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Recreational fishing: biological, economic and social assessment in Macaronesia (Activity. 2.1.3)

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Recreational fishing: Biological, economic and social assessment in Macaronesia

1. Executive Summary

Some difficulties to execute this task, implicated in a delay of the publication, which is now foreseen for the beginning of 2024. This task compiles the most important Marine Recreational Fishing (MRF) stakeholders, makes an overview of the literature on MRF and indicates some knowledge gaps and methodologies needed to be considered in the future. Macaronesia archipelagos, despite having some biological affinities, also have some differences due to latitudinal diversity gradient, distance from continental margins. Also, different levels of pressures are expected mainly due to the high diversity of population density found between Azores, Madeira and Canarias. But have in common that non-professional fishing activity has gone from being considered a mere supply of protein to a recreational activity and even of tourist interest. The management of MRF, has passed from an almost open access fishery in the nineteens of the last century (e.g., Azores and Madeira), to a regulated fishery with licenses and bag limits, in the first decade of 2000́ s. Research has been limited in time and space and despite some present indications that systematic data collection are starting to be implemented, as a requirement of the European regulations, there is still a long way to reach robust catch estimates. Moreover, to achieve balance management measures is needed to understand the socio economic role of MRF to the Macaronesian populations and to start implementing co-management processes, in order to obtain good acceptance of the rules and decrease the level of illegal fishing. In conclusion, MRF is highly popular in Macaronesia and much higher than in mainland Spain and mainland Portugal, for that reason this sector needs to be properly studied and regulated in the future.

2. MRF knowledge and gaps

1.1. Canarias

1.1.1. MRF Stakeholders list

Different types of actors in Canarias have been selected according to their role with regard to MRF. As there are two fisheries administrations, national and regional, public services have been taken into account (this group has been described as ‘Administration (civil service)’). Besides, the emission points of MRF permits have also been included. Due to the development of business and port structures related to the fishing sector (professional and recreational), among others, two other groups were included: i) companies supporting the activity (‘Company’) and ii) port structures (‘Port’). Specifically on the ‘Company’ group, as for businesses type fishing shops (dedicated to fishing and hunting products or similar), nautical equipment and nautical repair, as well as the sale of boats (in some cases also nautical equipment) or companies dedicated to fishing trips. Since MRF attracts a relatively large number of followers, another group has been created: the 'Organization'. Marine research companies, universities and research institutions that may be related to MRF have been reviewed and included. These provide information, analysis of data, surveys, etc. and studies of the marine environment. This group of entities has been called ‘Research’. Finally, the

database presents a total of 267 records: 14 'Administration'; 171 'Company' (for example 77 fishing stores and 32 recreational fishing charters, between others), 19 'Organization' (non-profit organization, clubs, etc), 43 Port (marinas, national and regional ports); 20 'Research' (companies, university research groups, etc.) (Pérez-González et al. in prep.)

1.1.2. Governance

The first legislative reference to MRF date back to 1936, although it was not until 1963 that three types of license were defined (distant waters, underwater and coastal/not-distant waters). As a result of the Spanish Constitution (1978), the Statute of Autonomy of the Canary Islands (1982) and Royal Decree 1938/1985, marine fishing has been divided between the government of the Canary Islands and the government of Spain, with responsibility for internal and territorial waters, respectively. Shellfishing is the exclusive competence of Canarias (Bilbao-Sieyro et al., 2017). Nowadays a license is required for MRF. There are four types: (i) boat trolling, (ii) spearfishing & shellfish, (iii) shore, boat - no trolling - and shellfish, and (iv) profit use per boat. There is no limit to the number of licenses issued each year and are valid for three years. On the other hand, there are daily catch limits and restrictions on the equipment that can be used. Only in the case of shellfish detailed information on species restrictions even at island level are given. Recreational fishing has no spatial or temporal restrictions beyond the three existing marine reserves of fishing interest, where there are no-take zones and exclusive professional fishing areas. Only spearfishing is restricted to specific locations on each island, also some temporal restriction in some areas. Shellfishing also has permitted areas and seasonal closures (Pérez-González et al., 2022.)

Due to the complexity and dynamism of the legislation in this field, nowadays, eighteen regulations (Canarias, Spain and Europe) can be considered applicable to MRF. A general reading of the regional and national rules reveals a degree of similarity that favors their application, regardless of the competence issue. However, there are certain differences that may cause difficulties in understanding the rules and therefore in applying them. For example: different daily catch volumes, seven differences in minimum legal sizes, some differences regarding the distances between recreational fishermen and other activities (e.g. professional fishing), the limitation for spearfishing to specific days, etc. In any case, the control of species subject to a differentiated protection regime (e.g. bluefin tuna) requires a permit from the Spanish government (Pérez-González et al., 2022).

The level of association at MRF could be close to 5% (Pascual et al., 2012). In any case, this has a great socioeconomic and political influence, which has been able to organize itself in order to assert its rights at key moments and achieve the modification of proposals for fisheries management. The authorities responsible for ensuring compliance with the regulations on MRF are the Directorate General for Fisheries (Canary Islands Government), the Ministry of Agriculture, Fisheries and Food (Spanish Government) and, in general, the State Security Forces. In view of the geography, the coastal perimeter and the vast area of sea to be covered, the human and technical resources allocated to fisheries control may not have the desired presence in the fishing grounds. From a political point of view, there has not been a systematic process leading to the definition of objectives, priorities and time-bound targets for MRF. More scientific advice during the rule-making process and more consensus building with stakeholders are desirable (González 2008).

1.1.3. Research

According to the data collection framework (DFC, Regulation (EU) 2017/1004) for MRF, the compilation of biological, environmental, technical and socioeconomic data is essential.

However, the MRF in the Canary Islands does not have official catch statistics even though there are around 90,000 recreational fishers unequally distributed among the eight islands along 1,500 km of coastline. Nevertheless, this has not been an obstacle for the research groups that have made notable efforts to infer the role of MRF in the Canary Island fishery. We found 54 research references (2000–2021) in this regard. The studies were classified according to Pita et al. (2020). Most of the references (22) corresponded to peer-reviewed articles. The key results were mainly related to catch and effort estimates (26) and few publications referring to dissemination (3) and legislation (1) has been done. The data collection techniques included: face to face interviews, on-site data gathering and telephonic and online surveys. Is noteworthy that the catch/effort data is directly taken from fishers in only three publications (peer-reviewed). On a regional basis, only one work considers all modalities (coast, boat and spearfishing) and the other two are about spearfishing with significant differences regarding total catch estimates (Bilbao-Sieyro et al. 2022).

As many authors have pointed out, most or all these methodologies are based on non-probabilistic samples or are specific to one island. Consequently, inferences must be taken with caution. The research carried out so far has been opportunistic (research groups) and with a short-term vision (administrations) to respond to specific needs. However, as in any fishery assessment, a long-term vision is necessary. Since January 2021 an MRF working group was created to contribute to the development of DFC at the national level. It would be a big step if the research groups could detail a roadmap with unified methodologies. In this way, the management of public resources would be more efficient. This effort should be led by the two fishing administrations (national and regional) (Bilbao-Sieyro et al. 2022).

1.1.4. Participation rate

The participation rate has been calculated as the ratio of the number of licenses issued to the population. At regional level, it is 4.4% in the Canary Islands (Bilbao-Sieyro et al. 2022). In Spain it has been estimated at 1.8% (Gordoa et al., 2019), while in Europe it is around 1.6% (Hyder et al. 2018). In other words the MRF in Canarias shows its importance as a socio-economic activity. However, if we take into account the island level, we can see that the capital islands (more populated) of Gran Canaria (3.5%) and Tenerife (3.9%) have lower values than the other less populated islands, such as Lanzarote (5.9%), Fuerteventura (9.5%), La Gomera (8.4%), Las Palmas (7.2%) and El Hierro (15.6%). This suggests that the study and management of recreational marine fisheries should take into account the island factor

1.1.5. Catch and Fishing Effort estimation

As mentioned above, the research carried out in Canarias has certain shortcomings in terms of the conclusions that can be drawn from its results. In any case, despite their limitations, the data obtained should be taken into consideration. Catch and effort estimates were the most common in terms of scientific and technical output (Bilbao-Sieyro et al. 2022). Six studies were selected because they were the most complete in terms of geographical coverage and/or type of fishing activity. We will not discuss here whether it is 'better' to collect this type of information through telephone or online interviews (which may overestimate catches, but can allow better monitoring over time and are cheaper) or face-to-face interviews (which allow the possibility of verifying catches in situ, but are more expensive and also seem to be designs where opportunism is more important than randomness in obtaining data (Pascual et al. 2012). In addition, as we shall see, the methodological strategies were quite variable.

The catch and effort studies estimate, for a given sample, the daily catch, the number of fishing days per year and finally the total catch for each type of fishing as a function of the

number of licenses. As will be seen, the studies considered have taken into account not only the number of licenses but also the type of license. In addition, these studies have generally attempted to distinguish between boat, shore and spearfishing. However, as mentioned above, the current type of license does not exactly meet this requirement. Each of the studies analyzed has therefore taken its own approach to dealing with this situation.

The first research (MAPyA. 2006) covered all islands and was conducted over three months. It was initially based on postal surveys (as - only this work - had access to fishermen's contact details), but the response rate was only 3.7% (n 160). This was followed by some telephone and face-to-face interviews at the docks (n 316). In terms of type of fishing, a distinction between coastal and distant water fishing was made. The total catch was reported as 6,700 t/year. Jiménez-Alvarado (2015) carried out his work (in 2010) for all the islands, over 8 months, using face-to-face interviews (n 203), differentiating between shore, boat and spearfishing (7%), and reports a total annual catch between 15,847 and 7,327 t/year. Pascual et al. (2012) only considered the island of Tenerife, but it is the most comprehensive study to date. It lasted twelve months and methodologically used field (n 1053) and telephone (n 1098) interviews, distinguishing between coastal, boat and spearfishing, giving a value of 574 t/year. The study by Jiménez-Alvarado (2015) suggests values between 5,696 and 2,634 t/year for Tenerife. Gordoa et al. (2019) conducted a nationwide study based on online interviews over 12 months (n 792), distinguishing between shore, boat and spearfishing, and showing a range of 11,769 to 5,583 t/year. The last two works refer only to spearfishing. Despite the fact that it is the modality with the fewest licenses issued, curiously is the one that has received the most attention. One of the causes of this could be because it is the only modality that, as mentioned above, has its own fishing zones, a fact that is not without controversy within the spearfishers, which considers this situation unfair and even claims that the selection of these zones is not based on scientific evidence. Martin-Sosa (2019) considered the whole archipelago for 24 months using online surveys (n 958) and reported 42 t/year. On the other hand, Jiménez-Alvarado et al. (2020) also considered all islands and was based on field interviews (n 93) and reported an annual catch of 837-491 t/year.

Overall, there are considerable differences in the estimates of total annual catches between the studies considered. Differences of up to one order of magnitude in kg of daily catch and up to two orders of magnitude in days fished per year were also observed.

1.1.6. Socioeconomic analysis

In Spain, it is estimated that 900,000 people practice marine recreational fishing, with an annual economic contribution of more than 600 million euros (Gordoa et al. 2019). The economic studies available for the Canary Islands were carried out as part of some of the work mentioned in the previous section, and therefore share the limitations described above. In any case, they take into account the social profile and the associated costs (Pascual et al. 2012, Jimenez-Alvarado 2015, Gordoa et al. 2019). This activity has a relevant and variable investment depending on the modality, for example whether a boat is used or not. On the other hand, as mentioned above, the number of fishing shops, companies with recreational fishing boats, marinas and ports is very high and their socioeconomic importance in relation to RMF has not been assessed. Although there are around 90,000 current licenses for recreational anglers (Bilbao et al. 2022), the frequency of development does not generally appear to be very high. There are unlicensed anglers, whose percentage varies depending on the methodology and scope of the research done (20% Pascual et al. 2012; 10% Jimenez-Alvarado 2015; 5% Gordoa et al. 2019). The Canary Islands are also one of the 17 autonomous

communities (AC) of Spain, 10 of which are coastal (for example, Galicia, Andalucía, Catalonia etc.). A fishing license from an AC is valid for the type of fishing you wish to carry out in others. There is an unquantified phenomenon that there are fishing shops in Canarias that manage license applications for fishermen through other AC than Canarias because in some of these locations the validity of the licenses is longer in time (J.J. Castro, pers. comm.).

Around 90% of angles are carried out by middle-aged men, who are employed and unemployed in the same terms, have a low income and, in general, a low level of education. However, these profiles vary according to the type of fishing carried out (shore, boat and spearfishing). The activity is mainly concentrated in the summer, at weekends and on festives. As far as the basic motivation of fishermen is concerned, it seems to be of a fun and relaxing nature. In general, these fishermen consider themselves informed about the rules, although their level of knowledge seems to be insufficient (Pascual, 2012). The issue of poaching deserves a separate mention. It is the main source of tension between recreational and professional sectors and also is a methodological challenge, as the techniques currently used for RMF may not be appropriate in this case (Pascual and Batista, 2021)

1.2. Madeira

1.2.1. MRF Stakeholders list

In the Autonomous Region of Madeira, as in other regions, there are a diverse variety of recreational nautical organizations. In the region we have various Nautical Clubs composed by a relevant number of members, that organize several fishing tournaments over the year. Fishing events are organized with more expression by the Associação de Pesca Desportiva da Região Autónoma Madeira that is responsible for organizing the regional individual and clubs fishing competitions and for disseminating and promoting the practice of the recreational fisheries in the Region. The clubs actively operating in the Autonomous Region of Madeira and incorporated in this Association are the following: Grupo de Amadores de Pesca Desportiva da Madeira; Clube Desportivo e Cultural do Porto Moniz; Grupo de Campismo Santo António; Clube de Tiro, Caça e Pesca da Madeira; Sporting Clube da Madeira; Clube Desportivo Mar e Serra and Centro Treino Mar. These local associations organise fishing tournaments every year, generally in multiple locations along the coastal regions of Madeira and Porto Santo islands.

The relationship of proximity we maintain with the fishing associations allows us to collect the data acquired through the carrying out these tournaments. With this and within the scope of the Data Collection Framework (DCF) for Madeira we are able to achieve the objective of covering at least 25% of the championships, obtaining morphometric parameters of all the species caught during these shore angling and spearfishing competitions. For the remaining fishing tournaments that are not covered in-situ, the fishing association or the clubs provide the capture reports with data at species level. The activities organized by these clubs and associations are of major relevance, since in these events fishermen can be informed about the surveys and the importance and objectives of the data collection, through awareness-raising and dissemination actions.

1.2.2. Governance

In Portugal, the practice of MRF is governed by Decree-Law no. 246/2000, of 29 September and by the changes introduced in 2005 (Decree-Law nº. 112/2005, of 8 July) and 2007 (Decree-Law nº. 56/2007, of 13 March) and in 2013 (Decree- Law nº. 101/2013 of 25 July) which defines the legal framework for the exercise of recreational fishing. Also Decree- Law nº 14/2014, of January 23, establishes the regime of recreational fishing and the value of licensing

fees and Decree- Law nº 184/2013, of May 16, establishing the amount to be charged for the issuance of a second license for recreational fishing (Annex II, points 2.5 and 2.6). Decree-Law no. 246/2000, of 29 September, provides for the modalities of recreational fishing (leisure and sports), the ways in which this activity is carried out (offshore, inshore and underwater), licensing and inspection regimes.

In the Autonomous Region of Madeira, the practice of recreational fishing was governed by the same Decree-Law of Portugal. In addition, the Regional Directorate of Tourism is the entity responsible for licensing in the Autonomous Region of Madeira, being governed by Regional Legislative Decree no. 30/2008 of 12 August, which establishes the legal regime for licensing, and inspection of tourist animation companies. The license is requested and granted by the Regional Directorate of Tourism, which is also in charge of analyzing all the opinions inherent in the inspection of equipment and facilities, in charge of other public entities. The license shall include the authorized activities, the identification of the dock and places of embarkation and the vessels to be used.

Also, Decree-Law no. 393/93, of 23 October, revision of Decree-Law no. 96/89, of 28 March, establishes the legal regime for the licensing of pleasure boats for recreational purposes, according to the International Ship Registry of Madeira (MAR). All private and foreign vessels operating in the ports of Madeira Island are subject to this registration.

Most recently, the Regional Legislative Decree No 19/2016/M, of 20 April regulates directed fishing for plant and animal species for recreational purposes in the marine waters of the Autonomous Region of Madeira. Articles 6, 7 and 8 regulate permitted gear, constraints, prohibitions and restrictions on the exercise of the activity, as well as the terms of the licensing. The Regional Directorate for the Fisheries and Sea of the Madeira Government is the entity responsible for issuing the licenses.

1.2.3. Research

The MRF research in the Madeira Archipelago is still scarce, and the existing studies do not characterize MRF in the whole archipelago. These are mainly focused on the characterization of recreational fishermen and catch and effort estimates, at local/island scale.

In 2009 it was elaborated the first characterization study of big game fishing in Madeira Island, which resulted in the master thesis of Graça, 2009, highlighting the activity and catch effort estimates of Blue Makaira (Makaira nigricans Lacepède, 1802).

More recently, between 2017-2020, it was developed a pilot study under DCF-Madeira, to assess catches of species obtained in recreational fisheries in order to compare the impact of these activities with commercial fisheries as well as determine the social and economic importance of Big Game fishing, Spearfishing and Shore Angling.

This pilot study resulted in the first peer reviewed studies, for each recreational fishery modality practiced in the region. Data obtained from fishing licenses and surveys conducted in 2004 and 2017 allowed the analysis of the practice of spearfishing in the Madeira archipelago. (Martínez-Escauriaza, et. al., 2020b). In 2017, a total of 4825 licenses were issued for shore angling in Madeira. Surveys were conducted and gave a general perception of the recreational shore fisheries in Madeira (Martínez-Escauriaza, et. al., 2020a). Through fishermen surveys and official registers of fish landings, it was possible to describe and characterize the small-scale fisheries in Madeira, comparing artisanal and recreational fisheries (Martínez-Escauriaza, et. al., 2021a).

Although Madeira Region does not hold yet a legal obligation to report fisheries data on recreational fishing activities under DCF, significant efforts have been made since 2020 to improve data collection with the objective of robust determination of fishing effort, composition of catches, catches per unit of effort and destination of catches.

The Regional Directorate for the Sea (DRM) has implemented since 2021 on-site biological sampling of a fixed percentage of shore angling and spearfishing tournaments. This monitoring program will increase the overall knowledge of these fisheries in Madeira archipelago in order to reach balanced regulations on MRF and maintain a sustainable exploration of the regional marine resources.

Due to difficulties encountered in the implementation of on-site data collection and high rejection rate to participate voluntarily on filing questionnaires, it is being developed a mobile application that will allow recreational fishing practitioners to easily report georeferenced catches as well as access updated information of interest. Complementary, off-site surveys will continue to be applied to collect data from shore angling, spearfishing and boat fishing.

1.2.4. Participation rate

The participation rate of Madeira population practicing MRF were estimated from official information on issued MRF licenses between 2020, 2021 and 2022 were 2.5%, which is similar to the Portuguese mainland and European average of 2% (Diogo 2020), reflecting thus a similar importance as a socioeconomic activity.

According to MRF licenses data, participation rate was higher for shore angling fishing mode (1.6%) and lower for boat angling and spearfishing (0.3% and 0.6%), evidencing fishing modes as a factor to take into account in the management of recreational marine fisheries.

1.2.5. Catch and Fishing Effort estimation

In the Autonomous Region of Madeira the marine recreational fisheries data is reported, at a national level, to the European Union voluntarily and annually under the Data Collection Framework (DCF). This reporting includes data from shore angling, spearfishing and Big Game Fishing and it is currently obtained from the regional fishing competitions and from surveys.

Nowadays surveys are only done offsite, when the fishers are obtaining their license, in person, in the gov-ernment office or online. This is presented to everyone requiring a monthly or annual marine recreational fishing license, independent of their nationality. The reluctance of the citizens in filling in the questionnaires by reporting the data in this format is considerable, with increased concerns when the questions are related to personal information. This issue would be overruled if onsite surveys could be implemented. An onsite survey at regional level would be very important in order to make the collection of robust data on catch rate and composition possible. Complementing the offsite surveys currently done, a recall survey could be implemented, however, and as it is already done in other regions, they could present numerous disadvantages and difficulties, such as the recall bias and the scarcity of human resources to perform the work.

Until this date there has not been a study performed using data of all recreational modalities practiced in the region. In Madeira, spearfishing has been practiced for decades, with the first legislation of the modality dating back to the year 1963 (Martínez-Escauriaza et al., 2020b). Of the most complete studies carried out to date, the first study related to spearfishing stands out, since it is the first study that characterizes this activity and its impact in the Madeira archipelago (Martínez-Escauriaza et al., 2020b). This study of 2020 used data from 509 *off-site*

surveys previously done in 2004 and 132 *off-site* surveys and 58 onsite surveys of 2017. This study estimated a total amount of 732 341 fish caught and 517.7 t in weight, for the total number of active spearfishers in 2017. In 2004, the estimated total catch was 321 906 fishes (Martínez-Escauriaza et al., 2020b).

Shore angling constitutes the most practiced modality in the Autonomous Region of Madeira. In 2017, 391 *off-site* surveys and 262 onsite surveys were carried out to col-lect information after a pilot study conducted on 69 anglers from November to December of 2016 (Martínez-Escauriaza et al., 2020a). In this study, the surveys that were conducted when the fishers were obtaining their licenses, in the gov-ernment office, and the ones carried out when the anglers were practicing shore angling, made it possible to estimate the total annual catch of 520.7 tonnes, with an average of 113.3 kg per angler, per year (Martínez-Escauriaza et al., 2020a).

In 2021 a comparison between artisanal and recreational boat fisheries of the Autonomous Region of Madeira was elaborated. 90 recreational boat fishers were surveyed at the gov-ernment office in 2017. These offsite surveys contributed to the estimation of an annual catch of 509.8 tonnes of fish (Martínez-Escauriaza et al., 2021a).

Another fishing method analyzed under DCF in Madeira is Big Game Fishing, in order to collect data from highly migratory species. The most recent study dates to 2021, when a study was performed using data from 2017 to 2019, using questionnaires performed directly to captains, logbooks and online reports of catches (billfishreport.com) focused primarily on the blue marlin (Makaira nigricans Lacepède, 1802) catches (Martínez-Escauriaza et al., 2021b). This study calculated that the overall weight of the blue marlin specimens captured and landed in 2017 was 2845.7 kg, in 2018, 1131.3 kg, while in 2019, a total of 2437.6 kg of blue marlin was landed, as inferred from nine dead specimens. Meanwhile the other pelagic species, caught by the big game fishing fleet represented, in relation to blue marlin catches, in 2017, 42.6% of the total catches, in 2018 this value was 59.7% and in 2019 only 30% of fishes caught were species other than blue marlin. Following what is expressed in the point 4 of article 6 of the Ordinance Nº 484/2016 of 14 November, fisheries aimed at large migratory species, must adopt the catch and release technique, as a good practice. The limited access to the biological information of the species captured, especially when practicing the catch and release technique, constitutes a disadvantage of using surveys (Cooke et al., 2000).

Surveys still present some limitations and can be a source of some inaccuracies; however, this method provides us with valuable information and allows us to have a general perception of the current state of recreational fishing in the Autonomous Region of Madeira.

1.2.6. Socioeconomic analysis

Socioeconomic data for robust analysis of Madeira Recreational Fisheries are still sparse and with significant data gaps. Some socioeconomic data are available but specific for some recreational fishing modalities only.

Recreational shore angling fishery socio-economic data were first assessed in 2017 (Martínez-Escauriaza, 2020 b), through the combination of data from licenses and questionnaires directed to anglers during license request. Almost half of the individuals were aged between 31 and 50, with an average age of 42.9±14.9. Regarding the education level, 33.7% of the interviews (n=635) had basic or no education, 44.7% secondary, 5.9% higher education and 15.7% had vocational training. While rejection rate to participate voluntarily were around 19.7%, from those who provided information, 30.6% were unemployed and 11.4% retired. From the employed fishermen strata, 20.7 % of the anglers earned less than €500 per month

and only 2.1% had a salary above €1500 per month, reflecting the economic relevance of this specific activity to the population strata with the lowest income. Accordingly, the mean annual expenditure was €254.3±413.5 per angler, resulting in €1.16 M of total expenditure for the angling modality in Madeira Archipelago (Martínez-Escauriaza, 2020 b).

Spearfishing is an activity generally practiced by younger people, due to fitness requirements to practice this leisure activity (i.e. free diving). Most also mention pleasure and physical activity as the main motivations to practice this activity and only a minority recognize that spearfishing is practiced with the main purpose of obtaining food resources. The average expenditure per spearfisher per year was 465.40 ± 798.80 euros (Martínez-Escauriaza, 2020 a).

Recreational boat fishing includes the touristic fishing companies (mainly directed to Big Game fishing) and amateur boat fishing practitioners. According to 2017 study (Martínez-Escauriaza 2021b), BGF fleet was composed of approximately 31 vessels (20 charters and 11 private boats), and a total of 789 vessels licensed to operate as recreational fishing boats (Martínez-Escauriaza 2020b). The boat fishers' ages ranged from 18 to 75, with an average age of 45.3±12.2, which is quite similar to shore angling average age. However, of the surveyed boat fishers, more than half of those had basic education (56%), and were employed (67.7%), with only 19% being unemployed fishermen, and 31.9% having either no income or less than €500, contrasting with socioeconomic data from shore anglers. Mean annual expenditure for recreational boat fishermen was €763.1±1054.7 euros, representing the modality with higher economic impact (Martínez-Escauriaza 2021a).

1.3. Azores

1.3.1. MRF Stakeholders list

In relation to the MRF Azores stakeholders currently the most important one is the ARPLA (Azorean Regional Recreational Fishing Association). This Association represents the three main fishing modes (shore angling, boat angling and spearfishing) and is currently the main Association that have been indicated for representation of this sector in establishment of MPA processes, Marine Spatial Planning meetings, Regional Fisheries Council and opinion on new legislation. In consideration of MRF Tourist Fishing (i.e. charter boats), they are maritime tourism companies and their activities are within the scope of the Association AOMA (Maritime-Tourist) operators in the Autonomous Region of the Azores). The position of ARPLA is that touristic fishing is not framed within the objectives of ARPLA since it's considered a commercial activity (Hugo Diogo, pers. comm.).

On the other hand, in Azores there are 22 Naval Clubs and Nautical Clubs with relevant importance at island level (or local level), since they are usually composed by many members and they organize shore angling and boat angling tournaments, in particular: Clube Naval de Lajes das Flores, Clube Naval de Santa Cruz das Flores, Clube Naval da Horta, Clube Naval da Madalena do Pico, Clube Náutico de Santa Cruz do Pico, Clube Naval de São Roque do Pico, Clube Naval de Velas, Clube Naval da ilha Graciosa, Clube Náutico de Angra do Heroísmo, Angra Iate Clube, Clube Naval da Praia da Vitória, Clube Naval de Ponta Delgada, Clube Naval de Vila Franca do Campo, Clube Naval da Povoação, Clube Naval do Nordeste, Clube Naval de Rabo de Peixe, Clube Naval de Santa Maria. Moreover. Also, there are Fishing Clubs that organize competitions events, such as: Clube De Pescas Desportiva Os Cagarros, Clube de Pesca Ilha Azul, Associação de Pesca Desportiva da Ilha do Pico, Sindicato do sector Financeiro, Clube Açoriano de Pesca Desportiva, Futebol Clube Calheta.

1.3.2. Governance

Marine recreational fishing in the Azores was an open access activity until 1984 without restrictions of any kind (Diogo et al., 2020). The first regional regulations dedicated to MRF only considered spearfishing, which were issued in the mid-1980s in the Azores (DLR 31/84/A). The Restrictions included daily catch limits (different for fish and specific crustaceans), prohibited species for specific fishing modes (e.g., dusky grouper, *Epinephelus marginatus* for spearfishing and one specimen/day for angling), mandatory fishing licenses, restrictions on allowed equipment, and the mandatory need to comply with existing or upcoming minimum landing sizes, and temporal and spatial restrictions for specific areas or species. More comprehensive regulations covering all MRF modes and including measures to control user access and catch (e.g., daily bag limits, temporal and spatial restrictions) were only issued in 2007 in the Azores (Regional Legislative Decree § 9/2007/A). Licenses were only applied for spearfishing and boat angling (i.e., boat owner), while shore angling and hand collecting do not have this obligation.

In Azores, in particular during the years of 2006/2007 the implementation of the DLR 9/2007/A was preceded by face-to-face meetings used as an informal consultation process in order to find solutions and consensus. Within this process was invited designated persons as naval clubs, a "High Sea sport fishing association" (that no longer exist) and scientific and Governmental partners (Diogo, pers. Com.). More recently, a great pressure has been made by the Commercial fishing sector (Federação das Pescas dos Açores) to impose more restrictions for MRF in Azores. During 2014/2015 the Azorean Government after several round tables in several islands, listening to several partners including science and naval clubs, the Government carried out an online consultative review process about the application of a new law with increasing restrictions on bag limits. However, due to the level of contestation and some well-founded opinions based on the few available scientific studies, marine recreational fishers demonstrated that the bases (from commercial fishing sector and the Government) supporting the new restrictions were not robust enough and, at the end, the new proposed law was not published (Diogo, Pers. Com.).

The MRF regulations enforcement in Azores is done by Inspeção Regional das Pescas, Guarda Nacional Republicana, Policia Maritima. In terms of law enforcement it is recognized that the enforcement is weak (Martins et al., 2010; Torres et al., 2022). For example, for some vulnerable resources as Limpets it is known that the illegal fishing within the reserves and outside of seasonal closure is high (Martins et al., 2010, Diogo et al., 2016; Torres et al., 2022). However, in terms of licenses, there are indications that the rate of unlicensed MRF is low (PNRD, 2022). Even so, this IUU tended to implicate uncertainty on the models to establish the level of exploration of some coastal stocks as the case of limpets, octopus, *Sparissoma cretense , Serranus atricauda* (Torres et al., 2020). Other technical measures that have been put in place as MPAs, however, many of them are yet considered paper parks (Abecassis et al., 2015). For example, the island's natural parks (PNI) implemented in all islands have designated network areas, however, the subsequent process for management plans were never implemented for these areas. At this moment a new process of restructuring the MPAs networking is ongoing, and the target is to reach 30% of MPAs with 15% of no/take zones by 2024.

1.3.3. Research

The Azorean MRF studies are, somehow, limited in time and space, generally highly descriptive, with local or island level catch and effort estimates. Even so, the Azores archipelago and the south mainland (Algarve and Alentejo) are the regions with most

published material in Portugal (Diogo et al., 2020). During 2001 - 2002 it carried out the first small on-site access survey in São Miguel island, highly limited in time and space (Diogo and Pereira, 2013a; Diogo et al., 2017). In Faial and Pico, other on-site roving creel survey was done during 2004 - 2005, which allowed to get annual estimates of effort and catch for shore angling, spearfishing and boat angling (Diogo and Pereira, 2013b, Diogo and Pereira, 2014) and also some analysis in terms of recreational hand collecting (Diogo et al., 2016). This work also allows to get the bases for the first catch estimations at regional level (Pham et al., 2013; Fauconnet et al., 2019).

More recently, since 2019 an off-site regional level survey was implemented by the DCF-Azores and established a Pilot Survey (PNRD, 2022). In 2022 the DCF-Azores established this off-site survey as a systematic data collection program. The survey is based on a recall license survey for boat angling and spearfishing within the informatic license system. As a complement, a phone survey is carried out for situations of no-response (first license, non-residents). Moreover, this recall survey is used as a recruitment base for the engagement of MRF in the on-line logbook (and APP - PNRD, 2022). However, this system is considered not user friendly and, for that reason, the Project Plasmar+ developed a new system that hopefully will improve the data collection in Azores, Madeira, and Canarias. Moreover, it is important to stress out that within Plasmar+, the first phone survey was accomplished in the Azores with new data on participation rate and catch estimation for shore angling being in preparation for publication. Finally, it is important to notice that no onsite surveys are being implemented at regional level, which is an important gap with implications on robustness of catch composition, catch rate and finally the total catch estimation (Strehlow et al., 2010). On the other hand, some economic studies have also been made for charter boats for big game fishing (Ressurreição and Giacomelo, 2013; Vieira and Antunes, 2017; Ressurreição et al., 2022).

1.3.4. Participation rate

The participation rate in Azores, according to the phone survey implemented in the Plasmar +, is around 9.1% (Diogo et al., in prep). The participation rate in Azores is much higher than in Portugal mainland (~2%) (Diogo et al., 2020). This fact is, mainly related to the population live extremely close to the sea. For example, in mainland 80% of MRF live 20 km from the coast, which can explain this divergence. This information is very important for estimation purposes, but also for revealing the importance of this sector in the region.

1.3.5. Catch and Fishing Effort estimation

The first available estimation of total harvest for MRF in Azores was done by Pham et al., (2013) that estimated a recreational harvest of around 600 tonnes (about 6% of the commercial landings), with 96% of the recreational catch related to shore and boat angling. However, this work was based on the limited work in time and space of Diogo and Pereira (2013b, 2014). However, some recent findings indicate that some differences between islands in terms of catch composition and catch rate implicate that the estimation of Pham et al., 2013 based on two islands in one year need to be seen with some caution (PNRD, 2022). The offsite survey from DCF Azores at Regional level will possibly give better information in the future, however it is important to take into account that it will be needed to also implement an onsite survey at regional level in order to collect robust data on catch rate and catch composition. Even so, DCF- Azores published a report with estimations for boat angling and spearfishing, however, these estimations are only based on catch and effort data collected on a recall bias within the informatic license system (PNRD, 2022). Despite the considerable number of complete interviews the recall bias is a problem and the estimations are overestimated as

referred to in the report (PNRD, 2022). Currently, DCF-Azores also have a panel of fishers that filed an on-line logbook and APP (e-form - SRAF), however, the recruitment (drop-ins) need to be increased to improve the precision in the estimates. It is important to notice that shore angling is the most popular fishing mode in Azores and is outside of the scope of DCF-Azores (Diogo and Pereira, 2014; PNRD, 2022). The Plasmar + has the first catch and effort estimation based on regional level survey for shore angling. This study showed the importance of implementing a complementary method to take in consideration the problem of recall bias (Diogo *in prep.*).

1.3.6. Socioeconomic analysis

Socioeconomic analysis is one of the main gaps in Azores. It is commonly recognized the social role and importance of this activity, but until now any research has evaluated this importance. Also, the profiling of the fishers should be carried out since they are still very limited (Diogo, 2007; Diogo and Pereira, 2013b). In general, it is known that the great majority are males with considerable range of ages, however, the spearfishers are younger than shore and boat anglers (Diogo et al., 2020). New data have been collected within DCF Azores, but this data was not yet reported. Moreover, a study on the perception of the current regulations should also be carried out to understand the level enforcement and indications of improvement of these regulations (Veiga et al., 2013). Also an analysis on the importance of MRF in terms of fish consumption and relation with wellbeing (physically and psychologically) should be conducted to understand the importance of the activity (Pita et al., 2022). In terms of economic importance it is obvious that the high participation rate indicates an expected importance due to fishing expenditures and jobs (Diogo, 2007; Diogo and Pereira, 2013b; Hyder et al., 2018). Also some other studies have indicated that touristic fishing, mainly based on big game fishing, have a relevant economic importance due to high values of expenses made by these tourists (Vieira and Antunes, 2017; Ressurreição et al., 2022). Moreover, several smaller vessels also are focus on coastal fishing targeting coastal pelagic predators and demersal species (e.g., yellow tail barracuda, jacks, groupers). Other aspects that have been indicated is the illegal fishing, considered to be a problem in the Azores, in particular for some species as limpets and octopus (Martins et al., 2011; Diogo et al., 2013a; Diogo et al., 2016; Diogo et al., 2017; Torres et al., 2022). At least in some locations, the number of illegal fishers (i.e., door-to-door fish sellers), it's considered to be a minor percentage. This type of fishers have high avidity patterns which imply that the total catch amount from them can be considered (Diogo and Pereira, 2013a; Diogo et al., 2017). The increasing law enforcement and the implementation of co-management processes can be the way to mitigate this situation. Even so, the socioeconomic background of these fishers is an important knowledge to fisher managers found the best ways to decrease this deep-rooted problem.

3. Conclusions

The Macaronesian archipelagos are distinctive from continental margins owing to the virtually absent shelf and narrow circum-littoral zone, ecotones that are the exclusive habitat of several littoral species, making them more vulnerable to activities that concentrate their fishing effort predominantly in those areas (Santos et al., 1995). There are considerable similarities between archipelagos in terms of coastal fish assemblage in the rocky shores of these archipelagos with about 2/3 of the species in common (Harmelin-Vivien et al., 2001). However, some ecological differences between archipelagos are also apparent due to the latitudinal diversity gradient, but also by the distance from the continental margins between archipelagos (Domingues et al., 2007; Almada et al., 2017). Also, these archipelagos show some differences in terms of human

pressure mainly due to the human population density, in particular Canarias with 2.2 millions distributed in eighth islands, while Azores with less than one quarter of a million distributed in nine islands, and Madeira archipelago with the majority of the population (approximately half of a million) concentrated in one island. It is important to stress out that MRF are considerably popular in Macaronesia in comparison with Portugal and Spain Mainlands. The popularity can be in some cases compared to the highest participation rates found in Europe (Diogo in prep.; Hyder et al., 2018). This probably can be explained by the extreme easy access to the sea, where the ocean is manytimes considered the playground of these populations. Also, in less urbanized and less populated islands there are some indications to exhibit higher participation rate, which could be related with several social economical factors that should be investigated. Despite the recognized MRF pressure on coastal ecosystems, it is important to highlight the social role of MRF, which is anecdotally recognized as considerable, however, was not yet subject of research. MRF is an outdoor activity that brings physical and psychological benefits, which is also positively associated with seafood intake, considered as healthy food (Pita et al 2022). Also, MRF activity may have relevant economic implications for public health systems, especially in countries such as Portugal and Spain with aging populations (Pita et al., 2022). Taking in consideration this frame, the challenge for the governance is to reach a balance that allows the population to practice MRF without compromising the stocks that are already in great pressure (Torres et al., 2022; González 2008; Friedlander et al., 2017). However, to manage these activities will be needed to implement systematic data collection programs that will allow expert bodies to evaluate the level of catch share (with commercial fishing) and exploitation of fish stocks. Despite MRF being regulated in these archipelagos with licenses, bag limits, size limits; these regulations are usually based on top-down management systems using precautionary measures. Moreover, the existing MPAs are few or still considered as paper Parks. A revision of these networks are needed, coupled with the implementation of co-management systems with MRF sector in order to participate in solutions for the best management actions and to increase the law enforcement (Veiga et al., 2013; Abecassis et al., 2015). Currently MRF data collection is a requirement within Data Collection Framework, in particular, in Azores a off-site survey has been put in place, but without a complementary onsite survey which implicate that the estimates are not yet robust (PNRD, 2022; DCF Work Plans, 2023). Madeira in recent years have been raising the effort in MRF research with several onsite surveys (Graça, 2009; Martínez-Escauriaza, 2020a, 2020b, 2021a, 2021b), publishing a new App for data collection and currently within DCF-Madeira Work Plan have been working with sportfishing tournaments, which data can be helpful in long term to detect differences in catch rates, lengths, and catch composition (DCF Work Plans, 2023). Canarias is embedded in a DCF national off-site survey level (Dedeu et al., 2019; Gordoa et al., 2019; DCF Work Plans, 2023), but without regional complementary surveys that are currently being implemented by local research groups. For the future, the cooperation between national level surveys and the local research groups could implicate a more robust data collection process (DCF Work Plans, 2023).

In this chapter an x-ray was made for the MRF “sector” and several gaps of knowledge and challenges were highlighted in the three archipelagos. Even so, this project tried to contribute to the increase of knowledge on MRF in Macaronesia, by implementing Pilot Studies as traditional methods - wire-phone surveys, or by improving data collection by developing a new system based on a web and mobile application, which will give Macaronesian research groups an advantage in obtaining panels of recreational fishermen. This added value could allow, through probabilistic sampling schemes, to obtain catch and fishing effort estimates that can be integrated in the models of stocks assessment and to obtain knowledge of the spatial

distribution of MRF, and thus assist in the knowledge of MSP policies, while also help the regions to fulfill the obligations within Common Fisheries Policies and MSFD.

4. References

Abecasis, R. C., Afonso, P., Colaço, A., Longnecker, N., Clifton, J., Schmidt, L., & Santos, R. S. (2015). Marine conservation in the Azores: evaluating marine protected area development in a remote island context. *Frontiers in Marine Science*, *2*, 104.

Almada, F., Francisco, S. M., Lima, C. S., FitzGerald, R., Mirimin, L., Villegas-Ríos, D., ... & Robalo, J. I. (2017). Historical gene flow constraints in a northeastern Atlantic fish: phylogeography of the ballan wrasse Labrus bergylta across its distribution range. *Royal Society open science*, *4*(2), 160773.

Bilbao-Sieyro, A., Pérez-González, Y., Lobo Rodrigo, A., Rodríguez Bahamonde, R., Couce Montero, L. , Jiménez Alvarado, D., Castro Hernández J.J. . Los elasmobranquios y las competencias espaciales pesqueras en Canarias. Okeanos. Nº5 julio-diciembre. 2017. 8-11 pp.

Bilbao-Sieyro, A., Pérez-González, Y., Martín-Sosa, P., Castro-Hernández, J.J., Jiménez-Alvarado, D., Pascual-Fernández, J.J. Marine Recreational Fisheries in the Canary Islands: State of Knowledge, Preliminary Results. *Biol. Life Sci. Forum* 2022, *13*, 7. https://doi.org/10.3390/blsf2022013007

Diogo, H. M. C. (2007). *Contribution to the characterisation of recreational fishing activities on the islands of Faial and Pico, Azores* (MSc Thesis, Departamento de Oceanografia e Pescas, Universidade dos Açores, Horta, Portugal).

Diogo, H. M. C., & Pereira, J. G. (2013). Impact evaluation of spear fishing on fish communities in an urban area of São Miguel Island (Azores Archipelago). *Fisheries Management and Ecology*, *20*(6), 473-483.

Diogo, H., & Pereira, J. G. (2013). Recreational boat fishing pressure on fish communities of the shelf and shelf break of Faial and Pico Islands (Azores Archipelago): implications for coastal resource management. *Acta Ichthyologica Et Piscatoria*, *43*(4), 267-276.

Diogo, H., & Pereira, J. G. (2014). Assessing the potential biological implications of recreational inshore fisheries on sub-tidal fish communities of Azores (north-east Atlantic Ocean) using catch and effort data. *Journal of Fish Biology*, *84*(4), 952-970.

Diogo, H., Pereira, J. G., & Schmiing, M. (2016). Catch me if you can: Non-compliance of limpet protection in the Azores. *Marine Policy*, *63*, 92-99.

Diogo, H., Pereira, J. G., & Schmiing, M. (2017). Experience counts: Integrating spearfishers' skills and knowledge in the evaluation of biological and ecological impacts. *Fisheries Management and Ecology*, *24*(2), 95-102.

Diogo, H., Veiga, P., Pita, C., Sousa, A., Lima, D., Pereira, J. G., ... & Rangel, M. (2020). Marine recreational fishing in Portugal: Current knowledge, challenges, and future perspectives. *Reviews in Fisheries Science & Aquaculture*, *28*(4), 536-560.

Domingues, V. S., Santos, R. S., Brito, A., Alexandrou, M., & Almada, V. C. (2007). Mitochondrial and nuclear markers reveal isolation by distance and effects of Pleistocene glaciations in the northeastern Atlantic and Mediterranean populations of the white seabream

(Diplodus sargus, L.). *Journal of Experimental Marine Biology and Ecology*, *346*(1-2), 102-113.

Fauconnet, L., Pham, C. K., Canha, A., Afonso, P., Diogo, H., Machete, M., ... & Morato, T. (2019). An overview of fisheries discards in the Azores. *Fisheries Research*, *209*, 230-241.

Friedlander AM, Ballesteros E, Clemente S, Gonçalves EJ, Estep A, Rose P, et al. (2017) Contrasts in the marine ecosystem of two Macaronesian islands: A comparison between the remote Selvagens Reserve and Madeira Island. PLoS ONE 12(11):e0187935. https://doi.org/10.1371/journal.pone.0187935

González, J. A. (2008). Memoria científico-técnica final sobre el estado de los recursos pesqueros de Canarias (REPESCAN). Telde.

Gordoa, A., Dedeu, A. L., & Boada, J. (2019). Recreational fishing in Spain: First national estimates of fisher population size, fishing activity and fisher social profile. Fisheries Research, 211(October 2018), 1–12. https://doi.org/10.1016/j.fishres.2018.10.026

Graça, M.J.D. Caracterização da Pesca Grossa na Ilha da Madeira. Master Thesis, Universidade do Algarve, Faro, Portugal, 2009.

Harmelin-Vivien, M. L., Harmelin, J. G., & Almeida, A. J. (2001). Structure of fish assemblages on coastal rocky shores of the Azores.

Hyder, K., Weltersbach, M. S., Armstrong, M., Ferter, K., Townhill, B., Ahvonen, A., ... & Strehlow, H. V. (2018). Recreational sea fishing in Europe in a global context—participation rates, fishing effort, expenditure, and implications for monitoring and assessment. *Fish and Fisheries*, *19*(2), 225-243.

Jiménez Alvarado, D. L. (2015). La pesca recreativa en Canarias: aspectos principales y evolución. Tesis Doctoral. Departamento de Biología. Universidad de Las Palmas de Gran Canaria.

Jiménez-Alvarado, D., Guerra-Marrero, A., Sarmiento-Lezcano, A., Meyers, E. K. M., & Castro, J. J. (2020). First assessment of the spearfishing impact in the Canary Islands. Regional Studies in Marine Science, 38, 101385. https://doi.org/10.1016/j.rsma.2020.101385

Martín-Sosa, P. (2019). Spearfishing in The Canary Islands: is the devil as black as it seems to be? Scientia Insularum. Revista de Ciencias Naturales En Islas, 2, 9–36. https://doi.org/10.25145/j.si.2018.01.01

Martínez-Escauriaza, R., Hermida, M., Villasante, S., Gouveia, L., Gouveia, N., & Pita, P. (2020a). Importance of recreational shore angling in the archipelago of Madeira, Portugal (northeast Atlantic). Scientia Marina, 84(4), 331-341.

Martínez-Escauriaza, R., Vieira, C., Gouveia, L., Gouveia, N., Hermida, M., & Trenkel, V. (2020b). Characterization and evolution of spearfishing in Madeira archipelago, Eastern Atlantic. Aquat. Living Resour, 33, 15.

Martínez-Escauriaza, R., Gizzi, F., Gouveia, L., Gouveia, N., & Hermida, M. (2021a). Small-scale fisheries in Madeira: recreational vs artisanal fisheries. Scientia Marina, 85(4), 257-270.

Martinez-Escauriaza, R., Pita, P., de Gouveia, M. L. F., Gouveia, N. M. A., Teixeira, E., de Freitas, M., & Hermida, M. (2021b). Analysis of big game fishing catches of blue marlin (Makaira nigricans) in the Madeira Archipelago (Eastern Atlantic) and factors that affect its presence. Sustainability, 13(16), 8975.

Martins, G. M., Jenkins, S. R., Hawkins, S. J., Neto, A. I., Medeiros, A. R., & Thompson, R. C. (2011). Illegal harvesting affects the success of fishing closure areas. *Journal of the Marine Biological Association of the United Kingdom*, *91*(4), 929-937.

MAPyA. (2006). Análisis y ordenación de la pesca de recreo en el ámbito de las Islas Canarias. Retrieved from https://www.mapa.gob.es/es/pesca/temas/pesca-deportiva-recreo/Analisis_tcm30-77485.pdf

Pascual Fernández, J. J., Chinea Mederos, I., Agustín Santana, T., Rodríguez, M.-S., Moreira Gregori, P., & Rodríguez Darias, A. J. (2012). Análisis de los resultados finales y elaboración de conclusiones sobre los resultados de las encuestas presenciales y de la encuesta telefónica sobre pesca recreativa a la población de la isla de Tenerife.

Pascual-Fernández, J. J., & Batista-Medina, J. A. (2021). Análisis de la producción científica sobre la pesca recreativa submarina.

Pérez-González., Y., A. Bilbao-Sieyro, D. Jiménez-Alvarado & J.J. Castro Hernández. Marine recreational fishery in the Canary Islands: a legislative historical journey. International Symposium on Artisanal and Recreational Fishing in Islands Systems: Assessment, Vulnerabilities and Management (ISARFIS) Las Palmas de Gran Canaria (Spain), 6-8thJuly 2022. p 32.

Pham, C. K., Canha, A., Diogo, H., Pereira, J. G., Prieto, R., & Morato, T. (2013). Total marine fishery catch for the Azores (1950–2010). *ICES Journal of Marine Science*, *70*(3), 564-577.

Pita, P., Gribble, M. O., Antelo, M., Ainsworth, G., Hyder, K., van den Bosch, M., & Villasante, S. (2022). Recreational fishing, health and well-being: findings from a cross-sectional survey. *Ecosystems and People*, *18*(1), 530-546.

Ressurreição, A., & Giacomello, E. (2013). Quantifying the direct use value of Condor seamount. *Deep Sea Research Part II: Topical Studies in Oceanography*, *98*, 209-217.

Ressurreição, A., Cardigos, F., Giacomello, E., Leite, N., Oliveira, F., Kaiser, M. J., ... & Santos, R. S. (2022). The value of marine ecotourism for an European outermost region. *Ocean & Coastal Management*, *222*, 106129.

Santos, R. S., Hawkins, S., Monteiro, L. R., Alves, M., & Isidro, E. J. (1995). Marine research, resources and conservation in the Azores. *Aquatic Conservation: marine and freshwater ecosystems*, *5*(4), 311-354.

Strehlow, H. V., Schultz, N., Zimmermann, C., & Hammer, C. (2012). Cod catches taken by the German recreational fishery in the western Baltic Sea, 2005–2010: implications for stock assessment and management. *ICES Journal of Marine Science*, *69*(10), 1769-1780.

Torres, P., i Figueras, D. M., Diogo, H., & Afonso, P. (2022). Risk assessment of coastal fisheries in the Azores (north-eastern Atlantic). *Fisheries Research*, *246*, 106156.

Veiga, P., Pita, C., Leite, L., Ribeiro, J., Ditton, R. B., Gonçalves, J. M. S., & Erzini, K. (2013). From a traditionally open access fishery to modern restrictions: Portuguese anglers' perceptions about newly implemented recreational fishing regulations. *Marine policy*, *40*, 53-63.

Vieira, J. C., & Antunes, M. C. (2017). Touristic big-game fishing in Saint Michael Island (Azores) Evaluating anglers' profiles, perceptions about the destination and business revenues. *Tourism Economics*, *23*(6), 1362-1368.

Online references:

PNRD, 2022. Sampling Design of Azorean Recreational Fishing Data Collection (ICES Xa) [accessed 7 december 2023]. https://www.dgrm.mm.gov.pt/documents/20143/124668/17_Azores_ICES_RecreationalSamp..pdf/7863f6bf-23ee-e6de-0425-d68403671742

DGRM. 2016. Análise dos resultados do inquérito sobre a pesca lúdica 2015 Lisboa, Portugal. [accessed 12 June 2018]. https://acessoreservado.dgrm.mm.gov.pt/xportal/xmain?xpid=dgrm&selectedmenu=1469973&xpgid=genericPageV2&conteudoDetalhe_v2=3435302.

DCF Work Plans, 2023. Work Plans 2023 - 2027 approved by the European Commission. https://dcf.ec.europa.eu/wps-and-ars/work-plans_en. [accessed 11 december 2023].