires that signatories to the Convention on Biological Diversity (CBD) work to "effectively and equitably" manage both terrestrial and marine protected areas. In response to this charge, there have been increasing efforts to assess and improve MPA management effectiveness. However, less attention has been paid to the assessment and management of social equity in MPAs. This paper builds on the growing body of work in this area and presents a novel method for using stakeholder perceptions to examine social equity. We encourage the adaptation, improvement and application of the methods presented here to improve social equity in both marine and terrestrial conservation initiatives elsewhere. There is also a need for national governments to further develop policies and guidance, and provide personnel, training and financing, to support conservation planning and management processes that will achieve social equity. In conclusion, we contend that the pursuit of social equity in conservation should be seen as an ethical imperative, but it might also be instrumental to the long-term success and effectiveness of conservation.

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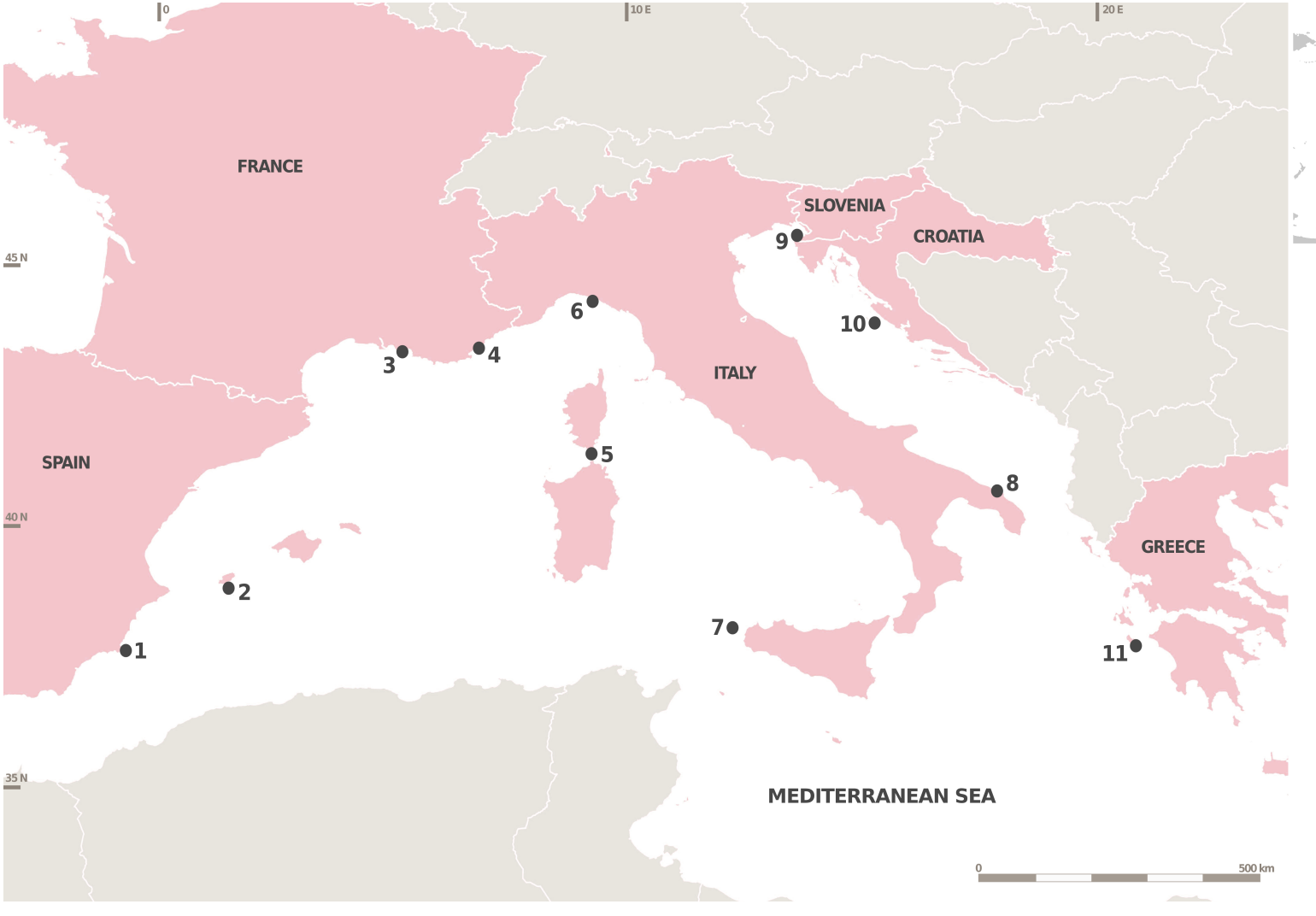
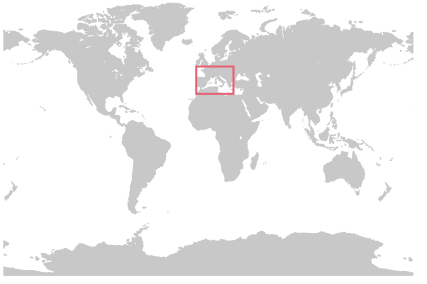
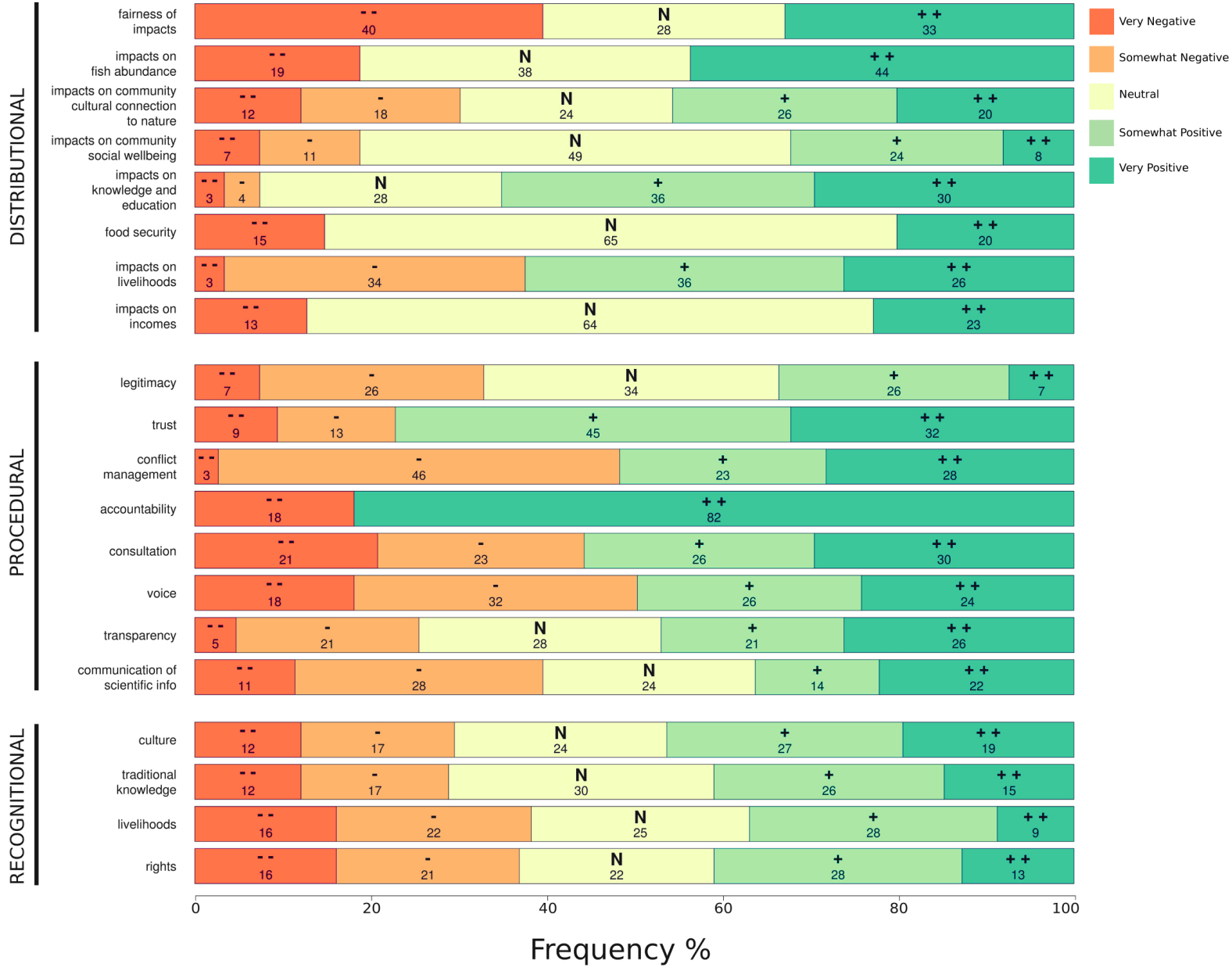
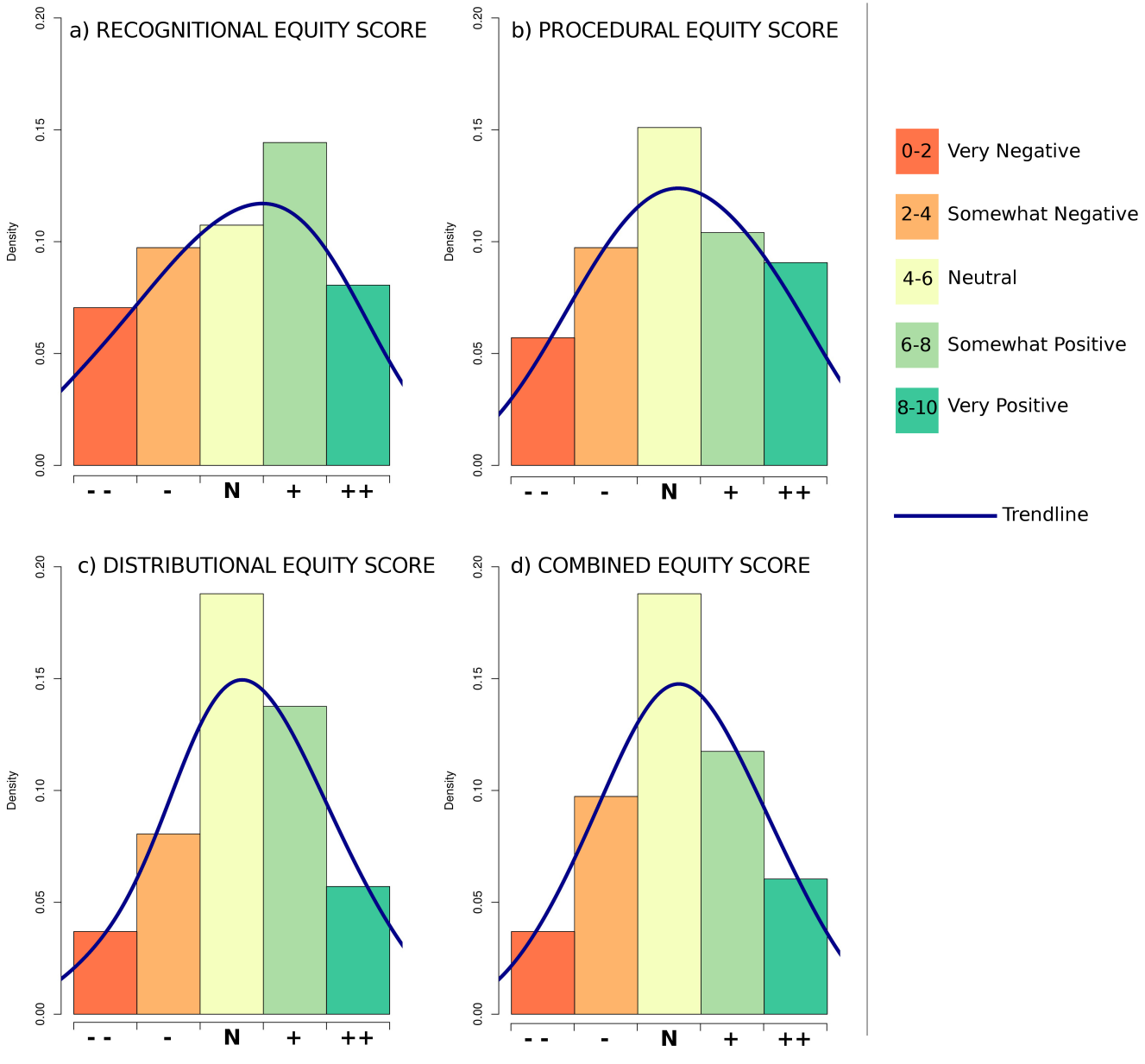
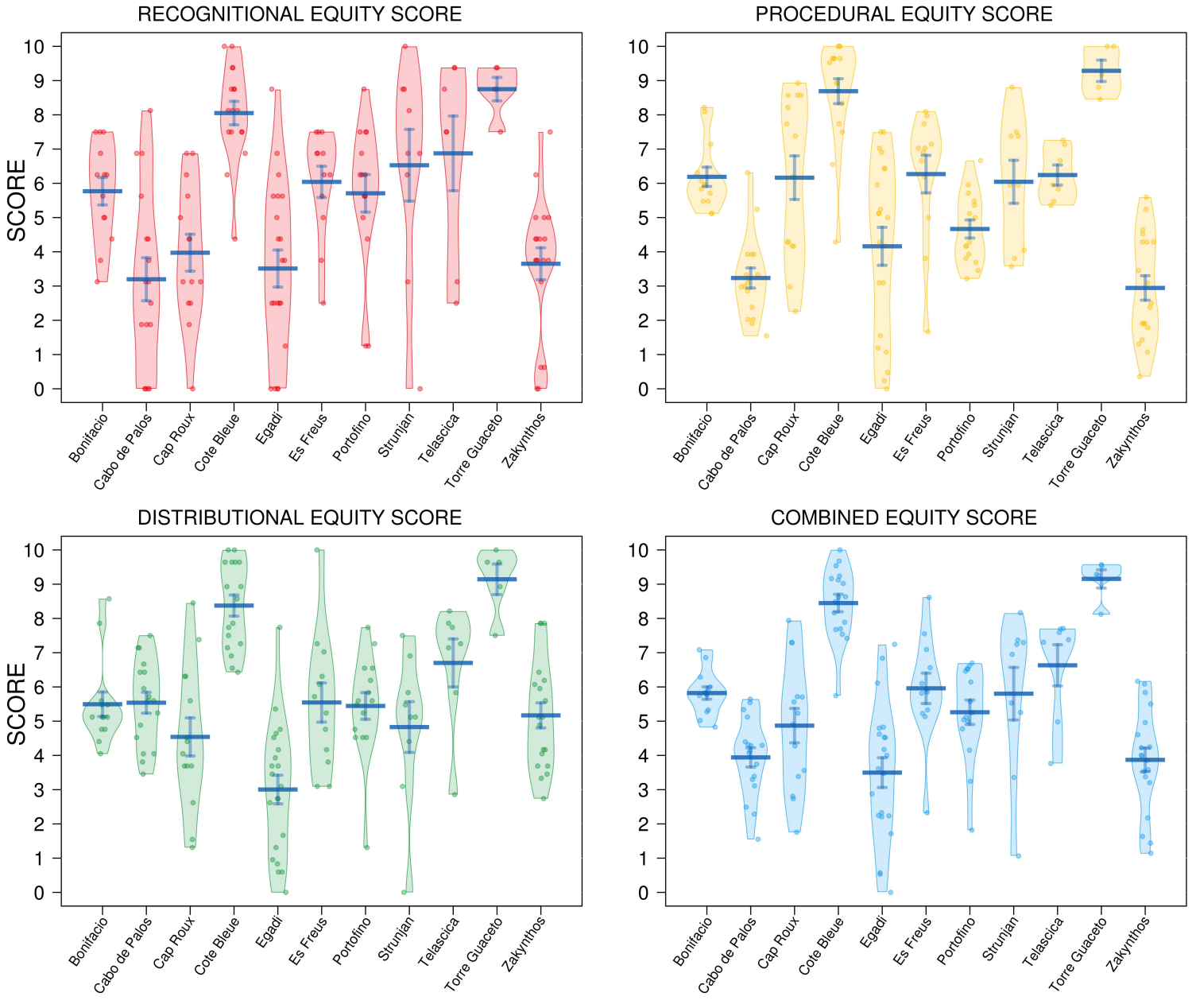


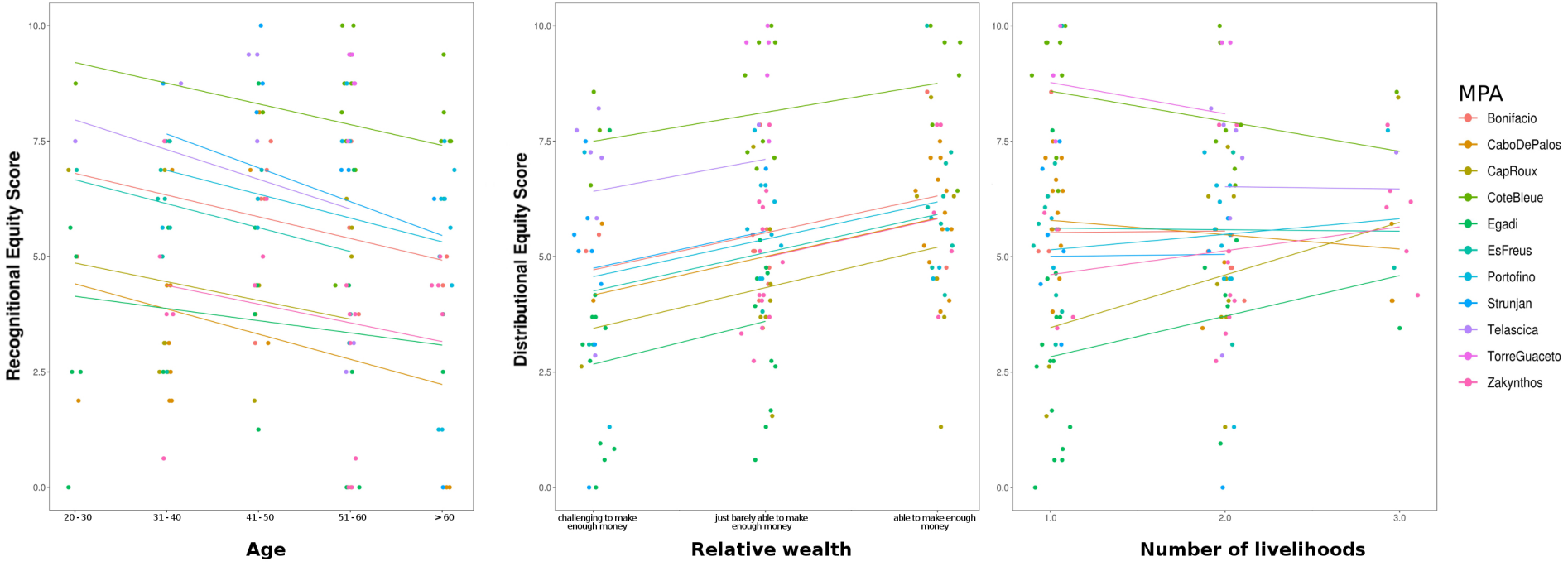



1. Cabo de Palos - Islas Hormigas Marine Reserve (SPAIN)
2. Es Freus of Ibiza and Formentera Marine Reserve (SPAIN)
3. Côte Bleue Marine Park (FRANCE)
4. Cantonnement de Pêche of Cap Roux (FRANCE)
5. Bonifacio Strait Natural Reserve (FRANCE)
6. Portofino MPA (ITALY)
7. Egadi Island MPA (ITALY)
8. Torre Guaceto MPA (ITALY)
9. Strunjan Landscape Park (SLOVENIA)
10. Telašćica Nature Park (CROATIA)
11. Natianal Marine Park of Zakynthos (GREECE)


DISTRIBUTIONAL
PROCEDURAL
RECOGNITIONAL
fairness of impacts
- - 40
N 28
+ + 33
impacts on fish abundance
- - 19
N 38
+ + 44
impacts on community cultural connection to nature
- - 12
- 18
N 24
+ 26
+ + 20
impacts on community social wellbeing
- - 7
- 11
N 49
+ 24
+ + 8
impacts on knowledge and education
- - 3
- 4
N 28
+ 36
+ + 30
food security
- - 15
N 65
+ + 20
impacts on livelihoods
- - 3
- 34
+ 36
+ + 26
impacts on incomes
- - 13
N 64
+ + 23
legitimacy
- - 7
- 26
N 34
+ 26
+ + 7
trust
- - 9
- 13
+ 45
+ + 32
conflict management
- - 3
- 46
+ 23
+ + 28
accountability
- - 18
+ + 82
consultation
- - 21
- 23
+ 26
+ + 30
voice
- - 18
- 32
+ 26
+ + 24
transparency
- - 5
- 21
N 28
+ 21
+ + 26
communication of scientific info
- - 11
- 28
N 24
+ 14
+ + 22
culture
- - 12
- 17
N 24
+ 27
+ + 19
traditional knowledge
- - 12
- 17
N 30
+ 26
+ + 15
livelihoods
- - 16
- 22
N 25
+ 28
+ + 9
rights
- - 16
- 21
N 22
+ 28
+ + 13
Very Negative
Somewhat Negative
Neutral
Somewhat Positive
Very Positive
0
20
40
60
80
100
Frequency %


a) RECOGNITIONAL EQUITY SCORE
b) PROCEDURAL EQUITY SCORE
c) DISTRIBUTIONAL EQUITY SCORE
d) COMBINED EQUITY SCORE
Density
0.00
0.05
0.10
0.15
0.20
- -
-
N
+
++
0-2 Very Negative
2-4 Somewhat Negative
4-6 Neutral
6-8 Somewhat Positive
8-10 Very Positive
Trendline


RECOGNITIONAL EQUITY SCORE
PROCEDURAL EQUITY SCORE
DISTRIBUTIONAL EQUITY SCORE
COMBINED EQUITY SCORE
SCORE
0
1
2
3
4
5
6
7
8
9
10
Bonifacio
Cabo de Palos
Cap Roux
Cote Bleue
Egadi
Es Freus
Portofino
Strunjan
Telascica
Torre Guaceto
Zakynthos


Recognitional Equity Score
10.0
7.5
5.0
2.5
0.0
20 - 30
31 - 40
41 - 50
51 - 60
> 60
Age
Distributional Equity Score
challenging to make enough money
just barely able to make enough money
able to make enough money
Relative wealth
1.0
2.0
3.0
Number of livelihoods
MPA
Bonifacio
CaboDePalos
CapRoux
CoteBleue
Egadi
EsFreus
Portofino
Strunjan
Telascica
TorreGuaceto
Zakynthos

# Supplementary Materials

This document is a supplement to the article titled "Social equity and marine protected areas: Perceptions of small-scale fishermen in the Mediterranean Sea"

*Supplementary Materials - Table S 1 - Survey questions related to the demographics and characteristics of small-scale fishers*

| **Survey questions related to the demographics and characteristics of small-scale fishermen** | | |
|---|---|---|
| *Topic* | *Survey Questions (Survey)* | *Potential Responses* |
| Gender | Interviewee's gender? | Male/female |
| Associated MPA | Associated marine protected area | Cabo de Palos(Sp)/Es Freus(Sp)/Cap Roux(Fr)/Cote Bleu(Fr)/Bonifacio(Fr)/Portofino(It)/Egadi Island(It)/Torre Guaceto(It)/Strunjan(Sl)/Telascica(Cr)/Zakynthos(Gr) |
| Associated country | Associated country | Spain/France/Italy/Slovenia/Croatia/Greece |
| Age | What is your age group? | 20-30/30-40/40-50/50-60/60+ |
| Education | What is your highest level of education completed? | None/Elementary school/Middle school/High school/University degree – bachelors or higher |
| People in household | How many people live in your household? | List # |
| Years in village | How many years have you lived in this village? | List # of years |
| Origin | Where are you originally from? | The local town or village/the nearby area (same county, province, etc)/the same country/another country |
| Relative wealth | In general, does you income from small-scale fisheries allow you to have a good quality of life (live well) in your village? | No, it can be challenging to make enough income to have a good quality of life in my village/Somewhat, I am just barely able to make enough income to cover the cost of living in my village/Yes, being a small-scale fisher allows me to make enough income to have a good quality of life in my village. |
| Percent income from fishing | What percentage of your household (family) income comes from small-scale fisheries? | Less than half/more than half/all |
| Livelihood Multiplicity | How many livelihoods, including fishing, do you participate in? | 1/2/3/4 or more |
| Fisheries Diversification | What types of gears do you use/types of fisheries do you engage in? Check all that apply. | Fixed nets for multi-species fisheries/Bottom longlines/Pelagic longlines/Traps for multi-species fisheries/Lobster fisheries/Cephalopod fisheries/Other (Check all that apply) – Combined for total # (1-7) |
| Dependence on fish for food | Approximately how many days of the week does your household eat fish or seafood (that you personally caught)? | List # (0-7) |

*Supplementary Materials - Table S 2 - Survey questions and responses related to recognitional, procedural and distributional equity (Note: All survey responses have been converted to the following symbols for communication purposes: ++=Very positive/+=Somewhat positive/N=Neutral/-=Somewhat negative/--=Very negative)*

| **Recognitional Equity** | | |
|---|---|---|
| *Attribute* | *Survey Questions* | *Potential Responses* |
| Rights | The rights of small-scale fishers are taken into account in MPA planning and management. | Fully disagree(=--)/somewhat disagree (=-) /neutral(=N)/somewhat agree(=+)/fully agree(=++) (1-5) |
| Livelihoods | The MPA management aligns with the livelihood needs of small-scale fishers. | Fully disagree(=--)/somewhat disagree (=-) /neutral(=N)/somewhat agree(=+)/fully agree(=++) (1-5) |
| Traditional Knowledge | The traditional knowledge of local small-scale fishers is documented and included in the MPA management | Fully disagree(=--)/somewhat disagree (=-) /neutral(=N)/somewhat agree(=+)/fully agree(=++) (1-5) |
| Culture | The MPA acknowledges and celebrates the unique culture and practices of small-scale fishers. | Fully disagree(=--)/somewhat disagree (=-) /neutral(=N)/somewhat agree(=+)/fully agree(=++) (1-5) |
| **Procedural Equity** | | |
| *Attribute* | *Survey Questions (Survey)* | *Potential Responses* |
| Informed | Is there research and scientific information available (from the MPA management) about the marine environment and status of fisheries? | Research and science is not available(=--)/ I don't know whether research and scientific information is available(=-)/Research and science is available upon request(=N)/Research and science is freely available and easily accessible(=+)/Research and science is directly communicated by MPAs(=++) (1-5) |
| Transparency | Is information about how MPA decisions are made and the reasons for MPA management decisions readily available? | Information about MPA decisions is not available(=--)/ I don't know whether information about MPA decisions is available(=-)/Information about MPA decisions is available upon request(=N)/Information about MPA decisions is freely available and it is easily accessible(=+)/Information about MPA decisions is actively communicated by management(=++) (1-5) |
| Participation | How much participation is there of small-scale fishermen in MPA decision-making and management activities? | No involvement(=--)/very little involvement(=-) /medium level of involvement(=+)/a high level of involvement(=++) (1-4) |
| Consultation & consent | Which of the following statement describes the way that MPA management decisions are made with regards to consultation and consent? | MPA management decisions are made without consultation with SSF(=--)/ I don't know whether MPA decisions are made in consultation with SSF(=-) /MPA management decisions are made after consulting with SSF(=+)/MPA management decisions are made after consulting with a seeking consent from SSF(=++) (1-4) |
| Accountability | When issues arise for small-scale fishers related to the management of the marine protected area you know with whom and how to communicate? | You (and other SSF) do not know with whom and how to communicate about MPA management issues that arise(=-)/You (and other SSF) know with whom and how to communicate about MPA management issues that arise (=+) (1-2) |
| Access to justice | Are there mechanisms to address disagreements or conflicts that arise between small-scale fishers and MPA management? | There are no mechanisms to resolve disputes that arise between MPA managers and SSF(=--)/ I do not know whether there are mechanisms to resolve disputes between managers and SSF (=-)/There are mechanisms to resolve disputes between MPA managers and SSF, but they are not working to resolve disputes(=+)/There are clear mechanisms to resolve disputes between MPA managers and SSF. Past disputes have been resolved(=++) (1-4) |
| Trust | How would you classify the level of trust between small-scale fisher's and MPA management? | No trust(=--)/A low level of trust(=-)/a medium level of trust(=+)/a high level of trust(=++) (1-4) |
| Legitimacy | Please read the following statements and rate your level of satisfaction: The overall management activities for the MPA | Very dissatisfied(=--)/Somewhat dissatisfied(=-) /Neutral(=N)/Somewhat satisfied(=+)/Very satisfied(=++) (1-5) |
| **Distributional Equity** | | |
| *Attribute* | *Survey Questions (Survey)* | *Potential Responses* |
| Impacts on income | What do you think has been the impact of the MPA on your income? (Q17 – income) | The MPA has led to a decline in your income(=-)/the MPA has not had an effect on your income(=N)/the MPA has led to an increase in your income (=+)(1-3) |
| Impacts on | How do you think the MPA has impacted your | The MPA has led to declines in all livelihoods in the area(=- |

| | | |
|---|---|---|
| livelihoods | livelihood? (Q18 – livelihoods) | -)/the MPA has had no impact on livelihoods in the area(=-)/the MPA has lead to decreases in some livelihoods but increases in other livelihoods(=+)/the MPA has led to increases in both fisheries and non-fisheries related livelihood opportunities in the area(=++) (1-4) |
| Impacts on food security | In your opinion, does the MPA impact the ability of small-scale fishers from the village to access and harvest fish for household consumption? (Q19 – food security) | The MPA has a negative impact on access to harvest seafood for your household consumption(=-)/the MPA has no impact on access to harvest seafood for your household consumption(=N)/the MPA has a positive impact on access to harvest seafood for your household consumption(=+) (1-3) |
| Impacts on knowledge and education | Please, indicate how the MPA affects the following aspects of the village: The knowledge of education of children or adults in the village about the marine environment (Q21a – knowledge and education) | Very negatively(=--)/ negatively(=-)/ neutral(=N)/positively(=+)/Very positively(=++) (1-5) |
| Impacts on community social well-being | Please, indicate how the MPA affects the following aspects of the village: Community activities and the overall sense of social well-being of people in the village | Very negatively(=--)/ negatively(=-)/ neutral(=N)/positively(=+)/Very positively(=++) (1-5) |
| Impacts on cultural connection to nature | Please, indicate how the MPA affects the following aspects of the village: The connection between people in the village and the local marine environment | Very negatively(=--)/ negatively(=-)/ neutral(=N)/positively(=+)/Very positively(=++) (1-5) |
| Impacts on fish abundance | In your opinion, the MPA is: | Leading to decreases in the number of fish in the sea(=-)/neither increasing nor decreasing the number of fish in the sea(=N)/leading to increases in the number of fish in the sea(=+) (1-3) |
| Perceptions of fairness | How do you view the fairness of the overall impacts and benefits of the MPA? | The impacts and benefits of the MPA are unfair for some user groups (some users are impacted or benefit more than others) (=-)/the impacts and benefits of the MPA are neutral for all user groups (there are no impacts or benefits) (=N)/ the impacts and benefits of the MPA are fair and neutral for all user groups (all users are impacted or benefit in the same way) (=+) (1-3) |
| **Combined Equity Scores** | | |
| Combined Recognitional Equity Score | Combined responses to above questions related to rights, livelihoods, traditional knowledge and culture | All individual items were first normalized on a scale of 0-2. The internal coherence of the items in each scale was then checked using Chronbach Alpha co-efficient. Items were then combined through summing them. This score was then normalized on a scale of 0-10. |
| Combined procedural equity score | Combined responses for all questions in procedural category including informed, transparency, participation, consultation and consent, Accountability, Access to justice, Trust, and Legitimacy | All individual items were first normalized on a scale of 0-2. The internal coherence of the items in each scale was then checked using Chronbach Alpha co-efficient. Items were then combined through summing them. This score was then normalized on a scale of 0-10. |
| Combined distributional equity scale | Combination of perceptions of social impacts, perceptions of impacts on fish abundance, and perceptions of fairness. | All individual items were first normalized on a scale of 0-2. The internal coherence of the items in each scale was then checked using Chronbach Alpha co-efficient. Items were then combined through summing them. This score was then normalized on a scale of 0-10. |
| Combined Equity Score | Combination of recognitional, procedural, and distributional equity scores. | The three equity category scores were combined through summing them. This score was then normalized on a scale of 0-10. |

*Supplementary Materials - Table S 3 - Descriptive summary of survey sample including demographics and characteristics of small-scale fishers (N=149)*

| Demographics or characteristics of SSF | Responses | Total= 149 n (%) |
|---|---|---|
| Associated MPA | Cabo de Palos (Spain) | 17 (11.4) |
| | Es Freus (Spain) | 12 ( 8.1) |
| | Cap Roux (France) | 14 ( 9.4) |
| | Cote Bleu (France) | 17 (11.4) |
| | Bonifacio (France) | 13 ( 8.7) |
| | Portofino (Italy) | 15 (10.1) |
| | Egadi Islands (Italy) | 21 (14.1) |
| | Torre Guaceto (Italy) | 5 ( 3.4) |
| | Strunjan (Slovenia) | 9 ( 6.0) |
| | Telescica (Croatia) | 7 ( 4.7) |
| | Zakynthos (Greece) | 19 (12.8) |
| Associated Country | Spain | 29 (19.5) |
| | France | 43 (28.9) |
| | Italy | 42 (28.2) |
| | Slovenia | 9 ( 6.0) |
| | Croatia | 7 ( 4.7) |
| | Greece | 19 (12.8) |
| Interviewee Age | 20-30 Years Old | 10 ( 6.8) |
| | 30-40 Years Old | 33 (22.4) |
| | 40-50 Years Old | 32 (21.8) |
| | 50-60 Years Old | 44 (29.9) |
| | 60+ Years Old | 28 (19.0) |
| | no response | 2 |
| Interviewee Gender | Male | 149 (100) |
| Interviewee Education Completed | None | 1 ( 0.7) |
| | Elementary School | 43 (29.1) |
| | Middle School | 64 (43.2) |
| | High School | 38 (25.7) |
| | University - Bachelor's Degree or Higher | 2 ( 1.4) |
| | no response | 1 |
| Number of People Living in Interviewee Household | 1 | 13 ( 8.8) |
| | 2 | 45 (30.6) |
| | 3 | 27 (18.4) |
| | 4 | 49 (33.3) |
| | 5 | 11 ( 7.5) |
| | 6 | 1 ( 0.7) |
| | 7 | 1 ( 0.7) |
| | no response | 2 |
| Origin of Interviewee | the local town or village | 120 (81.1) |
| | the nearby area (same county, province, etc) | 20 (13.5) |

| | | |
|---|---|---|
| | the same country | 5 ( 3.4) |
| | another country | 3 ( 2.0) |
| | no response | 1 |
| Income from SSF and quality of life in your village | No. It can be challenging to make enough income to have a good quality of life in my village. | 35 (24.5) |
| | Somewhat. I am just barely able to make enough income to cover the cost of living in my village. | 63 (44.1) |
| | Yes. Being a small-scale fisher allows me to make enough income have a good quality of life in my village. | 45 (31.5) |
| | no response | 6 |
| Percentage of household income from small-scale fisheries | less than half (of household income comes from small-scale fisheries) | 44 (30.8) |
| | more than half (of household income comes from small-scale fisheries) | 42 (29.4) |
| | all (of household income comes from small-scale fisheries) | 57 (39.9) |
| | no response | 6 |
| Number of livelihoods (including fishing) | 1 livelihood | 73 (53.3) |
| | 2 livelihoods | 54 (39.4) |
| | 3 livelihoods | 10 ( 7.3) |
| | 4 or more livelihoods | 0 ( 0.0) |
| | no response | 12 |
| Total number of different fisheries and gears | Mean (STD) | 2.8 (1.4) |
| | Median | 3.0 |
| | (Min-Max) | (1.0-6.0) |
| | Missing | 7 |
| Number of days the week that household eats fish or seafood | Mean (STD) | 2.8 (1.7) |
| | Median | 2.0 |
| | (Min-Max) | (0.0-7.0) |
| | Missing | 16 |
| Number of Years Interviewee Lived in Village | Mean (STD) | 43.3 (15.2) |
| | Median | 43.0 |
| | (Min-Max) | (1.0-74.0) |
| | Missing | 4 |

*Supplementary Materials - Table S 4 - Descriptive summary of responses to all individual perceptions indicatorsFor each item the upper row indicates absolute number of responses, the lower number indicates the relative percentage on the total number of responses (149).*

| EQUITY CATEGORY | ITEM | - - | - | N | + | ++ | |
|---|---|---|---|---|---|---|---|
| ***Recognitional*** | Rights | 24 | 31 | 33 | 42 | 19 | N |
| | | 16.11 | 20.81 | 22.15 | 28.19 | 12.75 | % |
| | Livelihoods | 24 | 33 | 37 | 42 | 13 | N |
| | | 16.11 | 22.15 | 24.83 | 28.19 | 8.72 | % |
| | Traditional knowledge | 18 | 25 | 45 | 39 | 22 | N |
| | | 12.08 | 16.78 | 30.2 | 26.17 | 14.77 | % |
| | Culture | 18 | 26 | 36 | 40 | 29 | N |
| | | 12.08 | 17.45 | 24.16 | 26.85 | 19.46 | % |
| ***Procedural*** | Communication of scientific info | 17 | 42 | 36 | 21 | 33 | N |
| | | 11.41 | 28.19 | 24.16 | 14.09 | 22.15 | % |
| | Transparency | 7 | 31 | 41 | 31 | 39 | N |
| | | 4.7 | 20.81 | 27.52 | 20.81 | 26.17 | % |
| | Voice | 27 | 48 | NA | 38 | 36 | N |
| | | 18.12 | 32.21 | NA | 25.5 | 24.16 | % |
| | Consultation | 31 | 35 | NA | 39 | 44 | N |
| | | 20.81 | 23.49 | NA | 26.17 | 29.53 | % |
| | Accountability | 27 | NA | NA | NA | 122 | N |
| | | 18.12 | NA | NA | NA | 81.88 | % |
| | Conflict management | 4 | 68 | NA | 35 | 42 | N |
| | | 2.68 | 45.64 | NA | 23.49 | 28.19 | % |
| | Trust | 14 | 20 | NA | 67 | 48 | N |
| | | 9.4 | 13.42 | NA | 44.97 | 32.21 | % |
| | Legitimacy | 11 | 38 | 50 | 39 | 11 | N |
| | | 7.38 | 25.5 | 33.56 | 26.17 | 7.38 | % |
| ***Distributional*** | Impacts on incomes | 19 | NA | 96 | NA | 34 | N |
| | | 12.75 | NA | 64.43 | NA | 22.82 | % |
| | Impacts on livelihoods | 5 | 51 | NA | 54 | 39 | N |
| | | 3.36 | 34.23 | NA | 36.24 | 26.17 | % |
| | Food security | 22 | NA | 97 | NA | 30 | N |
| | | 14.77 | NA | 65.1 | NA | 20.13 | % |
| | Impacts on knowledge and education | 5 | 6 | 41 | 53 | 44 | N |
| | | 3.36 | 4.03 | 27.52 | 35.57 | 29.53 | % |
| | Impacts on community social wellbeing | 11 | 17 | 73 | 36 | 12 | N |
| | | 7.38 | 11.41 | 48.99 | 24.16 | 8.05 | % |
| | Impacts on community cultural connection to nature | 18 | 27 | 36 | 38 | 30 | N |
| | | 12.08 | 18.12 | 24.16 | 25.5 | 20.13 | % |
| | Impacts on fish abundance | 28 | NA | 56 | NA | 65 | N |
| | | 18.79 | NA | 37.58 | NA | 43.62 | % |
| | Fairness of impacts | 59 | NA | 41 | NA | 49 | N |
| | | 39.6 | NA | 27.52 | NA | 32.89 | % |

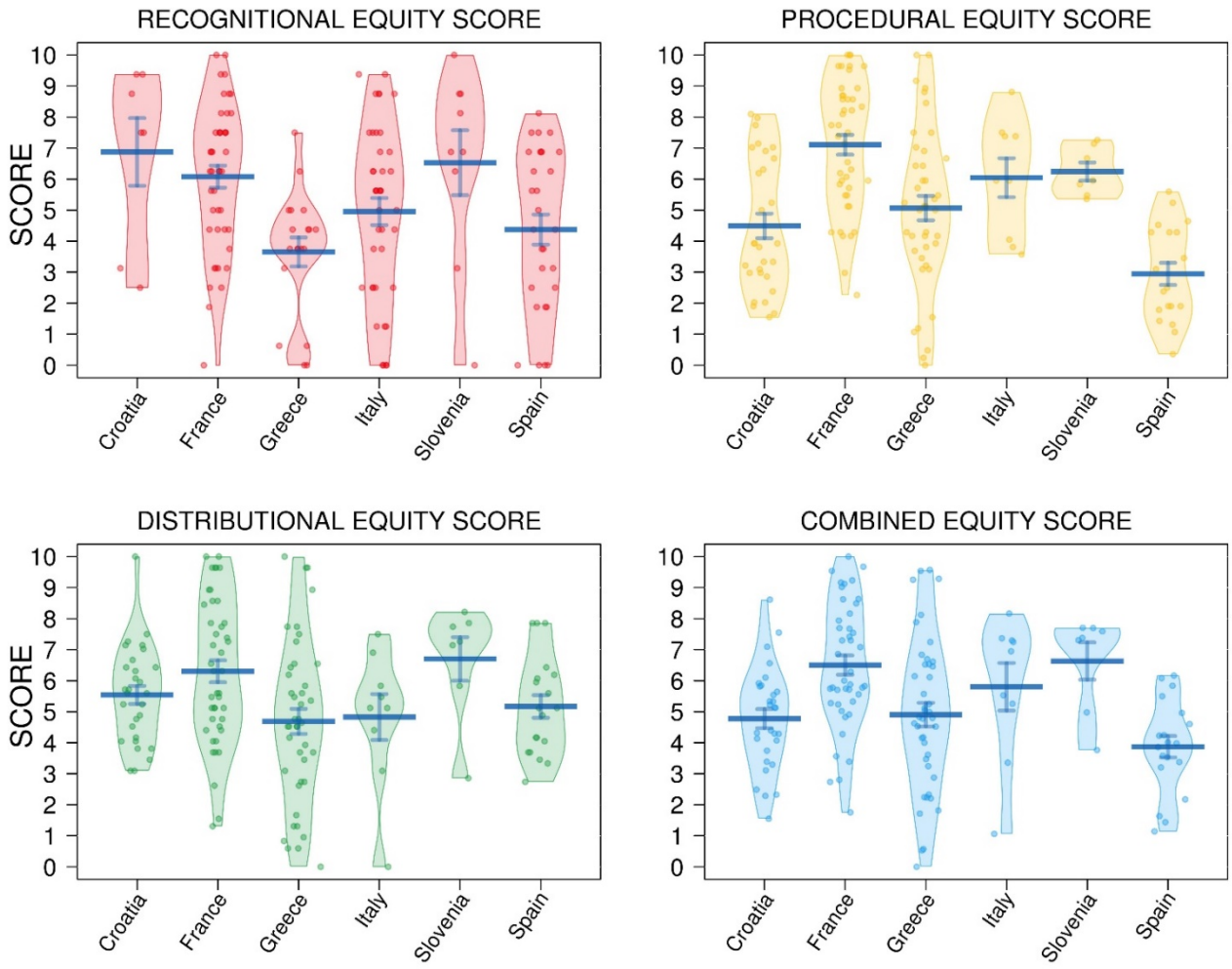
*Supplementary Materials - Table S 5 - Summary of composite scores for recognitional, procedural, distributional, and combined social equity composite scores. For each score the upper row indicates the absolute number of responses, the lower number indicate the relative percentage on the total number of responses (149).*

| | Recognitional | Procedural | Distributional | Combined | |
|---|---|---|---|---|---|
| *Very Negative* | 21 | 17 | 11 | 11 | N |
| *0-2* | 14.09 | 11.41 | 7.38 | 7.38 | % |
| *Somewhat negative* | 29 | 29 | 24 | 29 | N |
| *2-4* | 19.46 | 19.46 | 16.11 | 19.46 | % |
| *Neutral* | 32 | 45 | 56 | 56 | N |
| *4-6* | 21.48 | 30.20 | 37.58 | 37.58 | % |
| *Somewhat Positive* | 43 | 31 | 41 | 35 | N |
| *6-8* | 28.86 | 20.81 | 27.52 | 23.49 | % |
| *Very Positive* | 24 | 27 | 17 | 18 | N |
| *8-10* | 16.11 | 18.12 | 11.41 | 12.08 | % |
| *Mean* | 5.19 | 5.38 | 5.48 | 5.34 | |
| *sd* | 2.7 | 2.51 | 2.26 | 2.21 | |

*Supplementary Materials - Table S 6 – Summary of results from univariate models for MPA, country and SSF characteristics and equity scores. Mean ± standard error for each combination of score and level of considered predictors.*

| | | Recognitional Equity score | Procedural Equity score | Distributional Equity score | Combined Equity score |
|---|---|---|---|---|---|
| MPA | Bonifacio | 6.25 ± 0.4 | 6.19 ± 0.28 | 5.49 ± 0.36 | 5.82 ± 0.18 |
| | Cabo de Palos | 3.12 ± 0.63 | 3.24 ± 0.29 | 5.54 ± 0.31 | 3.94 ± 0.28 |
| | Cap Roux | 3.75 ± 0.54 | 6.16 ± 0.64 | 4.54 ± 0.56 | 4.87 ± 0.5 |
| | Cote Bleue | 8.12 ± 0.34 | 8.69 ± 0.36 | 8.38 ± 0.31 | 8.45 ± 0.26 |
| | Egadi | 3.75 ± 0.54 | 4.16 ± 0.55 | 3 ± 0.42 | 3.5 ± 0.43 |
| | Es Freus | 6.56 ± 0.46 | 6.27 ± 0.55 | 5.55 ± 0.57 | 5.96 ± 0.44 |
| | Portofino | 6.25 ± 0.55 | 4.67 ± 0.26 | 5.44 ± 0.39 | 5.26 ± 0.36 |
| | Strunjan | 6.88 ± 1.05 | 6.04 ± 0.63 | 4.83 ± 0.74 | 5.8 ± 0.77 |
| | Telascica | 7.5 ± 1.09 | 6.24 ± 0.29 | 6.7 ± 0.7 | 6.63 ± 0.6 |
| | Torre Guaceto | 8.75 ± 0.34 | 9.29 ± 0.31 | 9.14 ± 0.45 | 9.16 ± 0.27 |
| | Zakynthos | 3.75 ± 0.47 | 2.94 ± 0.36 | 5.17 ± 0.37 | 3.87 ± 0.35 |
| COUNTRY | Croatia | 4.38 ± 0.49 | 4.49 ± 0.4 | 5.54 ± 0.29 | 4.78 ± 0.31 |
| | France | 6.03 ± 0.36 | 7.11 ± 0.32 | 6.3 ± 0.35 | 6.5 ± 0.31 |
| | Greece | 5.03 ± 0.43 | 5.07 ± 0.4 | 4.69 ± 0.4 | 4.91 ± 0.38 |
| | Italy | 6.53 ± 1.05 | 6.04 ± 0.63 | 4.83 ± 0.74 | 5.8 ± 0.77 |
| | Slovenia | 6.88 ± 1.09 | 6.24 ± 0.29 | 6.7 ± 0.7 | 6.63 ± 0.6 |
| | Spain | 3.65 ± 0.47 | 2.94 ± 0.36 | 5.17 ± 0.37 | 3.87 ± 0.35 |
| AGE | 20-30 | 4.77 ± 0.82 | 5.55 ± 0.72 | 4.75 ± 0.79 | 5.01 ± 0.76 |
| | 31-40 | 4.96 ± 0.39 | 4.91 ± 0.35 | 5.53 ± 0.35 | 5.12 ± 0.29 |
| | 41-50 | 6.05 ± 0.39 | 5.27 ± 0.42 | 5.65 ± 0.27 | 5.66 ± 0.28 |
| | 51-60 | 5.19 ± 0.48 | 5.96 ± 0.42 | 5.69 ± 0.41 | 5.61 ± 0.41 |
| | >60 | 4.64 ± 0.51 | 5.1 ± 0.5 | 5.21 ± 0.43 | 4.96 ± 0.44 |

| | | | | | |
|---|---|---|---|---|---|
| EDUCATION | none | 4.38 ± NA | 2.98 ± NA | 5.6 ± NA | 4.28 ± NA |
| | elementary school | 4.32 ± 0.45 | 4.56 ± 0.4 | 5.28 ± 0.32 | 4.69 ± 0.35 |
| | middle school | 5.4 ± 0.33 | 6 ± 0.32 | 5.24 ± 0.31 | 5.54 ± 0.29 |
| | high school | 5.97 ± 0.37 | 5.5 ± 0.33 | 6.11 ± 0.3 | 5.86 ± 0.28 |
| | university | 3.44 ± 0.94 | 2.98 ± 1.31 | 5.83 ± 2.74 | 4.04 ± 1.71 |
| PEOPLE IN HOUSEHOLD | 1 | 5.48 ± 0.69 | 4.95 ± 0.56 | 5.55 ± 0.62 | 5.32 ± 0.56 |
| | 2 | 5.81 ± 0.45 | 6.38 ± 0.36 | 5.49 ± 0.37 | 5.9 ± 0.35 |
| | 3 | 4.82 ± 0.45 | 4.96 ± 0.43 | 5.42 ± 0.43 | 5.05 ± 0.4 |
| | 4 | 5.2 ± 0.36 | 5.25 ± 0.36 | 5.63 ± 0.3 | 5.35 ± 0.29 |
| | 5 | 3.41 ± 0.89 | 3.55 ± 0.83 | 4.75 ± 0.73 | 3.85 ± 0.75 |
| | 6 | 6.88 ± NA | 7.38 ± NA | 7.5 ± NA | 7.3 ± NA |
| | 7 | 2.5 ± NA | 5.12 ± NA | 4.52 ± NA | 4 ± NA |
| ORIGIN | local town or village | 5.11 ± 0.25 | 5.25 ± 0.22 | 5.38 ± 0.19 | 5.23 ± 0.19 |
| | nearby area | 5.62 ± 0.6 | 6.42 ± 0.58 | 6.02 ± 0.67 | 6.03 ± 0.59 |
| | same country | 4.62 ± 1.32 | 4.98 ± 1.12 | 5.12 ± 1.11 | 4.88 ± 1 |
| | another country | 6.46 ± 1.1 | 4.44 ± 2.24 | 6.39 ± 0.45 | 5.77 ± 1.12 |
| RELATIVE WEALTH | challenging to make enough money | 4.88 ± 0.51 | 5.34 ± 0.34 | 4.52 ± 0.4 | 4.89 ± 0.37 |
| | just barely able to make enough money | 5.38 ± 0.32 | 5.29 ± 0.34 | 5.53 ± 0.27 | 5.39 ± 0.29 |
| | able to make enough money | 5.18 ± 0.37 | 5.56 ± 0.37 | 6.2 ± 0.28 | 5.64 ± 0.29 |
| % INCOME FROM FISHING | less than half | 5.96 ± 0.39 | 5.79 ± 0.32 | 5.29 ± 0.3 | 5.68 ± 0.3 |
| | about half | 5.2 ± 0.3 | 5.52 ± 0.38 | 5.73 ± 0.31 | 5.48 ± 0.28 |
| | almost all | 4.58 ± 0.4 | 4.97 ± 0.36 | 5.46 ± 0.33 | 4.98 ± 0.33 |
| NUMBER OF LIVELIHOODS | 1 | 5.01 ± 0.35 | 5.43 ± 0.33 | 5.39 ± 0.31 | 5.26 ± 0.3 |
| | 2 | 5.51 ± 0.31 | 5.66 ± 0.29 | 5.47 ± 0.26 | 5.54 ± 0.25 |
| | 3 | 4.58 ± 0.65 | 3.98 ± 0.53 | 5.99 ± 0.44 | 4.83 ± 0.44 |
| FISHERY DIVERSIFICATION | 1 | 6.16 ± 0.45 | 6.4 ± 0.4 | 5.95 ± 0.38 | 6.18 ± 0.38 |
| | 2 | 4.56 ± 0.6 | 4.65 ± 0.49 | 4.78 ± 0.49 | 4.63 ± 0.48 |
| | 3 | 5 ± 0.52 | 5.25 ± 0.49 | 6.03 ± 0.49 | 5.42 ± 0.46 |
| | 4 | 4.36 ± 0.34 | 4.72 ± 0.39 | 5.13 ± 0.28 | 4.71 ± 0.27 |
| | 5 | 6.33 ± 0.6 | 5.81 ± 0.52 | 5.3 ± 0.48 | 5.82 ± 0.44 |
| | 6 | 4.06 ± 0.94 | 5.83 ± 0.12 | 4.94 ± 0.54 | 4.92 ± 0.1 |
| NUMBER OF NIGHTS EATING FISH | 0 | 5.8 ± 0.85 | 7.57 ± 0.79 | 5.34 ± 1.13 | 6.25 ± 0.89 |
| | 1 | 5.75 ± 0.57 | 5.82 ± 0.52 | 5.58 ± 0.54 | 5.72 ± 0.51 |
| | 2 | 5.5 ± 0.38 | 5.85 ± 0.37 | 5.27 ± 0.33 | 5.54 ± 0.32 |
| | 3 | 5.48 ± 0.48 | 5.5 ± 0.46 | 5.66 ± 0.41 | 5.54 ± 0.39 |
| | 4 | 4.2 ± 0.52 | 4.24 ± 0.39 | 5 ± 0.42 | 4.44 ± 0.4 |
| | 5 | 4.84 ± 1.07 | 4.94 ± 1 | 6.09 ± 0.49 | 5.28 ± 0.77 |
| | 6 | 6.25 ± 1.88 | 2.62 ± 0.24 | 5.77 ± 0.18 | 4.86 ± 0.79 |
| | 7 | 3.83 ± 1.21 | 4.51 ± 0.98 | 6.77 ± 0.78 | 5.02 ± 0.96 |




*Supplementary Materials - Figure S 1 - Pirate plots of equity scores separated by country. Blue horizontal and vertical bars represent means and standard errors respectively*