Article

Sustainable Fishing and Aquaculture Activities in the Atlantic Coast of the Portuguese North Region: Multi-Stakeholder Views as a Tool for Maritime Spatial Planning

Salas-Leiton E. 1,2,3,*, Vieira L.R. 1,2 and Guilhermino L. 1,2

1 Laboratory of Ecotoxicology and Ecology, Department of Population Studies, ICBAS-UP—Institute of Biomedical Sciences of Abel Salazar, University of Porto, 4050-313 Porto, Portugal; lsrvieira@icbas.up.pt (V.L.R.); lguilher@icbas.up.pt (G.L.)
2 Research Team of Ecotoxicology, Stress Ecology and Environmental Health, CIIMAR—Interdisciplinary Centre of Marine and Environmental Research, University of Porto, 4450-208 Matosinhos, Portugal
3 Laboratory of Hydrobiology and Ecology, Department of Population Studies, ICBAS-UP—Institute of Biomedical Sciences of Abel Salazar, University of Porto, 4050-313 Porto, Portugal
* Correspondence: ealeiton@icbas.up.pt

Abstract: The experienced view of stakeholders is a very valuable tool to build inclusive and reliable maritime spatial planning (MSP). Within this context, the present work assesses the potential and limitations for a further sustainable development of fishing and aquaculture activities, considering the Portuguese North Region as case study. The official strategies and legal framework drafted by Portugal in MSP issues were initially reviewed, with the corresponding management objectives identified. Official statistical data were used to show the current situation of regional fishery and aquaculture, while the perceptions of involved groups were collected by a methodology based in a multi-stakeholder survey and subsequent workshop. Taking into account the regional circumstances defined by a decreased fishing production (decline of 45.9% during the period of 2012–2019) and scarce aquaculture weight (<1% in terms of national production in 2018), the stakeholders brought to light great difficulties on the part of public administration to implement official management objectives. The stakeholders also considered that conflicts between maritime activities are almost inexistent at present, even though they predicted future disagreements when new players intend to use maritime space. A positive response about a successful future for aquaculture was obtained from every group surveyed, although the specialized stakeholders pointed out severe limitations for a further development of both off-shore and extensive coastal aquaculture modalities. In conclusion, it seems evident there is the need for a fluent collaboration with the regional fishing stakeholder, particularly promoting synergies involving small scale fleets, in order to avoid future potential conflicts. Against the challenges and limitations posed by the aquaculture industry, promoting the intensive cultivation of high commercial value fish and new interest local species, when conducted under sustainable practices that add value to the harvested product, would be an interesting strategy to implement in our case study.

Keywords: maritime spatial planning; Portuguese North Region; fisheries; aquaculture; stakeholders

1. Introduction

The Blue Growth Strategy promoted by the European Union (EU) is basically focused on the sustainable growth of the different maritime sectors, which in turn is ensured by an ecosystem-based coordinated planning [1–3]. Through a complex approach, the most recent reform of the Common Fisheries Policy (CFP) (EU Regulation No. 1380/2013) pursues the sustainability of fishing activities while integrating environmental, economic,
and social issues. The obligatory fulfilment of their most controversial actions, i.e., the restrictive adjustment of catch quotas and the discard ban in regulated species, constitutes a real challenge for the fishing industry at present. For its part, considering food security and nutritional quality as guiding principles, the aquaculture is called to guarantee the seafood consumed by a global human population that is expected to exceed 9 billion by 2050 (source: UN, United Nations, https://www.un.org) [4–6]. Aligned with this scenario, the EU assigns aquaculture a priority role, as inferred from the European Commission’s Strategic Guidelines [2] and the CFP itself (EU Regulation No. 1380/2013). Directive 2014/89/EU, which was adopted by the European Parliament and the Council, establishes the framework for maritime spatial planning (MSP), providing knowledge, legal certainty, and economical security. A rational spatial and temporal distribution of uses and activities in maritime areas is the basis to minimize conflicts, allowing for simultaneously locating pre-existing activities (e.g., fishery) and growing-interest maritime initiatives such as renewal energy and aquaculture [7–9]. The deadline established for the EU member states to adopt their respective MSP is the year 2021. Until then, a special effort must be made to carry out decisive tasks—such as gathering practical information, development of probabilistic models, and identification of new potential areas—that help to build inclusive and reliable MSP.

The engagement of stakeholders is a key intrinsic element to MSP [10,11]. European projects have actively promoted their involvement in relevant geopolitical areas—including Baltic, Mediterranean and North Seas (source: European Commission, Maritime Affairs, Integrated Maritime Policy, https://ec.europa.eu)—and their participation has been even considered as “highly integrated” in the MSP implemented in the United States and Norway [12]. Stakeholders’ questionnaire surveys and discussion round tables are, among others, usual practices successfully applied on both international trans-boundary and regional scales [13–15]. Thus, the experienced view of stakeholders is a very valuable tool, not only to help policy makers to take sectoral decisions [16] but also to adequately weigh the effectiveness of executed actions. Paying special attention to multi-stakeholder consultation, the ECOAST project, which consisted of different European case studies, aimed to test useful methodology for an adequate spatial and temporal management of fishing and aquaculture activities. Framed in the cited project, this study assesses the potential and limitations for a further sustainable development of both activities in the Atlantic coast of the Portuguese North Region (hereafter referred to as the Region). The official strategies and legal framework drafted by Portugal regarding MSP issues were reviewed, with their corresponding management objectives identified. Official statistical data were used to show the current context of regional fishery and aquaculture. The respective perceptions of involved groups were collected by a methodology based on a multi-stakeholder survey and a subsequent workshop. Taking the information provided in such a meeting as reference, the present work discusses key issues that eventually may promote or constrain the sustainable development of both activities in the Region. Future recommended actions are also presented.

2. Material and Methods
2.1. Description of Case Study

The western limit of the Portuguese North Region (NUTS II according to the EU Nomenclature of Terrestrial Units for Statistical Purposes—NUTS Commission Regulation (EU) No. 868/2014) is an Atlantic coastline (144 km) extending from the Minho River estuary to the southern boundary of the Porto Metropolitan Area (NUTS III, Commission Regulation (EU) No. 868/2014) (Figure 1). This statistic-bureaucratic state has a population of 3.6 million inhabitants (approximately 35% of the total population of Portugal), and its economy constitutes about 29% of the national gross domestic product (source: CCDRN, Comissão de Coordenação e Desenvolvimento Regional do Norte, https://www.ccdrn.n.pt).
Figure 1. Coastal zone of the Portuguese North Region, extended from the Minho River estuary to the southern boundary of the Porto Metropolitan Area.

The Douro river estuary constitutes the main regional geographical feature and is subjected to a high anthropogenic-origin pressure in terms of population and tourism, with over 500,000 habitants (considering both Porto and Gaia districts) and most of the 10.8 million of overnight stays/year registered in 2019 in the entire area of the Region (sources: PORDATA, Base de Dados Portugal Contemporâneo, https://www.pordata.pt; INE, Instituto Nacional de Estatística, https://www.ine.pt). Moreover, relevant industry activities are settled in the border district of Matosinhos, namely, port activity (101 touristic cruisers/year and a traffic of 685,810 TEUs/year by 2600 shipping vessels in 2019) and oil refinery (capacity of 100,000 barrels of oil/day) (sources: APDL, Administração dos Portos do Douro, Leixões e Viana do Castelo, SA, https://www.apdl.pt; GALP, Galp Energia Group, https://www.galp.pt).

2.2. Official Information Sources

The official management objectives for fishery and aquaculture were identified from the National Ocean Strategy (NOS) 2013–2020 [17] and the Strategic Plan for Portuguese Aquaculture 2014–2020 [18]. The subsequent legal framework was extracted from the national Official Gazette (Diário da República, http://dre.pt).

The annual series of official data (Estatísticas da pesca, http://www.ine.pt) was the government source used to assess the current context of the fishing and aquaculture activities. Their respective evolutions of production, expressed in terms of catching (in ton), were plotted at the national and regional levels.
2.3. Multi-Stakeholder ECOAST Survey

The ECOAST international questionnaire was implemented, from July 2018 to February 2019, through personal interviews to stakeholders. By a set of simple questions, this questionnaire surveyed perceptions about (i) the current and future maritime spatial competition between fishing and aquaculture activities; (ii) the legal framework and planning tools for sustainable activities; (iii) future trends for fishery, aquaculture, habitat, and species; and (iv) potential maritime areas for aquaculture. Special attention was paid to the fishing community, i.e., small-scale fishermen, ship-owners, and fishery cooperatives, which is by far the most influential and relevant stakeholder present in the Region. A total of 56 persons were interviewed. Each person filled out one survey, and they all responded to all the questions. The participants’ questionnaires were grouped by stakeholder groups according to their main activity sub-sector. Three participants had their main activities in two activity sub-sectors and their responses were included in the two corresponding stakeholder groups, resulting in the following number of participants per stakeholder group: fishery (N = 35), fishery management (N = 1), aquaculture production (N = 3), aquaculture consultancy (N = 4), trade (N = 5), academic research (N = 4), and other (N = 7). For each question, the relative percentages of different responses within each stakeholder group were calculated in relation to the number of participants per stakeholder group.

2.4. Multi-Stakeholder Regional Workshop

The respective views of the involved stakeholders about the potential and limitations for sustainable fishing and aquaculture activities in the Region were explored in the workshop held on 7 May 2019 in the facilities of the Institute of Biomedical Sciences Abel Salazar (ICBAS) (Porto, Portugal). The ultimate goal of this meeting was to gather conclusions, in terms of planning and conflicts, that would allow recommendations to be suggested to the correspondent policymakers.

The workshop was attended by a total of fifteen representatives (professional experience above 30 years) from the following stakeholder categories: fishery, fishery management, aquaculture consultancy, aquaculture production, trade, and academic research. At least N = 2 members per stakeholder category — except for the fishery management category which had just one representative — were in attendance. The entities that were thus represented are as follows: the Agriculture and Fisheries Northern Regional Bureau (DRAPN), the regional government institution with the responsibility to deal with fishing issues; Docapesca–Portos e Lotas, S.A., the authority responsible for managing the 22 major first-sale markets in continental Portugal; VianaPesca O.P., a fishery cooperative associated with 400 small-scale vessels; Baleeira Pescas Lda., a large-scale fishing company (Vila Praia de Âncora, Portugal); Testa & Cunha S.A., a large-scale fishing and off-shore aquaculture production company (Gafanha da Nazaré, Portugal); and Riosearch Unipessoal Lda., an aquaculture research company (Murtoosa, Portugal). In terms of public research, teaching, and training, representatives from the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR) (consisting of 10 research groups and 31 research teams), the Institute of Biomedical Sciences Abel Salazar (ICBAS) (constituted by 300 teachers, including 150 PhD, and 30 full professors), and the Fishing and Sea Professional Training Centre (FOR-MAR) (national institution in charge of formal training in fishing and aquaculture activities) were in attendance. Moreover, aquaculture independent professionals who specialize in extensive and RAS modalities also attended the meeting.

In the meeting, the results from the ECOAST survey were firstly presented, and subsequently a round table was initiated. In order to structure adequately the discussion, three major topics, among other, were debated: (i) the Portuguese MSP, (ii) potential conflicts between activities, and (iii) the concept of sustainability in the fishing and aquaculture industries. Once the discussion period concluded, all the participants were requested to write briefly their opinions about the discussed topics. The most relevant conclusions
reached in this meeting, along with the facts and data that would support them, are presented in the discussion section of the present work.

3. Results

3.1. Portuguese Official Policies and Legal Framework

The National Ocean Strategy (NOS) 2013–2020 [17] constitutes the earliest base document drafted by Portugal on MSP issues (Table 1). Approved in 2013 and aligned with the European “blue economy”, its overall objective was to identify intervention areas while defining the specific objectives and results to achieve for every considered category: blue energy, aquaculture, coastal and cruiser maritime tourism, marine mineral resources, and blue technology. The need to update the existing legal framework and pursue an adequate planning of the national maritime space (Table 2) was considered a necessity according to the NOS 2013–2020. Moreover, the NOS 2013–2020 specifically pointed to both on-shore and off-shore aquaculture modalities the responsibility to counteract the expected insufficient level of fishing captures in following years. Consequently, and in line with the Strategy of Sustainable Development for European Aquaculture, Portugal implemented in early 2015 the Strategic Plan for Portuguese Aquaculture 2014–2020 [18]. This document is responsible not only for identifying the main drawbacks that are associated with aquaculture activity in Portugal (i.e., the natural and environmental, business, and institutional origin), but also for establishing the management objectives that should lead to an increased and diversified national offer of aquaculture products (Table 2).

Table 1. Main official policies and legal framework presently existing in Portugal related to fishery, aquaculture and other maritime activities.

<table>
<thead>
<tr>
<th>Document Type</th>
<th>Document Type</th>
<th>Year</th>
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<tbody>
<tr>
<td>Law n. 17/2014, from 10 April, establishing the Basis of the Policy for Planning and Management of National Sea Area</td>
<td>Legislation</td>
<td>2014</td>
</tr>
<tr>
<td>Decree-law n. 38/2015, from 12 March, developing the law of Basis of the Policy for Planning and Management of National Sea Area</td>
<td>Legislation</td>
<td>2015</td>
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<tr>
<td>Decree-law n. 139/2015, from 30 July, modifying the Decree-law n. 38/2015, from 12 March</td>
<td>Legislation</td>
<td>2015</td>
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<tr>
<td>Order n. 11494/2015, from 14 October, referring to the authorities with responsibility for the elaboration the Maritime Spatial Plan of the National Maritime Area</td>
<td>Legislation</td>
<td>2015</td>
</tr>
<tr>
<td>Order n. 1608/2018, from 13 February 2018, referring to elaboration of Aquaculture Map for Transition Waters</td>
<td>Legislation</td>
<td>2018</td>
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<tr>
<td>Resolution of Council of Ministers n. 203-A/2019, from 30 December 2019, referring to the approval of the Maritime Spatial Plan for continental Portugal, Madeira and extended continental platform</td>
<td>Legislation</td>
<td>2019</td>
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</tbody>
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Table 2. Summary of the main management objectives of the Portuguese official policy for fishing and aquaculture activities.

<table>
<thead>
<tr>
<th>Intervention Area</th>
<th>Objective</th>
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<tbody>
<tr>
<td>Administration</td>
<td>To establish a complete and updated legal frame that defines the actions focused on an adequate organization and use of the Portuguese maritime area.</td>
</tr>
<tr>
<td></td>
<td>To build a maritime spatial plan that identifies potential areas for each maritime activity, minimizing impacts and favoring synergies.</td>
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<td></td>
<td>To simplify the bureaucratic-administrative procedures required for the achievement of licenses to operate in sea areas (by making a unified digital platform available).</td>
</tr>
<tr>
<td>Fishing industry</td>
<td>To promote structural and organizational changes, i.e., a sector mainly constituted of small companies (vessels under 12 m and 1–2 workers) must advance towards producer associations and cooperatives, with an enhanced environmental focus and a greater potential to innovate and adopt technology.</td>
</tr>
</tbody>
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To valorize fish as a primary product by adding value to captures, where new alternative methods of conservation, transformation and diversification, along with the achievement of a Portuguese-origin product certificate (in terms of quality and sustainability) and the foreign investment attraction, constitute key strategies.

**Aquaculture industry**
- To adopt structural and organizational changes allowing the current business network (large number of small family companies with limited management and innovation abilities) to evolve towards a higher degree of professionalization.
- To identify areas potentially adequate for aquaculture by information gathering and planning, considering the off-shore modality and aquaculture in transition waters (with special attention to disused or degraded wetlands) as key targets.
- To increase, diversify (in terms of species and products), and valorize the national aquaculture offer, assuming sustainability, quality and food safety as main ruling principles.

**Research on fisheries**
- To achieve a greater knowledge on the status, evolution, and sustainability of main fish stocks.
- To develop new fishing practices in order to meet standards based on technological efficiency, capture selection, and reduction of fish discard.
- To study in detail the wild ecosystems hosting valuable fish species.

**Research on aquaculture**
- To increase the knowledge regarding genetic selection of breeders, pathology control, nutritional and feeding parameters optimization, and improvement of environmental footprint.
- To transform base research into valuable “know-how” useful for the aquaculture sector.

As promoted by the official strategies, Portugal has approved in the recent years a complete legal framework aiming at an adequate organization and utilization of its national maritime space (from the coastal lines to the outer limits of continental platform beyond 200 nautical miles). The law n. 17/2014 of 10 April and the subsequent decree-law n. 38/2015 of 12 March (see Table 1) are responsible for promoting a sustainable economic exploitation of the marine resources, guaranteeing the compatibility of the different uses and activities, as well as preventing or minimizing eventual conflicts between them. The key tool to achieve such purposes is the Maritime Spatial Plan, which must collect the space-time distribution of current and future uses and activities, while also identifying those marine areas susceptible to be protected. With respect to the private initiative, this framework eventually guarantees legal security for those players interested in the exploitation of the national maritime space; this includes the enabling of an ad hoc unified digital platform as relevant management objective (Table 2).

The above Maritime Spatial Plan [19], definitively approved for continental Portugal and Madeira in December 2019 (Resolution of Council of Ministers n.º 203-A/2019), does not consider any potential maritime area for off-shore aquaculture in our case study (Figure 2). In contrast, areas destined for the development of wind energy—adjacent to the existing plant—and for a major use of leisure, sport, and tourism were effectively assigned [19] (Figure 2). Regarding aquaculture activity and complementing the information contained in the Maritime Spatial Plan, Portugal recently submitted to public consultation the second version of the Aquaculture Map for Transition Waters [20]. Supported by the Decree-law n. 38/2015 and Order n. 1608/2018 (Table 1), such a map is responsible for planning the uses and activities in the national bodies of water close to the mouths of the river, that is, partially salt bodies that are significantly influenced by continental water flow. Even though it has not been definitively approved yet, its current version also does not assign a potential area to host new aquaculture activity in any transitional water bodies (Minho, Lima, Câvado, Ave and Douro estuaries) existing in our case study.
3.2. Current Context of Regional Fishing and Aquaculture Activities

Fishery is a maritime activity deeply rooted in the Region, with well-identified local communities that hosted more than 4600 registered fishermen in 2019 [21]. They constitute a very relevant artisanal fleet (vessel < 10 m) mainly devoted to multi-gear fishery [21]. The regional fishing fleet has significantly decreased the number of vessels (~11.7%) throughout the 2012–2019 period, although both total tonnage and power have remained practically constant (+2.0 and +2.7%, respectively) [21,22].

In a larger proportion in comparison with continental Portugal, the fishing production—led by horse mackerel, mackerel, sardine and octopus—in our case study was reduced from 31,480 to 17,023 t (decline of 45.9%) during the 2012–2019 period [21,22] (Figure 3). Multiple causes—e.g., abundance of stocks, management of resources, political decisions, etc.—are likely to underlie such decline, and these deserve a more detailed independent approach. In any case, the data here point to the sardine fishery as the main party responsible, as its nominal catch decreased by 78.8% throughout this period [21,22], which is enough to justify the ambitious plan of management and recovery (www.dgrm.mm.gov.pt) that Portugal and Spain are currently executing (implementation period: 2018–2023) [23]. In economic terms, the regional fishing production reached, in 2019, a value of €39.13 million in first sale markets (€2.30 Kg⁻¹ seafood), implying an appreciation of the primary product above 61.0% in comparison with 2012 [21,22]. This positive pricing trend has partially allowed for counteracting the decreased fishing production, in turn helping to mitigate its impact on the regional fishing industry.
Figure 3. Evolution of total fishing production in continental Portugal and in the Portuguese North Region throughout the 2012–2019 period (source: INE, Instituto Nacional de Estatística, https://www.ine.pt). It includes fresh and refrigerated fish, crustaceans and mollusks from marine and transition waters. Discards are not included.

The weight of the regional aquaculture activity in marine and transition waters has been very small to date. The regional aquaculture production in 2018 was 51 t, accounting for lower than 1% of the national production (Figure 4, left). Moreover, the time-based analysis reveals a very unstable aquaculture production between 2011 and 2018 (Figure 4, right), as a consequence of the operational and cultivation modality changes that occurred in the production units. Such data may be easily explained considering that, at present, no offshore aquaculture and only three coastal units exist in our case study (Figure 5). Two growth units of Pacific oysters (Crassostreas gigas) and clams (Ruditapes decussatus), working in extensive regime (with production capacities up to 140 and 20 t/year, respectively), are located in the Lima estuary, close to Viana do Castelo. The remaining aquaculture facility is located in Estela (Póvoa de Varzim district) and is a hatchery-nursery that produces Senegalese sole (Solea senegalensis) under a recirculating aquaculture system (RAS). With a current production capacity above $5 \times 10^6$ juveniles per year, this facility left in the past the fattening stage to focus only on hatchery-nursery activities. As a result, from 2014 onwards, aquaculture harvesting in the Region comes exclusively from extensive cultivation conditions. Nonetheless, the strategic importance of this facility within the national aquaculture scenario is remarkable, since it was responsible, in combination with the complementary growth unit placed in Torreira (Aveiro district, Center Region of Portugal), for the only 144 tons of sole (value above €1,800,000) that were produced under intensive conditions by Portugal in 2018 [21].
Figure 4. National aquaculture production (%) in 2018 shown by NUTS II (left) and evolution of aquaculture production (in ton) in the Portuguese North Region between 2011 and 2018 (right) (source: INE, Instituto Nacional de Estatística, https://www.ine.pt). In marine and transition waters.

Figure 5. Location of the aquaculture growth units (Id 2069 and Id 1761) existing in the Portuguese North Region. (A) Active aquaculture systems in transition waters (ZP area 3763, Lima estuary, for oysters and clams, Id 2069). (B) Active fish aquaculture in Estela, Póvoa do Varzim (Intensive hatchery-nursery working under recirculating aquaculture system, Id 1761). Map produced in QGIS and pictures from Google Earth.

3.3. Multi-Stakeholder ECOAST Survey

The majority of the fishery stakeholder fully disagreed on the fact that the fishing and aquaculture activities compete for the access to sea areas (Figure 6). A similar view—likely arisen from the low regional aquaculture activity (above described)—was achieved when the remaining stakeholder groups were considered, even though in this occasion the opinions were more diverse (Figure 6).
Figure 6. Responses from surveyed stakeholder groups to the assertion: “Fisheries and aquaculture at present compete for the access to sea areas in the Portuguese North Region”. Fish = fishery; Fish Manag. = fishery management; Acad Res. = academic research; Aquacult Cons. = aquaculture consultancy; Aquacult Prod. = Aquaculture production.

Participants belonging to the fishery stakeholder mostly disagreed (either fully or partially) that the existing legal framework supports the sustainable development of fishing and aquaculture activities (Figure 7, left). In contrast, other stakeholder groups, such as fishery management, academic researchers, and trade, showed a higher degree of satisfaction (Figure 7, left). When questioned about whether the existing planning tools are sufficient to comply with the laws and regulations, more than 80% of the participants within the fishery stakeholder disagreed (fully or partially), whereas higher percentages of agreement were found in other questioned stakeholder groups (Figure 7, right).

Figure 7. Responses from surveyed stakeholder groups to the assertions: “The current existing legal framework supports sustainable fisheries and aquaculture” (left) and “The current existing planning tools are sufficient to comply with the laws and regulations” (right), respectively. Fish. = fishery; Fish Manag. = fishery management; Acad Res. = academic research; Aquacult Cons. = aquaculture consultancy; Aquacult Prod. = aquaculture production.

With the exception of the fishery stakeholder, most of the remaining groups—namely fishery management, academic research, and trade stakeholders—agreed on the high priority given to the fishing activity by the regional administration (Figure 8, up). When asked whether aquaculture is also considered a priority by the regional administration, there was either total and partial disagreement in the next stakeholders: academic research, aquaculture consultancy, aquaculture production, and other. In turn, the fishery management stakeholder partially agreed, and the trade group showed a wide variety of responses (Figure 8, down).
Figure 8. Responses from surveyed stakeholder groups to the assertions: “Fisheries are presently given a high priority by management within the Region” (up) and “Aquaculture is presently given a high priority by management within the Region” (down). Fish = fishery; Fish Manag. = fishery management; Acad Res. = academic research; Aquacult Cons. = aquaculture consultancy; Aquacult Prod. = aquaculture production.

The different questioned stakeholders were widely in agreement about a future decreasing of the fishing activity (Figure 9, up and left); only the trade and other stakeholder groups showed a higher degree of optimism. In contrast, an almost unanimous response about a successful future for aquaculture activity was achieved from every stakeholder (Figure 9, up and right). The different stakeholders found it difficult to predict the future relationship in terms of competition over access to marine space that might be established between fishery and aquaculture (Figure 9, down and left). Nonetheless, it is interesting to highlight two points in this regard: (1) the aquaculture specialists unanimously responded that the current situation will not be modified, at least not in the short term, and (2) there was a high proportion of “don’t know” answers given by the fishery stakeholder (Figure 9, down and left). Regarding the future conservation of vulnerable species and habitats, 100% of the participants from academic research, aquaculture consultancy, aquaculture production, and other stakeholder groups thought that it will become more important (Figure 9, down and right). In turn, the fishery management stakeholder and more than 50% of the fishery group indicated that the relevance of this issue will remain similar (Figure 9, down and right).
Figure 9. Responses from surveyed stakeholder groups to the following assertions: “Until the year 2040 and in light of environmental change, fisheries will either increase, not change, decrease, or you do not know” (up and left); “Until the year 2040 and in light of environmental change, aquaculture will either increase, not change, decrease, or you do not know” (up and right); “Until the year 2040 and in light of environmental change, the competition over space between fisheries and aquaculture will increase, not change, decrease or you do not know” (down and left); and “Until the year 2040 and in light of environmental change, conservation of vulnerable species and habitats will become more important, neutral, less important or you do not know” (down and right). Fish. = fishery; Fish Manag. = fishery management; Acad Res. = academic research; Aquacult Cons. = aquaculture consultancy; Aquacult Prod. = aquaculture production.

When asked about the existence of new potential areas for aquaculture in the Region, the majority of the responses from fishery management, academic research, aquaculture consultancy, trade, and other stakeholders were positive (Figure 10). Nevertheless, the aquaculture producers showed a less solid conviction, and most of the members of the fishery stakeholder indicated they did not know (Figure 10). A wide range of proposals were presented during the interviews, mainly by both aquaculture and academic research stakeholders. For instance, the Viana do Castelo district appears as target location (Minho and Lima estuaries, and the coastal area extending between them) to enhance an extensive coastal aquaculture. Moreover, an activity based in RAS was also proposed, taking advantage from a predominantly rocky coastline to anchor the seawater collection systems. Lastly, the off-shore aquaculture modality was pointed out as a future option with a higher potential, despite the challenges and high risk involved in our case study.

Figure 10. Responses from surveyed stakeholder groups about the question: “Are there any new potential areas for aquaculture in the Region?” Fish. = fishery; Fish Manag. = fishery management;
4. Discussion

4.1. The Portuguese MSP and Potential Conflicts between Activities

Regarding whether the Portuguese MSP was making adequate progress in terms of time and reliability, the majority of stakeholders were not in agreement with this statement. The stakeholders, particularly those groups related to fishing and aquaculture production, complained about the scarce relevance assigned by the administration to the involved players during the decision-making process. The legal uncertainty caused by the fact that, after a long time, both the Maritime Spatial Plan and the Aquaculture Map for Transition Waters had still not been definitely approved (Status report, on 2 October 2018, and Notice n. 8592/2019, from 17 May 2019, respectively) probably underlies such negative perception. The MSP was essentially conceived as a democratic mechanism responsible for effectively integrating the intrinsic value of the stakeholders involved [24,25]. A futile or insufficiently participatory approach would thus act clearly against the very criteria of good governance that should rule the MSP [26,27]. The national maritime areas destined for aquaculture could be considered as a sufficient representative example of the main claim of the stakeholders. In the opinion of aquaculture producers and consultants, the location of such aquaculture production areas (APA) was not always chosen correctly from a technical point of view, which helps to explain why the increased national area for aquaculture activity registered in 2012 and mainly in 2013 [28,29] did not result in the expected growth in aquaculture production.

The stakeholders considered that at present the conflicts between maritime activities are practically non-existing in the Region. Nevertheless, they predicted that potential conflicts will arise when new maritime activities are interested in using maritime space that is currently occupied exclusively by fishery. Such a perception would be aligned with the recent conflict arising from WindFloat Atlantic project (source: EDP, Energias de Portugal, S.A., https://www.edp.pt), which is an offshore wind power plant installed at 9–10 nautical miles away from Viana do Castelo (Figure 2). The occurrence of conflicts between maritime activities, caused by direct competition over a limited space, is a relatively common event within the framework of a growing economy, as it is the case in Portugal (source: IMF, International Monetary Fund, https://www.imf.org). Offshore wind farms and fishery, along with maritime transport and marine conservation, have in fact been identified by the EU as sectors with a higher probability of arising conflict between them [30]. Thus, an adequate dissemination based on reliable information and broad crossed-sectoral agreements, both demanded by our regional stakeholders, seem the best choice to avoid, or at least to mitigate, this kind of situations.

4.2. Sustainability and Growth of Fishing and Aquaculture Activities

The stakeholder groups, mainly fishery, traders, and aquaculture production and consultancy, were unable to identify a well-defined management plan that would contribute to a further development of the regional maritime economy; this shows the difficulties on the part of the administration to achieve certain management objectives (Table 2) (see Section 3.1). In the case of fishery, the involved stakeholders recognized the current unsustainable situation, and the need to apply new management concepts and models [31,32]. As an example, prioritizing gear and net types that add value to the catches under the premise “quality instead of quantity” [33], as well to invest efforts in new potential valuable species to diversify the commercial offer (e.g., blue whiting and Atlantic bonito), would seem to be reasonable actions in order to establish a solid initial sustainable basis. In contrast, excessively rigid laws, not enough well-coordinated national institutions, and an inadequate European policy are the main limitations that, under their view, prevent progress towards a more sustainable fishing management.
The early nature of the aquaculture industry existing at present in the Region would easily explain the wide view and numerous proposals offered by consultants and researchers. As seen in the hard metocean conditions to develop an off-shore modality in its coastline [34], the Maritime Spatial Plan does not consider any maritime space for aquaculture in our case study [19] (Figure 2). Nonetheless, pilot hydraulic studies conducted in the last few years have led to the patenting of off-shore cultivation cages suitable for deep waters (200 m) with wave heights up to 5 m [35]. Waiting for such technological advances could make such modality viable in the long term, coastal aquaculture based on bivalve rearing in estuaries and intensive production in RAS seem to be more appropriate options. As mentioned above, the bivalve extensive aquaculture already constitutes a reality in the Region. Taking advantage from the nutritional and feeding studies recently carried out in Portugal on Pacific oyster broodstock [36–38], promoting a hatchery activity for this species would be a particularly interesting initiative for the Region. Thus, the current foreign dependence on oyster seeds might at least be minimized, while also meeting official aquaculture management objectives [18]. In turn, the lack of physical space, partially polluted environments, protected areas, and conflicts with river traffic are the main drawbacks identified by the involved stakeholder groups to expand this aquaculture modality. The fact that the Aquaculture Map for Transition Waters does not assign any new potential area to aquaculture activity in the Region [20] would actually support this last view. With respect to the intensive production, and even recognizing the heavily required investment and the environmental footprint associated with this modality, the specialists confirmed good potential conditions to host facilities that chose the RAS option. In this regard, focusing efforts on the cultivation of both fish of high commercial value and new species of interest local would constitute a diversified rational strategy for our case study. Considering the current role of the Senegalese sole for the regional aquaculture (see Section 3.2), and taking into account its high aquaculture potential [39] and the stable growth rates shown under different nutritional conditions [40,41], this species might be undoubtedly a key target for the Region. Meanwhile, the sea urchin (Paracentratus lividus), whose first nutritional studies in RAS conditions have been recently initiated [42], is a clear example of local species with potential to be intensively cultivated.

5. Conclusions

The recent approval of the Maritime Spatial Plan for continental Portugal and Madeira is the first milestone achieved by this country in MSP issue. Regarding our case study, the final approval of the Aquaculture Map for Transition Waters must constitute the next achievement, providing the reference information and legal certainty demanded by the potentially interested players. In aiming to promote synergies and minimize conflicts, it seems evident, in any event, that there is a need for a prior positive response from the regional fishing stakeholder when “new” maritime activities intend to use the maritime space. In this regard, the promotion of synergies involving the small scale fishery and any leisure maritime activity, aligned with the Maritime Spatial Plan assigned to our case study, should constitute a priority goal to meet in the short term.

Until further technological solutions allow off-shore aquaculture to be developed, enhancing a coastal modality is a more pragmatic option for the Region at present. Specific technical assessments that are carried out by public institutions in identifying on-land locations suitable for RAS facilities is highly recommendable in order to facilitate private investment. Moreover, advancing the intensive cultivation of high commercial value fish and local species of new interest, under sustainable practices that add value to the harvested product, might result very interesting to attract both foreign and domestic trade.

A reliable research approach, properly supported by well-structured fund management programs, should ensure the requested innovative technological solutions and the subsequent transfer of know-how. Only by consolidating a competitive business network,
which is especially necessary in the case of aquaculture, whose impact is so far very limited, will it be possible to achieve a greater sustainable development of the regional fishing and aquaculture activities.

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**Abbreviations**

- APA: Aquaculture production area
- CFP: Common Fisheries Policy
- EU: European Union
- MSP: Maritime spatial planning
- NOS: National Ocean Strategy
- RAS: Recirculating aquaculture system

**References**


