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Research and management priorities for Atlantic marine recreational fisheries in Southern Europe

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ABSTRACT

Marine Recreational Fishing (MRF) is an important activity in Europe, with 9 million fishers and generating annually € 6 billion in direct expenditures. However, there is a lack of data and understanding of MRF in Europe, particularly in Southern countries, which prevents a number of fish stocks from being effectively assessed and managed. In November 2016, a participatory workshop on MRF was held in Vigo (Spain) to identify challenges and opportunities for data collection, and to diagnose key research gaps and management issues for MRF in the Southern European Atlantic. Experts from a wide range of disciplines (researchers, policy makers, fisheries managers and commercial and recreational fishers) highlighted that the management of MRF is a challenge due to complex and dispersed legal frameworks, with multiple administrations involved, and overlapping uses of space with commercial fishing, aquaculture, navigation and tourism, among others. The lack of strong and representative fishing associations hampers research and management initiatives. Effective communication between recreational fishers, researchers and fisheries managers is also lacking. Despite the ecological, social and economic relevance of MRF, there is no systematic and comprehensive collection of information on fishing effort, recreational catches, expenses, social profile and access conditions of European recreational fishers. These data would be useful to avoid biases in the assessment of recreational fisheries due to the great diversity of ecosystems, species and typologies of users. Strategic recommendations and research priorities were also identified to address knowledge gaps and are discussed in the context of the management of MRF across Europe.

1. Introduction

Marine European fisheries are being recovered [1] from historic overfishing practices of commercial fleets [2–5]. In this context, there are concerns about the impacts of Marine Recreational Fishing (MRF) on ecosystems [6–8] and its combined effects with other human activities such as commercial fishing, especially on species in higher trophic levels [9]. The European Union (EU) Common Fisheries Policy (CFP) states that "recreational fisheries can have a significant impact on fish resources and Member States should, therefore, ensure that they are conducted in a manner that is compatible with the objectives of the CFP" [10]. Moreover, MRF representatives can join the Advisory Councils, stakeholder-led organizations that provide recommendations on fisheries management in the EU [11].

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MRF is an important activity in Europe, with almost 9 million fishers spending around 6 billion euros per year [12]. However, little research has been conducted on MRF in Europe, particularly in the South. MRF in Southern European waters has begun to be studied in recent years in France e.g., [13–16], Portugal, e.g., [17–19] and Spain, e.g., [20–23], but extensive research is still needed to better support current and future management initiatives and to reduce conflicts between recreational and commercial fishers, and other users of marine ecosystems [24].

In November 2016, a workshop on MRF organized in Galicia (NW Spain) brought together a group of experts from different disciplines (biology, ecology, economics and other social sciences) that included researchers, fisheries managers, policy makers and recreational and commercial fishers and other stakeholders. Based on the expert knowledge the attendees, this article presents a synthesis of the current state of knowledge on ecological, social, and economic aspects of MRF in the Southern Atlantic European waters (Section 3.1) and an assessment of the main MRF modalities (Section 3.2). In addition, main challenges and recommendations to policy makers, researchers and managers are presented (Section 3.3); including future priorities for MRF research are discussed in a global context to guide future management plans (Section 4).

2. Materials and methods

The 2-day workshop on MRF was held in Vigo in November 11–12, 2016. It was attended by 35 experts including researchers (13), recreational fishers (13), public fisheries managers (3), NGOs representatives (3), commercial fishers (2), and managers of nautical companies (2) from Spain and Portugal.

The workshop began with opening lectures on key topics describing current management systems, socioeconomic characteristics of recreational fishers, and current research on the field. This information was incorporated as part of the results of this article. The next step consisted of dynamic sessions designed to encourage collective participation and discussion among different stakeholders in focus groups designed to collect the expert knowledge of the attendees [25]. Likewise, final consensual conclusions of each of the topics covered during the sessions was incorporated to this article.

Moreover, the current institutional fit of MRF was also analysed (Section 3) by using an adaptation of the Institutional Analysis and Development Framework (IADF) [26,27]. The experts were asked to assign values (1 = very poor to 5 = excellent) to a list of 13 principles included in the framework (Table 1). Furthermore, experts also performed a Strengths, Weaknesses, Opportunities and Threats (SWOT) analyses of the main modalities of MRF in Europe (Section 4).

3. Results

3.1. Current state of knowledge about MRF in the European South Atlantic

3.1.1. Management

EU institutions define MRF as “non-commercial fishing activities exploiting marine living aquatic resources for recreation, tourism or sport” [11]. The EU has recently begun to include MRF, together with commercial fisheries, in fisheries regulations [10,11,28], but European priorities focus on a few species managed by the total allowable catch system and on species with minimum conservation reference sizes [29]. Therefore, management of MRF still largely depends on national and regional legislations [30].

Unlike other European regions (e.g., the Netherlands, United Kingdom), in France, Portugal and Spain there is social and legal support to manage MRF jointly with commercial fisheries [30]. However in these countries, the actual management of MRF is hampered by complex and dispersed legal frameworks [31] due to the existence of multiple administrations (local, regional, national and European) in charge of different competences (e.g., issuing licenses, on-board security or fisheries management). Furthermore, the lack of a license system in France makes more difficult to establish the actual number of recreational fishers [13]. In addition, MRF is carried out in coastal areas intensively used by other stakeholders, carrying out both recreational (e.g., navigation and tourism) and commercial activities (e.g., fisheries, aquaculture, shipping and energy generation). The direct conflict over space and resources with the small-scale inshore commercial fisheries sector is particularly relevant in this area of the Atlantic [23,32].

In fact, retired commercial fishers often engage in MRF, particularly in Spain [33]. Despite the lack of factual information, it is likely that in some cases the illegal sale of catches of retired commercial fishers, among other potential poaching collectives like unemployed people, is significant. For instance, illegal sale of catches by some recreational fishers is documented in Portugal [17,19,34]. Furthermore, illegal sale of catches by this group of recreational fishers is very relevant in Turkey [35], where a similar management framework is in place [30]. Low reported incomes (e.g., the current average pension in Spain is € 1122 per month, while that of retired fishers is only € 958 [36]) are likely the main triggering factor for this phenomenon. Furthermore, environmental degradation of European coasts [37], and lack of basic knowledge about the different MRF modalities (mainly shore angling, spear fishing and boat fishing in Southern Europe [38]) poses additional challenges to the management and sustainability of the recreational fishing sector.

Moreover, results from the workshop indicate that the current institutional fit of MRF in the Atlantic coasts was found to be poor (mean IADF = 1.96 ± 1.19 SD) and therefore needs to be improved (Fig. 1). In this context, each of the actors involved in MRF has an agenda: fisheries administrations are mainly interested in the impact of the catches, the

Table 1
List of principles (P) scored by experts included in the Institutional Analysis and Development Framework (IADF) used to analyse the institutional fit of MRF [26,27].

P	IADF principle
1	Differences between recreational fishers, commercial fishers and poachers are well established in regulations. Their numbers are known
2	Target species and fishing areas are clear in regulations. Ecology and dynamics of fish stocks are known
3	Regulations are balanced at national, regional and local levels. Legal adaptation to sudden events is easy
4	Administrative fees partly finance fisheries management and are proportional to fishers’ catches
5	Recreational fishers’ organizations are powerful, representative and democratic and use fishers’ knowledge to modify regulations, adapting them to local circumstances
6	Fisheries control bodies can be supervised by recreational fishers’ organizations, or integrate them into their operations
7	Fisheries research bodies can be supervised by recreational fishers’ organizations, or integrate them into their operations
8	Proportionality of penalties to illegal fishers is established by recreational fishers’ organizations or by agents supervised by them
9	There are cheap arenas to solve conflicts quickly between recreational fishers
10	There are cheap arenas to solve conflicts quickly between recreational fishers and managers
11	Recreational fishers’ organizations are managed without the supervision of the authorities
12	Catch regulation, monitoring, enforcement and control, and general governance or MRF rely on entities dependent on recreational fishers’ organizations
13	Catch regulation, monitoring, enforcement and control, and general governance or MRF rely on government entities

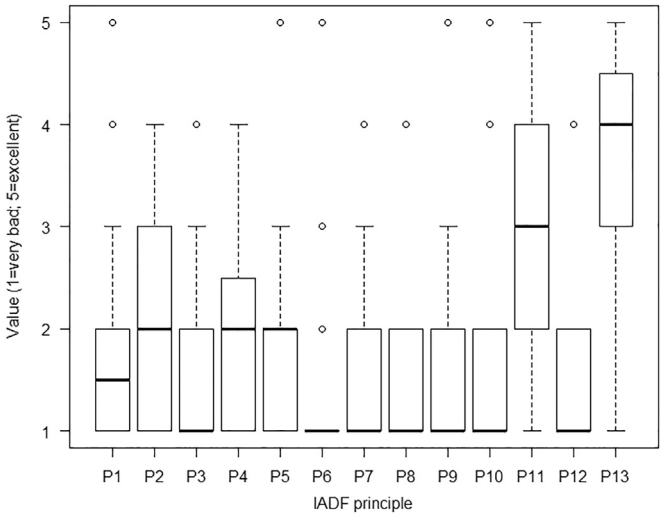

Fig. 1. Institutional Fit Analyses of MRF based in a set of 13 principles (P1-P13, see text and Table 1 for further details) scored by experts. The top and bottom side of the boxes correspond to the first and third quartiles of the values for each principle, the whiskers extend up to 1.5 times the interquartile range and the median is indicated with a horizontal line.

recreational sector (fishers' associations and companies) in analysing its socioeconomic importance, while researchers are generally focused on both the ecological and socioeconomic impacts of the activity. As a consequence, the management for MRF is aimed at meeting multiple targets: the sustainable exploitation of marine resources, the promotion of responsible practices, and the maximization of social and economic benefits. Unfortunately, some of these goals are not fully compatible and operate at different scales, leading to potential sectoral conflicts [39] and hampering adaptive management [40].

Communication between science and fisheries management was found to be deficient in key aspects, which has been related with additional difficulties for environmental sustainability and effective management [31]. For example, the definition of legal minimum catch sizes, which for some recreationally important species are lower than the size of first maturation (e.g., two-banded sea bream [41]). In addition, despite the increase in number and complexity of fishing regulations in recent years, they are often implemented without solid scientific support and the participation of recreational fishers [18,31].

Recreational fishers involved from the early stages of the decision making process are more likely to be supportive and accept the regulations put in place [18,31,42]. Consequently, an increase of scientific knowledge and the integration of multiple stakeholders into management initiatives are essential to promote social, economic and ecological sustainability of MRF [42], as much as commercial fishing, for which bottom-up approaches are now relatively common [43–46].

3.1.2. Socioeconomics

Many of the social and economic benefits of MRF, e.g., potential health welfare or economic revenues have been already studied in other European regions [47–51]. However, except for big-game fishing [52,53], the socioeconomic relevance of MRF in the Southern European Atlantic is still largely unknown. The information about the contribution of MRF to the economy is particularly scarce, although the available data suggests that their socioeconomic importance is high; it is estimated that the 1.13 million fishers operating on the Southern European Atlantic coasts spend around € 730 million per year [12].

The lack of strong and representative recreational fishers' associations is one of the potential factors explaining the lack of socioeconomic information for the recreational fishing sector, which can also hamper its adequate management [42]. This may also be explained because neither recreational fishers nor merchants of fishing goods and services consider themselves part of the fishing sector [54].

3.1.3. Research

Research on MRF in the European Atlantic is scarce, especially in Spain. By way of comparison, to date 14 articles specifically focused on MRF in Portugal have been published in international journals, while only 3 in Spain (Table A1-Appendix A). The three common topics that have been analysed in these articles are regulation frameworks [18], monitoring programs [55], and post-release mortality [56]. Yet, most of the studies have been focused on the impacts of the different types of fishing on ecosystems, including shore angling [17,19,21,34,55,57–59], spear fishing [19–22,60], boat fishing [21,52,53,61,62] and shellfish gathering [19,59,63].

In addition to the fact that generally marine scientists have been focusing more on ecology and on commercial fisheries [64,65], research on MRF is also hampered by a combination of lack of representative bodies and a lack of interest from the funding and managing entities, which has resulted in a paucity of long-term scientific data [20].

On the other hand, there is no comprehensive and systematic collection of information on MRF in Europe to the best of our knowledge. This is likely because the EU only requires to collect data from Member States on recreational catches of European eel, blue fin tuna, cod, sea bass, salmon and sharks [28], while the list of species targeted by MRF is, by far, much wider. However, since the creation, in 2009, of the Working Group on Recreational Fisheries Surveys within the International Council for the Exploration of the Sea (ICES), recreational catches have been progressively taken into consideration [66], to the point that they are now included in the European Council regulations about the allocation of fishing opportunities to EU Member States in EU waters [67].

As a result of the scarcity of scientific information on ecosystems, species, and activity of recreational fishers, management of MRF has traditionally been based on extrapolations and inferences from studies conducted in other regions (e.g., for the Spanish Atlantic, from the Spanish Mediterranean). Nevertheless, the use of data from one region to determine ecological and/or economic and social impacts on other regions should be avoided, e.g. due to different methodological problems such as the influence of representativeness bias and sampling errors [13,68]. To minimise these biases, it is important that data collection (e.g., participation, effort, catches, expenses and social profile of fishers) and management are conducted at the same scale, especially considering the enormous variation in ecosystems, species and typologies of users in the Iberian Atlantic coasts, which includes the Macaronesia region.

3.2. Assessment of MRF modalities

3.2.1. Shore angling

Shore angling is the main modality in number of participants in Portugal and Spain [17,34,69–71], while shellfish gathering is very relevant in France [14]. In Portugal, e.g., although shore anglers and shellfish gatherers use the same license [72], more than half of the recreational licenses issued between 2007 and 2015 corresponded to shore angling [73].

The large number of participants combined with the fact that its practice requires fewer logistics, is cheaper, and likely less dependent on the sea conditions than other modalities (e.g., than spear fishing), suggests that fishing effort of shore anglers should be greater than that of other MRF modalities (Fig. 2). Consequently, and although their individual catch rates appear to be lower [34] than those of spear fishers [22,60] and boat fishers [17,61], their overall ecological impact could be relevant (see e.g. [14,19,21]). Similarly, individual expenses of shore anglers are lower compared to other recreational fishers, but their total contribution is likely to be very important for economic development. For instance, the economic contribution of shore angling

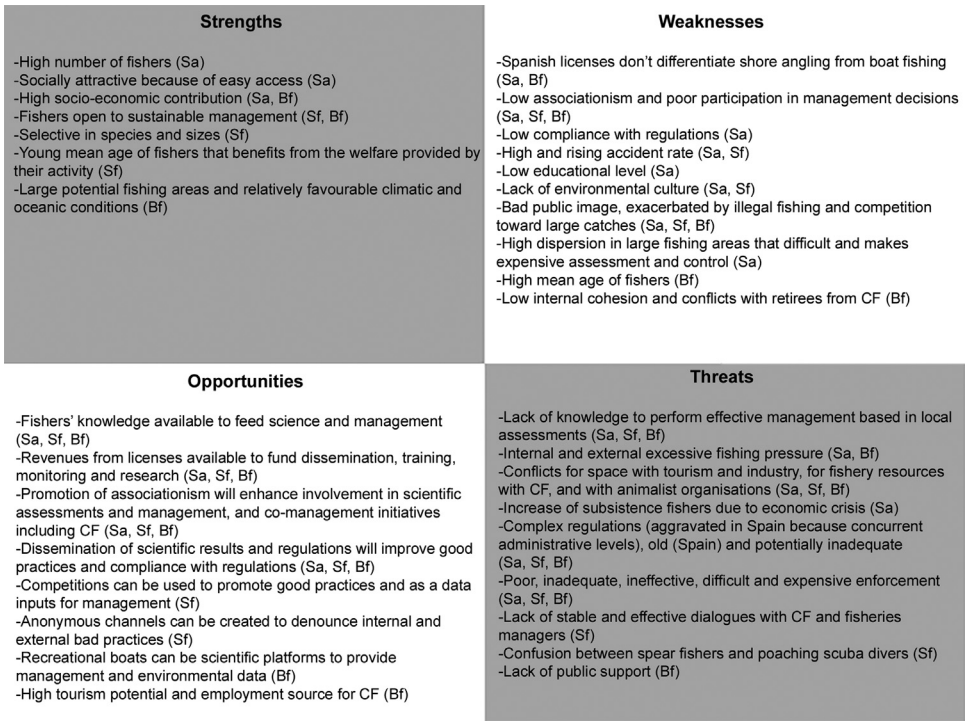

Fig. 2. Results of a Strengths, Weaknesses, Opportunities and Threats (SWOT) analyses on recreational fishing modalities performed by experts in MRF (N = 35; Sa = shore angling; Sf = spear fishing; Bf = boat fishing; CF = commercial fishing).

was found to represent 1% of the Gross Domestic Product of the Spanish Island of Majorca [51].

Despite the ecological, social and economic importance of shore angling, information on this modality is still highly limited in Europe, probably due to low rates of associativeness and a greater dispersion of anglers through the coasts compared to other recreational fishers, which makes on-site surveys difficult to carry out by national administrations (Fig. 2) [15,17,21,34].

3.2.2. *Spear fishing*

According to expert opinion [74], spear fishers have limited knowledge about their potential negative impacts on coastal ecosystems (Fig. 2). For example, bigger reef fish sizes are found in areas of the southern Mariana Islands where spear fishing is banned [75]. In Europe, some of these impacts have been described in the Mediterranean [16,76–78] and the Atlantic [19,21,22,60]. Moreover, while in the Mediterranean spear fishers keep their activity all year-round [76], their fishing effort in the Atlantic is limited by regular adverse oceanic conditions during winter [22,60]. However, long-living, slow-growing, sedentary and hermaphrodite fishes with low reproductive potentials are vulnerable species to spear fishing [22,60,79]. The depletion of these species on coastal areas can result in important ecological changes [20,34,65].

There are fewer spear fishers than shore anglers and boat fishers (e.g., 7% of issued licenses in Portugal [73] and 4% in Galicia [22]); however, their operating costs are probably higher than shore anglers [51]. Therefore, they potentially make an important economic contribution developing retail trade in fishing and nautical materials, shipbuilding and marinas [76]. However, as for shore angling, there is still limited information on this modality (Table A1-Appendix A).

The need for a federative license in Spain, in addition to the MRF license, has favoured internal cohesion among spear fishers. Their relatively high associativeness (e.g., the Galician Federation of Underwater Activities has approximately 3500 spear fishers [22]) would favour their participation in management and research initiatives, but in practice this is limited due to the current conflicts with administrations (Fig. 2). By way of example, spearfishers effort is specially limited in Galicia when compared with shore angling and boat fishing [80], to the point that spear fishing is the only recreational modality banned from some Marine Protected Areas, e.g. in France [16], Portugal [81,82] and Spain [83,84]. This type of restrictive measures, lacking scientific support in some cases, has created tensions between spear fishers' organizations and fisheries administrations throughout Europe [74].

Conflicts also exist with part of the commercial fisheries sector due to competition for space and resources [32,34]. On the contrary, and unlike in the Mediterranean [76,85], in the Atlantic there are fewer conflicts with scuba divers (Fig. 2).

3.2.3. *Boat fishing*

The number of boat fishers in Spain is difficult to determine due to deficient regional license systems that do not differentiate between shore and boat anglers (e.g., [86]). This is not the case of Portugal (mainland), where a specific license is issued for boat fishers (≈64,000 in 2016) [72].

Annual recreational boat fishing catches has been estimated in 7000 t in the Canary Islands [87], 400 t in the Basque Country [33], and 400 t in the Azores [61,88]. In the Azores, boat angling dominates MRF captures, overlapping artisanal fisheries in fish species and sizes, and fishing grounds. High competition for space and fishing resources between boat fishers and commercial fishers (particularly artisanal) has also been documented in the Mediterranean [48,89–91].

Relevant economic contribution of this recreational modality has been also well documented in the Mediterranean [35,49,51]. The current high purchasing costs of a boat, e.g. €24,931 on average in France [14] and €11,000 in Spain (National Association of Nautical Companies, ANEN, pers. comm.), and also its maintenance, e.g. €1256 per year in France [14] and €2000 in Spain (ANEN, pers. comm.), explain the high socioeconomic relevance of boat fishing (Fig. 2). Direct expenses of boat fishers have been estimated to reach €60 million in the Basque Country [33] and also in the Azores [61].

The relatively higher associativeness of boat fishers with respect to shore anglers (Fig. 2) and the need of access points with facilities for their boats, favour assessment programmes on this modality. However, there are 102 marinas in the continental Iberian Atlantic coast alone, which gives an idea on the potential difficulties and costs of conducting

systematic and large-scale on-site studies in this region.

3.3. Recommendations for research and management

In order to guide research programmes and improve management of MRF in Europe, the experts who attended the workshop agreed on the following 13 key priority initiatives linked to MRF:

- Studies are needed on the ecology (target species, reproductive biology, population dynamics, stock status and post-release survival), socioeconomics (user profiles and value chain analysis), and governance (participation, organizational structure and decision making) aspects of MRF;
- Rapid dissemination of research results, adapted to the various audiences (managers, fishing sector, science), is needed in order to strengthen cooperation between science, the MRF sector and administrations;
- Strengthening of partnerships between fishers' associations, scientific organizations and administrations is required to identify research needs, improve the collection of information and assess the performance of monitoring programs;
- Regular meetings are required between science, administrations, recreational and commercial fishers, NGOs and other stakeholders to foster collaboration, identify areas of conflict, and improve governance systems;
- Improving communication and collaboration between regional, national and international administrations (e.g., between Member States within the EU) is vital for successful management of MRF;
- Stable and formal forums at the national level between administrations and recreational fishers' associations should be created and/or potentiated;
- Regulations on MRF need to be revised and simplified, involving all stakeholders from the early stages of the decision making process in order to increase fishers' compliance;
- Suitability and economic, ecological and social adequacy of management measures should be assessed before implementation of any additional restrictions to MRF;
- Standardized license frameworks and periodic assessments should be implemented to obtain updated information on effort, catches and socioeconomic relevance of MRF;
- Funds from license fees could be used in fishers' training (e.g. about regulations or about how to collaborate with scientific programs by collecting and sharing standardized data), research and monitoring;
- A differential treatment could be given to retired commercial fishers (and perhaps to other economically deprived collectives involved in poaching) to avoid illegal fishing and unreported activities, while providing an economic complement to the lowest pensions (see e.g. [32]);
- Fishers' associativeness and internal participation should be promoted to improve their contribution in research and monitoring, in the development of regulations and to reduce social conflicts;
- The knowledge of recreational fishers in safety, regulations and environmental sustainability could be improved by encouraging the adoption of Codes of Conduct (e.g. [24]).

4. Challenges, opportunities and future priorities

In recent times the EU has committed significant funds for MRF under the Data Collection Framework [28] and Multi-annual plans [92]. However, more attention on MRF is still needed from Member States and regions of Southern Europe [78]. Here, as in many other regions of the world [93], insufficient resources are allocated to the assessment and control of MRF as well as to the promotion of ecological and socioeconomic sustainability. Notably, this lack of attention is a serious inconvenience to develop integral management initiatives that the EU agreed to perform [94].

To improve knowledge among researchers and managers about ecological and socioeconomic relevance, MRF should be incorporated into the curricula of master's and bachelor's degrees related to fisheries and maritime affairs. Better scientific and technical knowledge will help administrations to regulate the activity in an efficient and more informed way. Fishers' compliance will also be favoured, especially if fishers are involved in the decision making process [18].

Co-management models have also proven to be valuable procedures to enable access and management of marine resources without compromising long-term sustainability [44]. To develop this type of initiatives, it will be necessary to define basic commitments between the parties that favour co-responsibility in the administration of common goods [45].

Promoting associativeness in the MRF sector and Codes of Conduct [24] is important to foster responsible behaviours and commitment to environmental sustainability, favouring healthier social environments and enhancing economic returns [42]. The development of Information and Communications Technology tools applied to MRF, e.g. smartphone apps with MRF regulations [95], also in combination with the use of the traditional ecological knowledge of recreational fishers [46], could support all of these processes in the next years.

Challenges, opportunities and future priorities of MRF are very coincident with those of small-scale commercial fishing [32]. Therefore, it is important to generate a culture of understanding and collaboration between these two sectors with common interests, and thus enhance their contribution to the socioecological sustainability of marine ecosystems [96].

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Appendix A

See Table A1

Table A1
List of studies related to marine recreational fisheries (MRF) in the Iberian Atlantic coast, published in peer reviewed Journals.

Year of data or study	Reference	Country (region)	Modality	Objectives
Portugal				
2001	[17]	Mainland Portugal (north)	Shore angling	Describe fishing activity and estimate catch, harvest and effort
2009	[59]	Mainland Portugal (south)	Coastal fisheries (both commercial and recreational)	Review of estimates on fishing intensity and yield, users perceptions on conservation, and other data on fisheries in the Parque Natural do Sudoeste Alentejano e Costa Vicentina
2004–2005	[61]	Azores, Portugal (Faial and Pico islands)	Boat fishing	Describe fishing activity and estimate catch, harvest and effort
2001–2002	[60]	Azores, Portugal (S. Miguel island)	Spear fishing	Describe fishing activity and estimate catch, harvest and effort
1998–2012	[53]	Azores (Condor seamount)	Boat fishing (big-game)	Assess the economic impact of marine activities operating at Condor seamount, including big-game recreational fishing
2004–2005	[19]	Azores, Portugal (Faial and Pico islands)	Shore angling, spear fishing, shellfish gathering	Describe fishing activity and estimate catch, harvest and effort
2004–2005	[55]	Azores, Portugal (Faial and Pico islands)	Shore angling	Compare daytime and night-time catches in a shore angling fishery
2006–2007	[34]	Mainland Portugal (south)	Shore angling	Describe fishing activity and estimate catch, harvest and effort
2006–2007	[18]	Mainland Portugal (south)	Shore angling	Study anglers' attitudes and perceptions about MRF regulations
2007	[57]	Mainland Portugal (south)	Shore angling (sport fishing)	Characterize sport fishing competitions and estimate catch and effort
2007–2010	[62]	Mainland Portugal (south)	Boat fishing (big-game)	Describe diet of blue marlin, caught by recreational anglers
2009	[56]	Mainland Portugal (south)	Shore angling	Estimate short term hooking mortality for three recreationally important sparid species
2004–2005	[63]	Azores, Portugal (Faial and Pico islands)	Shellfish gathering (limpet)	Investigate if limpet harvesting is more influenced environmental aspects or by legal constraints
2014	[52]	Azores (San Michael)	Boat fishing (big-game)	Investigate angler opinions, angler profiles and business revenues of touristic big-game fishing
Spain				
2012	[21]	Mainland Spain (Basque country)	Shore angling, boat fishing, spear fishing	Compare different survey methods to estimate European sea bass recreational catches
1953–2007	[20]	Mainland Spain (Galicia)	Spear fishing	Investigate estimate long-term changes in coastal ecosystems using spearfishing competition historical data
1953–2007	[22]	Mainland Spain (Galicia)	Spear fishing	Assess the impact of spear fishing through competitions records and underwater visual censuses

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