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Fisher's perceptions about a marine protected area over time

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ABSTRACT

The perceptions of fishers towards the Arrábida Marine Park, a marine protected area (MPA) in the west coast of Portugal, were studied through face-to-face interviews in two different moments of the MPA life cycle. Fishers' perceptions about the MPA and the impact it had on the fishing activity over time were identified just before the full implementation of the zoning and regulations of the management plan and 10 years later. This study aimed to investigate fishers' knowledge, acceptance and perceptions about the MPA changed with time, if support for the MPA was linked to the impact of the MPA on the fishing activity, and if fishers' perceptions about the impact of the MPA on the fishing activity match with local landings trends. Results show that although knowledge about the marine park significantly improved over time, fishers' acceptance did not. A decrease on fishers' support was not substantial but occurred. Issues such as the disagreement with regulations reinforced concerns raised during the implementation of the marine park, particularly in relation to the top-down decision-making, which commonly confers minor participation, recognition and legitimacy to fishers. Apparently, fisheries benefits were still not perceived by local fishers, though they are central for fishers' support. Further, the perceived negative impacts of the park seemed to be more related to social aspects and individual interests than to impacts on catches. Addressing adequate management, enforcement and participation of local fishers is still possible and are advocated here as to contribute to the expected socioecological outcomes and respective support, leading to the future successful performance of the Arrábida Marine Park. Assessing fishers' perceptions towards an MPA over time is central and should be included on periodical socioecological monitoring and inform an effective adaptive management.

1. Introduction

Global targets (Aichi targets), agreed under the Convention on Biological Diversity (CBD) to have 10% of global coastal and marine areas protected by 2020, have resulted in a large expansion of Marine Protected Areas (MPAs), and currently MPAs are expected to achieve an increasing set of conservation, social and economic objectives (Edgar et al., 2014; Watson, Dudley, Segan, & Hockings, 2014; Gruby et al., 2017; Ban et al., 2017; Gill et al., 2017). Concern is growing worldwide that the focus on MPAs expansion, solely to reach Aichi targets, is actually undermining effective conservation (Barnes, Glew, Wyborn, & Craigie, 2018; Giglio et al., 2018; Magris & Pressey, 2018). Not uncommonly, MPAs fail to reach their full potential (Edgar et al., 2014)

and the relative lack of success and effectiveness of past MPAs raises doubts about what these management measures can achieve (Mora et al., 2006).

Despite the wide variability of MPA types, they usually directly impact, and are impacted by, the fishing activity, which is typically the most relevant extractive activity to manage when establishing an MPA (Charles & Wilson, 2009; Horta e Costa et al., 2016; Mascia, Claus, & Naidoo, 2010; Pita, Pierce, Theodossiou, & Macpherson, 2011). Those who depend heavily on resources for their livelihoods, like fishers, have a lot at stake (Buanes, Jentoft, Karlsen, Maurstad, & Soreng, 2004; Mascia et al., 2010; Mikalsen & Jentoft, 2001) and besides being worried and skeptical about MPAs, they may also, and many times do, boycott implementation and violate rules (Charles & Wilson, 2009;

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Suman, Shivlani, & Milon, 1999). The Aichi target will further increase the number of MPAs with consequences to the fishing industry.

Resource-user's attitudes and perceptions are known to affect the performance of any management or conservation measure (Walmsley & White, 2003; Pita et al., 2011, 2013). Fishers' perceptions of MPAs, as well as towards any other management tools, vary according to a number of factors, including the MPA's age (Charles & Wilson, 2009; Pita et al., 2011; Walmsley & White, 2003). Studies investigating fishers' perceptions about MPAs over time are scarce (Pita et al., 2011). Yet, knowing fishers' opinions about MPAs, and how and why, they change over time is crucial. As shown by Chuenpagdee et al. (2013), even stakeholders who initially supported the MPA, may lose faith in the MPA over time and stop supporting it. The attitudes of fishers towards MPAs are a critical area of concern for management as commercial fisheries have a disproportionately profound influence on MPAs and fishers' behaviour can result in their success or lack thereof (Charles & Wilson, 2009; Fox et al., 2012; Grip & Blomqvist, 2018; Gruby et al., 2017; Walmsley & White, 2003).

The main objective of this study was to evaluate fishers' perceptions and attitudes towards a marine park over time and potential factors influencing them, specifically just before the full implementation of the MPA management plan and 10 years later, as well as the impact the MPA had on the fishing activity. In particular, this study aims to address the following questions: Do fishers' knowledge, acceptance and perceptions about the MPA changed with time? How is fishers' support for the MPA linked to the impact of the MPA on the fishing activity? Do fishers' perceptions about the impact of the MPA on the fishing activity match with local landings trends?

2. Arrábida Marine Park

The Arrábida Marine Park (AMP), also known as Luiz Saldanha

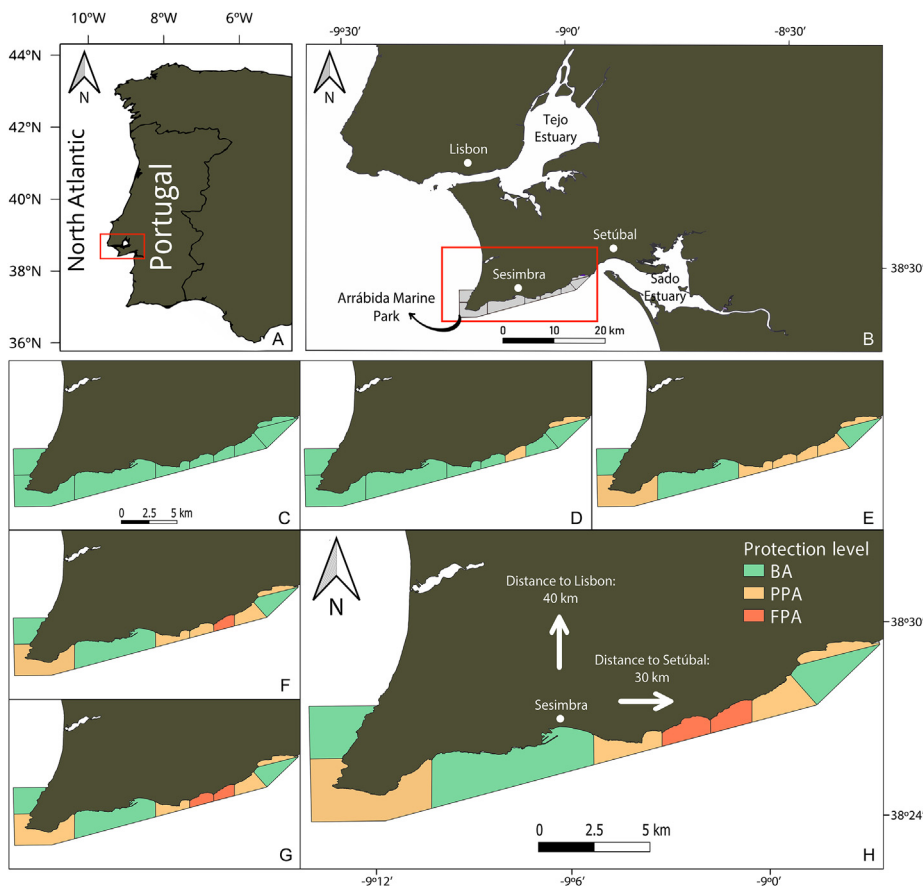


Fig. 1. Location of the Arrábida Marine Park (A, B). This marine park went through a transitional period for the implementation of the management plan zoning and regulations, between 2005 and 2009, when it was fully implemented (C–H). See text and Fig. 2 for more details. BA: buffer area, PPA: partially protected area, FPA: fully protected area.

Marine Park (LSMP), extends over 38 km of coastline (53 km²) on the west coast of Portugal (Fig. 1), mostly facing south and surrounded by high cliffs conferring protection from the prevailing winds and waves. Its location at a biogeographic transitional zone contributes to the remarkable biodiversity in the park (around 1400 species distributed in a mix of sandy, muddy and complex nearshore rocky habitats) when comparing to other neighbouring temperate areas (Gonçalves et al., 2015; Henriques, Gonçalves, & Almada, 2007; Horta e Costa et al., 2014). The main objectives of the park are to protect marine biodiversity, recover marine habitats in particular seagrass meadows, promote research applied to marine conservation, contribute to dissemination and environmental education and promote sustainable activities, such as traditional small-scale fishing and eco-tourism.

The AMP is located near the cities of Lisbon and Setúbal, and in the centre of the park there is the historical fishing town of Sesimbra, which in the last three decades also became an important touristic area. These features contribute to the high year-round use of the park by commercial and recreational activities (Horta e Costa, Gonçalves, & Gonçalves, 2013a).

The AMP was created in 1998 adjacent to a terrestrial nature park implemented in 1976, the Arrábida Natural Park. The marine park was created to protect the existing high natural values and to promote sustainable local activities. The management plan for the park was only approved in August 2005 (Portuguese legislation, Council of Ministers Resolution 141/2005), establishing three types of zones with distinct protection levels: a fully protected area (FPA, total area = 4.3 km²), which is a no-take/no-go area, with the exception of monitoring, surveillance and education activities; four partially protected areas (PPAs, total area = 21 km²) allowing non-extractive recreational activities and licensed commercial fishing using traps and jigs only beyond 200m from coast; and three buffer areas (BAs, total area = 27.5 km²), where recreational activities and licensed commercial fishing are allowed,

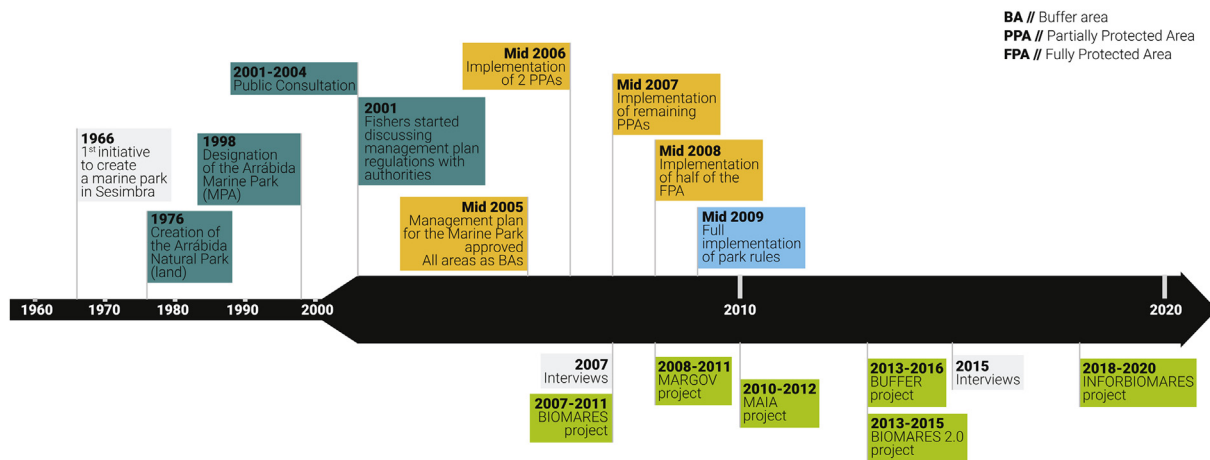


Fig. 2. Chronological description of events related to the Arrábida Marine Park (AMP), including the creation of the Natural Park, the MPA designation, the implementation of the management plan and respective transitional period, and main projects occurring in the AMP. The two moments of interviews conducted for the present study are also shown (2007 and 2015, within BIOMARES and BUFFER projects, respectively).

with the exception of commercial fishing vessels larger than 7m, spearfishing, commercial fishing diving, purse-seining, trawling and dredging (Horta e Costa et al., 2013a, b). Zones and specific regulations for fisheries were sequentially implemented during a transition period, being fully implemented only in mid-2009 (Figs. 1 and 2).

Local fisheries in the area of the park are small-scale fisheries using multiple gears, including octopus' traps, trammel and gill nets, jigs and longlines (Batista, Baeta, Costa, & Cabral, 2011; Horta e Costa et al. 2013a). Since the approval of the management plan, commercial fishers need a license to operate within the park, which is only attributed to fishers from the local town of Sesimbra who maintain a minimum of 100 annual selling days at the fish auction. In 2006, 116 fishers got a license to fish within the park area but the management plan suggested a gradual reduction of this number. The initial number of fishing licenses was decided by the MPA managers and licenses were given to all fishers from Sesimbra operating within the MPA area with vessels smaller than 7m in total length. New licenses cannot be immitted or sold, and licenses can only be 'inherited' by direct descents. This way the number of licenses, and fishing effort, were expected to decrease through time (further detail in Horta e Costa et al., 2013a, b). Before the management plan was approved, commercial fishing diving and clam dredging were already forbidden (since 1998), and the borders of the marine park were already recognized.

Fishers started to discuss the management regulations with authorities around 2001, but the public consultation on the management plan was still ongoing in late 2004, and was considered contentious (Vasconcelos, Caser, Ramos Pereira, Gonçalves, & Sá, 2012; Horta e Costa et al., 2013a; Stratoudakis, Fernández, Henriques, Martins, & Martins, 2015). The main problems were related with the exclusion from the park of fishers from outside Sesimbra, particularly those operating dredgers and purse seiners, and the exclusion of local vessels larger than 7m. Some fishers operating with small vessels (particularly small longliners), were poorly represented in fishers' associations, and therefore in the consultation process. Restrictions of certain fishing gears from particular zones also raised concerns, as this would lead to displacement from traditional fishing grounds and subsequent competition for space (Horta e Costa et al., 2013a, b). Nevertheless, after 2004, and as a consequence of fishers' participation in the public consultation process, the regulations concerning the management plan allowed for traps and jigs to operate in the PPAs (greatly reducing the proposed fully protected zone) and nets in the BAs (Horta e Costa et al., 2013a).

Several research projects have been conducted in this marine park since 2007 to understand ecological and socio-economic benefits/impacts of the management plan, such BIOMARES (2007–2011), MAIA

(2009–2012), BUFFER (2013–2015), BIOMARES2.0 (2013–2015 in association with BUFFER), and InforBiomares (started in 2018); and governance aspects of the AMP, projects MAIA and MARGOV (2008–2011) (Fig. 2).

3. Methodology

3.1. Surveys

To understand fishers' perceptions as well as the potential social and economic impacts of the implementation of the management plan of the AMP, a questionnaire survey was conducted face-to-face with local commercial fishers with license to operate within the park. Twenty-six fishers were surveyed both in mid-2007 during the BIOMARES LIFE project (LIFE06 NAT/P/000192) and in early 2015 as part of the BUFFER project (ERA-Net BiodivERSa project "BUFFER—Partially protected areas as buffers to increase the linked social-ecological resilience") in the Sesimbra fishing port. The sample of twenty-six fishers accounted for 24% and 41% of all the fishers with licenses to operate within the park area in 2007 and 2015, respectively.

The questionnaires (in both periods) included questions to identify and characterize the métiers (characterizing the vessel, identifying and describing in detail the fishing operation, gear used, species caught, fishing areas, seasons, and time of the day), questions to gauge fishers' perceptions of the park and impact of the park on fisheries, as well as demographic questions. The 2015 questionnaire included a set of more detailed questions about the impact of the park on their fishery (e.g., fishing effort, fishing grounds), benefits from the park, impact of the park on their catch, and fishing effort as well as questions about conflicts, park regulations and how to improve them, park control and surveillance, the future of fisheries and of the park. Questions in year 2007 were asked in a five-point Likert-scale format (Strongly Disagree to Strongly Agree), while in year 2015 questions were asked in Likert-scale and binary formats. For comparison purposes, all data were subsequently collapsed to a binary format.

3.2. Data analysis

Differences between perceptions of fishers from the two periods (2007 and 2015) were tested with chi-square tests (or Fisher's exact test, when assumptions were not met by the data).

To assess if fishers' perceptions about trends in fishing effort and catches after the implementation of the management plan (asked in the 2015 survey) matched local landings trends, those perceptions were compared to landings reported in official statistics. Landings data from

2005 to 2014 were selected to cover the period after implementation. Two periods of 3-years were retained for comparison: (i) 2005–2007, corresponding to the beginning of the transition period and including the 3 years before the 2007 survey (called “before”); and (ii) 2012–2014, also corresponding to the 3 years before the 2015 survey, but after the full implementation of the management plan, completed in mid- 2009 (called “after”). To ensure landings data were comparable among periods, only data from fishing vessels with license to operate within the park, and with reported landings at least during half of the total years were used. To allow for a robust comparison, the species (or groups of species) selected for analysis were those fishers reported as the most commonly landed: octopus (*Octopus vulgaris*), squid (Loliginidae n.id.), cuttlefish (*Sepia officinalis*) and soles (Soleidae n.id.). These are the main target species of the most important fishing gears: traps (octopus), jigs (squid and cuttlefish) and trammel nets (soles and cuttlefish). Landings by species and by boat were summed for each year and divided by the total number of annual landing days of respective vessels, resulting in annual species Landings Per Unit Effort (LPUE; landing days was used as proxy for fishing days, as small local vessels land their catches daily) by vessel. Landings data for the Sesimbra port were provided by the Portuguese General Directorate of Natural Resources, Safety and Maritime Services (DGRM).

Since data did not follow a Normal distribution, Mann-Whitney U statistics were conducted to test differences in fishing effort (i.e. number of landings days) and LPUE between periods (before vs. after) for the chosen species pooled together.

4. Results and discussion

Most interviewed fishers operated alone or in pairs (average 1.4 men on board), in small (average 5.2m in total length) wooden vessels, using hooks and lines, jigs, traps, trammel nets and gillnets (Table 1).

4.1. Do Fishers’ knowledge, acceptance and perceptions about the MPA changed with time?

4.1.1. Fishers’ knowledge on borders and legislation

Fishers reported a significant increase ($p < 0.05$) in familiarity with park regulations, with 92% of fishers in 2015 reporting to be familiar with regulation. In fact, this was the only significant trend between 2007 and 2015. Fishers also reported to have improved their knowledge about the geographical limits of the park through time, with an important proportion of fishers (85%) reporting to be familiar with the limits of the park in 2015 (Table 2). Time is needed to acquire and consolidate knowledge on new borders and new rules, explaining these increases. Despite the MPA external limits having been established

Table 1

Characteristics of the fishing activity within the park. Data are shown as means (\pm standard deviation) or percentages.

	2007	2015
Characteristic of fishing activity		
Vessel characteristics		
Average size (m)	5.2 (1.7)	5.2 (1.6)
TAB	1.1 (1.1)	1.5 (1.1)
Vessel construction material (%)		
Wood	55.0	56.0
Fibre	45.0	44.0
Metiers/fishing gears licences (%)		
Gillnet	25.0	30.8
Trammel net	50.0	53.9
Traps	55.0	57.7
Hooks and line	95.0	84.6
Jigs (“toneira”)	90	80.8
Average number of gear licences per vessel	4.0 (1.1)	3.9 (1.4)
Average crew size	1.4 (0.6)	1.4 (0.6)

since 1998, regulations and zoning had only been designated in the management plan as recently as 2005.

4.1.2. Fishers’ acceptance of the marine park and perception about the impact of the park on fisheries

Sesimbra fishers’ acceptance of the park seem to have decreased over time, although not significantly (Table 2). A great proportion of fishers were not pleased with the creation of the park in 2007 (65%), and this proportion increased in 2015 (73%). This, despite the decrease in the number of fishers referring a negative impact of the marine park on their fishing interests (96% in 2005 to 85% in 2015) (Table 2). Still, only a few fishers considered that the park improved fisheries management, and this decreased over time (23.1%–15.4%). More detailed questions about the impact of the marine park on fisheries were conducted in 2015 and are discussed below.

Fishers’ satisfaction with the park was not accomplished even a decade after the establishment of the management plan and zoning, and actually their acceptance of the park has even decreased. This is not uncommon; several authors, from around the world, have noticed that fishers perceive conservation MPAs to have an overall negative impact on their fishing activity (Charles & Wilson, 2009; Christie, 2004; Dimech, Darmanin, Philip Smith, Kaiser, & Schembri, 2009; Himes, 2003; Hogg, Gray, Noguera-Mendez, Semitiel-Garcia, & Young, 2019; Jones, 2008; Oikonomou & Dikou, 2008; Suuronen, Jounela, & Tschernij, 2010). Actually, a decrease in the acceptance of MPAs over time was also observed amongst fishers operating in and around the Alonissos marine park in Greece (Oikonomou & Dikou, 2008), in an exclusive fisheries marine zone in Malta (Dimech et al., 2009) and in other Mediterranean countries (France, Spain, Italy, Malta and Portugal), where fishers tended to believe that the potential of MPAs to deliver fisheries objectives declined the older the MPA was (Mangi & Austen, 2008). McNeill, Clifton, and Harvey (2018) also noticed negative responses towards MPAs from fishers in western Australia, who were fearful of the detrimental impact of the loss of fishing grounds. For some fishers, these feelings persisted over time despite their own acknowledgement that the park had limited impact on their fishing activity (McNeill et al., 2018). On the other hand, other studies revealed that fishers living in areas adjacent to older no-take zones had less negative perceptions towards these management tools than those living closer to newer ones (Boubekri & Djebbar, 2016; Leleu et al., 2012; McClanahan, Davies, & Maina, 2005).

4.2. Is Fishers’ support for the MPA linked to the impact of the MPA on the fishing activity?

After 10 years of establishment of the marine park, and with most fishers having more than 10 years of experience fishing in the park area (92%; Table 3), the fact that the majority are still not pleased with the park and report negative impacts on fishing interests, suggest that fishers are not experiencing relevant positive benefits in their activity (Bennett & Dearden, 2014; Charles & Wilson, 2009).

A considerable proportion of fishers interviewed in 2015 were of the opinion that, so far, the park does not protect the ecosystem, considering its impact irrelevant (58%), and only a few were of the opinion that the park contributes to the sustainability of small-scale fisheries (35%; Table 3). This is relevant, as protection of the ecosystem and contributing to the sustainability of small-scale fisheries are amongst the main objectives of the marine park, as stated in the 2005 management plan. Surprisingly, a small proportion of fishers recognized ecosystem conservation and cultural heritage (19%) or resource conservation/sustainability (14%) as the main functions of the marine park. An even lower proportion mentioned fisheries management (10%), and in fact, only a few of them considered that the park contributed to improve fisheries management (15%), with most considering that the park had actually negatively impacted the fishing activity (65%) (Table 2).

Table 2

Perceptions about the park and its impact on fisheries. Chi-square test was used to test for significant differences between the two periods.

Perceptions	2007	2015	Statistics
Park (%)			
Not pleased with the creation of the park	65.4	73.1	Chi2 = 0.36, p = 0.548
Familiar with the geographical limitations of the park	76.0	84.6	Chi2 = 0.60, p = 0.439
Familiar with the rules and regulations for fisheries in the park	68.0	92.3	Chi2 = 4.78, p = 0.023
Impact of park on fisheries (%)			
The interest of fishers will be negatively impacted with the creation of the park/The interests of fishers were negatively impacted with the creation of the park	96.2	84.6	Chi2 = 1.99, p = 0.158
The park will improve fisheries management in the area/The park improved fisheries management in the area	23.1	15.4	Chi2 = 0.49, p = 0.482

Note: Question in year 2007 were asked in a five-point Likert-scale format (Strongly Disagree to Strongly Agree), in year 2015 questions were asked in Liker-scale and binary formats, subsequently dropped to a binary format for analysis purposes.

Table 3

Perceptions of fishers about the park, uses of the park, fisheries, management of the park and participation in the decision-making process, after the full implementation of the park (2015 surveys). Data are shown as percentages.

	2015
Over 10 years' experience fishing in the park area	92.3%
General perception about the marine park	
Main functions of the park	
Valuing fisheries	57.1%
Fisheries management	9.5%
Resource conservation/sustainability	14.3%
Ecosystem conservation and cultural heritage	19.1%
Park has an irrelevant impact on the ecosystem	57.7%
Park has a negative impact on the fishing activity	65.4%
The park contributes to the sustainability of the small-scale fishing activity	34.6%
The park does not contribute to improving fishing practices	76.9%
Perception about uses of the marine park	
Conflicts with other park users	26.9%
Who benefits most from the park	
Recreational activities	50.0%
Commercial fisheries	23.1%
Illegal fisheries	15.4%
Research	11.5%
Recreational activities not sufficiently controlled inside the park area	65.4%
Perception about fisheries within the marine park	
Main function of the park related to fisheries	
Reserve access to park exclusively to local fishers	34.6%
Protect fish stocks	11.5%
Promote the implementation/application of the existent regulation	30.8%
Promote new opportunities for revenue	7.7%
Value fishery products	7.7%
Other	7.6%
Main problems related to fisheries management in the park	
Excessive number of vessels in the park area	42.3%
Excessive rejections	34.6%
Illegal fisheries	15.4%
Prevalence of certain arts in the area	7.7%
The park resulted in changes on fishers' behaviour	73.1%
Resulting changes ^a	
Decrease fishing effort	26.3%
More selective fisheries	73.7%
Changed fishing areas	52.6%
Changed fishing gears	26.3%
Perceptions about management	
Too much fisheries control inside the park	40.0%
The regulations within the park are inadequate	100%
Participation in the park decision-making process	
Participation in organized meeting related to the park	76.9%
Fishers are well represented in park management board	26.9%

Note: ^a Multiple-choice question (consequently it might add to more than 100%).

Valuing fisheries was considered the main function of the park by most fishers (57%; Table 3), and that may explain why they are not satisfied with the park. In fact, considering these answers, it seems that fishers expected the establishment of the marine park to bring positive benefits to fishing, more than to conservation or management of the

area. Experiencing increased revenues, catches and/or species value at auctions as a result of the implementation of the park could be some of the expected outcomes related to valuing fisheries. Fisheries-related goals were also considered a priority for fishers in other MPAs (Higgins, Vandeperre, Pérez-Ruzafa, & Santos, 2008; Mangi & Austen, 2008). It is not unreasonable that fishers had these expectations as fisheries benefits are advocated by ecological studies in no-take MPAs, relating larger fish sizes and density-dependence mechanisms with spillover effects and increased fishing catches in surrounding areas (Abesamis & Russ, 2005; García-Charton et al., 2008; Gell & Roberts, 2003; Goñi et al., 2008; Hogg et al., 2019). These effects are supported by some socio-economic studies (Goñi, Hilborn, Díaz, Mallof, & Adlerstein, 2010; Pipitone, Badalamenti, Vega Fernández, & D'Anna, 2014) and are amongst the main arguments to gather fishers' support for the establishment of MPAs (Charles & Wilson, 2009; Higgins et al., 2008).

Expectations of perceived benefits from no-take areas are usually indirectly reported by aggregations of fishers near no-take borders, a phenomenon called 'fishing the line' (Kellner, Tetreault, Gaines, & Nisbet, 2007; Murawski, Wigley, Fogarty, Rago, & Mountain, 2005; Stelzenmüller et al., 2008; Wilcox & Pomeroy, 2003). A study in the Arrábida Marine Park tracking fishing distribution over time suggests that some fishing activity displaced towards the no-take borders since the beginning of the implementation of the zoning system, likely seeking 'territorial rights' and increased catches (Horta e Costa et al., 2013b).

Increases in catches through time should compensate for the loss of fishing grounds or other potential negative impacts, contributing to increase support for MPAs (Higgins et al., 2008; Leleu et al., 2012; Bennett et al., 2014; Ovando, Dougherty, & Wilson, 2016). Conversely, if, after some point, expected benefits are not perceived and negative impacts are still experienced, fishers' support is likely to decline.

Nevertheless, despite ecological effectiveness being central for fisheries benefits through enhanced fish biomass and/or spillover, a very recent study in 11 Mediterranean MPAs found that good governance and adequate management of social impacts may be more important for fishers' support for MPAs (Bennett et al., 2019).

In the Arrábida Marine Park, the lack of these three factors (perceived ecological effectiveness, good governance and adequate management of social impacts) seem to be contributing to a low level of support. Ecological effectiveness has been demonstrated for some local commercial species (e.g. White seabream, Octopus, Senegalese sole, Common sole) within the no-take and surrounding highly regulated partially protected areas (Horta e Costa, Erzini, Caselle, Folhas, & Gonçalves, 2013c; Abecasis, Afonso, & Erzini, 2014, 2015; Sousa et al., 2018). Yet, catches of larger sized-fish or fish biomass export towards adjacent buffer or outside areas remains uncertain and are likely not experienced by fishers. In fact, conservation outcomes can usually be accrued in a short time span, but net benefits for fisheries may take more than a decade (Ovando et al., 2016). This would explain why the majority of fishers are still not pleased with the park, a slight majority report that the park is irrelevant for the ecosystem, and only a reduced

proportion refers to the park contributing to the sustainability of small-scale fisheries (Table 3). Furthermore, as in most Portuguese MPAs, the governance structure is top-down and protection measures are settled by decision-makers, with a public consultation process that confers minor participation, decision power and knowledge recognition to local stakeholders (Vasconcelos et al., 2012; Horta e Costa et al., 2013a, b). This is quite common, with several studies from around the world, having found that fishers perceive their participation in the MPA decision-making process to be either lacking or insufficient (Fox et al., 2012; Gelcich, Godoy, & Castilla, 2009; Gerhardinger, Godoy, & Jones, 2009; Himes, 2003; Oikonomou & Dikou, 2008; Semitiel-García & Noguera-Mendez, 2019; Suman et al., 1999; Walmsley & White, 2003). Despite that, fishers in the Arrábida Marine Park did actually change initial planned regulations by managing to have some gear (traps and jigs) in the partially protected areas and nets in the buffer areas. By adding fishing gears to the PPAs, the size of the no-take area was reduced from ~25 km² to ~4 km², revealing some fishers' influence during the consultation process. Also, Portuguese MPAs are reported to have a lack of staff, budget, as well as poor enforcement and monitoring (Álvarez-Fernández, Fernández, Sánchez-Carnero, & Freire, 2017), which undermines adequate management, including of social impacts (Gill et al., 2018). In fact, the occurrence of illegal fishing has been reported for this area (Cunha et al., 2011), and the combination of a small no-take area with poor enforcement and poor compliance of regulations, precludes it to correctly function and deliver outcomes as expected.

In the present study, all fishers interviewed considered regulations within the park to be inadequate and most considered that the existing regulation did not improve fisheries management (Table 3). This perception would affect support and is likely related to the insufficient level of fishers' engagement during MPA planning, design and definition of regulations. The perceptions of fishers about the effectiveness of MPAs and adequacy of measures is related to leadership and trust, as indicators of legitimacy, and to a correct MPA design and implementation (Dehens & Fanning, 2018). In a Mediterranean MPA, fishers support for fishing regulations increased with their full participation and engagement, leading to high compliance with regulations (Boubekri & Djebbar, 2016). In the Arrábida Marine Park, only a minor proportion of fishers acknowledged being well represented in the park management board (27%; Table 3). The Arrábida Marine Park zoning and respective regulations were supported by previous scientific studies (Gonçalves, Henriques, & Almada, 2003), a fact that does not occur in many MPAs worldwide. Yet, stakeholders were not adequately involved in the implementation of the park and a feeling of ownership is lacking (Stratoudakis et al., 2015; Vasconcelos et al., 2012).

In a Greek MPA, Oikonomou and Dikou (2008), reported that after 13 years of implementation, there was a perceived decrease in fish stocks and fishing grounds, a lack of support for the MPA and a feeling of mistrust towards the management body. Further, there was a general conviction amongst the local community, that the management of the MPA was ineffective, including the enforcement of regulations in place (Oikonomou & Dikou, 2008). The majority of fishers operating in the Jurien Bay Marine Park (western Australia) were also not convinced about the effectiveness of the park, being of the opinion that the park lacked clear objectives, purpose and monitoring, with some perceiving it to be an ineffective tool to manage fish stocks (McNeill et al., 2018).

Despite the relatively insufficient engagement and participation, public consultancy during the development of the Arrábida Marine Park management plan included meetings with fishers that led to some changes in regulations. More recently, due to the variety of projects being conducted in this marine park (see Fig. 2), and particularly one related to collaborative governance (MARGOV), fishers participated in a number of meetings related to the marine park, likely contributing to a large majority of fishers answering positively to participating in organized meetings (77%; Table 3).

Further, only some fishers (40%) referred that too much fisheries

control exists in the marine park (Table 3). Although this evidences a lack of enforcement, it may be also seen as a negative impact of the marine park on local fishers, as control possibly reflects more on fines related to safety or boat equipment than with compliance with specific MPA regulations (*pers. obs.*).

Some fishers perceived the main function of the park in relation to fisheries to be the exclusive access for local fishers (35%), and the main problems related to fisheries management in the park to be the excessive number of vessels in the park area (42%) and excessive discards (35%). Even with the positive discrimination for local commercial fishers, buffer areas (particularly the most used buffer area in front of Sesimbra), displayed an increase of recreational and commercial use. The high density of trammel nets and other conflicting uses in buffer areas, due to the displacement from excluded areas, might have been associated to a negative impact of current zoning for fishers using that gear (Batista et al., 2015; Horta e Costa et al., 2013b). The exclusion of longlines from highly regulated partially protected areas was also contentious (Horta e Costa et al., 2013b). Compulsory changes in fishing habits with possible territorial-based conflicts, might have contributed to the large disagreement with regulations in place and to the common perception that the marine park did not contribute to improve fishing practices (77%) or fisheries management (Table 3).

Despite such perceptions, there was an overall decrease in trammel nets density through time, the main fishing gear targeting soles, one of the most valuable fishing resources of the park (Batista et al., 2011, 2015). The decrease in the price of sole and increase of octopus prices at auction over time, could be the reason for the decrease in the use of trammel nets and the shift to a more frequent use of octopus' traps amongst fishers with licenses to use both fishing gears. The fact that traps are allowed in highly regulated partially protected areas, due to their higher selectivity, might have also contributed to the increase in use of this gear (Batista et al., 2015; Horta e Costa et al., 2013b). Such behaviour suggests that multi-gear fishers can adapt more easily to changes in regulations and in markets preferences (Horta e Costa et al., 2013b), preventing extra negative impacts from the implementation of the MPA. Here, local fishers recognized that the park resulted in changes in fishers' behaviour (discussed in the next section), namely in a more selective fishery (73%), displacement (53%) and change in fishing gears used (26%). These results are consistent with previous studies assessing fisheries inside the park after the establishment of the MPA (Batista et al., 2015; Horta e Costa et al., 2013b).

Only some fishers recognized conflicts with other users of the park (27%), with some mentioning that recreational activities are not sufficiently controlled within the park (65%). In fact, when questioned about who benefits most from the park, half of the fishers interviewed referred to recreational activities and only 23% to commercial fisheries (Table 3). Although conflicts with other uses were not reported as a concern by most fishers, the perceived contrast between benefits of other users and theirs may be also contributing to some fishers' dissatisfaction. McClanahan et al. (2005, 2008) found that Kenyan and Tanzanian fishers, as well as other stakeholders (including park and fisheries officials), also perceived fishers (and local communities) not to be the group that benefits the most by the creation of MPAs.

4.3. Do Fishers' perceptions about the impact of the MPA on the fishing activity match with local landings trends?

In the 2015 survey, fishers were asked about their perceived changes in their fishing behaviour, effort and catches as a consequence of the establishment of the marine park. These answers were compared with official data to understand if they matched. Most fishers recognized that the park resulted in changes in fishers' behaviour (73%; Table 3), with 28% saying that fishing effort decreased, the same proportion affirming that it increased, leaving 44% of those interviewed with the opinion that effort continued the same over time (Table 4). Nevertheless, almost half of the fishers refer an excessive number of

Table 4

Perceptions of fishers about the state of fishing resources, effort and landings. Data from questions asked solely in 2015. Data are shown as percentages.

%	Decreased	Same ^a	Increased
Since started fishing, fish stocks have	38.5	50	11.5
Since the implementation of the park			
Effort	28.0	44.0	28.0
Landings	41.7	37.5	20.8

Note: ^a same = no tendency + no change.

vessels in the park area (Table 3). Despite the perception of the maintenance of fishing effort, a slight, though significant, increase in fishing days was detected between before and after periods (Mann-Whitney 2-tailed = 11618000, $p < 0.001$). Batista et al. (2015), found that in the first five years of the marine park, the number of licensed vessels decreased with time, from 22 to 18 vessels, with the increase of effort being driven by a significant increase in fishing gear density in particular zones (Batista et al., 2015). Here, we advocate that an increase of days at sea is also an important aspect of fishing effort that needs to be addressed.

Despite the slight increase in days at sea, almost half (42%) of the surveyed fishers reported a decrease in catches, leaving 38% of the fishers saying catches were maintained and 21% reporting an increase since the implementation of the park (Table 4). When asked about the state of fish stock since the beginning of their fishing activity, most fishers referred a maintenance (50%), with 39% reported a decrease and only 11% an increase on fish stock (Table 4).

By comparing perceptions with official landings data for the most important species in the catch, a significant decrease in landings per unit effort (LPUE) occurred between the before and after periods (Mann-Whitney 2-tailed = 264490, $p < 0.001$), mostly matching the reported perceptions.

Distinct and dispersed fishers' perceptions about the impact of the MPA on effort and landings support the variability of individual experiences. Leleu et al. (2012) also discussed that individual benefits are less well perceived than general ones.

Whilst we noted a decrease, Batista et al. (2015) found significant increases in total landings, and in revenue generated by landings, during the first years of the park. Some factors that might be related with this difference are the species included in the analysis (Batista et al. 2015 used landings of a larger pool of species) and the different period analysed (Batista et al. 2015 used 2004–2010 landings data). Batista et al. (2015) also found that official landings data do not match with catch data (on board sampling) for most species, with octopus showing the largest mismatch, and this further reflects the complexity, and difficulty of getting an accurate picture, when using landings data for analysis. Hence, opinions based on personal experience might be more related to real catches than official landings, precluding an effective comparison.

The fact that 42% of the fishers interviewed perceived a decrease in catches (Table 4), might be a reason for the perceived negative impact of the park on the fishing activity (65%; Table 3) and on their interests (87%; Table 2) referred by most fishers. Still, the differences between the perceived negative impact on the fishing activity and fishers' interests suggest that perceptions of negative impacts could be more related to social impacts and/or to the lack of ownership, as discussed in previous sections, than to impacts on catches. In fact, a previous study conducting questionnaires during 2012 in the same marine park, also found that fishers were not detecting ecological improvements, but were having an overall positive vision related to the evolution of the park and its interaction with fisheries, with the exception of some socioeconomic aspects (Stratoudakis et al., 2015).

5. Conclusions

The present study shows that although knowledge about the marine park improved, fishers' acceptance of the marine park did not increase over time. The decrease in support was not substantial, yet it highlights the issues of insufficient participation in the decision-making process raised in the initial phase of implementation of the marine park and the fact that the expectations fishers had from the implementation of the marine park were not met yet.

In the Arrábida Marine Park, fisheries benefits caused by ecological outcomes are apparently still not perceived by local fishers, though they are central for fishers' support. Furthermore, social and management aspects, such as those related to recognition, legitimacy and inclusive decision-making, poorly considered in consultation processes as the one related to the implementation of this marine park, may have undermined fishers trust in, and feeling of ownership of, the MPA goals and performance. To add to this, if the no-take area is small, the enforcement is not frequent and the risk of poaching is real, resulting in less prominent ecological and fisheries benefits, the offset of imposing additional regulations is weakened and precludes fishers support.

All the issues discussed in this paper are not uncommon to many MPAs from around the world and are broadly recognized as influencing fishers' support for MPAs. Hence, addressing them is vital for MPA success. In the Arrábida Marine Park, the perceived negative impacts may be more associated to social aspects and individual interests than to the impact of the MPA on catches. Even though the initial stages of the MPA could have been challenging, fishers recognized valuing fisheries as the main function of the park. Their expectations can still be met and fisheries benefits can still be accrued if social impacts are well managed, a good and fair governance occurs, and ecological effectiveness is enhanced by an efficient, active and adaptive management, informed by monitoring, and implemented by regular enforcement.

Despite the fact that fishers' perceptions towards and acceptance of MPAs are known to change over time and to greatly influence the success of MPAs, to the best of our knowledge this is one of the first studies following the same fishers over time, in different moments of an MPA life cycle. Such type of surveys should be included on periodical socioecological monitoring, as they would be important to support adaptive management.

Declaration of competing interest

None.

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