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Towards Sustainability: A Framework for Evaluating Portuguese Small-Scale Fisheries

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Abstract: Portugal has a historical tradition in fisheries, and its small-scale fishery (SSF) communities are the backbone of the national industry. There have been increased concerns about the state of fisheries and fish resources, particularly the sustainable performance of fishing sectors. In light of this aspect, understanding economic, social, environmental, and governmental aspects is a key element in assessing sustainability. Given the relevance of the fishing industry in Portugal, it is paramount to understand if the Portuguese SSFs are sustainable. This study aims to develop a contextualized indicator framework for SSFs' sustainability with economic, social, environmental, and governance dimensions. Further, we developed a systematic literature review to evaluate Portuguese SSFs using such a framework. Of the list of suggested 31 indicators (8 economy, 9 social, 12 environmental, and 8 governance), 1394 published references were recovered from the systematic review for Portuguese SSFs. Results suggests that Portugal must improve socioeconomic and environmental data and strengthen governmental support for a sustainable fishing industry. In particular, understanding fishers' financial stability and ecological knowledge and promoting further studies on fisheries' impact on the marine environment is essential. Overall, the qualitative list of indicators provided represents an innovative and unique framework for evaluating fisheries' sustainability in different worldwide settings.

Keywords: small-scale fisheries; indicators; sustainability; Portugal; SDG 14

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1. Introduction

The sustainability of the fishing sector is a relevant topic in worldwide discussions on ocean health and sustainability given the industry's tendency for overcapacity, food security issues, habitat destruction, poor labor conditions, and gender work inequalities [1–5]. Despite these concerns, there is still hope that sustainable fishery management can meet future food demands [6,7]. Most scholars argue that food security for future generations relies on the success of small-scale fisheries (SSFs) [8,9]. In the most recent data provided by The United Nations Food and Agriculture Organization (FAO), in 2020, there were 38 million fishery-related jobs, and it is estimated that around 90% of those are involved in small-scale fishing [3]. The FAO Voluntary Guidelines (2015) characterizes SSFs as an important pillar of local culture and traditions, in which the fishers are self-employed, and the majority of their catches are consumed within their households or local communities [10]. SSFs are, in fact, extremely valuable since they provide protein to millions of people worldwide, particularly in coastal regions [11,12].

In Portugal, the fishing industry is a central element of coastal communities' economies, particularly in coastal cities with a higher incidence of SSFs. Actually, 91% of the Portuguese fleet is characterized by small-scale, local, and coastal operations, operating with low-tech fishing vessels, with a length of less than 12 m, working with multiple gears (e.g., set gillnets, trammel nets, set longlines, handlines, pots, and traps) [13,14]. This fleet supports several

local businesses, including being a source of fresh seafood fish to nearby restaurants, and is an important industry for the active purchase and consumption of fishing gear materials from local suppliers [13,15].

A growing body of literature has emphasized the need to increase research on Portuguese SSFs [13,16,17], in particular to assess its sustainability across different communities and fleets [18–21]. Achieving a sustainable fishing sector is a global obligation, in line with the United Nations (UN) Sustainable Development Goals (SDG) framework and the FAO SSF guidelines. Following these paramount documents, and the current literature, sustainable fisheries management must integrate economic, social, ecological, and governance elements to provide a multidisciplinary assessment of the sector [11,17,22]. The studies of Direção-Geral de Políticas do Mar [23], Garcia et al. [24], and Potts [25] have selected various criteria across these four dimensions to develop indicator frameworks, stressing that the development of such frameworks can promote general sustainable objectives into practical management outcomes, and highlight that the development of fisheries management tools should embrace a multidisciplinary and integrated sustainable approach. Potts (2003) applied its indicator framework in three case studies (Australia, Canada, and New Zealand), and Garcia et al. (2000) applied its indicator framework in an Australian example. Direção-Geral de Políticas do Mar (2016) developed some indicators as a foundation to monitor the results of the National Ocean Strategy 2013–2020 regarding 'Fisheries, Aquaculture and the Fish Processing Industry', but these have not been tested.

Environmental-related indicators (such as species biology and ecology or the degree of ecosystem impacts) are crucial to understanding the status of the species and ecosystems that support the fisheries to guarantee long-term sustainable harvests (i.e., protection and prevention of fish stock) [26], but socioeconomic features are often overlooked in fishery research and management [27,28]. Nonetheless, recently, scholars and other stakeholders have turned their attention to social dynamics among fishing communities [29,30], acknowledging that human willingness to modify rooted practices, such as gears used or target species, is a key factor towards sustainability.

Thus, overlooking social factors and fishers' perspectives can undercut effectiveness towards sustainability [21,31]. Further, fishers' profits and the economic viability of the activity influence social and working conditions; hence, improving these conditions will improve sustainability effectiveness [9,27]. Finally, governance indicators are important to analyze the quality of the current fishery management scheme [32] to understand if all relevant actors are accounted for in the decision-making processes [32–36] and to verify if there is proper governmental support in its national policies, which should be aligned with international standards for fishery sustainability and worker's rights [3,10].

Considering that Portugal is deeply marked by its fisheries, where fish is not only a product, but a tradition and a cultural symbol, it is important to understand whether the national fishing sector is sustainable, assess its components, identify potential weaknesses, and ensure the longevity of the sector. In Portugal, previous studies on the fishery sector have focused on biological data (e.g., catch efforts [18,20,37], discards [20,38,39]), social issues [13,21,40–42], or economic difficulties of the sector [13,17,43], and there is emerging research in the social-ecological systems in fisheries (e.g., [17,28]). Realizing how resources, policies, and communities interact is essential for ensuring efficacy and compliance, which enhances the sustainability of the industry [11,44]. Nevertheless, experts continue to stress that the use of ecological processes, community well-being, governance, and economic systems is crucial to creating a foundation for fisheries' sustainable development [10,22,45]. To the best of our knowledge, there is no other study that presents a framework of indicators in these four dimensions of environmental, economic, social, and governance, nor is there one performing a systematic literature review addressing the sustainability of Portuguese SSFs.

The aims of this study are to (1) develop a contextualized indicator framework addressing a small-scale fishery's economic, social, environmental, and governance dimensions to evaluate the sector's sustainability and (2) perform a systematic literature review of the Portuguese small-scale fishery industry to collect data on such indicators. In Materials and

Methods section we will detail the methodology for developing the proposed indicator framework and the systematic literature review undertaken. The results section will present the indicator framework proposed and the most relevant data obtained in the literature review. This information will be critically analyzed in the discussion section, and final conclusion section follows with major insights.

2. Materials and Methods

A set of indicators was selected from DGPM [23], Garcia et al. [24], and Potts [25] and organized into the following four dimensions: economy, social, environment, and governance.

To collect data on the Portuguese SSFs, peer-reviewed journal articles, book chapters, gray literature, including academic dissertations, technical reports, governmental documents, and webpages were retrieved based on a systematic literature review methodology adapted from Smith and Basurto (2019) [46] and Carrera-Rivera et al. (2022) [47] and considered the following research question: "What Portuguese SSF social, economic, environmental, and governance data is available?"

2.1. Data Collection for Each Dimension's Indicator

Literature was retrieved by performing a wide search at Scopus database, through the following query string:

> TITLE-ABS-KEY (("fisheries" , OR "fisher", OR "small-scale fisheries", OR "artisanal") AND ("Portuguese" , OR "Portugal")) AND PUBYEAR > 1979 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE , "ch") OR LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE

This first screening allowed the identification of missing and relevant issues, features, and words to further incorporate in the review for each specific dimension. Hence, a second review was performed by adding the following terms to the previous query string: ("economic", OR "subsidies", OR "assessment", OR "performance"); ("social", OR "gender", OR "consumption"); ("stocks", OR "ecological", OR "environmental", OR "ecosystem", OR "gear"); ("governance", OR "integrated", OR "approach", OR "local-ecological knowledge", OR "workshop", OR "participation", OR "participatory"), for economy, social, environment, and governance dimensions, respectively.

2.2. Data Limitations

For information inclusion, several criteria were considered: (i) only studies conducted in Portugal were considered; (ii) analysis should implicate coverage of SSFs; (iii) documents should be fully accessible in digital format; and (iv) only English or Portuguese publications were considered.

To address the lack of governmental and other official documents retrieved, Portuguese government reports, published from 2010 to 2023, were retrieved from DGPM (www.dgpm.mm.gov.pt) and Direção-Geral de Recursos Naturais, Segurança e Seviços Marítimos (DGRM) (www.dgrm.pt), and statistical data were collected from the Instituto Nacional de Estatística (INE) (www.ine.pt) websites.

3. Results

The framework of 37 indicators was selected from 8 economic, 9 social, 12 environmental, and 8 governance (Table 1). For Portuguese SSFs, a total of 1384 hits were retrieved after the final tuning of the literature review process; 19 indicators presented data, 14 had incomplete data, and data was absent for 9 indicators.

Table 1. Economic, social, environmental, and governance indicators to assess the sustainability of a small-scale marine fishery and data availability in Portuguese literature for each indicator.

Dimension	Indicator	Unit of Measure	PT Data Availability
Economy	Composition of the national fishing fleet by segment	Nº, GT, kW	Complete
	Gross Value Added (GVA) of the national fishing sector	EUR	Incomplete
	Revenue from each fishing fleet	EUR	Incomplete
	Small-scale fishery production	EUR, Kg	Incomplete
	Fisheries commercial balance	EUR	Complete
	Price paid to fishers by DOCAPESCA * in first sale	EUR	Complete
	Fishers' average annual operational costs	EUR	Absent
	Fishers' average annual profits	EUR	Absent
Social	Per capita consumption of fish	Kg	Complete
	Registered fishers	Nº	Complete
	Information on gender	Nº	Absent
	Registered fishers by age group	Nº	Complete
	Registered fishers by fleet	Nº	Complete
	Direct jobs in the fishing industry	Nº	Complete
	Incentives for young people to join the fishing industry	Nº	Absent
	Fishers' household dependency on their catches	Yes/No	Absent
	Reported accidents	Nº	Complete
Environment	Stock assessment on target-species	Yes/No	Complete
	Stocks exploited at 'Maximum Sustainable Yield' levels	Nº	Complete
	CO_2 emissions from fishing vessels	Kg CO^2-eq	Incomplete
	Fuel use efficiency in fishing vessels	L of fuel/ton of fish landed	Incomplete
	Use of selective fishing gears	Yes/No	Incomplete
	Use of non-destructive fishing gears	Yes/No	Incomplete
	Direct effect of fishing gear on ecosystem	qualitative	Incomplete
	Direct effect of fishing gear on non-target species (accidental catches)	Nº	Incomplete
	Discard rate	Nº, %	Incomplete
	Waste generated by fishing gear	qualitative	Incomplete
	Fishing vessels equipped with electronic positioning	Yes/No	Complete
	Fishing vessels equipped with catch reporting device	Yes/No	Complete
Governance	Workshop sessions about fisheries sustainability	% of attendance	Incomplete
	Fishers' local ecological knowledge	qualitative	Incomplete
	Policies addressing climate change adaptation in fisheries management	qualitative	Absent
	Management plans	qualitative	Complete
	Quota system	Yes/No	Complete
	National plan of action for illegal, unregulated, and unreported landings	Yes/No	Absent
	Subsidies/public funds allocated to SSFs	EUR	Incomplete
	Sustainability label or certificate for fishery products	Yes/No	Complete

* DOCAPESCA: In Portugal, fishers are not allowed to perform "direct" sales, they must land all catches at the mandatory auction site (lota)—DOCAPESCA, PORTOS, LOTAS, S.A., commonly referred as "DOCAPESCA" (in mainland), Lotaçor (in Azores) and Regional Directorate for Fisheries (in Madeira), where first-sale auctions are performed, and where registered buyers can acquire fresh-caught seafood products.

3.1. Economic Dimension

Table 1 lists eight indicators considered relevant for the economic dimension of SSFs. Regarding Portugal, two indicators presented available information, and seven were absent or had insufficient information.

In 2022, there were 7608 registered Portuguese fishing vessels, with a total of 8630.4 gross tonnage (GT) and 34,761.9 kilowatts (kW) [16]. Small-scale fishing vessels represented 83.8% of the total registered vessels (about 6376 fishing vessels), with 5 GT, and a total of 12,027.6 kW [48]. From the 3875 licensed fishing vessels (i.e., fleet authorized to operate with certain fishing gear, in a specific area and for a specific period, with one or more fishing gears), 3536 have a license for hooks, 2523 for nets, 1764 for traps, 681 for trawling, and 299 for purse seine. This information includes small- and large-scale fishing vessels [48].

During 2020, DGPM's economy reports, presented a conjoint GVA for fisheries, aquaculture, transformation and commercialization of fishery products (39.0%) [49]. No information regarding revenue for specific fishing fleets was retrieved.

In 2022, the Portuguese fishery production (fresh and refrigerated fish) stood at 121,069 tons (Kg) and represented a value of EUR 335.5 million, transitioned at first-auction sites. The available data do not discriminate between the LSF (large-scale fisheries) and SSFs [48].

During 2022, the national fishing industry spent EUR 2596.3 million in imported fishery products and exported a total of EUR 1315.7 million [16], presenting a negative balance of EUR 1280.6 million [48]; results relate to SSFs and LSFs.

Official governmental data on the first auction price for every species and region available for 2022 indicates that the average annual price for landed seafood was EUR 2.65 [48]. Data or estimations on fishers' operational costs and profits are absent.

Additional relevant information about economic-related aspects of specific SSFs can be found in peer-reviewed papers such as [17,43,44].

3.2. Social Dimension

Table 1 lists nine indicators of relevance for SSFs. For Portuguese fisheries, six revealed available information in the literature reviewed.

In 2020, Portugal reported a fish per capita consumption of 57.67 Kg (most recent available data) [50], and in 2022, there were 14156 registered fishers. In official Portuguese statistical data, no information was found regarding gender identification among the number of registered fishers.

Overall, 56.1% of the total registered fishers ranges from 35 to 54 years old, 22.9% from 16 to 34 years old, and 21.0% are 55 years or older [48].

In 2022, the polyvalent fleet registered 9866 registered fishers, and purse seine fishing accounted for 2194 fishers, and trawl fisheries had 1415 fishers [48].

The Portuguese fishing industry provided 29124 direct jobs in 2020 (most recent available data) [49].

No official incentives to promote young people/employees in fisheries were registered. Also, no information concerning fishers' household dependency on catches was found.

Further, in 2022, seven accident-related fishery victims perished, and 650 individuals were injured [48].

3.3. Environmental Dimension

Table 1 lists 12 indicators to characterize environmental-related traits in SSFs, of which 4 had available information for Portuguese fisheries, and 8 presented absent or insufficient information.

DGRM and Instituto Português do Mar e da Atmosfera (IPMA) are the Portuguese governmental entities responsible for providing information regarding fish stocks and ecosystem status and performing stock assessment reports [23,51]. Both institutions regularly deliver a summary report with the most recent results of assessments on the state of the exploitation of stocks and respective scientific advice for management [23,51]. These

reports are complemented with the information provided by the International Council for the Exploration of the Sea (ICES), the Northwest Atlantic Fisheries Organization (NAFO), the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the Indian Ocean Tuna Commission (IOTC), which provide scientific advice for international fish stocks.

In Portugal, there are two main studies assessing, among other parameters, CO_2 emissions from fishing vessels; one dedicated to the sardine purse seining [52], and the other focuses on the common octopus' fishery [53]. Regarding fuel efficiency, besides these studies, two peer-reviewed articles evaluating trawl fisheries were found [54,55]. Further, in the work developed by DGPM (2016) [23], an estimate of carbon emissions, from the fishing and aquaculture sectors (2010 to 2013) is described, ranging from 1.52 to 1.38 Kg CO_2-eq/EUR. However, information regarding CO_2 emissions only from the fishing sector is absent, and the need for more recent data is also relevant.

Regarding indicators on fishing gear performance and their impact on the environment, several academic-related research studies can be found in the literature. For example, studies on the environmental impact of purse seine [52,56–59], trammel nets [18,39,60–63], bottom trawling [64–66], and traps and pots [67] were retrieved.

No data were found concerning estimations on fishing gear waste produced by the Portuguese SSFs on the effect of fishing on marine food webs or on the water quality in fishing and non-fishing areas.

In Portugal, only fishing vessels that are over 12 m in length are obliged to have an electronic fishing journal, under regulation (EC) 1224/2009 of 20 November 2009 [68]. The Portuguese government also created a vessel monitoring system, which is mandatory for vessels over 12 m in length, named MONICAP, which embodies a mobile device that provides information regarding location, fishing gear, and fishing practices [68].

3.4. Governance Dimension

Table 1 lists eight indicators, reflecting governmental features of SSFs. It was possible to retrieve information on the Portuguese SSFs for four of the indicators.

Regarding governmental subsidies and/or public funds to support the Portuguese SSFs, in accordance with Portaria n.º 225/2022, Portugal provided EUR 550 million to reduce fuel costs for fishers in 2022. The Portuguese government also provides subsidies for fisheries that are inactive due to bad weather or due to species' closing seasons, in accordance with Decreto-Lei n.º 61/2014, de 23 de abril.

Regarding seafood label and certification, DOCAPESCA has created a sustainable fishing label—'Comprovativo de Compra em Lota'—providing information on landed seafood (e.g., location, gear, etc.) traded at the auction [69]. Portugal also had the Marine Stewardship Council (MSC) certification for the Portuguese sardine from purse seining, but this certification was lost in 2014 following the collapse of the fishery [52].

Information on participatory processes, including workshops for fishers regarding several aspects of the sector's sustainability, was retrieved from a diversity of peer-review articles. Horta e Costa et al. [70] and Guimarães et al. [71] performed multi-stakeholder workshops to discuss several aspects, including governance of marine-protected areas. In Sonderblohm et al. [40] and Rangel et al. [36], a participatory process to analyze several aspects of the Algarve's octopus' fishery is described; and Pita et al. [33] presents data on meetings and workshops with fishers and their representatives, also of the Algarve's octopus' fishery.

Furthermore, there are some studies on fishers' local ecological knowledge (LEK) in some of the most important fisheries in the country (e.g., sardine [72], lamprey [73,74], octopus [31,36,44], clams [75], edible cockle [76,77], and cetaceans [78]) and some specific fishing communities (e.g., Azores [79–81], Setúbal [82], and Berlenga's Marine Natural Reserve [83]).

Moreover, Portugal has three main documents that analyze sustainable policies for national industries: (i) the Roadmap for Carbon Neutrality 2050; (ii) the National Energy

and Climate Plan 2021–2030; and (iii) the National Ocean Strategy 2021–2030. However, climate change adaptation policies for the Portuguese fishing sector were not found. There is a minor reference in the National Ocean Strategy 2021–2030 in action no. 77 (https://www.dgpm.mm.gov.pt/), but it is not climate-change related.

As ruled by EU Regulation (EU) No. 1380/2013, as of 11 December, fishery management systems should implement specific management plans for critical fisheries [84]. Portugal has 10 management plans in place (e.g., eel, sardine, black scabbardfish, sea bass) [84]. As an EU state member, Portugal must comply with of the European Union, and Portugal must also comply with the Common Fisheries Policy (CFP) rules, regulations, and policies. The CFP and sets the common ground for EU fishing policies, defining annual total allowable catches (TACs) and quotas for selected species in every member state.

No national action plan for illegal unreported and unregulated (IUU) fisheries was found.

4. Discussion

In this study, **a framework of indicators to address SSFs' sustainability is proposed**, and the **availability of data for Portuguese fisheries is analyzed**. The tool developed seems to **adequately address sustainability in SSFs**, providing an easily replicable methodology to be used and compared in different contexts. Further, the framework **can be used to address sustainability in Portuguese SSFs**, but results emphasize the **need for additional information** to feed the provided indicators and understand the issues that need to be addressed to guarantee sustainability in the different proposed dimensions.

The proposed framework includes indicators (Table 1) divided across the following four dimensions: economy [11], society [9], environment [14], and governance [8]. The framework provides a one-model-fits-all to address sustainability in SSFs across different contexts, highlighting the sector's sustainability performance and identifying potential data gaps [85,86].

The fishing industry in Portugal holds significant importance for coastal communities, serving as a crucial activity essential for their livelihoods. It offers ecosystem services, such as food supply, and constitutes a substantial portion of their income and employment, while being deeply woven into the fabric of the national culture [13,15,44]. It is critical to guarantee the sustainability of the fishing sector to ensure its success in the long term.

A persistent issue debated by the scientific community is the fact that there is not enough available information to address Portuguese fisheries in all indicators identified for each dimension [13,85]. In fact, data on the Portuguese SSFs seem to be scattered over several case-study articles, covering specific aspects and areas, and on official governmental grey literature and restricted reports (often not available to the general public) or websites. Hence, a systematic literature review through Scopus may not provide enough information to characterize the Portuguese SSF sector. Furthermore, researchers frequently point out the difficulty in gathering SSF data, due to the variety inherent to the sector such as the wide range of gears employed and species targeted, covering large geographical and frequently remote areas [13,85,86].

Data available for the Portuguese SSF **economic dimension** reveals an increasing tendency for consuming imported seafood products (e.g., cod) [16,48], reflecting consumer choices [87] that seem not to privilege SSF products. Improving data sharing among fishers, retailers, and the public and promoting seafood literacy, improving information, and advertising seafood certification schemes and labels could address these issues and influence customers to choose fish caught in national waters [29,87].

Information regarding fishers' annual operational costs and earnings is considered scarce to assess the allocation of the income-to-work expenses and to the profitability of small-scale fishers [9,13]. There is a common belief that small-scale fishers receive marginal earnings (sometimes as low at 10% of the final sale price of the product) that are disproportional to the profit earned by intermediaries [88]. Further, Portugal's fishery

market system, which has a mandatory state-owned intermediary (DOCAPESCA), suffers from a diagnosed lack of transparency, in particular concerning prices, incomes, and profit flows [89]. If auction places were to be managed by the fishing associations, maybe profitability would increase for fishers, as the main beneficiaries of the selling process. In Algarve, the first auction facilities from Fuzeta village are managed by the local fishing association on behalf of DOCAPESCA, and the results, such as a perceived black-market reduction, are encouraging [36,44].

Fishers' earnings data and their operational costs are relevant to understand if their profits allow for a sustainable livelihood [9]. Insufficient earnings may lead to unsustainable fishing activities (e.g., black market sales or non-compliance with gear, space, or time restrictions), which can lead to overexploitation behaviors [9].

Regarding fishery production estimates, official Portuguese governmental reports do not register information among large- and small-scale operations. Hence, it is difficult to realize how much these two segments really contribute to the national fishing sector and assess what percentage of the national fishery production is a result of SSF operations.

Concerning the social dimension, further research is needed to characterize Portuguese SSFs. Overall, Portugal has important data gaps regarding gender profiling of small-scale fishers, since official statistics do not differentiate between the number of registered male and female fishers, which can deepen the recognition on the importance of female fishers [90–92]. This information is crucial to accurately address if the evolution of the Portuguese SSFs is aligned with the FAO's SSF guidelines, which emphasizes the need to establish social justice and gender equity (guideline no. 4 and no. 5).

Further, the Portuguese small-scale fishing industry has historically been a sector with a workforce predominantly composed by middle-age to old fishers ("55 years and above"), with a lower percentage of young ("16 to 34 years old") registered fishers. This trend was surpassed last year, in which the percentage of "16 to 34 years old" was higher than the percentage of "55 years and above" [48]. The lack of governmental incentives to promote the regeneration of fishery workers and ensure the continuity of the industry may be an important aspect of promoting this reality. Nonetheless, there are some specific SSFs where the number of younger fishers is significant, such as the Algarve octopus trap and pot fishery, probably due to the high incomes associated, and the relatively smaller and less demanding working days when compared to other SSFs [44].

Additional information to feed social indicators regarding small-scale specific fisheries that take place in Portugal can also be found in other publications such as [13,17,36,42,93].

With respect to the environmental dimension the data on Portuguese SSFs is fragmented across numerous peer-reviewed publications, owing to the significant diversity in fishing fleets, gear types, targeted species, fishing locations, seasons, and habitats. This aspect limits the ability to perform comparative studies between fisheries and gears given that fishing fleets, gear, target species, locations, seasons, and ecosystems vary greatly, Portuguese fishery data are scattered throughout peer-reviewed publications (e.g., [18,52,53,56,57,59–65,67]). These characteristic makes it more challenging to conduct research that compares fishing impacts among fisheries and gears [85,86]. An important step forward in data collection would be to promote research about gear selectivity (e.g., accidental catches and discards), which could be used to review fishing gear (e.g., mesh size, materials, number) and adjust them to reduce their impact on the marine environment [53]. Therefore, besides the significant academic efforts, more data are needed to completely describe the impact of fishing gear used on target and non-target species and on the marine environment. Nonetheless, the literature reviewed supports the conclusion that Portuguese SSFs tend to present a low percent of accidental catches, except for the trawl fishing fleet [64–66].

Regarding governance indicators, there is increased research awareness of the importance of incorporating fishers' local ecological knowledge into fishery management and

decision-making systems [34,36,74,83]. Allowing fishers to have an active voice in their resource and fishery management may promote fishers' willingness to change ongoing behaviors and adjust toward more sustainable practices [34,36,74,83,94].

The fishing sector is highly vulnerable to the consequences of climate change. Hence, policymakers have to shift their strategies towards adaptation and mitigation measures in order to provide flexibility for ecosystem changes [95,96]. It is increasingly recognized that the success of effective fishery management relies on a strong interaction between resources, policies, and the communities, as seen by the co-management committee of the octopus fishery in Algarve, to be officially implemented in 2024, and represents the first one designated for a regional fishery in Portugal with the support of the major stakeholders of this fishery, including research, administration, non-governmental environmental organizations, civil society, and all the fishing associations in the area [36,44,53,71].

Further, data on subsidies allocated to the fishing sector are extremely relevant to assess the dependency of the sector regarding governmental support and the type of activities that administrations are supporting. In fact, although the Common Fisheries Policy (CFP) strongly advocates for the end of subsidized fisheries [97], European SSFs are still highly dependent on these economic supports (e.g., to support fishers during fishery closures and areas) [98]. It is, however, important to understand if financial supports are really required and address sustainability issues of SSFs or if they are being used to support non-sustainable practices that endanger the environment and may not support the communities that really need them [9]. In Portugal. subsidies for supporting fuel prices, closing seasons, and bad weather situations were found, but no further information concerning their impact on the sector was produced (e.g., variations in fishing efforts) (www.dgpm.mm.gov.pt).

Finally, regarding fishery enforcement, it should be noted that additional information on illegal, unreported, and unregulated Portuguese fishing landings and catches on its small-scale fisheries are needed, since data gaps might lead to insufficient control and the increase of overexploitation practices [9].

Overall, the proposed framework provides the first assessment on the sustainability of Portuguese SSFs following social, economic, environmental, and governance dimensions. The most relevant information gaps are identified, and the available data to feed the suggested framework are detailed, allowing for the definition of the most important next steps to assess the sustainability of Portuguese SSFs. A new methodology should be considered in the future to allow for quantifying sustainability in the proposed dimensions. It would also be desirable that the proposed framework be tested in specific settings and fisheries to fine-tune the set of indicators to better suit its purpose.

5. Conclusions

The literature reviewed portrays a Portuguese small-scale fishing industry, which requires further research to adequately address sustainability considering the challenges, complexity, and diversity of SSFs. Of the proposed 42 indicators, 21 presented sufficient data, 13 revealed insufficient information, and for 9 no information was retrieved.

Overall, the findings of this study revealed significant data gaps in the existing literature, posing challenges to a comprehensive assessment of the sustainability of the Portuguese fishing industry.

It is paramount that Portugal encourages more research to overcome the knowledge gaps identified in this study, not only to complete this framework analysis but also to guarantee the sustainability of this sector.

We believe that the framework developed allows a comprehensive range of fishery systems to check data availability to assess the sector's sustainability. Future research should include the definition of a scoring system to establish levels of sustainability in accordance with an internationally fit fishery score, which would greatly benefit the small-scale fisheries at a global scale.

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References

1. Campbell, L.M.; Gray, N.J.; Fairbanks, L.; Silver, J.J.; Gruby, R.L.; Dubik, B.A.; Basurto, X. Global oceans governance: New and emerging issues. *Annu. Rev. Environ. Resour.* **2016**, *41*, 517–543. [CrossRef]
2. European Commission, Directorate-General for Maritime Affairs and Fisheries, Joint Research Centre; Borriello, A.; Calvo Santos, A.; Ghiani, M.; Guillén, J.; Peralta Baptista, A.; Petrucco, G.; Pleguezuelo Alonso, M.; Pattumelli, G.; Quatrini, S. *The EU Blue Economy Report 2023*; Publications Office of the European Union: Luxembourg, 2023. Available online: https://op.europa.eu/en/publication-detail/-/publication/9a345396-f9e9-11ed-a05c-01aa75ed71a1/language-en (accessed on 10 November 2023).
3. Food and Agriculture Organization of the United Nations. The State of World Fisheries and Aquaculture 2022. Available online: http://www.fao.org/documents/card/en/c/cc0461en (accessed on 16 November 2023).
4. Garcia, S.; Rosenberg, A. Food security and marine capture fisheries: Characteristics, trends, drivers and future perspectives. *Philos Trans. R Soc. Lond B Biol. Sci.* **2010**, *365*, 2869–2888. [CrossRef] [PubMed]
5. Pauly, D.; Christensen, V.; Guenette, S.; Pitcher, T.; Sumaila, U.; Walters, C.J.; Watson, R.; Zeller, D. Towards sustainability in world fisheries. *Nature* **2002**, *418*, 689–695. [CrossRef] [PubMed]
6. Blanchard, J.L.; Watson, R.A.; Fulton, E.A.; Cottrell, R.S.; Nash, K.L.; Bryndum-Buchholz, A.; Büchner, M.; Carozza, D.A.; Cheung, W.; Elliott, J.; et al. Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture. *Nat. Ecol. Evol.* **2017**, *1*, 1240–1249. [CrossRef] [PubMed]
7. Costello, C.; Cao, L.; Gelcich, S.; Cisneros-Mata, M.Á.; Free, C.M.; Froehlich, H.E.; Golden, C.D.; Ishimura, G.; Maier, J.; Macadam-Somer, I.; et al. The future of food from the sea. *Nature* **2020**, *588*, 95–100. [CrossRef]
8. Hendriks, S.L. Sustainable small-scale fisheries can help people and the planet. *Nature* **2022**, *606*, 650–652. [CrossRef]
9. Schuhbauer, A.; Sumaila, U.R. Economic viability and small-scale fisheries—A review. *Ecol. Econ.* **2016**, *124*, 69–75. [CrossRef]
10. FAO. Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries in the Context of Food Security and Poverty Eradication. Rome: Food and Agriculture Organization of the United Nations. 2015. Available online: https://www.fao.org/3/i4356en/I4356EN.pdf (accessed on 27 January 2023).
11. Chuenpagdee, R.; Jentoft, S. Transforming the governance of small-scale fisheries. *Marit. Stud.* **2018**, *17*, 101–115. [CrossRef]
12. Kittinger, J.N.; Finkbeiner, E.M.; Ban, N.C.; Broad, K.; Carr, M.H.; Cinner, J.E.; Gelcich, S.; Cornwell, M.L.; Koehn, J.Z.; Basurto, X.; et al. Emerging frontiers in social-ecological systems research for sustainability of small-scale fisheries. *Curr. Opin. Environ. Sustain.* **2013**, *5*, 352–357. [CrossRef]
13. Pita, C.; Gaspar, M. Small-Scale Fisheries in Portugal: Current Situation, Challenges and Opportunities for the Future. In *Small-Scale Fisheries in Europe: Status, Resilience and Governance*; Pascual-Fernández, J.J., Pita, C., Bavinck, M., Eds.; Springer: New York, NY, USA, 2020; pp. 283–306.
14. Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos. RELATÓRIO ANUAL FROTA DE PESCA PORTUGUESA—2022. Available online: https://www.dgrm.mm.gov.pt/web/guest/relatorios (accessed on 27 December 2023).
15. Bué Alves, D. *Economia Azul*; Fundação Francisco Manuel dos Santos: Lisbon, Portugal, 2022.
16. Almeida, C.; Vaz, S.; Karadzic, V. The seafood market in portugal: Driving forces and consequences. *Mar. Policy.* **2015**, *61*, 87–94. [CrossRef]
17. Pinto, M.; Albo-Puigserver, M.; Bueno-Pardo, J.; Monteiro, J.N.; Teodósio, M.A.; Leitão, F. Eco-socio-economic vulnerability assessment of Portuguese fisheries to climate change. *Ecol. Econ.* **2023**, *212*, 107928. [CrossRef]
18. Batista, M.I.; Teixeira, C.M.; Cabral, H.N. Catches of target species and bycatches of an artisanal fishery: The case study of a trammel net fishery in the Portuguese coast. *Fish Res.* **2009**, *100*, 167–177. [CrossRef]

19. Braga, H.; Azeiteiro, U.; Oliveira, H.; Pardal, M. Evaluating fishermen's conservation attitudes and local ecological knowledge of the European sardine (*Sardina pilchardus*), Peniche, Portugal. *J. Ethnobiol. Ethnomed.* **2017**, *5*, 13–25. [CrossRef] [PubMed]
20. Castro, N.; Romão, F.; Castro, J.J.; Pereira, T.J.; Pedro, S.; Viegas, V.; Costa, J.L. Catches, sales and discards: Small-scale fisheries in a Portuguese Marine park. *Reg. Stud. Mar. Sci.* **2021**, *42*, 101643. [CrossRef]
21. Silva, P.; Cabral, H.; Rangel, M.; Pereira, J.; Pita, C. Ready for co-management? Portuguese artisanal octopus fishers' preferences for management and knowledge about the resource. *Mar. Policy* **2019**, *101*, 268–275. [CrossRef]
22. Stephenson, R.L.; Benson, A.J.; Brooks, K.; Charles, A.; Degnbol, P.; Dichmont, C.M.; Kraan, M.; Pascoe, S.; Paul, S.D.; Rindorf, A.; et al. Practical steps toward integrating economic, social and institutional elements in fisheries policy and management. *ICES J. Mar. Sci.* **2017**, *74*, 1981–1989. [CrossRef]
23. Direção-Geral de Políticas do Mar. Volume V—Monitorização dos Objetivos para as Áreas Programáticas Pesca e Indústria de Pescado e Aquicultura. 2016. Available online: https://www.dgpm.mm.gov.pt/seamind (accessed on 27 December 2023).
24. Garcia, S.M.; Staples, D.J.; Chesson, J. The FAO guidelines for the development and use of indicators for sustainable development of marine capture fisheries and an Australian example of their application. *Ocean. Coast Manag.* **2000**, *43*, 537–556. [CrossRef]
25. Potts, T. Sustainability Indicators in Marine Capture Fisheries. Ph.D. Thesis, University of Tasmania, Tasmania, Australia, 2003. Available online: https://figshare.utas.edu.au/ndownloader/files/40917719 (accessed on 27 December 2023).
26. Buonocore, E.; Donnarumma, L.; Appolloni, L.; Miccio, A.; Russo, G. Marine natural capital and ecosystem services: An environmental accounting model. *Ecol. Model.* **2020**, *424*, 109029. [CrossRef]
27. Bennett, N.; Schuhbauer, A.; Skerritt, D.; Ebrahim, N. Socio-economic monitoring and evaluation in fisheries. *Fish Res.* **2021**, *10*, 105934. [CrossRef]
28. Fernandes, M.D.L.; Sanz, F.J.L.; Alves, F.L. Spatial characterization of marine socio-ecological systems: A Portuguese case study. *J. Clean Prod.* **2022**, *363*, 132381. [CrossRef]
29. Anderson, C.M.; Himes-Cornell, A.; Pita, C.; Arton, A.; Favret, M.; Averill, D.; Stohs, S.; Longo, C.S. Social and Economic Outcomes of Fisheries Certification: Characterizing Pathways of Change in Canned Fish Markets. *Front. Mar. Sci.* **2021**, *8*, 791085. [CrossRef]
30. Barclay, K.; Voyer, M.; Mazur, N.; Payne, A.M.; Mauli, S.; Kinch, J.; Fabinyi, M.; Smith, G. The importance of qualitative social research for effective fisheries management. *Fish Res.* **2017**, *186*, 426–438. [CrossRef]
31. Farr, E.; Stoll, J.; Beitl, C. Effects of fisheries management on local ecological knowledge. *Ecol Soc.* **2018**, *23*, 15. [CrossRef]
32. Aguado, S.; Segado, I.; Vidal, M.; Pitcher, T.; Lam, M. The quality of fisheries governance assessed using a participatory, multi-criteria framework: A case study from Murcia, Spain. *Mar. Policy* **2021**, *124*, 104280. [CrossRef]
33. Pita, C.; Costa, B.H.; Franco, G.; Coelho, R.; Sousa, I.; Gonçalves, E.J.; Erzini, K. Fisher's perceptions about a marine protected area over time. *Aquac. Fish.* **2020**, *5*, 273–281. [CrossRef]
34. Sousa, A.; Jacinto, D.; Penteado, N.; Pereira, D.; Silva, T.; Castro, J.J.; Leandro, S.; Cruz, T. Temporal variation of the fishers' perception about the stalked barnacle (*Pollicipes pollicipes*) fishery at the Berlengas Nature Reserve (Portugal). *Reg. Stud. Mar. Sci.* **2020**, *38*, 101378. [CrossRef]
35. Karr, K.A.; Fujita, R.; Carcamo, R.; Epstein, L.; Foley, J.R.; Fraire-Cervantes, J.A.; Gongora, M.; Gonzalez-Cuellar, O.T.; Granados-Dieseldorff, P.; Guirjen, J.; et al. Integrating science-based co-management, partnerships, participatory processes and stewardship incentives to improve the performance of small-scale fisheries. *Front. Mar. Sci.* **2017**, *4*, 345. [CrossRef]
36. Rangel, M.; Pita, C.; de Oliveira, M.M.; Guimarães, M.H.; Rainha, R.; Sonderblohm, C.; Monteiro, P.; Oliveira, F.; Ballesteros, M.; Gonçalves, J.M.S.; et al. Do fisher associations really represent their members' needs and opinions? The case study of the octopus fishery in the Algarve (south Portugal). *Mar. Policy* **2019**, *101*, 276–284. [CrossRef]
37. Acuña-Alonso, C.; Varandas, S.; Álvarez, X.; Martinho, A. Analysis of the evolution of a fisheries management plan based on environmental governance: Living laboratory in the Olo River, Portugal. *Fish Res.* **2023**, *260*, 106595. [CrossRef]
38. Borges, T.; Erzini, K.; Bentes, L.; Costa, M.; Gonçalves, J.; Lino, P.; Pais, C.; Ribeiro, J. By-catch and discarding practices in five Algarve (southern Portugal) métiers: By-catch and discarding practices in Portugal. *J. Appl. Ichthyol.* **2008**, *17*, 104–114. [CrossRef]
39. Gonçalves, J.; Stergiou, K.; Hernando, J.; Puente, E.; Moutopoulos, D.; Arregi, L.; Soriguer, M.; Vilas, C.; Coelho, R.; Erzini, K. Discards of trammel nets in southern European small-scale fisheries. *Fish Res.* **2007**, *88*, 5–14. [CrossRef]
40. Sonderblohm, C.P.; Guimarães, M.H.; Pita, C.; Rangel, M.; Pereira, J.; Gonçalves, J.M.S.; Erzini, K. Participatory assessment of management measures for *octopus vulgaris* pot and trap fishery from southern Portugal. *Mar. Policy* **2017**, *75*, 133–142. [CrossRef]
41. Melo, F. *Os Últimos Marinheiros*, 1st ed.; Fundação Francisco Manuel dos Santos: Lisbon, Portugal, 2015; p. 70.
42. Santos, M.P.N.D.; Seixas, S.; Aggio, R.B.M.; Hanazaki, N.; Costa, M.; Schiavetti, A.; Dias, J.A.; Azeiteiro, U.M. A Pesca enquanto Atividade Humana: Pesca Artesanal e Sustentabilidade. *Rev. Gest. Costeira Integrada.* **2012**, *12*, 405–427. [CrossRef]
43. Pita, C.; Roumbedakis, K.; Fonseca, T.; Matos, F.L.; Pereira, J.; Villasante, S.; Pita, P.; Bellido, J.M.; Gonzalez, A.F.; García-Tasende, M.; et al. Fisheries for common octopus in europe: Socioeconomic importance and management. *Fish. Res.* **2021**, *235*, 105820. [CrossRef]
44. Pita, C.; Pereira, J.; Lourenço, S.; Sonderblohm, C.; Pierce, G.J. The Traditional Small-Scale Octopus Fishery in Portugal: Framing Its Governability. In *Interactive Governance for Small-Scale Fisheries: Global Reflections*; Jentoft, S., Chuenpagdee, R., Eds.; Springer: New York, NY, USA, 2015; pp. 117–134.
45. Fletcher, W.; Chesson, J.; Sainsbury, K.; Hundloe, T.; Fisher, M. A flexible and practical framework for reporting on ecologically sustainable development for wild capture fisheries. *Fish Res.* **2005**, *71*, 175–183. [CrossRef]

46. Smith, H.; Basurto, X. Defining Small-Scale Fisheries and Examining the Role of Science in Shaping Perceptions of Who and What Counts: A Systematic Review. *Front. Mar. Sci.* **2019**, *6*, 236. [CrossRef]
47. Carrera-Rivera, A.; Ochoa, W.; Larrinaga, F.; Lasa, G. How-to conduct a systematic literature review: A quick guide for computer science research. *MethodsX* **2022**, *9*, 101895. [CrossRef] [PubMed]
48. Instituto Nacional de Estatística. Estatísticas da Pesca: 2022. 2022. Available online: https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_destaques&DESTAQUESdest_boui=593987491&DESTAQUESmodo=2 (accessed on 27 December 2023).
49. Direção-Geral de Políticas do Mar. Relatório de Monitorização da Estratégia Nacional para o Mar 2021–2030. Available online: https://www.dgpm.mm.gov.pt/post/relat%C3%B3rio-de-monitoriza%C3%A7%C3%A3o-da-enm-2021-2030-1 (accessed on 29 January 2024).
50. European Commission. Direcorate General for Maritime Affairs and Fisheries., EUMOFA. The EU Fish Market: 2023 Edition. 2023. Available online: https://data.europa.eu/doi/10.2771/38507 (accessed on 17 December 2023).
51. Instituto Português do Mar e da Atmosfera. Estado dos Stocks em 2020 e Aconselhamento Científico para a Sua Gestão em 2021. Available online: https://www.ipma.pt/pt/publicacoes/pescas/index.jsp?page=rel.cientificos.xml (accessed on 29 January 2024).
52. Almeida, C.; Vaz, S.; Cabral, H.; Ziegler, F. Environmental assessment of sardine (*Sardina pilchardus*) purse seine fishery in Portugal with LCA methodology including biological impact categories. *Int. J. Life Cycle Assess.* **2014**, *19*, 297–306. [CrossRef]
53. Almeida, C.; Loubet, P.; Laso, J.; Nunes, M.L.; Marques, A. Environmental assessment of common octopus (*Octopus vulgaris*) from a small-scale fishery in Algarve (Portugal). *Int. J. Life Cycle Assess* **2022**, *27*, 849–867. [CrossRef]
54. Campos, A.; Fonseca, T.; Parente, J.; Fonseca, P. Fuel efficiency in trawlers under different fishing tactics using a consumption model and VMS data: A case-study for the Portuguese fleet. Sustain. *Marit. Transp. Exploit. Sea Resour.* **2011**, *2*, 1037–1041.
55. Parente, J.; Fonseca, P.; Henriques, V.; Campos, A. Strategies for improving fuel efficiency in the Portuguese trawl fishery. *Fish Res.* **2008**, *93*, 117–124. [CrossRef]
56. González-García, S.; Villanueva-Rey, P.; Belo, S.; Vázquez-Rowe, I.; Moreira, M.T.; Feijoo, G.; Arroja, L. Cross-vessel eco-efficiency analysis. a case study for purse seining fishing from north portugal targeting european pilchard. *Int. J. Life Cycle Assess.* **2015**, *20*, 1019–1032. [CrossRef]
57. Marçalo, A.; Katara, I.; Feijó, D.; Araújo, H.; Oliveira, I.; Santos, J.; Ferreira, M.; Monteiro, S.; Pierce, G.J.; Silva, A.; et al. Quantification of interactions between the Portuguese sardine purse-seine fishery and cetaceans. *ICES J. Mar. Sci.* **2015**, *72*, 2438–2449. [CrossRef]
58. Marçalo, A.; Guerreiro, P.M.; Bentes, L.; Rangel, M.; Monteiro, P.; Oliveira, F.; Afonso, C.M.L.; Pousão-Ferreira, P.; Benoît, H.P.; Breen, M.; et al. Effects of different slipping methods on the mortality of sardine, Sardina pilchardus, after purse-seine capture off the Portuguese Southern coast (Algarve). *PLoS ONE* **2018**, *13*, e0195433. [CrossRef]
59. Wise, L.; Silva, A.; Ferreira, M.; Silva, M.A.; Sequeira, M. Interactions between small cetaceans and the purse-seine fishery in western Portuguese waters. *Sci Mar.* **2007**, *71*, 405–412.
60. Baeta, F.; Costa, M.J.; Cabral, H. Trammel Nets' Ghost Fishing off the Portuguese Central Coast. *Fish. Res.* **2009**, *98*, 33–39. [CrossRef]
61. Baeta, F.; Batista, M.; Maia, A.; Costa, M.J.; Cabral, H. Elasmobranch Bycatch in a Trammel Net Fishery in the Portuguese West Coast. *Fish. Res.* **2010**, *102*, 123–129. [CrossRef]
62. Coelho, R.; Erzini, K.; Bentes, L.; Correia, C.; Lino, P.G.; Monteiro, P.; Ribeiro, J.; Gonçalves, J. Semi-pelagic Longline and Trammel Net Elasmobranch Catches in Southern Portugal: Catch Composition, Catch Rates and Discards. *J. Northwest Atl. Fish Sci.* **2005**, *35*, 531–537. [CrossRef]
63. Erzini, K.; Monteiro, C.C.; Ribeiro, J.; Santos, M.N.; Gaspar, M.; Monteiro, P.; Borges, T.C. An experimental study of gill net and trammel net in the Algarve (southern Portugal). *Mar. Ecol. Prog. Ser.* **1997**, *158*, 257–265. [CrossRef]
64. Campos, A.; Henriques, V.; Erzini, K.; Castro, M. Deep-Sea Trawling off the Portuguese Continental Coast—-Spatial Patterns, Target Species and Impact of a Prospective EU-Level Ban. *Mar. Policy* **2021**, *128*, 104466. [CrossRef]
65. Costa, M.; Erzini, K.; Borges, T. Bycatch of crustacean and fish bottom trawl fisheries from southern Portugal (Algarve). *Sci. Mar.* **2008**, *72*, 801–814.
66. Fonseca, P.; Campos, A.; Garcia, A. Bottom trawl codend selectivity for cephalopods in Portuguese continental waters. *Fish Res.* **2002**, *59*, 263–271. [CrossRef]
67. Vasconcelos, P.; Pereira, F.; Moreno, A.; Gaspar, M.B. Bycatch, discards and survival rates in the small-scale cuttlefish trap fishery on sandy bottoms off the Algarve coast (southern Portugal). *Fish Manag. Ecol.* **2019**, *26*, 334–344. [CrossRef]
68. Diário de Pesca Eletrónico—DGRM. Available online: https://www.dgrm.pt/diariodepescaeletronico (accessed on 13 February 2024).
69. CCL—Comprovativo de Compra em Lota. Available online: https://www.docapesca.pt/ccl.html (accessed on 30 January 2024).
70. Horta e Costa, B.; Guimarães, M.H.; Rangel, M.; Ressurreição, A.; Monteiro, P.; Oliveira, F.; Bentes, L.; Sales, H.N.; Sousa, I.; Alexandre, S.; et al. Co-design of a marine protected area zoning and the lessons learned from it. *Front. Mar. Sci.* **2022**, *9*, 969234. [CrossRef]
71. Guimarães, M.; Rangel, M.; Horta e Costa, B.; Ressurreição, A.; Oliveira, F.; Gonçalves, J. Creating a common ground for the implementation of a community-based marine protected area—A case study in algarve, portugal. *Ocean Coast. Manag.* **2023**, *240*, 106627. [CrossRef]

72. Braga, H.O.; Pardal, M.; Azeiteiro, U.M. Sharing fishers' ethnoecological knowledge of the European pilchard (*Sardina pilchardus*) in the westernmost fishing community in Europe. *J. Ethnobiol. Ethnomed.* **2017**, *13*, 52. [CrossRef] [PubMed]
73. Braga, H.O.; Pereira, M.J.; Musiello-Fernandes, J.; Morgado, F.; Soares, A.M.V.M.; Azeiteiro, U.M. The role of local ecological knowledge for the conservation and sustainable fisheries of the sea lamprey (*Petromyzon marinus* Linnaeus, 1758) in the Iberian Peninsula. *Ocean Coast Manag.* **2020**, *198*, 105345. [CrossRef]
74. Braga, H.O.; Pereira, M.J.; Morgado, F.; Soares, A.M.V.M.; Azeiteiro, U.M. Ethnozoological knowledge of traditional fishing villages about the anadromous sea lamprey (*Petromyzon marinus*) in the Minho river, Portugal. *J. Ethnobiol. Ethnomed.* **2019**, *15*, 71. [CrossRef]
75. Sordo, L.; Vasconcelos, P.; Piló, D.; Carvalho, A.N.; Pereira, F.; Gaspar, M.B. Recreational harvesting of the wedge clam (*Donax trunculus*) in southern Portugal: Characterization of the activity based on harvesters' perception and local ecological knowledge. *Mar. Policy* **2023**, *155*, 105694. [CrossRef]
76. Braga, H.O.; Azeiteiro, U.M.; Magalhães, L. A case study of local ecological knowledge of shellfishers about edible cockle (*Cerastoderma edule*) in the Ria de Aveiro lagoon, Western Iberia. *J. Ethnobiol. Ethnomed.* **2022**, *18*, 11. [CrossRef]
77. Braga, H.O.; Azeiteiro, U.M.; Schiavetti, A.; Magalhães, L. Checking the changes over time and the impacts of COVID-19 on cockle (Cerastoderma edule) small-scale fisheries in Ria de Aveiro coastal lagoon, Portugal. *Mar. Policy* **2022**, *135*, 104843. [CrossRef]
78. Goetz, S.; Read, F.L.; Ferreira, M.; Portela, J.M.; Santos, M.B.; Vingada, J.; Siebert, U.; Marçalo, A.; Santos, J.M.; Araújo, H.; et al. Cetacean occurrence, habitat preferences and potential for cetacean-fishery interactions in Iberian Atlantic waters: Results from cooperative research involving local stakeholders. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2015**, *25*, 138–154. [CrossRef]
79. Santos, R.; Peixoto, U.I.; Casal-Ribeiro, M.; Medeiros-Leal, W. Complementary Role of Fishers' Experiential Knowledge to Conventional Science in Terms of Species-Specific Biological Traits and Population Changes in Azorean Waters. *Biology* **2023**, *12*, 194. [CrossRef] [PubMed]
80. Sampaio, I.; Braga-Henriques, A.; Pham, C.; Ocaña, O.; De Matos, V.; Morato, T.; Porteiro, F. Cold-water corals landed by bottom longline fisheries in the Azores (north-eastern Atlantic). *J. Mar. Biol. Assoc. UK* **2012**, *92*, 1547–1555. [CrossRef]
81. Peixoto, U.I.; Casal-Ribeiro, M.; Medeiros-Leal, W.M.; Novoa-Pabon, A.; Pinho, M.; Santos, R. Scientific and Fisher's Knowledge-Based Ecological Risk Assessment: Combining Approaches to Determine the Vulnerability of Fisheries Stocks. *Sustain. Switz.* **2022**, *14*, 14870. [CrossRef]
82. Couto, J.S. Small-scale fishers' knowledge for ocean sustainability: An ethnography in Setúbal, Portugal. In *Transdisciplinary Marine Research: Bridging Science and Society*, 1st ed.; Gómez, S., Köpsel, V., Eds.; Routledge: London, UK, 2022; pp. 175–190.
83. Braga, H.O.; Pardal, M.Â.; Azeiteiro, U.M. Incorporation of Local Ecological Knowledge (LEK) into Biodiversity Management and Climate Change Variability Scenarios for Threatened Fish Species and Fishing Communities—Communication Patterns Among BioResources Users as a Prerequisite for Co-management: A Case Study of Berlenga MNR, Portugal and Resex-Mar of Arraial do Cabo, RJ, Brazil. In *Handbook of Climate Change Communication*; Leal, W.F., Manolas, E., Azul, A., Azeiteiro, U., McGhie, H., Eds.; Springer: New York, NY, USA, 2018; pp. 237–262.
84. Management Plans—DGRM. Available online: https://www.dgrm.mm.gov.pt/en/web/guest/planos-de-recuperacao/gestao/acao-e-ajustamento-de-esforco-de-pesca (accessed on 27 December 2023).
85. Pita, C.; Villasante, S.; Pascual-Fernández, J.J. Managing small-scale fisheries under data poor scenarios: Lessons from around the world. *Mar. Policy* **2019**, *101*, 154–157. [CrossRef]
86. Zetina-Rejón, M.J.; López-Ibarra, G.A.; Rocha-Tejeda, L.; Flores-Guzmán, A.; López-Ercilla, I.; Rodríguez-Rodríguez, E.; Sandoval-Jiménez, S.A.; Arreguín-Sánchez, F.; Cisneros-Montemayor, A.M. A Framework for Simulating Ecosystem Effects in Data-Poor Small-Scale Fisheries Using Science-Based and Local Ecological Knowledge-Based Models. *Front. Mar. Sci.* **2022**, *8*, 799068. [CrossRef]
87. Murthy, A.; Galli, A.; Madeira, C.; Moreno, S.P. Consumer Attitudes towards Fish and Seafood in Portugal: Opportunities for Footprint Reduction. *Sustainability* **2023**, *15*, 1363. [CrossRef]
88. Penca, J.; Said, A.; Cavallé, M.; Pita, C.; Libralato, S. Sustainable small-scale fisheries markets in the Mediterranean: Weaknesses and opportunities. *Marit. Stud.* **2021**, *20*, 141–155. [CrossRef]
89. Purcell, S.W.; Crona, B.I.; Lalavanua, W.; Eriksson, H. Distribution of economic returns in small-scale fisheries for international markets: A value-chain analysis. *Mar Policy* **2017**, *86*, 9–16. [CrossRef]
90. Frangoudes, K.; Gerrard, S.; Kleiber, D. Situated transformations of women and gender relations in small-scale fisheries and communities in a globalized world. *Marit. Stud.* **2019**, *18*, 241–248. [CrossRef]
91. Zhao, M.; Tyzack, M.; Anderson, R.; Onoakpovike, E. Women as visible and invisible workers in fisheries: A case study of Northern England. *Mar. Policy* **2013**, *37*, 69–76. [CrossRef]
92. Ram-Bidesi, V. Recognizing the role of women in supporting marine stewardship in the Pacific Islands. *Mar. Policy* **2015**, *59*, 1–8. [CrossRef]
93. Alves, F.; Casaleiro, P.; Valentim, C.S.; Castro, P.; Pardal, M. Small-scale artisanal fisheries and its networks: The case of Arte Xávega in Portugal. *Mar. Policy* **2021**, *128*, 104484. [CrossRef]
94. Smallhorn-West, P.; Abesamis, R.A.; Notere Boso, D.; Cinner, J.; Cohen, P.J.; Gelcich, S.; Harrison, H.B.; Jones, G.; Jupiter, S.D.; Khan, F.; et al. *The Fisheries Co-Management Guidebook: Emerging Research for the Effective Management of Small-Scale Fisheries*; Wildlife Conservation Society: New York, NY, USA; WorldFish: Penang, Malaysia, 2023. [CrossRef]

95. Bryndum-Buchholz, A.; Tittensor, D.; Lotze, H. The status of climate change adaptation in fisheries management: Policy, legislation and implementation. *Fish Fish.* **2021**, *22*, 1248–1273. [CrossRef]
96. Harsem, Ø.; Hoel, A.H. Climate change and adaptive capacity in fisheries management: The case of Norway. *Int. Environ. Agreem. Politics Law Econ.* **2012**, *13*, 49–63. [CrossRef]
97. Carvalho, N.; Rege, S.; Fortuna, M.; Isidro, E.; Edwards-Jones, G. Estimating the impacts of eliminating fisheries subsidies on the small island economy of the Azores. *Ecol. Econ.* **2011**, *70*, 1822–1830. [CrossRef]
98. Sumaila, U.R.; Teh, L.; Watson, R.; Tyedmers, P.; Pauly, D. Fuel price increase, subsidies, overcapacity, and resource sustainability. *ICES J. Mar. Sci.* **2008**, *65*, 832–840. [CrossRef]