JOÃO CARLOS OLIVEIRA PONTES

RECREATIONAL SHORE ANGLING IN THE SOUTH AND SOUTHWEST COAST OF MAINLAND PORTUGAL

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Recreational shore angling in the south and southwest coast of mainland Portugal

Declaração de autoria de trabalho

Declaro ser o autor deste trabalho, que é original e inédito. Autores e trabalhos consultados estão devidamente citados no texto e constam da listagem de referências incluída.

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ABSTRACT

All fishing-related activities impact exploited ecosystems, which is underestimated by fisheries statistics that rely only on commercial fisheries information. Collection of recreational fishing data is mandatory under the EU Data Collection Framework (DCF, EC 199/2008), and will provide reliable, enabling the integration of catch estimates from commercial and recreational fisheries for stock assessments. Nevertheless, and despite the obligation of data collection on recreational fisheries, there is still the lack of up-to-date scientific information to support management. This studied aimed to characterize shore-based marine recreational fishing (MRF) in the south and southwest coast of Portugal (from Setúbal to V.R.S. António), promoting a systematic collection of data to ensure a solid scientific basis to implement adequate measures adjusted to the reality.

Data collection was undertaken trough roving creel surveys using face-to-face questionnaires (in a digital Android system). The methodology implied a comprehensive sampling strategy in which the coastline was divided into 5 km sections considering the two Territorial Units for Statistical Purposes (NUTS II) in the study. A total of 403 shore angers were approached, resulting in 349 valid questionnaires (response rate of 87%). The studied population is constituted mainly by male individuals, of a wide range of age distribution, more common between 41 and 70 years old, with a high experience in the recreational activity. Sportfishing is not very popular among the surveyed anglers. The generically low educational level and the low monthly incomes are common for both regions of study, being most of the angler's resident in the nearby region where the interview was developed and were fishing either alone or with their families/friends in equal proportion. The activity has his fishing effort peak during the Spring and Summer months, despite most of the surveyed anglers referred fishing during the entire year. The great majority of the anglers referred to know and to be reasonably satisfied with the current legislation and management measures. Nevertheless, a steady decay in the abundance of marine resources has been noticed and pollution and commercial fishing were pointed out as the main causes.

A total of 856 individuals were caught, from 33 different species, with a total weight of 274.76 kg. The most important targeted species were the white seabream

(*Diplodus sargus*) both in number and weight (N=365; W=86.07 kg), followed by the gilthead seabream (*Sparus aurata)* with 97 individuals caught that weighed72.93 kg and the spotted seabass (*Dicentrarchus punctatus*) with 106 individuals caught weighing 22.37 kg. The Sparidae family (*Diplodus* spp.) importance must be emphasized corresponding to 65.62% of the total catch. An annual harvest of 1992.48 tons of fish was estimated for shore-based marine recreational anglers of the Alentejo and the Algarve during 2018. The sargo breams (*Diplodus* spp.*)* are the most relevant catch species/group of species with 463.81tons, followed by the European seabass (*Dicentrarchus labrax*) with an estimated annual total catch of 116.40 tons, and the spotted seabass (*Dicentrarchus punctatus*) with 82.88 tons of fish. The economic revenue of the shore-based activity in the regions of Alentejo and Algarve, only regarding the direct expenses, was estimated to be 1.67 million euros.

To ensure adequate management of the aquatic resources, it is crucial that studies like this continue being carried on a periodical basis, providing information that can serve as a baseline to support the current management measures.

Keywords: Marine recreational Fisheries (MRF); shore-based angling; roving creel surveys; data collection; effort; catch estimates; management

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1. INTRODUCTION

Humans have always felt the need to create escapes from the daily routine (Wilde & Ditton, 1994). This urge led to the proliferation of many recreational activities, including fishing.

In fact, recreational fishing is one of the most popular leisure activities in the world, involving millions of enthusiasts, and having important social and economic impacts such as jobs and important economic revenues (Cisneros-Montemayor & Sumaila, 2010; Parkkila *et al.*, 2010; Lynch *et al.*, 2016; Griffiths *et al.*, 2017; Hyder *et al.*, 2017; Pita *et al.*, 2018; Pita & Villasante, 2019).

This activity is practiced mainly for sport, if included in a competition or tournament, and leisure, if done for recreational purposes only (DGRM, 2019b). For the great majority of recreational fisheries, there are no social barriers, which helps to explain the rising number of participants (Sousa, 2000). Around the world, several differences in the cultural impact of recreational fishing can be observed, such as the importance for the communities, the techniques and the different gears allowed (Ditton, 2008).

1.1 DEFINITION OF RECREATONAL FISIHNG

"There's a fine line between fishing and just standing on the shore like an idiot"

Steven Wright

Recreational fishing is defined as fishing of aquatic animals (mainly fish) that do not constitute the individual's primary resource to meet basic nutritional needs and are not sold or otherwise traded on export, to domestic or black markets (FAO, 2012).

Not all non-commercial fishing can be described as purely recreational. In Europe there are few examples of subsistence (non-commercial, but also not recreational)

fisheries. Some definitions of recreational fishing specify the type of gear and methods for the practice of recreational fishing, while other focus on the motivations and drives of the activity (Pawson *et al.*, 2007).

In Portugal, the definition of fishing for leisure was first established in 2000, with the Decree of Law 246/2000. This law characterizes recreational fishing as the capture of marine species, vegetal or animal, from shore, boat or underwater, without commercial purposes. The final purpose of the catch is what differentiates recreational from commercial fishing (it is forbidden to sell recreational fishing catches).

1.2. MARINE RECREATIONAL FISHING

Marine Recreational fishing (MRF), the practice of recreational fishing in a marine environment, is divided in two types: i) Recreational fishing, where the only purpose is to fish for leisure; ii) Sport fishing, where fishing is related to fishing tournaments, organized by sportfishing clubs or federations.

In MRF it is possible to practice three different fishing modes: a) shore-based angling; b) boat-angling; c) spearfishing. Shore-based angling includes all types of fishing that can be performed from shore, including surfcasting, spinning, float fishing and handlines fishing. Boat-based angling is similar to the previous, but it is practiced on board. This last mode allows access to different fishing grounds and different types of fishing. By boat it is possible to practice bottom-fishing, spinning, trolling, big-game fishing, jigging, float-fishing and handlines fishing. Spearfishing is performed underwater without artificial breathing support (i.e. snorkelling) (DGRM, 2019b).

Although sportfishing is in fact very similar to recreational fishing, the activity is conducted within organized competitive events (DGRM, 2019b). It can be performed from shore and from boat, considering all types of fishing.

1.2.1. GLOBAL OVERVIEW OF MARINE RECREATIONAL FISHERIES

Recreational fisheries are becoming increasingly diversified and efficient, due to the new fishing technologies available (e.g. GPS) and due to the widespread and easy access to specialized (e.g. internet forums) information (McPhee *et al.*, 2002; Griffiths, 2012). Within the fishing community, information sharing is huge, and there is so much to know when it comes to fishing that the conversations and discussions are endless.

Globally, marine and freshwater fish stocks are facing several threats and commercial fishing is traditionally blamed for this (Erzini *et al.*, 2008; Veiga *et al.*, 2010; Hyder *et al.*, 2017; Pita *et al.*, 2018; Pita & Villasante, 2019). Nevertheless, both recreational and commercial fishing have the potential of negatively affecting fish stocks (Hyder *et al.*, 2017; Pita *et al.*, 2018;). In fact, if not properly regulated and practiced, recreational fishing can have many of the same negative effects as commercial fishing. These includes reduction of the size of fish stocks, decreasing mean size, diminishing of the genetic pool, promoting ecosystem level changes and habitat degradation (Cooke & Gowx, 2006; Allen *et al.*, 2013; Lloret *et al.*, 2016).

Fishery scientists and managers have been struggling to expose the implications of recreational fishing in coastal environments for many years, particularly in marine fisheries, where recreational catches have traditionally been considered insignificant when compared to commercial catches (Bishop & Samples, 1980).

The number of recreational fishers varies among countries and can be difficult to estimate accurately (Erzini *et al*., 2008; Veiga *et al.*, 2010; 2013; Hyder *et al*., 2017; Pita *et al.*, 2018). Overall, about 10% of the worldwide developed countries' population is estimated to engage in this activity (Hyder *et al.*, 2017) but, in the Scandinavian countries, these figures appear to be much higher: Denmark: 12,5%, Iceland: 31,5%, Finland: 40%, Norway: 50% (Toivonen, 2002). In Europe, it is estimated that more than 25 million people are recreational fishers, with both direct and indirect expenditures of about 8 - 10 thousand million euros annually (Hyder *et al.*, 2017).

With the pressure on fish stocks increasing, there is evidence that management based solely on data from commercial fishing is insufficient to prevent over-exploitation (Veiga *et al.*, 2010; Hyder *et al.*, 2017). To allow for proper research and sustainable management of the fisheries sector, data relative to total catches as well as fishing effort

are required (Rangel, 2003; Coleman *et al.*, 2004). The integration of recreational fishing data is essential to provide reliable catch estimates and improve stock assessments studies (Zischke *et al.*, 2012; Veiga *et al*., 2013; Hyder *et al.*, 2017; Pita *et al.*, 2018;).

Nowadays, and mostly because of EU pressures, recreational fishing is recognized as an important part of the overfishing and of fisheries management, as strongly emphasized by the new Common Fisheries Policy (CFP) and by the Marine Strategy Framework Directive (MSFD). Nevertheless, and even though recreational fisheries data collection is a requirement under the EU Data Collection Framework (DCF, EC 199/2008), there is a lack of scientific knowledge regarding this activity in most of EU countries, especially in the south (Pita *et al.*, 2018).

1.3 MANAGEMENT OF RECREATIONAL FISHING

All fishing related activities have a certain impact on the ecosystem explored, with a variety of direct and indirect effects in food webs, making it extremely difficult to access the exact extension of that impact and the time necessary to recover (Rangel 2003; Diogo, 2003; Diogo, 2007). The blind confidence in the inaccurate notion that marine resources are inexhaustible due to human action has been weakened in recent years (Watson *et al.*, 2015).

Worldwide catches continue to decline (Watson & Pauly, 2001; Kelleher, 2005; FAO, 2016), the majority of the world's fishing grounds are commercially overexploited (Worm *et al.*, 2009; Costello *et al.*, 2016) and the European Union (EU) seems to keep fishing mortality rates above scientific recommendations (Carpenter et al., 2016; Borges, 2018). There is an urgent need to understand the sustainability of these activities and to ensure a correct assessment and monitoring of the target species, the environment, and the recreational activity that exploits those species (Monkman *et al.*, 2018).

There is no doubt that recreational fisheries potentiate the pressure on marine ecosystems (Cooke & Cowx, 2006; Lewin *et al.*, 2006), especially on coastal areas, which are key ecosystems particularly impacted by humans (Lotze *et al.*, 2006; Pita *et al.*, 2018). It is inevitable that any recreational activity will result in species removal, since the

release rates are rarely 100% (Ferter *et al.*, 2013) and the post release mortality in some species is unavoidable (Barthomew & Bohnsack, 2005; Lewin *et al.*, 2018).

The underestimation of the potential impacts of leisure fishing in fisheries research, and the focus on commercial fishing is often explained by several factors. First, the dimension of angling is often underestimated, since researchers' assumptions are based on the idea that a single angler has substantially lower impact on fish stocks when comparing to a commercial fisher operating, such as a large trawler for example (Cooke & Cowx, 2006). This perspective overlooks the cumulative impacts that millions of recreational fishers can induce. The second reason is the fact that recreational fishing, in contrast with commercial fishing, is practiced for a multitude of non-consumptive purposes, where catching fish for consumption is only one of many drivers (Policansky, 2002). However, it does not take in consideration that catching fish is not only one of the drivers, but it is the most important aspect determining the main "product" of angling experience, satisfaction (Lewin *et al.*, 2006).

In most of the developed and developing countries there is a significant lack of information regarding recreational catches (Erzini *et al.*, 2008; Kieran *et al.*, 2017). Although recreational fisheries have been included in EU Data collection since its beginning, they have not been monitored with the same rigor as commercial fisheries. Additionally, recreational anglers are not obliged to register their catches, and estimates for recreational fisheries are difficult and expensive to obtain and require different methodological procedures when compared to the commercial sector (Zarauz *et al.*, 2015).

Nevertheless, some developed countries already have important statistic databases regarding the recreational fishing sector, through large/local scale or regular/intermittent survey programs (Hyder *et al.*, 2018), such as the United States (Essig & Holliday, 1991; Harper *et al.*, 2000; Lockwood, 2000; Coleman *et al.*, 2004; Wilberg, 2009; Larkin *et al.*, 2010; NOAA, 2017), Australia (West & Gordon, 1994; Malseed & Sumner, 2001; Sumner *et al.*, 2002; Henry & Lyle, 2003; Steffe & Chapman, 2003; Sumner *et al.*, 2008; Smallwood *et al.*, 2011), Canada (Cooke *et al.*, 2000; Duffy & Mosindy, 2001; Lester *et al.*, 2003; Mosindy & Duffy, 2007; Dempson *et al.*, 2012) and South Africa (Clarke & Buxton, 1989; Brouwer *et al.*, 1997; Fennessy *et al.*, 2003; Beckley *et al.*, 2008).

In Europe, only a few pilot studies have been done in the last 20 years, such as the ones conducted in Belgium (Verleve, *et al.,* 2019), France (Herfaut *et al.,* 2013; Levrel *et al.,* 2014; Bellanger & Levrel, 2017), Spain (Pita & Freire, 2014; Morales-Nin *et al.,* 2015; Zarautz *et al.,* 2015; Pita *et al.,* 2018; Gordoa *et al* ., 2019; Pita & Villasante, 2019), Portugal (Diogo, 2003; Rangel, 2003; Castro, 2004; Cunha *et al.,* 2005; Lima, 2006; Diogo, 2007; Guerreiro *et al*., 2007; Dias *et al*., 2008; Marcelino, 2010; Veiga *et al*., 2010; 2011a; 2011b; 2013; Costa, 2012; Aleixo, 2013; Carvalho *et al.,* 2013; Diogo & Pereira, 2013; DGRM, 2016), England (Armstrong *et al.,* 2013; Hyder *et al.,* 2014; 2018), Nederlands (van der Hammen, de Graaf, & Lyle, 2016; Denmark (Sparrevohn & Storr-Paulsen, 2012), Germany (Strehlow *et al*., 2012) and Norway (Vølstad *et al.,* 2011; Ferter *et al.,* 2013) but most of them lack continuity or monitoring.

In some parts of the World, data on MRF removals are included in stock assessments, and separate quota allocations are made for commercial and recreational fisheries for certain stocks (Ryan *et al.,* 2016). Nevertheless, in the EU, the consistent lack of reliable estimates of recreational fishing catches has resulted in MRF being excluded from important stock assessments and allocations for many years (Pawson, Tingley & Paddal, 2007). Recently, there has been a growing perception on the importance of recreational fishing because they share important fish stocks with commercial fisheries (Hyder *et al.,* 2017; Pita *et al.,* 2018). The lack of reliable estimates of recreational catches has resulted in MRF being excluded from stock assessment and allocations over the years (Pawson, Tingley & Paddal, 2007). This may create a potentially problematic situation in some widely targeted species such as Atlantic cod (*Gadus morhua*) and European seabass (*Dicentrarchus labrax)* because it will undermine the ability to manage fish stock to maximum sustainable yield (Hyder *et al.,* 2014).

Recognizing the urgent need for data to support fisheries management with MRF, and following the specific concerns of the new Common Fisheries Policy (EU, 2013), and of the Marine Strategy Framework Directive (MSFD), legal mandatory requirements were introduced in the European Data Collection Framework (DCF) for Member States to provide specified MRF data, including estimates of recreational catches and releases of some selected species (DCF, EC 199/2008). Nevertheless, member states are currently only obliged to provide data on recreational catch and releases of species under the regulation of total allowable catches (TAC), or under recovery plans (Commission Implementing Decision (EU) 2016/1251).

This is a major improvement and an important aspect that emphasizes the importance of having a better knowledge of the biological, ecological and socioeconomic aspects of this activity. Taking into consideration the importance of the activity to the economy, data on MRF can contribute to the EU "Blue Growth" initiative, which provides policy makers at a European, national, regional and local management levels, with comprehensive, robust and consistent analysis of possible future policy options to support smart, sustainable and inclusive growth from oceans, seas and coasts (European commission, 2012).

1.3.1 METHODOLOGY FOR SURVEYING MARINE RECREATIONAL FISHING

Fisheries management requires consistent, timely data and analysis of the status and dynamics of fish populations (not to mention systematic monitoring). However, retrieving solid and valuable information from the recreational fisheries sector is difficult, mainly because it is not a formal sector of the economy, which implies lack of systematic data (Erzini *et al*., 2008; Hyder *et al.*, 2014). The main difficulties in recreational fisheries surveys are the large number of practitioners, and the fact that they do not land their catches at specific points (Zarauz *et al.*, 2015).

It must be emphasised that recreational fishing surveys are the only tool to assist managers with data regarding this activity which, apart from the commercial activity, are an important component of the overall fishing activity (Veiga *et al.*, 2013).

Survey methods associated with the fisheries sector consist in observing a portion of the fishery, determine the catch and effort in that portion, and then expand the observations to the whole fishery by dividing the fraction of the fishery observed (Pollock *et al.*, 1997).

To survey marine recreational fisheries, a large variety of survey methodologies is available in the literature. The different approaches have their own strengths and weaknesses and must be selected according to the scale and objectives of each survey (Pollock *et al.*, 1994). The most common, accepted and reliable method to collect data

regarding recreational fishing are the surveys campaigns (Mackenzie, 1991; Gartside, Harrison & Ryan, 1999).

MRF surveys have main two components: onsite, where anglers are directly approached and interviewed during or immediately after fishing, at or near the location where they engaged the activity (i.e. aerial, access point and roving surveys) and off-site, non-presential, where anglers are surveyed after the fishing event (e.g. phone, mail or fishing diaries) (Sullivan *et al.*, 2006; Marcelino, 2010;Veiga *et al.*, 2010).

Off-site methods are more cost-effective and accessible, being the most used to collect information on recreational fisheries effort, catch and harvest in many EU member states (ICES, 2010). However, they are known to be associated with several biases, of which coverage, non-response and recall biases are the most reported (Lyle *et al.*, 2002; Zarauz *et al.*, 2015).

Regarding the experimental design, the preferentially used are: i) access point surveys, based on complete sampling of the catches by approaching anglers immediately after the fishing event; ii) roving creel survey, mostly based on incomplete sampling of the catches, by approaching anglers while they are still fishing (Pollock *et al.*,1994; 1997).

Access point survey is used to estimate the total fishing effort and the catch *per* unit of fishing effort (catch rate), where the interviewer is fixed in a permanent and previously determined location. The anglers are only accounted for and surveyed when they are leaving the fishing ground, providing the total fishing effort and total catch *per* fisher *per* unit of fishing effort (i.e. hours of fishing) (Pollock *et al.*, 1997).

From these surveys it is possible to obtain diverse information in terms of catches (e.g. fishing mortality, trends in catches, most targeted species), fishing effort (and its spatial and temporal distribution), economic data (expenditures) and social dimension data (e.g. fishers' characteristics, perceptions and motivations) (Veiga *et al.*, 2013; Pollock *et al.*, 1994).

1.4. MARINE RECREATIONAL FISHING IN PORTUGAL

Coastal and maritime activities have traditionally been of major importance for the national economy and for the historical, social and cultural identity of Portugal.

(Leitão *et al.,* 2014). The country has long relied on fishing as a major source of subsistence and many coastal communities depend almost exclusively on fisheries and related activities (Gonçalves *et al.,* 2006). Marine recreational fishing has always been considered a popular activity in Portugal, and it is estimated, according to the official licensing statistics that it involves between 170 to 200 thousand participants a year (Hyder *et al.,* 2018; DGRM, 2019a).

For legal and statistic purposes, in the Portuguese legal framework, recreational activity is divided in three separate, yet very similar, activities: a) recreational fishing, where the only purpose is to fish for leisure or recreation; b) sportfishing, where the fishing is related to fishing competitions, organized by clubs and sport fishing federations; c) angling tourism or charter boat fishing, when the exercise of recreational fishing is conducted under the terms of the Maritime-Touristic activities (DGRM, 2019b).

The first regulatory framework was in 1957, from Decreto-lei 41444/1957, nevertheless marine recreational fishing was an open access activity until 2005, without restrictions of any kind (Rangel & Erzini 2007; Veiga *et al*., 2013).

Since 2006, the exercise of fishing for recreational purposes, apart from harvesting, is subjected to mandatory licensing (Portaria n. º 868/2006). Licenses can have daily, monthly or annual periods and four different modes available: i) Shore angling: exclusively for the practiced from land (shore) or from rock formations; ii) boat-angling: practiced onboard a fishing boat (the validity of this licence allows the anglers also to fish from land (shore) or in rock formation) iii) spearfishing: exclusively for the practice of underwater fishing and iv) general: a complete license that englobes all of the above modes. According to the official statistics, in 2017, 203,177 MRF licenses were issued. The most important mode licenced was shore angling (55.18%), followed by boat angling (38.08%), spearfishing (4.90%) and general (1.84%) (DGRM, 2019a).

From 2007 to 2013, fishing licenses could be emitted on a regional level or on a national level, with the periodicity of one day, one month, one year or triannual. Since 2014, the licensing system only allows to emit a fishing license on a national level. When it comes to manage marine recreational fisheries, or any other type of fisheries, it is crucial to know what regions are most impacted by the activity. This could be easily performed in the previous licensing system, only by analysing the General Directorate of Marine Resources, Safety and Maritime Services (DGRM) online platform. Nevertheless, with

the new licensing system it is literally impossible to know how the fishing licenses are distributed and where are the most concentrated areas of anglers.

1.4.1 MARINE RECREATIONAL FISHING STUDIES

Recreational fishing has been shown to have an important component of fishing mortality across the globe (Post *et al.*, 2002; Arlinghaus & Mehner, 2006; Ferter *et al.*, 2013; Pita *et al.*, 2018). However, data for assessment and management purposes is generally lacking (Rangel, 2003; Rangel & Erzini, 2007; Veiga *et al.*, 2013; Pita *et al.*, 2018).

Research on marine recreational fishing in Portugal is relatively recent, few studies on marine recreational fishing have been conducted and only five of these were large-scale studies, two were on shore-based angling (Rangel, 2003; Veiga *et al.*, 2010), only one was on boat-angling (Lima, 2006), one on spearfishing (Assis *et al.*, 2018) and one on all fishing modes (DGRM, 2016). Most of these studies were based on on-site surveys via roving creel or access point surveys (Table 1). However, two studies (Castro, 2004; Veiga *et al.*, 2010) applied a complementary aerial roving creel surveys and another used a phone survey for recreational boats (Lima, 2006).

Rangel (2003), carried out roving creel surveys in the North of Portugal to examine recreational shore-based angling and describe several important aspects of the activity (such as catch, effort, target species), and the socioeconomic characteristics of anglers. Most recently, Erzini *et al.* (2008) conducted a similar, yet more complete, study in southern continental Portugal. The author performed roving creel and aerial surveys, and obtained the recreational shore-based angling catch, harvest and effort estimates. Due to the quantity and quality obtained data he was able to carry out an even broader approach concerning the human dimension of this activity. As so, in addition to the catch and effort study, he evaluated the compliance of fishers regarding legislation and studied the trends in sportfishing competitions for the study area.

Lima (2006), conducted phone-surveys complemented with access point surveys to characterize boat angling in the North of Portugal. By combining these two survey

methods, he aimed to help filling the gap and contribute with reliable data for an adequate fisheries management.

Assis *et al.* (2018), conducted web-based surveys in order to characterize spearfishing in mainland Portugal. The nationwide web-based survey provided baseline information on practitioner's socioeconomic characteristics, fishing effort, fishing locations, the reasons that lead them to engage in the activity, and perceptions towards current management measures.

Most recently, the General Directorate of Marine Resources, Safety and Maritime Services carried out a web-based survey that aimed to characterize the marine recreational fishing sector, regarding all fishing modes (DGRM, 2016). A text-message was sent individually to all licensed fishers to inform them about the realization of this study and to encourage them to participate.

Table 1 – Compilation of the existing marine recreational fishing studies in Portugal, ordered by date. Location, objectives, survey period, survey type and reference of the studies.

Location	Objectives	Survey period	Survey type	Study
Alentejo	Evaluate the importance and impact of human exploration of marine resources	2 years	Aerial-roving creel	Castro, 2004
North/Centre Portugal (mainland)	Characterize marine recreational fishing in the North of Portugal	7 months	Access point	Rangel (2003); Rangel &Erzini 2007
Aveiro lagoon (Centre Portugal (mainland)	Characterize hand-harvesting in the Aveiro lagoon	1 year	Access point	Cunha *et al.*, 2005
São Miguel island (Azores)	Characterize spearfishing activity in the Azores in terms of temporal variability, catch compositon, and to assess the pressure on marine species	1 year	Access point	Diogo &Pereira, 2013
Faial and Pico islands (Azores)	Characterize marine recreational fishing in the Faial and Pico islands (Azores)	1 year	Roving creel	Diogo, 2007
Tagus estuary (Lisbon - mainland portugal	Characterize hand-harvesting in the Tagus estuary	1 year	Roving creel	Dias *et al*., 2008
North of Portugal (mainland)	Characterize boat-based angling in the North of Portugal	4 months	Phone -Access point	Lima, 2006
Alentejo and Algarve (mainland Portugal)	Characterize marine recreational fishing in the south and southwest region of Portugal	1 year	Aerial-roving creel	Veiga *et al*., 2010; 2011a; 2011b; 2013
Peniche (mainland Portugal)	Characterize marine recreational fishing in the Peniche peninsula	6 months	Roving creel	Marcelino, 2010
Portugal (mainland)	Characterize spearfishing in mainland Portugal	2 months	Web-based	Assis *et al*., 2018
Douro estuary (mainland Portugal)	To study the sustainability ot bait fishinf in esturine systems: Douro case study	1 year	Not defined	Carvalho *et al.*, 2013
Alentejo (mainland Portugal)	Characterize marine recreational fishing in Alentejo rocky shores -intensity, yield and protection effects.	7 months	Roving creel	Costa, 2012
Aveiro lagoon (mainland Portugal)	Characterize daytime marine recreational fishing and the bait fishing of the cacoon worm	1 year	Roving creel	Aleixo, 2013
Portugal (mainland)	To characterize marine recreational fishing in Portugal, using a web-based survey	6 months	Web-based	DGRM, 2016

Despite all the effort from previous studies to complement the existing gap in reliable scientific information regarding MRF, until 2018 there was no nationwide program to survey marine recreational fishing in Portugal.

Nevertheless, and because the EU mandatory agenda that obliges the member states to collect information on MRF (EU, 2001), the "PESCARDATA" project, a one-year pilot-project financed by the DGRM and conducted by the Centre of Marine Sciences of the University of Algarve (CCMAR) was undertaken during 2018.

The present study was developed within the PESCARDATA project, but refers only to the areas of Alentejo and Algarve, whereas the overall aim of the main project was to study several aspects of the MRF and sport fisheries in mainland Portugal. Data referring this study were not made public so far.

1.5 HUMAN DIMENSION OF RECREATIONAL FISHING

The first recreational fishing management studies where focused only on biological aspects such as catch and fishing effort (Aas & Ditton, 1998). However, since the mid-20th century, social scientists began describing fishers' characteristics, to help managers understand the social side of recreational fishing (Hunt *et al.*, 2013). The inclusion of the stakeholders in decision making under participatory processes is an imperative of the new Common Fisheries Policy (CFP), and it is important to have a characterization of the sector (Rangel *et al.*, 2019).

Managing fisheries is ultimately managing people's behaviour and introducing human dimensions in research results in an integrative social-ecological system (SES). For recreational fisheries, the SES is described with a conceptual model that consists in the interaction of two systems: the social system and the ecological (resource) system (Ostrom, 2009).

Fisheries scientists are trying to understand how recreational fisheries regulations (size limits, seasonal closures, bag limits) affect fishers. It is possible to evaluate angler's reactions to management measures from observation (ideally before and after the implementation, which highlights the importance of consistent monitoring of the

activity), or by applying qualitative and quantitative surveys, once they can be complemented with the inclusion of social and economic data. It is possible to collect human dimension information, such as angler attitudes, motivations, management preferences, expenditures and demographics.

In recreational fisheries, understanding fishers' motivations and satisfaction factors is crucial to shape the dynamics of a fishery (Fedler & Ditton, 1994) and thereby influence the level of participation and thus effort and catch (Grifffiths *et al.*, 2017).

Portugal has a current problem due to the implementation of seasonal closures in the Parque Natural do Sudoeste Alentejano e Costa Vicentina (PNSACV), where fishers do not agree with the management measures imposed because the closures are only applied to recreational fishing, whereas commercial and some recreational off-shore fishing can still be practiced during the closure periods (Portaria nº115-B/2011). Furthermore, the International Council for the Exploration of the Sea (ICES) is considering the recommendation of restrictions to the amount of catches of European seabass, *Dicentrarchus labrax*.

Considering the above, it is crucial to evaluate fishers' opinions and perspectives regarding MRF to allow for proper management (while promoting compliance) of these resources (Pita *et al.*,2018).

Although miscommunication problems have been identified as a potential source of conflict (Cargile *et al.*, 2006), the published literature only points out the scientist's point of view. Studying the perceptions, opinions and characteristics of the recreational fishers provides important data that can be used to model angler's behaviour and generate predictions of responses to policy scenarios (Johnston *et al.*, 2010; Fenichel *et al.*, 2013).

1.6 OBJECTIVES

The lack of scientific data contrasts with its importance, since fisheries scientists have repeatedly stated three major needs of recreational fisheries: obtain more accurate, detailed information of direct and indirect ecological and economic impacts; systematise and carefully evaluate the social impacts; implement adaptive management plans using an adaptative management, including the stakeholders in the decision making (Pitcher & Hollingworth, 2000; Rangel *et al.*, 2019).

Therefore, the main objective of this work is to characterize shore-based marine recreational fishing in the south and south-west coast of mainland Portugal (from Setúbal to V.R.S. António), providing a solid scientific basis to implement adequate management measures adjusted to the reality of the national fishing resources. This thesis aims to:

1- Evaluate fishing effort and quantify shore-based marine recreational fishing catches, over a one-year period, and evaluate their impact on marine resources
2- Compare estimated recreational catches with the commercial fisheries landings regarding the most captured species and the DCF species that occur in the study
3- Obtain socioeconomic information about the fishing population of the study area: a) demographic data; b) fishing participation and habits; c) expenditures; d) opinions towards the current fishing legislation and management measures and e) perceptions and empiric knowledge about the current state of marine resources and their opinion about the causes.

2. METHODS

2.1 STUDY AREA

The present study was undertaken along the south and south-west coast of mainland Portugal (approximately 320 km), delimited in the north by Setúbal (38º48' N; -8º96'W) and in the south by V. R. S. António (37º17' N; -7º38'W) (Fig.1).

Figure 1 - Map of Portugal, including the study area: the regions of Alentejo and Algarve, and the limits north (Setúbal) and south (V. R. S. António) of the study area.

For methodological procedures, two of the NUTS II (Territorial Units for Statistical Purposes) of mainland Portugal areas were considered for survey design and stratification: Alentejo and Algarve.

The region of Alentejo, has some particular and different coastline features, such as the extensive and almost pristine sandy beaches from Setubal until Sines, and the area delimitated for Sines (north) and Odeceixe (south), which is included in the PNSACV Natural Park, which due to its protection status has little anthropogenic interaction and the main economic activities are agriculture and artisanal fishing (Veiga *et al*., 2013). All the coastline has unique and specific features, with high cliffs (most of them inaccessible), and characterized by rough sea conditions. Fishers have little to choose when they want to engage in the MRF activity, either they fish from the cliffs or they swim to the fishing spots that are not accessible by land (*pers. obs.*, 2018).

The Algarve region is the most important Portuguese sun and sea touristic destination, which implies high demographic concentration near the coast due to the intensive use (Cruz, 2014). The Algarve coastline is also very diversified, varying from abrupt and jagged cliffs, extensive sandy beaches and inlets formed by lagoons systems and estuaries (INAG & ARH Algarve, 2009). Ria Formosa coastal lagoon and the Guadiana estuary are the two most important systems in the region. The connectivity between coastal lagoons or estuaries and the adjacent areas is extremely important for a great number of marine species (Costa *et al.*, 2007).

Because of its geolocation, this coastline is protected by the northern winds and swells, and, thus, characterized by calmer sea conditions and low turbidity in comparison with the southwest coast. In this area, recreational fishers explore piers and jetties at the mouth of the lagoon systems and estuaries, but also fish from the sandy beaches (Guerreiro *et al.*, 2011).

2.2 POPULATION SAMPLED

In 2018, 187,372 licenses were emitted, 106,554 for shore angling, 68,296 for boat angling, 8,812 for Spearfishing and 3,710 to general licensing (a license that allows practitioners to engage in any MRF mode).

As previously referred, in 2014 the legislation changed (Portaria nº14/2014) and the licensing shifted to a country base level *per* fishing mode (shore-based angling, boat-based angling and spearfishing). Licensing could be local (NUTS II level) or national, and valid from daily, monthly, yearly or triannual periods.

It is important to refer that a single individual can obtain multiple licences to practice different modes or a unique license that allows all type of modes, so the number of fishing licenses may not reflect the exact number of recreational fishers. It is also important to emphasise that there are records of individuals who engage in recreational fishing without any type of fishing license.

Given the above, instead of the number of fishing licenses, the number of licensed shore/based anglers *per* year and *per* NUTS II between 2007 and 2013 (official data: DGRM, 2017) was used for methodological design and analysis (Fig.2). For the study area, the average number of recreational fishers was of:

- Alentejo region: 5,687 shore-based anglers; 1,736 boat-based anglers; 1,049 spearfishers.
- Algarve region: 10,929 shore-based anglers, 7,394 boat-based anglers and 2,998 spearfishers.

This proxy for the number of recreational fishers was chosen because this time period (from 2007 and 2013) was the only that could provide information of recreational fishers *per* fishing mode and *per* NUTS II and because the number of recreational fishers maintains a constant throughout the years, it does not vary significantly (Fig.2).

Figure 2 - Total number of licensed fishers *per* year for mainland Portugal and *per* fishing mode, between 2007 and 2013 (official statistics by DGRM, 2018).

It is also important to refer that the methodology and the allocation of the sampling effort was based on the total number of recreational fishers (all fishing modes), since this

study was included in a larger scale project called PESCARDATA, where methodologies for the characterization of MRF considering all fishing modes were defined.

2.3 FIELD METHODOLOGY

2.3.1 QUESTIONNAIRE

Questionnaire design for this study were defined in order to incorporate information regarding:

1) General characterization of the activity - information regarding the fishing trip: starting time, expected fishing time, bait, number of rods, target species and fishing method.
2) Fisheries related data

2.1) Equipment – type of fishing gear used: number of rods, reels, hooks, natural/artificial baits and fishing method.

2.2) Catches – information related with target species, fish caught (retained and discarded).

3) Legislation – data on the opinions and perceptions of the anglers towards management and legislation and opinions about MRF in Portugal.

4) Economic characterization of the activity – information on diverse expenditures related to the activity: expenditures on fishing reels, fishing rods, baits, fuel, licenses and all others fishing related expenditures

5) Demography: information about baseline characteristics of the anglers, such as age, gender, education, marital status, monthly net income, membership of fishing clubs, fishing experience and place of residence. All fishes retained by anglers were identified, weighted, counted and measured (total length (TL), to the nearest mm).

The questionnaire was initially developed in paper format, and then transformed into digital format, through the Open Data Kit (ODK) app, that is a complete set of tools in open data source developed to create, collect and manage surveys data in mobile Android platforms (https://opendatakit.org/about/).

The ODK collects information in digital format, in this case with the use of a tablet mobile device, allowing real time data collection, reducing errors and time associated with manual insertion of data (Fig.3).

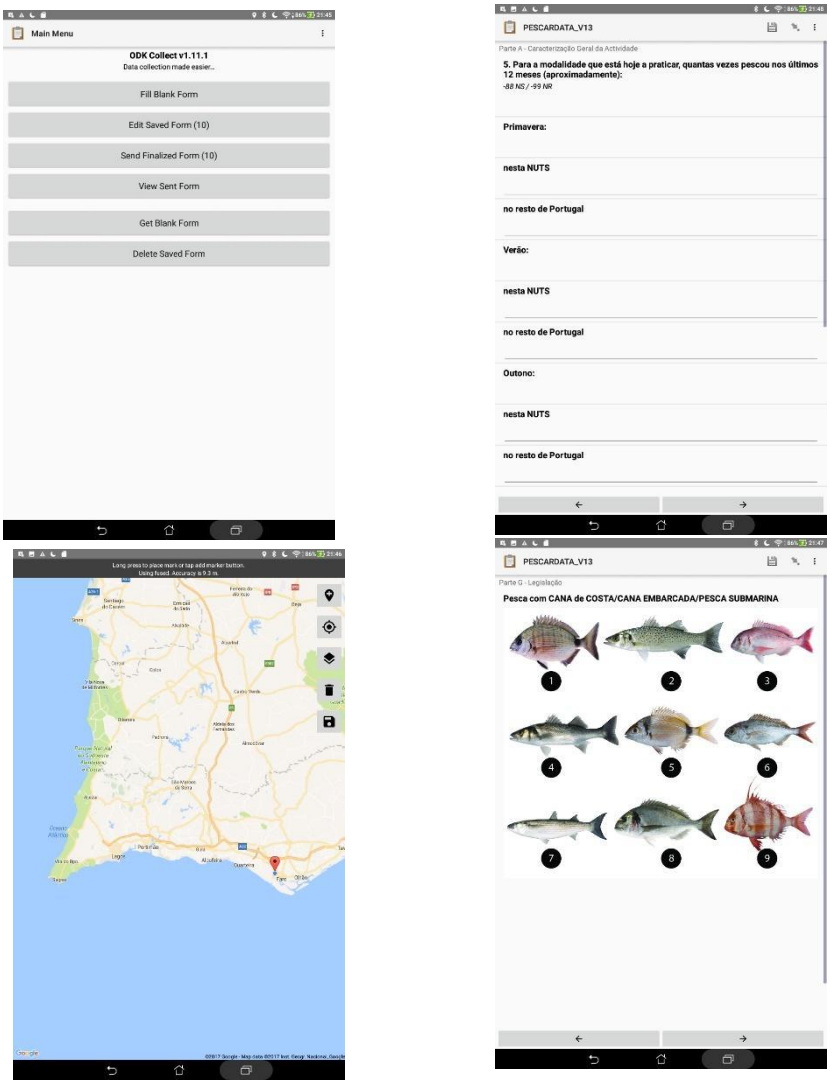

Figure 3 - Example menus of the face-to-face questionnaire in the digital format (Tablet).

2.4 NUMBER OF SAMPLING CAMPAIGNS

This thesis was included in a broader, and more complete study of MRF in mainland Portugal. This project, PESCARDATA, coordinated by the Centre for Marine Sciences of the University of Algarve (CCMAR) aimed to characterize all recreational fishing modes. Consequently, the stratification had to be coordinated in a larger scale, considering the total number of licensed individuals for the practice of MRF (all modes) *per* NUTS II. However, for the purpose of this master thesis, only shore-based marine recreational fishing data for the areas of Algarve and Alentejo were used.

To stratify the sampling effort allocated to each NUTS II, the number of licensed shore-based anglers was weighted considering the total number of licensed MRF *per* region.

To predict the minimum number of surveys required to do the correct characterization of the MRF in mainland Portugal, a "Power Test" (Crawley, 2005) was developed using data of Catches *per* Unit of Effort (CPUE) in number of fish caught *per* hour *per* fisher obtained by Veiga (2013), who characterized shore-based angling in the south and southwest of Portugal. According to the Power-test, it was estimated that, to characterize all marine recreational fishing (shore-based, boat-fishing and spearfishing) in mainland Portugal, 2000 questionnaires would allow an acceptable mean CPUE estimates with a maximal error of 10%. Within the aim of the project, and to attain this error objective, the number of sampling episodes *per* mode *per* NUTS II was calculated by NUTS II, according to the weighted proportion of recreational fishers (average 2007-2013) observed in Table 2.

Table 2 - Average number of shore-based licensed individuals *per* year between 2007 and 2013, *per NUTS* II and percentage of shore-based anglers with fishing license *per* NUTS II.

NUTS II	Shore-based licensed fishers (N)	Percentage regarding the total average of licenses
1) NORTH	8 963	11%
2) CENTRE	25 765	34%
2) AML	15 391	27%
4) ALENTEJO	5 687	8%
3) ALGARVE	10 929	20%
TOTAL	**66 708**	**100%**

A strategy of 2 weekdays and 2 weekend days/holidays sampling for season for the Alentejo area, and a total of 3 weekdays and 3 weekend days/holidays for season for the Algarve area was defined.

2.5 SPATIAL STRATIFICATION

The coastline of the study area was divided in sections of 5km (grids) of survey areas (Fig.4). For the onsite surveys, one grid was assigned for each campaign period using on a non-uniform probability of sampling design, with replacement, using R software. The adjacent grid was sampled in the following daily period.

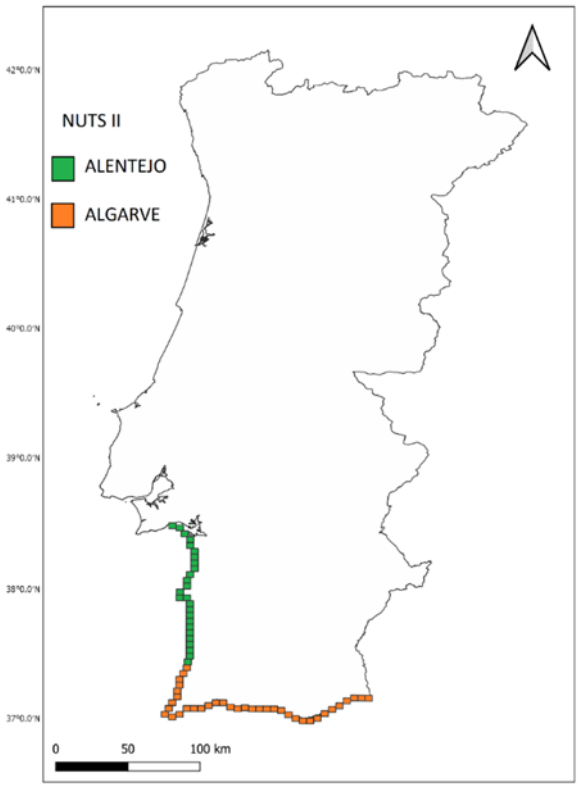

Figure 4 - Map of the study area, including NUTS II areas of Alentejo and Algarve and the 5km grid division of the coastline.

To prevent biases, random selection of the grid starting point and direction was defined previously to each survey and anglers subsequently interviewed.

2.6 TEMPORAL STRATIFICATION

The sampling effort was uniformly stratified by season, according to weekdays and weekend days/holidays and morning/afternoon periods.

Sampling episodes by week and weekend /holiday days were defined as:

- morning campaigns: 09:00 – 13:00 along a randomly selected 5km grid

- afternoon campaigns: 14:00 – 18:00 along the adjacent 5km grid

Stratification, such as by weekday or weekend day, tends to congregate similar activity levels and reduce variability in estimates. Due to logistical constraints, mostly related to the safety of the interviewers, no night sampling was contemplated in the sampling design. By choosing these two sampling periods, an empirical assumption was made: the beginning of the morning sampling period would incorporate night anglers leaving the area, while the afternoon sampling period would allow to encounter anglers beginning their night activity.

2.7 ROVING CREEL SURVEYS

Data collection for shore-based angling was conducted using face-to-face questionnaires (digital Android system – see section 2.3.1.2) campaigns, with the roving creel method.

Roving creel surveys are onsite angler surveys during which the interviewers walk along a predefined route and interviews anglers along the way and while they are fishing (Pollock *et al.*, 1994; Pollock *et al.*, 1998). This method favours studies that need to cover extensive fishing grounds, where the distribution and dispersion of fishers is not clear (Malvestuto, 1996).

As soon the interviewer arrived to the pre-defined 5km sampling area (grid) (see section 2.5), began the search for the recreational anglers. When an angler was identified, the interviewer went to his encounter and began the questionnaire, asking if the angler accepted to participate in the study and if he had been fishing for at least 30 minutes. If

all the previous premises were fulfilled, the questionnaire could begin. The adjacent 5km grid (section 2.5) was surveyed in the following daily period (section 2.6).

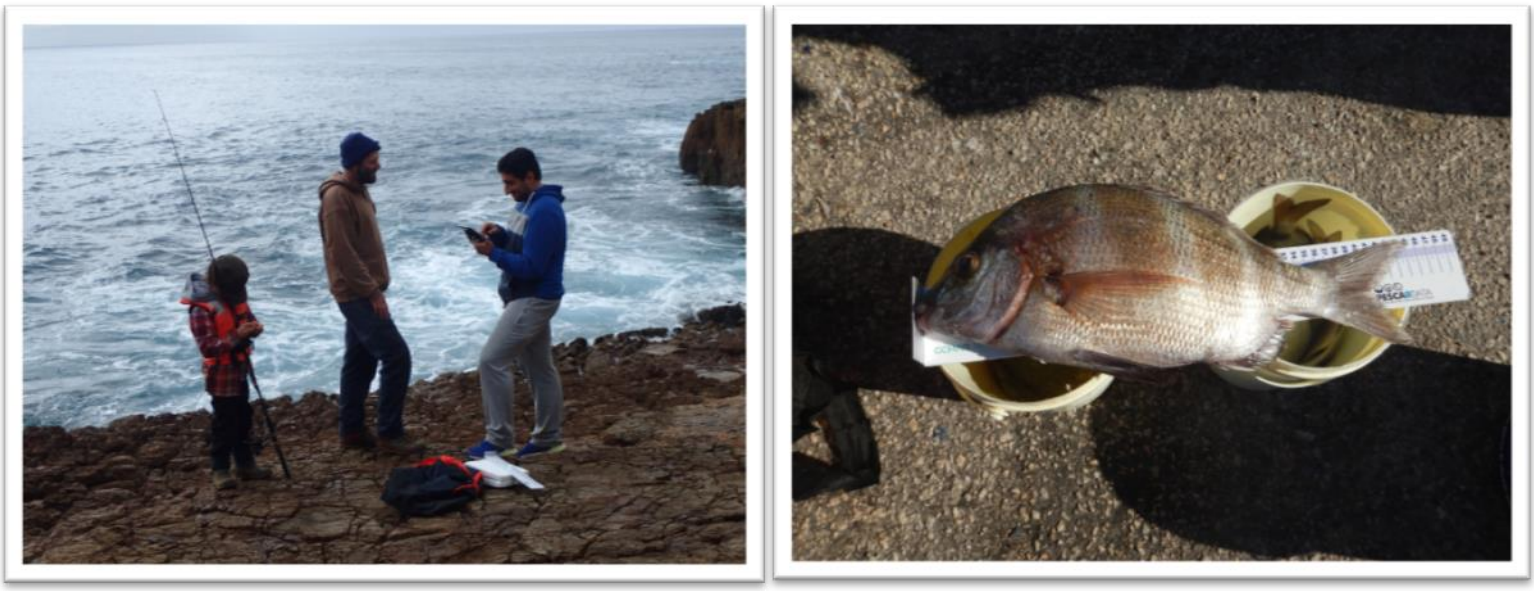

Figure 5- Example of the conduction of a face-to-face questionnaire using the roving-creel method for shore-based angling, and measurement example of a caught specimen during this study.

2.8 DATA ANALYSIS

The data obtained with the face/to/face questionnaires were included in a database and analysed with different software's: MS Excel 2016; R v.3.4.4; QGIS v.3.4.4 and Brodgar v.2.7.5.

Regarding the raw data, and considering the difficulty of obtaining the individual weight *per* species (in some occasions only the size is reported by the fishers), the weights were estimated through length-weight relationships available in the literature, and whenever possible, using length-weight relations from the study area (Petrakis & Stergiou 1995; Gonçalves *et al.*, 1997; Santos *et al.*, 2002; Dulcic & Glamuzina, 2006; Froese & Pauly, 2018). Simultaneously, and according to Erzini *et al.* (2008), for all the specimens reported without size or weight, the species mean size and weight for the given region from Fishbase.org was used. Also, and according to the same authors, when a precise measure for a certain specimen was lacking, the mean value from the class 5 cm below the size provided by the fisherman was considered (i.e. for a reported total length below

15 cm, the length of 12.5 cm was considered, assuming that if the size of the fish were below 10 cm, that would be the indication provided by the fisher).

The information collected from the questionnaires also allowed the statistical analysis of diverse aspects, according to the NUTS II areas, and the sampling season, such as:

- Regarding the recreational fishing population in study: socioeconomic and demographic analysis of the population; the importance of the fishing activity; preferences related with tide, moon phases and related with the time of the day.
- Regarding the fishing event in study: general aspects related with the fishing event; fishing methods; characterization of fishing modes; pinpointing the preferences related to the fishing spots; identification of target species; characterization and quantification of species captured and their destinations.

In this section, the several statistical assumptions and calculations will be carefully described.

2.8.1 AVIDITY CLASSES

Avidity, or frequency of participation, is the measure, in number, of different days in which participation occurred. The results of a survey-based study may not be an adequate representation of the angler's population given that in the sample population there are different avidity classes, different fishing zones, ages, etc (Armstrong *et al.*, 2013; Teixeira *et al.*, 2016; Bellanger & Levrel, 2017; Pita *et al.*, 2018). In fact, the most avid anglers have a higher probability of being found and approached during the sampling campaigns, which leads to a sampled population that may not be representative of the real population (Strethlow *et al.*, 2012; Pita *et al.*, 2018; Gordoa *et al.*, 2019).

The avidity bias can be corrected, as it was in this study, through the stratification of surveys data by avidity classes and by NUTS II. This type of methodology was already carried out in some recent studies of recreational fishing, such as: Pita *et al.*, (2018), Pita

et al., (2017) and Armstrong *et al.*, (2013), where the authors considered 4 classes of avidity frequency (inactive fishers: 0 fishing days *per* year; occasional fishers: 1-10 fishing days *per* year; regular fishers: 11-40 fishing days *per* year: frequent fishers: more than 41 fishing days *per* year). For these studies, and in order to adjust to the reality of the angler's universe, the results were extrapolated for the total population of each stratum, using the information *per* stratum of the percentage of anglers in the Basque country for the same strata (Ruiz *et al.*, 2014).

In this study, and for the definition of catch estimates (total and retained) the same correction procedure by avidity classes for shore-based anglers was used. For that, five avidity classes were defined (according to the fishing days in the last 12 months) and the percentage of anglers surveyed by class, based on the online survey conducted by DGRM in 2015 (DGRM, 2016).

This web-based survey conducted by DGRM, obtained answers from 5,568 individuals who stated "I usually buy a fishing license for shore fishing, boat fishing or spearfishing" (3,800 for shore fishing; 1,278 for boat fishing; 490 for spearfishing – 549 individuals took a general license but they were not considered because they could not be included in a unique fishing mode), and the number of answers for the avidity classes corresponding to the question: "How many times did you go fishing in the last 12months" were used.

Five avidity classes were considered: 1) Inactive – did not go fishing; 2) Occasional – fished up to a total of 10 days; 3) Regular – fished between 11 and 30 days; 4) Frequent – fished between 31 and 60 days; 5) Very frequent – fished more than 60 days.

For the estimated universe of recreational shore-based anglers (for the study area) assumptions were made based on the proportions of the number of anglers between the classes of avidity by NUTS II, according to the distribution obtained in the web-based survey conducted by DGRM in 2015 (DGRM 2016).

2.8.2 CATCH *PER* UNIT OF EFFORT

The capture rates $(\overline{R})$ in number and weight of fish captured *per* fisher *per* hour of fishing (CPUE in number - Nh^{-1}; and in weight - Wh^{-1}) were obtained considering all

the information from the surveys campaign aggregated by season ("multiple day estimates") (Lockwood, 1999), which allowed reaching a unique value for the CPUE *per* season and *per* NUTS II areas.

This approach is recommended when there is a small amount of fisheries data *per* sampling day (Pollock *et al.*, 1994; Lockwood, 1999; Erzini *et al.*, 2008) which applies to this study. All the data were analysed considering the captures including discards (total catch) and considering only retained catch. The estimator used for the capture rates is the "mean of ratios", as recommended by the literature. It was considered that all the questionnaires were incomplete, considering that most of the surveyed individuals continued fishing after the end of the questionnaire.

The definition of capture rate, or CPUE, in number of fish/hours of fishing, or in kg of fish/hour of fishing was conducted according to the following equation (Lockwood, 1999):

$$\overline{R}_p = \frac{\sum_{i=1}^{k_p}\left(c_{pi}/h_{pi}\right)}{k_p} \qquad \text{Equation 1}$$

Where:

$\overline{R}p$ = Catch rate *per* strata for the period p (season);
C_{pi} = number or weight (in kg) captured by the fisher i;
h_{pi} = number of fishing hours by the fisher i;
K_p = total number of surveyed fishers

For the catch rate defined in equation 1, the variance estimated resulted from the following formulation (Lockwood, 1999):

$$\hat{Var}(\overline{R}_p) = \frac{\sum_{i=1}^{k_p}\left(c_{pi}/h_{pi}\right)^2 - \frac{\left(\sum_{i=1}^{k_p}\left(c_{pi}/h_{pi}\right)\right)^2}{k_p}}{k_p\left(k_p-1\right)} \qquad \text{Equation 2}$$

Where:

$\bar{R}p$ = Catch rate *per* strata for the period ***p*** (season);
C_{pi} = number or weight (in kg) captured by the fisher ***i;***
h_{pi} = number of fishing hours by the fisher ***i***;
K_p = total number of surveyed fishers;

The CPUEs were calculated regarding the species/groups of species considered of importance in this study: 1) DCF species caught, 2) sargo breams (Diplodus spp.), 3) the rest of the species was combined in group designated by "Others".

2.8.3 UNIVERSE OF RECREATIONAL FISHERS

For the correct determination of the total number of recreational shore-based anglers, the average number of licensed shore anglers *per* NUTS II between the years of 2007 and 2013 (the only time interval where this specification was made available by DGRM) was considered. The average number of anglers that had a national fishing license (license that does not specify the NUTS II where the fishing is going to take place), weighted by the number of licensed fishers and *per* stratum (NUTS II) was also added.

It is important to emphasize that the number of recreational fishers who stated that they did not possess a valid fishing license was considered residual, being excluded from the calculations. For the calculations, the average number of licensed shore anglers *per* NUTS II was weighted by the percentage of avidity class in the web-based survey of DGRM (DGRM, 2016).

2.8.4 FISHING DAYS

During the survey campaigns, anglers were asked to provide information on the number of fishing days (regarding the fishing mode that they were practicing in the moment of the interview), in the last 12 months, according to the season, and the NUTS II where they were at the moment of the interview. When fishermen didn't have a precise memory or didn't demonstrate a trustable level of detail in their response, only registered

the number of times that the individual have fished in the last 12 months in the NUTS II where the interview took place was registered. Many surveyed individuals did not remember at all the number of fishing trips, what lead to being excluded of the sampled population.

As previously stated, the first and most relevant error in this type of answer (where the interviewee is asked about the number of times that he or she executed an activity in the past) is the recall bias or memory error. To mitigate this type of error, to the individuals who reported fishing more than 284 days a year (average of fishable days of 2017 and 2018), several methodologies were applied.

The first step was to limit the number of fishing days by defining the maximum number of possible fishable days in a year, as was previously done in Erzini *et al.* (2008). To correctly assess the maximum number of possible fishable days in one year, the mean number of maximum days with meteorological conditions to engage in the activity *per* NUTS II (Alentejo and Algarve) and *per* season, was defined considering the following limitations: winds less than 20knots; waves less than 3m high; absence of heavy rain; absence of thunderstorms; absence of warnings of extreme cold periods; absence of prohibitions to walk/stay near the sea. These conditions were revised using the archive of the meteorological records of WINDGURU website (www.windguru.cz), as well the daily meteorological records during the sampling campaigns (daily records from the IPMA.PT and windguru.cz websites) to the main cities of the NUTS II areas in question.

Nevertheless, even for the less avid anglers, recall bias is recognized as an important and highly influential factor when making estimates. This error tends to increase accordingly to the period that the individuals are being asked to remember, meaning that the longer the period, the higher the associated recall bias or memory error. Thus, and to mitigate this potential influence as a source of bias in the estimates, to the value obtained in the answer of each individual in the surveys, the correction factor of 44.5% for recall bias was applied (Connelly & Brown, 1995). According to the latter authors, it is a correction factor that can be used, in absence of correction factors specific to the region, fisher's population, and fishing mode in study.

Another potential source of error already targeted in the literature is the influence of the representation of the most avid anglers in the samples of studies of this nature. It is reasonable to assume that in face-to-face questionnaires the most avid anglers tend to be in greater number, as well as certain ages, or the practitioners of a certain fishing mode, which indicates that the sample may not be truly representative of the population that

engages in the activity (Armstrong *et al.*, 2013; Teixeira *et al.*, 2016; Bellanger & Levrel, 2017; Pita *et al.*, 2018). For this reason, in the present study, for certain estimates scenarios (view section 2.10.8), the mean annual number of fishing days was also stratified by avidity class.

2.8.5 FISHING HOURS

In order to determine the total amount of hours that each individual spent engaged in marine recreational shore angling ($\bar{Hh}$), the mean number of hours by avidity class, was applied to the time each angler stated began each fishing event and the time each angler stated that the fishing event ended.

For the calculations of the catch estimates, the mean fishing hours was defined by avidity class. Since it was not possible to obtain with detail and robustness the mean fishing hours *per* NUTS II area, a mean fishing hours ($\bar{Hh}$), by avidity class similar for all the NUTS II areas was assumed.

2.8.6 FISHING EFFORT (STRATIFIED BY AVIDITY CLASS AND NUTS II)

The fishing effort, in hours, and in combination with the NUTS II area (p), and avidity class (a) was calculated using the following equation:

$$E_{pa} = \Sigma L_{pa} * \bar{D}_{pa} * \bar{H}_{pa}$$ Equation 3

Where:

E = fishing effort *per* stratum (NUTS II and avidity class), to each one of the group of species or groups of species of interest caught, in hours;
L = number of fishers with license
D = mean number of fishing days in the last 12 months
H = mean number of fishing hours *per* fishing episode

2.8.7 ANNUAL FISHING EFFORT

As previously done by Erzini *et al.* (2008), annual fishing effort calculations, in hours, was calculated using the sum of all individual estimates *per* stratum (NUTS II and avidity class) (Cochran, 1977).

$$E_{total} = E_{p1} * E_{p2} * E_{p3} \ldots\ldots + E_{pn} \qquad \text{Equation 4}$$

2.8.8 TOTAL CAPTURE *PER* FISHING MODE AND NUTS II (SCENARIOS)

While stratification by avidity class is an important tool to obtain realistic estimates that are representative of the fisher's universe, in this study, multiple scenarios were considered. The scenarios are no more than combinations of parameters (including non-stratification by avidity classes). With this approach the intention was to have a broader spectrum of potential scenarios, having in consideration the uncertainties and potential sources of error that are associated with this type of studies. Global catch *per* strata (in weight) was estimated for the total catch (including discards) and for the harvest capture, being considered three different scenarios (Table 3).

In Table 4, we can examine the different combinations of stratifications by NUTS II and avidity classes of such parameters like: number of fishers with a valid fishing license, mean number of fishing days *per* year, mean number of fishing hours *per* fishing episode and the CPUE of the species or group of species considered of interest (in kg h^{-1})

In order to make the calculations for the capture estimates ($\hat{C}$p) *per* fishing mode and *per* strata (NUTS II), in each scenario tested, it used the following formulation that used the product between the CPUE (in weight) ($\hat{R}$p), and the fishing effort ($\hat{E}$) was used:

$$\hat{C}_{pm} = \hat{R}_{pm} * \hat{E}_{pm} \qquad \text{Equation 5}$$

Where:

$\hat{\mathbf{E}}$ = fishing effort, in hours

$\widehat{\boldsymbol{R}}_{\boldsymbol{pm}}$ = Catch *per* Unit of Effort, in weight (according to the species or groups of species considered)

Table 3 - Different scenarios (combinations of possible stratifications) of total catches (Catch) and retained catches (Harvest) with the stratifications applied by NUTS II and avidity class.

	Scenarios					
	1		2		3	
Stratification	**NUTS II**	**Avidity Class**	**NUTS II**	**Avidity Class**	**NUTS II**	**Avidity Class**
Number of fishers with a valid license	Yes	Yes	Yes	Yes	No	No
Mean annual fishing days	No	Yes	No	Yes	No	No
Mean number of hours *per* fishing episode	No	Yes	No	Yes	No	No
CPUE (kg h-1)	Yes	Yes	Yes	No	No	No

Scenario 1: This scenario considered a stratification process by region (NUTS II) and by avidity class of the recreational fisher, in order to minimize the variability between the different classes within these factors. The stratification process is applied to variables related with the fishing effort (number of fishers with a valid license, mean annual fishing days, mean number of hours *per* fishing episode) and the CPUE *per* species or group of species of interest (in weight). The stratification by NUTS II is not considered for the variables of the mean annual fishing days and the mean hours *per* fishing episode.

Scenario 2: This scenario differs from scenario 1, by not being stratified by CPUE, because when using stratifications, the sample population is being divided, and in

certain cases the number of surveyed fishers (when applying this stratification by avidity classes and NUTS II) is very small, reducing the robustness of the estimation. Thus, this scenario considers the same type of stratification as in scenario 1, with the exception that the CPUE was not stratified by avidity class.

Scenario 3: This scenario considers the only fishing effort value, for Portugal, that exists in the literature, in order to allow the comparison of the values of fishing effort and catches at a European level (the calculations of the mean fishing days were carried out in the same way for all the countries). For that, no type of stratification *per* NUTS II or avidity class (mean values of the region of Algarve and Alentejo) was considered and the mean annual fishing days calculated for the recreational fishing in mainland Portugal by Hyder *et al.*, (2018): 36.83 days.

2.8.9 TOTAL ANNUAL CATCH

Calculations of the annual catch estimates was conducted by adding all the individual estimates *per* strata (Cochran, 1977):

$$\hat{C}_{\text{total}} = \hat{C}_{\text{m1}} + \hat{C}_{\text{m1}} + \hat{C}_{\text{m1}} \ldots. + \hat{C}_{\text{mn}} \qquad \text{Equation 6}$$

Where:

p = is the fishing mode

m = is the stratum (NUTS II)

2.8.10 COMPARISON OF RECREATIONAL FISHING CATCH ESTIMATES AND THE OFFICIAL STATISTICS OF COMMERCIAL FISHING LANDINGS

The comparison between the commercial and the recreational fishing sector was done using the official commercial fishing statistics from INE (Instituto Nacional de

Estatística). The nominal data *per* NUTS II regarding the mean of the commercial fishing landings statistics of the last available years (2007-2017) (www.ine.pt) was used as the primary source. This sets of data were compared with the annual catch estimates (Catch and Harvest) calculated in this study for the species/groups of species most targeted by the universe of recreational anglers and also the DCF species that occur. These calculations will be conducted using the 2018 global data.

3. RESULTS

EXPLANATORY NOTE

In the following section will be presented in detail the description and phased analysis of the results obtained during the period comprehended between 1 of January of 2018 and 15 of December of 2018. All the sampled seasons will be treated as one, with rare exceptions were there is a need to analyse separately the data.

The DCF (Data Collection Framework) species that occurred during the samplings where identified and highlighted in the results due to its importance in the identified target species and due to the PESCARDATA obligations. However, only the European seabass (*Dicentrarchus labrax*) and the spotted seabass (*Dicentrarchus punctatus*) have occurred.

CPUE's, total captures (Total catch), retained captures (Harvest) and the comparative analysis to the commercial fishing sector of the species/groups of species most targeted by the universe of recreational anglers and also the DCF species that occur. These calculations will be conducted using the 2018 global data.

3.1. ONSITE QUESTIONNAIRES

The present study was conducted during the civil year of 2018, in the period comprehended between 1st of January of 2018 and the 15th December of 2018. A total of 80 valid face-to-face-questionnaires sampling campaigns were carried out (40 days with 2 campaigns/day). During the survey campaigns, a total of 402 individual questionnaires were conducted, with a total of 349 fishing episodes (corresponding to 345 interviewed anglers) validated for analysis.

Some anglers were interviewed more than once, for that reason the number of fishing episodes does not match the number of surveyed anglers.

3.1.1 RESPONSE RATES

The response rates of the presential anglers' questionnaires were considered high throughout all the year of sampling, and in all the sampling regions (Fig 6). Both in Alentejo and Algarve the response rates are above 85%.

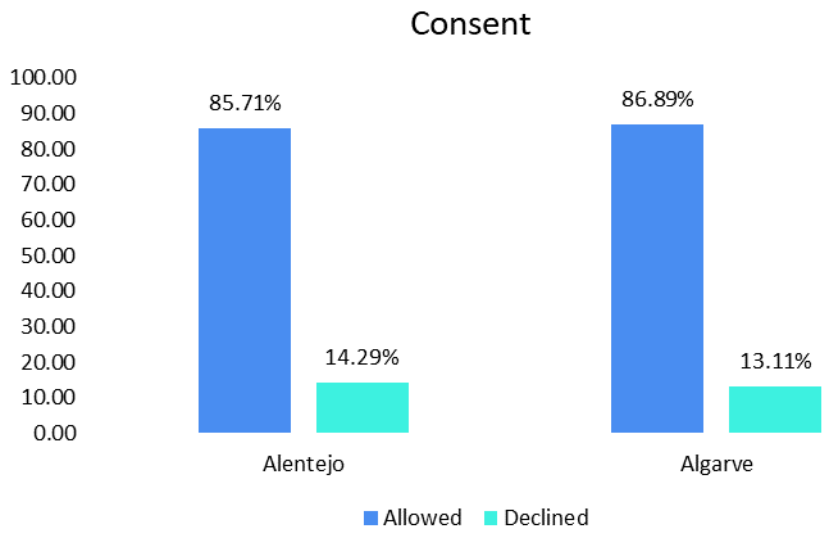

Figure 6 - Percentage of allowed and declined questionnaires in all sampled seasons according to the regions of Alentejo (N=98) and Algarve (N=304).

The following figure (Fig.7), reflects the influence of the weekly and daily period in the presence/absence of anglers in the exercise of marine recreational fishing.

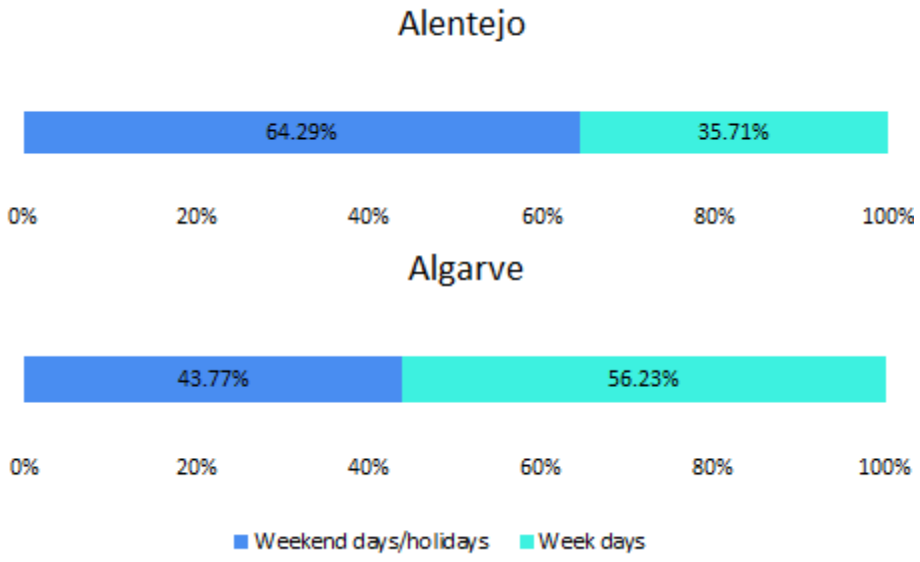

Figure 7 - Questionnaires conducted in all sampled seasons *per* weekdays and weekend days (or holidays), according to the region of study (Alentejo and Algarve). Values presented in percentage (%).

In the two regions of study, anglers had different preferences regarding the chosen period to engage in MRF (Fig.8). In the region of Alentejo, the surveyed anglers had a clear preference of weekend days/holidays to engage in the practice of recreational fishing. In different circumstances are the surveyed anglers of the region of Algarve, that preferred weekdays to practice the recreational activity.

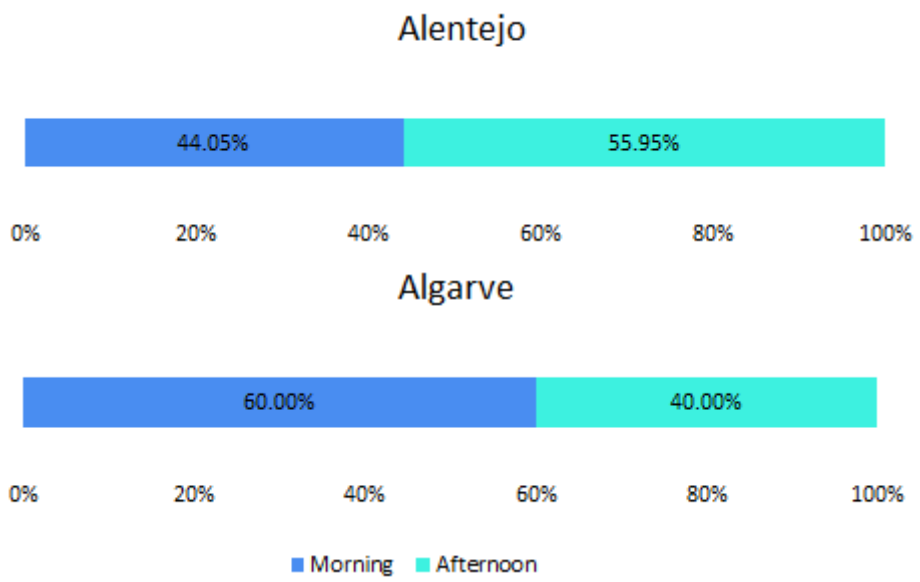

Figure 8 - Questionnaires conducted in all sampled seasons *per* daily period (Morning/Afternoon) according to the region of study (Alentejo and Algarve). Values presented in percentage (%).

3.2 GENERAL CHARACHTERIZATION OF MARINE RECREATIONAL FISHING

3.2.1 SOCIOECONOMIC AND DEMOGRAPHIC DESCRIPTION

For the socioeconomic and demographic analysis conducted in this study, a total of 349 surveyed anglers were considered (Alentejo: N=84; Algarve: N=265). All the data collected during this period is synthesised in Table 4.

At Alentejo, the great majority of the surveyed anglers were Portuguese (92.86%), males (98.81%), with an average age of 52.42 years and employed (63.10%). The interviewed reported an average formal education up to the 9 years of formal education (67.86%). for 34.52% of the surveyed anglers, monthly earning ranged between 501-750 euros. The Algarve anglers are mostly Portuguese (86.04%), males (98.49%), with an

average age of 51.58 years and employed (66.42%). The average educational level is higher for these anglers when compared with the Alentejo, and the monthly earnings range between 501-750 for 30.19% of the surveyed population.

Table 4 - Demographic and socioeconomic characteristics of the sampled population of this study according to all of the sampled seasons and the NUTS II region. Data presented in percentage (%) and in number (N) of individuals.

	NUTS II			
	ALENTEJO		**ALGARVE**	
Characteristic	**N**	**%**	**N**	**%**
Gender				
Male	83	98.81	261	98.49
Female	1	1.19	4	1.51
Total	**84**	**100.00**	**265**	**100.00**
Age Class (years)				
≤20	1	1.19	2	0.75
[21-30]	9	10.71	22	8.30
[31-40]	10	11.90	47	17.74
[41-50]	13	15.48	51	19.25
[51-60]	20	23.81	50	18.87
[61-70]	22	26.19	62	23.40
≥71	6	7.14	25	9.43
NR	3	3.57	6	2.26
Total	**84**	**100.00**	**265**	**100.00**
Mean age years)	**52,42 years**		**51,58 years**	
Marital status				
Single	17	20.24	42	15.85
Married	64	76.19	172	64.91
Union of fact	2	2.38	6	2.26
Divorced	1	1.19	10	3.77
Widowed	0	0	4	1.51
NR	0	0	4	1.51
NQ	0	0	27	10.19
Total	**84**	**100.00**	**265**	**100.00**
Professional activity				
Employed	53	63.10	176	66.42
Unemployed	5	5.95	12	4.53
Student	1	1.19	1	0.38
Retired	22	26.19	73	27.55
NR	3	3.57	3	1.13
Total	**84**	**100.00**	**265**	**100.00**

Note: NR: No Response, NQ: No question was asked to these anglers regarding the characteristic in study.

This recreational activity, seems to be favoured by male anglers, representing more than 90% of the study population. The two studied regions have similar

demographic and socioeconomic patterns. The average educational level and monthly income is higher for these anglers, when compared with the region of Alentejo.

Table 4 (cont) - Demography and socioeconomic characteristics of the sampled population of this study, according to all of the sampled seasons and the NUTS II region. Data presented in percentage (%) and in number (N) of individuals.

	NUTS II			
	ALENTEJO		ALGARVE	
Characteristic	**N**	**%**	**N**	**%**
Nationality				
Portuguese	78	92.86	228	86.04
Other	6	7.14	37	13.96
Total	**84**	**100.00**	**265**	**100.00**
Education				
0-3 years	3	3.57	8	3.02
Primary school	15	17.86	39	14.72
Preparatory school	19	22.62	45	16.98
9 years	23	27.38	69	26.04
12 years	9	10.71	56	21.13
University education	11	13.10	32	12.08
NR	4	4.76	16	6.04
Total	**84**	**100.00**	**265**	100.00
Monthly income				
0	3	3.57	5	1.89
[1-250]	0	0.00	0	0.00
[251-500]	11	13.10	9	3.40
[501-750]	29	34.52	80	30.19
[751-1000]	12	14.29	51	19.25
[1001-1250]	7	8.33	36	13.58
[1251-1500]	4	4.76	18	6.79
[1501-1750]	2	2.38	12	4.53
[1751-2000]	2	2.38	6	2.26
[2001-2500]	1	1.19	9	3.40
> 2500	3	3.57	10	3.77
DN	2	2.38	1	0.38
NR	8	9.52	28	10.57
NA	0	0.00	0	0.00
Total	**84**	**100.00**	**265**	**100.00**

Note: NR: No response. DN: Doesn't know. NA: Not applicable.

The surveyed anglers do not show a clear preference regarding if they prefer fishing alone, or if they want to share the recreational activity with family/friends. A total of 52.15% of the anglers were fishing with family/friends at the time of the questionnaire, while 47.56% of them were fishing alone (Fig.9).

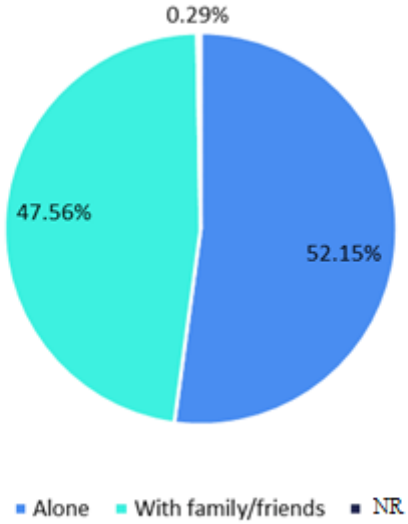

Figure 9 - Percentage of anglers regarding if they engage in the practice of MRF alone, or with family/friends, regarding both study regions. NR: No response.

3.3 EXPENDITURES

For the present analysis only the direct expenditures where included, because they could be accounted for with the needed degree of precision. The mean value spent by each angler was of 13.06 euros (€), from which 6.89 € corresponds to bait, 5.36 € to transportation and 0.81 € to fishing gears (Fig.10).

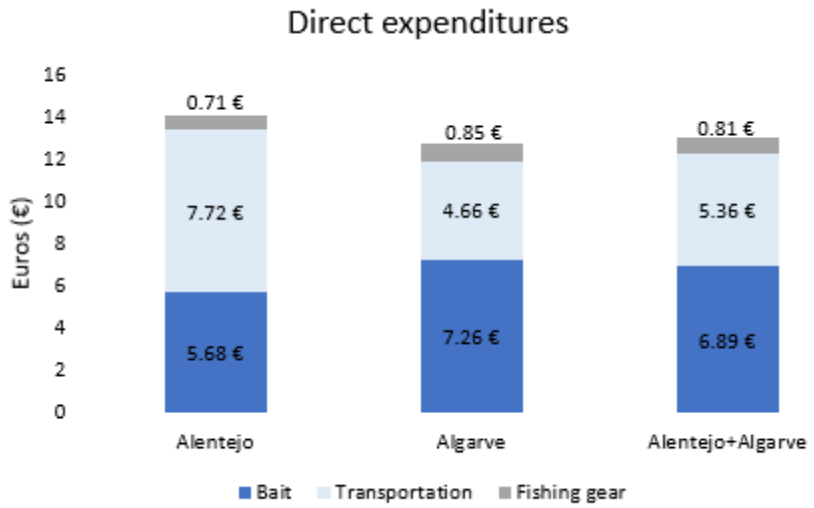

Figure 10 - Average value spent, for direct expenditures (bait, transportation and fishing gear), in the fishing episode at the time of the questionnaire, for the Alentejo and Algarve regions (values expressed in euros).

3.4 IMPORTANCE OF THE MARINE RECREATIONAL FISHING ACTIVITY

Regarding the analysis of the importance that recreational fishing has in the life of the surveyed anglers, Fig.11 clearly reflects that it represents a major role on the daily activity of the anglers. For the both regions in study, recreational fishing activity is the most important recreational activity, and in some cases (36.9% Alentejo; 46.0% Algarve), the only one.

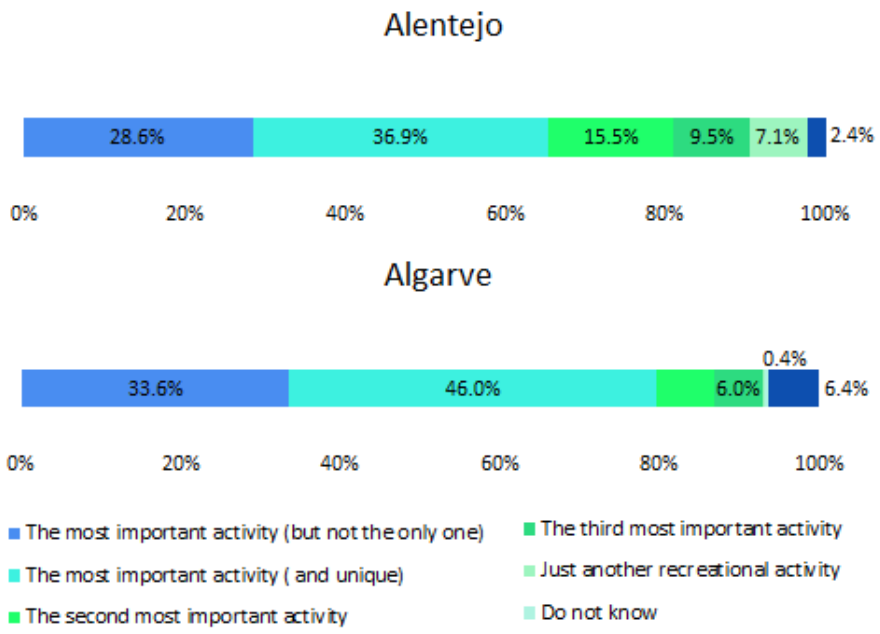

Figure 11 - Percentage of surveyed individuals in all the sampled seasons, according to the importance attributed to the recreational activity (shore-based fishing), in the regions of Alentejo (N=84) and Algarve (N=265).

3.5 FISHING EXPERIENCE

The experience on recreational fisheries (years) was accounted for the regions of study. In Alentejo the less experienced angler encountered started fishing less than a year before, whereas the most experienced angler had 68 years of experience.

Overall, the surveyed population is highly experienced, with almost 35% of the anglers having more than 40 years of experience in the recreational activity (Fig.11).

In the Algarve, the less experienced angler approached started fishing less than a year before, whereas the most experienced angler reported having 78 years of experience

in recreational fishing. In Alentejo, the majority of the surveyed anglers had more than 40 years of experience in the recreational activity (Fig.12).

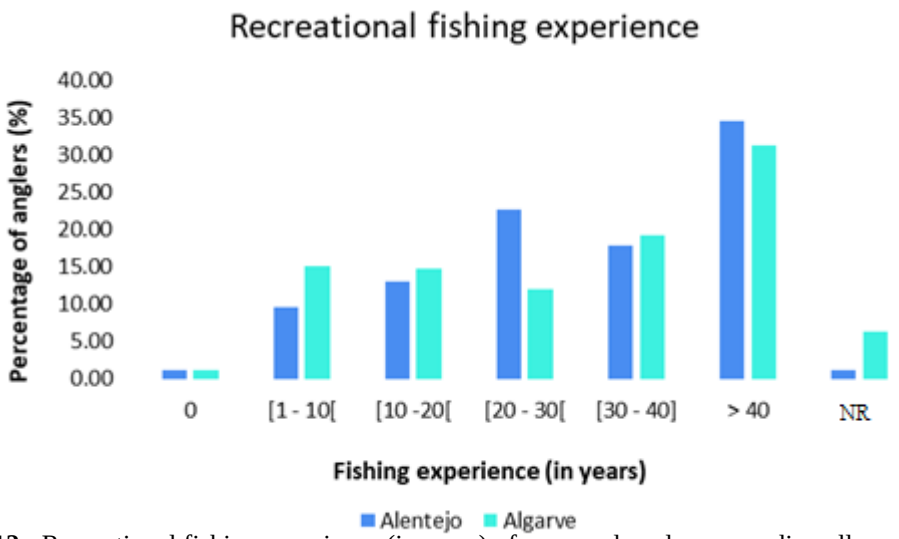

Figure 12 - Recreational fishing experience (in years) of surveyed anglers, regarding all sampled seasons, all NUTS II regions, excluding the years where there was no activity practiced. Data in percentage (%). NR: No response.

At Alentejo, 11 anglers (N=98) have stated that apart from the recreational component of the activity, they also engage in sportfishing competitions. Nevertheless, most of surveyed anglers do not have sportfishing experience (Fig.12). In the Algarve, 32 anglers (from the 265 that answered this question), stated that they also engage in sportfishing competitions. However, similar to what happens in Alentejo, the great majority of the anglers do not have sportfishing experience. (Fig. 13).

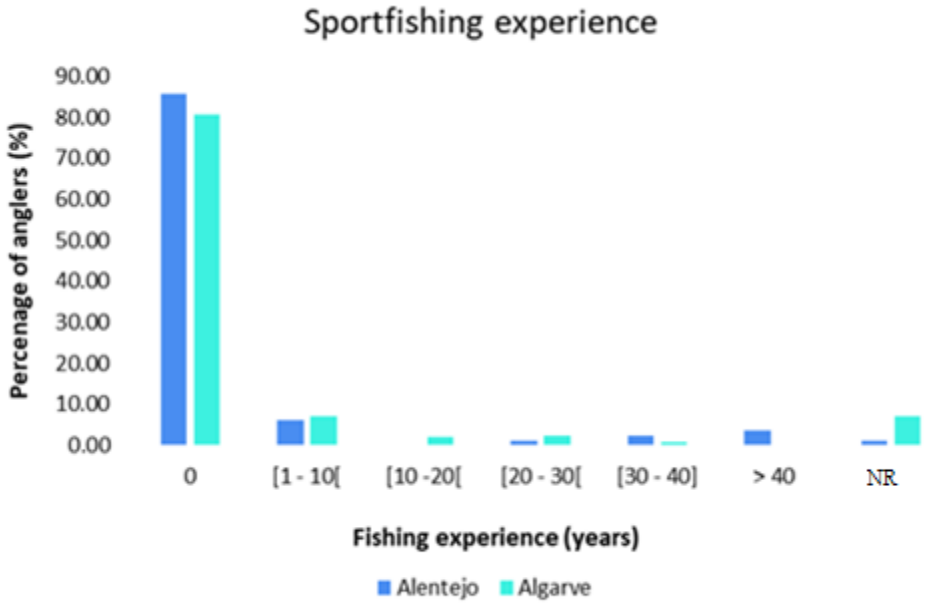

Figure 13 - Sportfishing experience (in years) of surveyed anglers, regarding all sampled seasons, all NUTS II regions, excluding the years where there was no activity practiced. Data in percentage (%). NR: No response.

3.6 CHARACTERIZATION OF THE FISHING EPISODES

3.6.1 FISHING MODALITIES

Recreational anglers have several fishing modalities to choose from when they want to engage in the fishing activity. During this study, two modalities stand out from the rest in both regions of study. For the Alentejo (Fig.14), the two most practiced fishing modalities are Surfcasting (N=43) and Floatfishing/”chumbadinha”/feel (N=33).

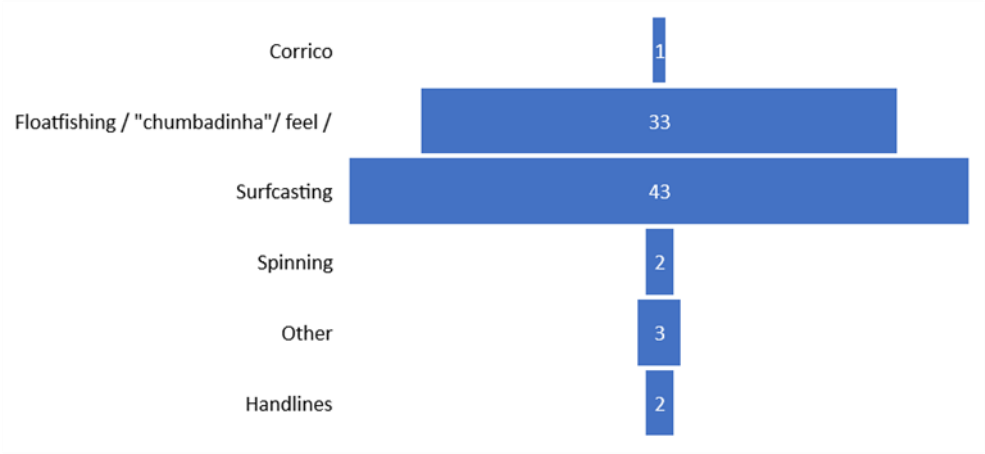

Figure 14 - Number of surveyed anglers according to the different fishing modalities, in the region of Alentejo.

The same occurs in the region of Algarve (Fig.15), however there is a clear preference for the Surfcasting (N=215) when compared to Floatfishing/”chumbadinha”/feel (N=28).

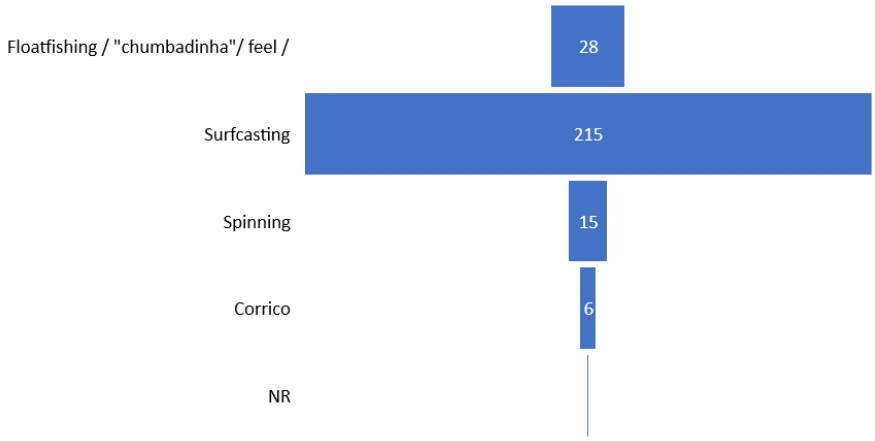

Figure 15 - Number of surveyed anglers according to the different fishing modalities, in the region of Algarve. NR: No response.

3.6.2 BAIT PREFERENCES

Having in consideration the preferences regarding the type of bait (natural vs artificial), the great majority of the surveyed angler's population reported the preference for natural baits rather than artificial baits (Fig.16). This is a unanimous preference for both of the regions of study, where the percentage of preference for natural bait is always superior to 90%.

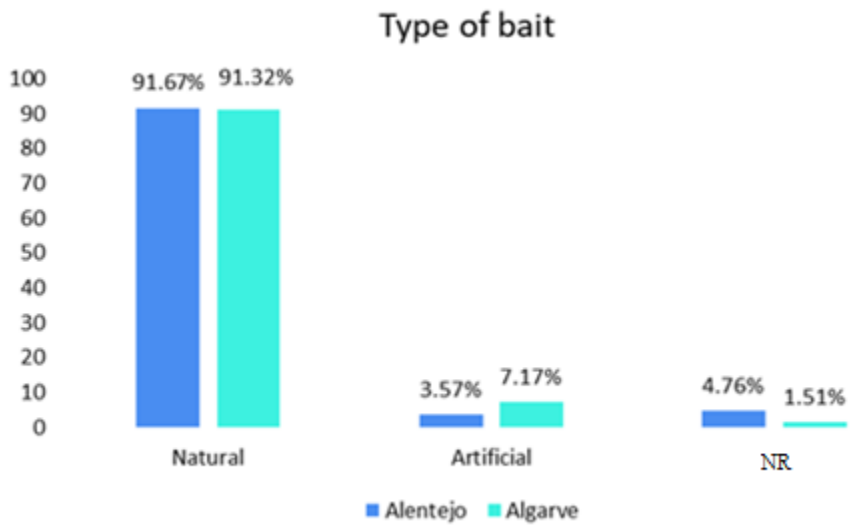

Figure 16 - Percentage of the type of bait used by the surveyed anglers in all sampled seasons, according to the different regions of study (Alentejo and Algarve). NR: No response.

Considering the baits that the surveyed anglers were using at the time of the questionnaire, in the two regions of study were different preferences reported. In Alentejo (Fig.17), the most used bait was the shrimp (25.96%), followed by the annelid worm "coreano" (13.46%) and the sardine (12.50%). A total of 18 different types of bait were reported in this region of study.

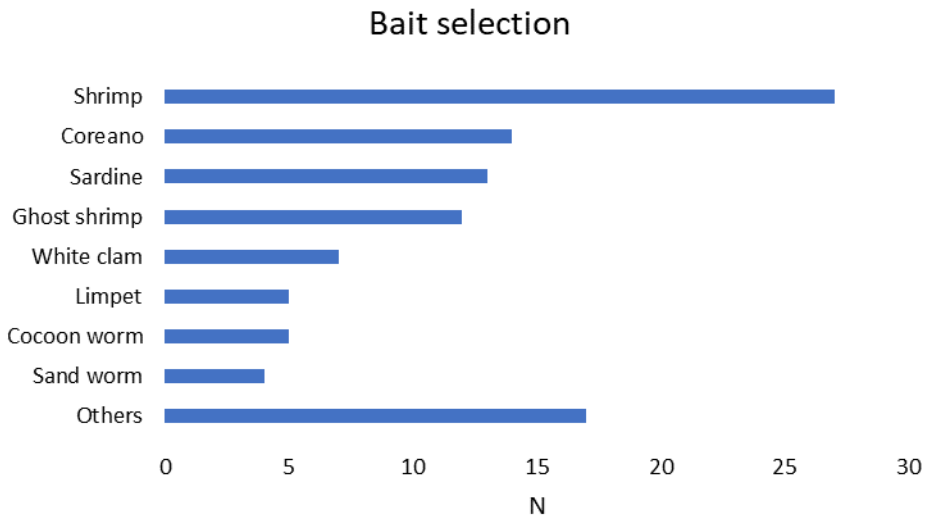

Figure 17 - Bait selection of the surveyed anglers during 2018 for the region of Alentejo (Others:<17). Data presented in percentage (%).

In the Algarve (Fig.18), 32 different baits were registered, which is higher than in the region of Alentejo (N=18). The razor clam (N=46) was the most used bait during the sampling year, followed by the annelid worm "coreano" (N=45), the ghost shrimp (N=45) and the green crab (N=44). In this region, some peculiar bait choices were reported, such as chicken skin and salted cod.

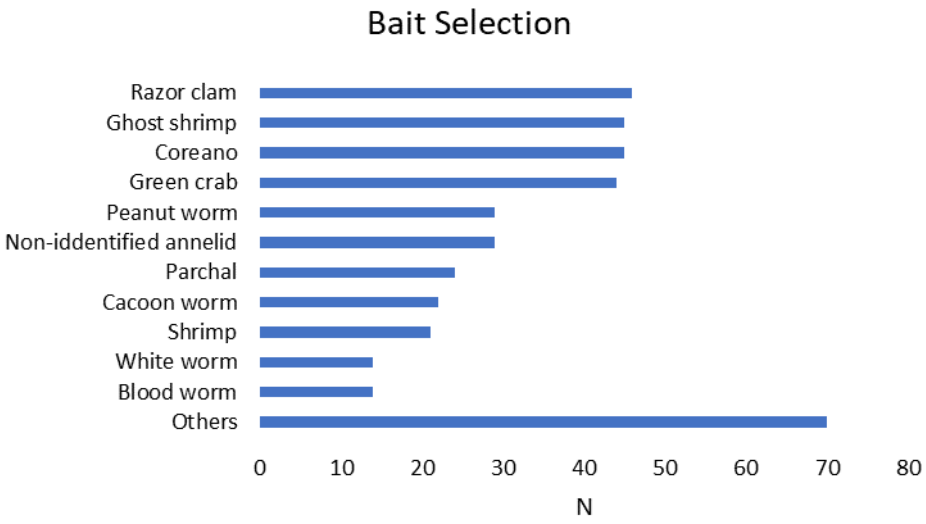

Figure 18 - Bait selection of the surveyed anglers during 2018 for the region of Algarve (Others:<70). Data presented in percentage (%).

3.7.1 FISHING LICENSES

Regarding the legal component of the recreational activity, the surveyed anglers were asked if they possessed (at the time of the questionnaire) a valid fishing license. In the Alentejo region, 82.29% of the interviewed fishers stated to have a valid fishing license at the time of the interview, 5.95% stated that they did not have a valid fishing license and 4.76% of the surveyed anglers preferred not to answer the question. In the Algarve region, the great majority of the anglers followed the same pattern, with more than 94% of fishers licensed at the time of the survey (Fig.19).

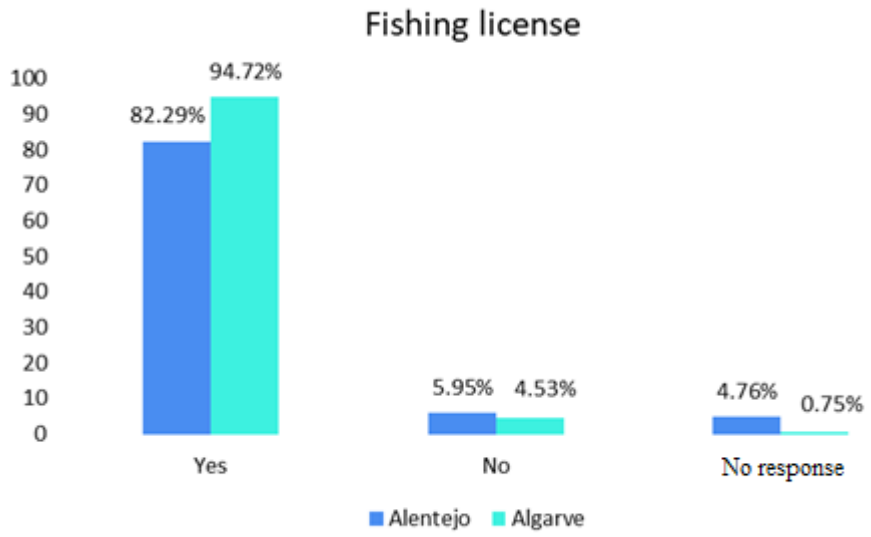

Figure 19 - Percentage of surveyed anglers about the validity of their fishing license, in all sampled seasons, for the two regions of study (Alentejo and Algarve.

3.7.2 PERCEPTIONS AND ATTITUDES TOWARDS MANAGEMENT AND LEGISLATION MEASURES

In terms of perceptions and attitudes towards management and legislation measures, the surveyed anglers showed to be informed regarding the current legislation.

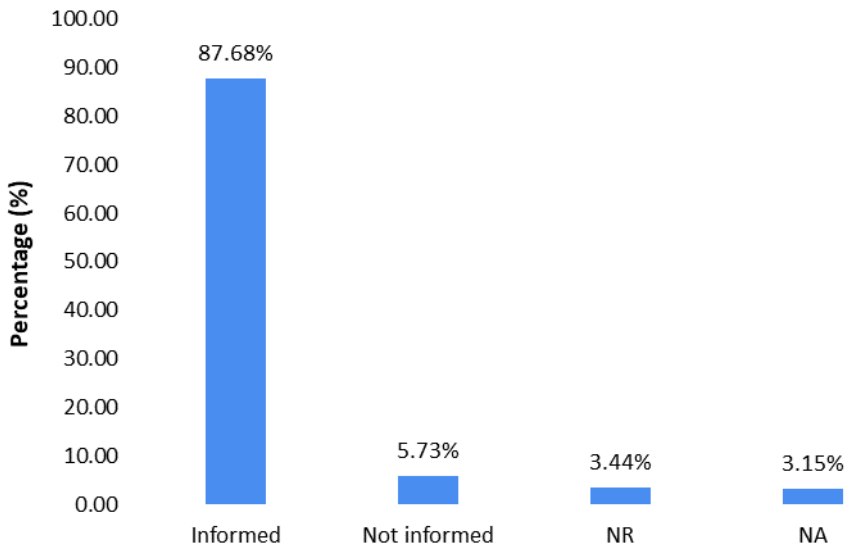

Figure 20 - Percentage of surveyed anglers regarding the degree of information on the current of the legislation in all sampled seasons, for the two regions of study (Alentejo and Algarve). NR: No response. NA: Not applicable.

In the Alentejo region, there seems to be a general acceptance towards the management and legislation measures, with 44.05% of the anglers referring to be reasonably satisfied.

At the Algarve, the results were similar, revealing that most part of the surveyed anglers were reasonably satisfied with the management measures in place. However, 8.30% of the anglers stated that they did not possess enough information to accurately answer this question.

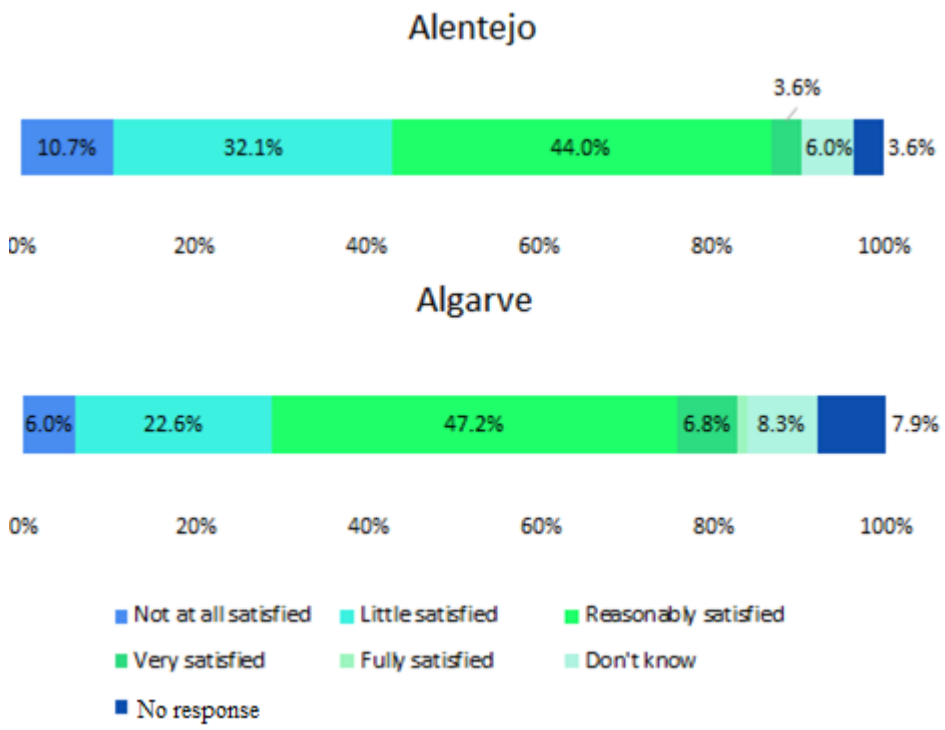

Figure 21 - Percentage of surveyed anglers about their level of satisfaction towards the legislation measures in all sampled seasons, in the regions of Alentejo and Algarve.

3.7.3 PERCEPTIONS ABOUT THE STATE OF THE MARINE RESOURCES

The opinion of the stakeholders regarding the state of the marine resources is essential to understand their initial perceptions at the beginning of their fishing activity, and their opinion on the state of the resources nowadays. To analyse these issues, the surveyed anglers were questioned about the abundance of fish when they first started engaging in the fishing activity and in the present days. In both regions of study, there is the common perception that there has been a reduction of the marine resources in the last years.

In Alentejo, 44.05% of the surveyed anglers stated that marine resources appear to be less abundant nowadays when compared with the when they started fishing. Also 27.38% of the surveyed anglers did not answer this question, and 17.86% stated that they did not know how to answer this question. In the Algarve, 61.13% of the surveyed anglers state that the abundance of marine resources in the present days is lower when compared

with the time when they started fishing. A total of 23.02% of the interviewed anglers choose not to answer, and 8.68% stated that they did not have enough years of experience to answer this question properly (Fig. 22).

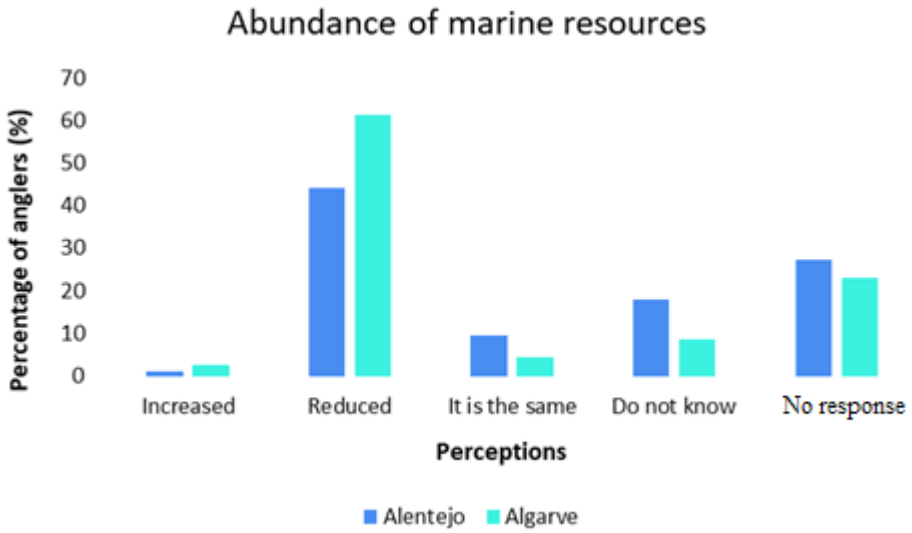

Figure 22 - Percentage of surveyed anglers regarding their perceptions about the abundance of fish in the present days, compared to when they started fishing in all sampled seasons, in the regions of study (Alentejo and Algarve).

The sampled angler population was also questioned about the causes that lead to the stated opinions regarding the state of marine resources, and about who was to blame for the current state of resources. In the Alentejo (Table 5), a great part of the surveyed anglers chose not to answer this question (41.67%), 10.71% said that pollution was the main responsible for the current state of the marine resources, and 8.33% stated that they didn't have enough years of experience to answer this question. Commercial fishing, fishing nets too close to the shore, trawlers and overfishing were the other most cited reasons.

Table 5 - Total number and percentage of surveyed anglers regarding their opinions about who is responsible for the current state of marine resources in all sampled seasons, in the region of Alentejo.

NUTS II	Alentejo	
Angler opinions	**N**	**%**
NR	35	41.67
Pollution	9	10.71
Doesn't know	7	8.33
Commercial fishing	6	7.14
Fishing nets too close to the shore	6	7.14
Trawlers	4	4.76
Overfishing	4	4.76
Spearfishing	2	2.38
Increase in seawater temperature	2	2.38
The amount of fish is the same, there are more fishermen nowadays	2	2.38
Other reasons	7	8.33
Total	**84**	**100.00**

Note: NR- No response

In the Algarve (Table 6), similar to what happened in the region of Alentejo, a considerable part of the surveyed anglers chose not to answer this question (29.06%), or thought they didn't have enough fishing experience to provide a reliable answer (9.06%)- According to the surveyed anglers, the main causes for the current state of marine resources are: pollution (13.58%), commercial fishing (12.83%) and climate change (8.30%).

Table 6 - Number and percentage of surveyed anglers about their opinions about the responsibility of the current state of marine resources in all sampled seasons, in the region of Algarve.

NUTS II	Algarve	
Angler opinions	**N**	**%**
NR	77	29.06
Pollution	36	13.58
Commercial fishing	34	12.83
Do not have enough experience to accurately answer	24	9.06
Climate change	22	8.30
Trawlers	15	5.66
Nets too close to the shore	11	4.15
Fishing of juvenile fish	9	3.40
Less baitfish	6	2.26
Other reasons	31	11.69
Total	**265**	**100.00**

Note: NR- No response

3.8 NUMBER OF FISHING DAYS

The surveyed anglers were asked about the number of times that they have engaged in the practice of recreational fishing (in the fishing mode that they were practicing at the time of the interview), in the last 12 months (Table 8).

In average, a recreational angler of the south and southwest region of Portugal fishes 47 days/year. The anglers surveyed at the Alentejo region seem to be more active anglers, with an average of 59 yearly fishing days, while the anglers of Algarve stated to go fishing an average of 44 days/year. Marine recreational anglers of Alentejo and Algarve are more active during the summer period, with a mean number of fishing days *per* season of 16 and 12 respectively (Table 7).

Table 7 Average number of fishing days *per* season and *per* region of study

	Seasons				
NUTS II	**Winter**	**Spring**	**Summer**	**Autumn**	**All seasons**
ALENTEJO	13 days	15 days	16 days	14 days	59 days
ALGARVE	10 days	10 days	12 days	10 days	44 days
ALENTEJO + ALGARVE	11 days	11 days	13 days	11 days	47 days

To future estimation processes, the number of annual fishing days were subjected to correction factors and weighted according to the anglers' avidity: Avidity class 1 (inactive) – 0 fishing days; Avidity class 2 (occasional) – 6 fishing days; Avidity class 3 (regular) – 20 fishing days; Avidity class 4 (frequent fishers) – 46 fishing days; Avidity class 5 (very frequent) – 106 fishing days;.

3.9 MONTHS OF RECREATIONAL FISHING ACTIVITY

Most of the recreational anglers in the regions of study, referred that they do not have a preferred month to go fishing, and that they fish during the entire year whenever possible (Table 8).

Nevertheless, the months with higher number of surveyed anglers were the months of June, July and September.

Table 8 - Periods of shore-based recreational fishing activity (Alentejo and Algarve). Values presented in percentage.

	Period of activity Number of interviewed (%)	
NUTS II	The entire year	Not the entire year
Algarve	58	42
Alentejo	62	38
Alentejo + Algarve	59	41

3.10 MARINE RECREATIONAL FISHING CATCHES

3.10.1 TARGET SPECIES

Each angler was asked to indicate the targeted species of the fishing event in question at the time of the questionnaire. In the Alentejo (Fig. 23), the most targeted species were the white seabream (*Diplodus sargus*), the European seabass (*Dicentrarchus labrax*) and the gilthead seabream (*Sparus aurata*). It is important to refer the importance that the Sparidae family seem to have in marine recreational fishing. In fact, from nine species referenced as target, four are from the Sparidae family.

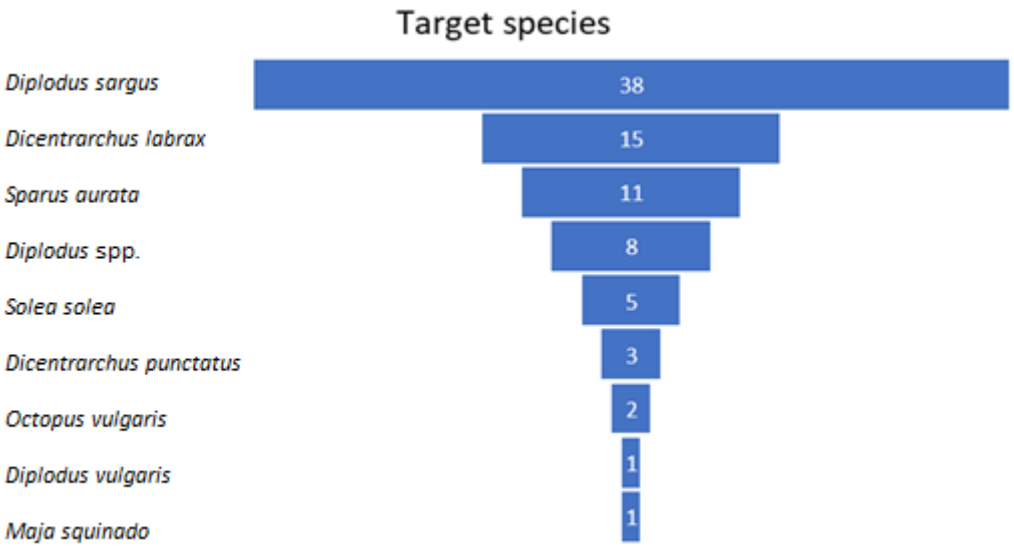

Figure 23 – Target species according to the fishing event in question in all sampled seasons., at the Alentejo region. Data presented in absolute values (N=84).

In the Algarve the most targeted species were the same as in the Alentejo region, but with a different ranking. Within a universe of 265 anglers, the most targeted species were the gilthead seabream (*Sparus aurata*), the European seabass (*Dicentrarchus labrax*), and the White seabream (*Diplodus sargus*) respectively (Fig. 24). There is however a clear preference for the gilthead seabream.

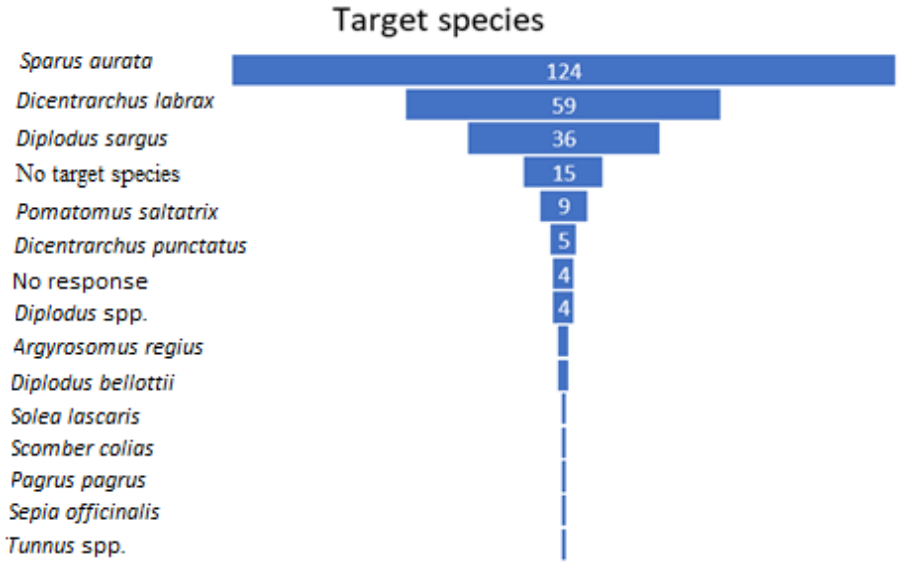

Figure 24 -Target species according to the fishing event in question in all sampled seasons, in the Algarve region. Data presented in absolute values (N=265).

3.10.2 FISHING EVENTS

A total of 349 fishing episodes was considered in the analysis and synthesised in Table 17 (84 for the region of Alentejo and 265 for Algarve).

In the Alentejo, most of the fishing events surveyed resulted on the catch of fish or another marine organism (75.00%). For the Algarve region the fishing events were more heterogeneous, with 57.74% having catches, and 42.26% having no reported catches (Fig.25).

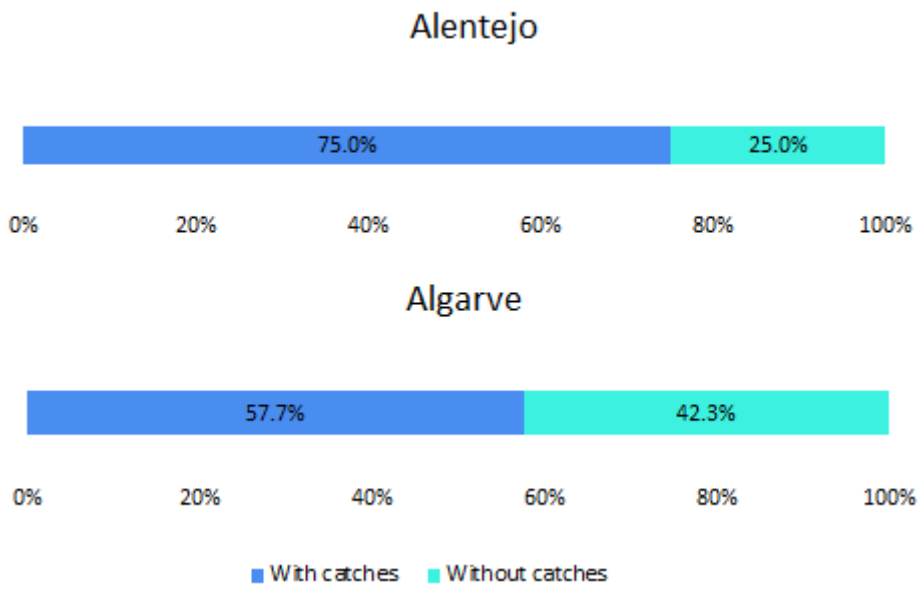

Figure 25 - Percentage of fishing episodes with and without catches in all sampled seasons (N=349). Data presented by NUTS II region.

3.10.3 CATCH PER UNIT OF EFFORT

The CPUEs were calculated regarding the species/groups of species considered of importance in this study: 1) DCF species caught, 2) sargo breams (*Diplodus* spp.), 3) the rest of the species was combined in group designated by "Others".

CPUEs were calculated according to the NUTS II, the avidity class and the absence of avidity class.

In the following tables (9,10 and 11), the CPUE's regarding avidity classes /absence of avidity class, *per* species/group of species are highlighted.

For the Alentejo region, the European seabass avidity class 2 registered the highest value of CPUE with 0.085 individuals caught/hour of fishing and 0.015 kg/hour of fishing. For the spotted seabass, the highest registered value was 0.099 individuals caught/hour and 0.019 kg/hour (avidity class 5). The sargo breams highest registered value was 0.885 individuals/hour of fishing and 0.201 kg/hour of fishing, corresponding to no avidity class. The "Other species" had the highest registered value of 0.175 individuals caught/hour and 0.077 kg/hour (avidity class 5). For the total species caught, the highest registered CPUE value of 1.811 individuals caught/hour and 0.439 kg/hour (avidity class 5) (Table 9).

Table 9 - Catch rates (CPUE) and Standard Error, calculated for the region of Alentejo, and avidity classes, in number (fish/hour) and in weight (kg/hour).

	CPUE (N/hour; kg/hour) *per* avidity class						Standard error from CPUE (N/hour; kg/hour) *per* avidity class					
NUTS II Species CPUE (N and weight)	**1**	**2**	**3**	**4**	**5**	**Without avidity class**	**1**	**2**	**3**	**4**	**5**	**Without avidity class**
ALENTEJO												
European seabass												
CPUE_N	0	**0.085**	0.011	0	0.036	0.028	-	0.026	0.003	0	0.006	0.003
CPUE_Weight	0	**0.015**	0.005	0	0.006	0.006	-	0.005	0.001	0	0.001	0.001
Spotted seabass												
CPUE_N	0	0.040	0	0.019	**0.099**	0.049	-	0.012	0	0.004	0.018	0.005
CPUE_Weight	0	0.006	0	0.003	**0.019**	0.008	-	0.002	0	0.001	0.003	0.001
Sargo breams												
CPUE_N	0	0.476	0.581	0.425	1.501	**0.885**	-	0.144	0.141	0.095	0.265	0.098
CPUE_weight	0	0.130	0.123	0.098	0.337	**0.201**	-	0.039	0.030	0.022	0.060	0.022
Others												
CPUE_N	0	0	0.123	0.129	**0.175**	0.127	-	0	0.030	0.029	0.031	0.014
CPUE_Weight	0	0	0.045	0.038	**0.077**	0.047	-	0	0.011	0.008	0.014	0.005
Total												
CPUE_N	0	0.601	0.714	0.573	**1.811**	1.088	-	0.181	0.173	0.128	0.320	0.121
CPUE_Weight	0	0.151	0.173	0.139	**0.439**	0.262	-	0.045	0.042	0.031	0.078	0.029

In the Algarve region, for the European seabass, the avidity class 3 registered the highest value of CPUE, with 0.150 individuals caught/hour of fishing and 0.035 kg/hour of fishing. For the spotted seabass, the highest registered value was 0.099 individuals caught/hour and 0.019 kg/hour for the avidity class 4. The sargo breams highest registered value was of 0.536 individuals/hour of fishing and 0.090 kg/hour of fishing, corresponding to the avidity class 4. The group "Other species" had the highest registered value of 0.490 individuals caught/hour and 0.367 kg/hour corresponding to no avidity classes. For the total species caught, the highest registered value was 1.461 individuals caught/hour and 1.122 kg/hour for the avidity class 5 (Table 10).

Table 10 - Catch rates (CPUE) and Standard Error, calculated for the region of Algarve, and avidity classes, in number (fish/hour) and in weight (kg/hour).

	CPUE (N/hour; kg/hour) *per avidity* class						Standard error from CPUE (N/hour; kg/hour) *per avidity* class					
NUTS II Species CPUE (N and weight)	**1**	**2**	**3**	**4**	**5**	**Without avidity class**	**1**	**2**	**3**	**4**	**5**	**Without avidity class**
ALGARVE												
European seabass												
CPUE_N	0	0.032	**0.068**	0.047	0.011	0.042	-	0.005	0.007	0.006	0.001	0.003
CPUE_Weight	0	0.018	**0.064**	0.022	0.008	0.031	-	0.003	0.007	0.003	0.001	0.002
Spotted seabass												
CPUE_N	0	0.106	0.063	**0.150**	0.072	0.098	-	0.015	0.007	0.018	0.009	0.006
CPUE_Weight	0	0.020	0.012	**0.035**	0.018	0.021	-	0.003	0.001	0.004	0.002	0.001
Sargo breams												
CPUE_N	0	0.168	0.396	**0.536**	0.323	0.374	-	0.024	0.044	0.064	0.041	0.023
CPUE_weight	0	0.035	0.066	**0.090**	0.072	0.068	-	0.005	0.007	0.011	0.009	0.004
Others												
CPUE_N	0	0.465	0.260	0.289	1.055	**0.490**	-	0.068	0.029	0.035	0.133	0.030
CPUE_Weight	0	0.254	0.148	0.123	1.023	**0.367**	-	0.037	0.016	0.015	0.129	0.023
Total												
CPUE_N	0	0.771	0.787	1.021	**1.461**	1.004	-	0.112	0.087	0.122	0.184	0.062
CPUE_Weight	0	0.327	0.289	0.271	**1.122**	0.486	-	0.048	0.032	0.032	0.141	0.030

For both the regions of study, the European seabass registered the highest value of CPUE in the avidity class 3, with 0.060 individuals caught/hour of fishing and 0.054 kg/hour of fishing. For the spotted seabass, the highest registered CPUE value was of 0.121 individuals caught/hour and 0.028 kg/hour for the avidity class 4. The sargo breams highest registered value was 0.720 individuals/hour of fishing and 0.161 kg/hour of fishing, corresponding to the avidity class 5. The other species had the highest registered value was 0.759 individuals caught/hour and 0.703 kg/hour (avidity class 5). For the total species caught, highest registered value was 1.579 individuals caught/hour and 0.889 kg/hour for the avidity class 5 (Table 11).

The Alentejo region has registered the highest values of CPUE for the sargo breams, both in number (0.885 individuals/hour) and weight (0.201 kg/hour), for the stratification with no avidity class. While the Algarve region has the highest CPUE values regarding the other species of interest: European seabass (0.042 individuals/hour; 0.031 kg/hour), spotted seabass (0.098 individuals/hour; 0.021 kg/hour), Others (0.490 individuals/hour; 0.367 kg/hour) and “Total number of individuals” (1.004 individuals/hour; 0.486 kg/hour).

Table 11 - Catch rates (CPUE) and Standard Error, calculated for both the regions of study, avidity classes, in number (fish/hour) and in weight (kg/hour).

	CPUE (N/hour; kg/hour) *per avidity* class						Standard error from CPUE (N/hour; kg/hour) *per avidity* class					
NUTS II **Species** **CPUE (N and weight)**	**1**	**2**	**3**	**4**	**5**	**Without avidity class**	**1**	**2**	**3**	**4**	**5**	**Without avidity class**
ALL NUTS II												
European seabass												
CPUE_N	0	0.041	**0.060**	0.036	0.019	0.039	-	0.005	0.006	0.004	0.002	0.002
CPUE_Weight	0	0.017	**0.054**	0.017	0.008	0.025	-	0.002	0.005	0.002	0.001	0.001
Spotted seabass												
CPUE_N	0	0.090	0.052	**0.121**	0.081	0.086	-	0.012	0.005	0.013	0.008	0.005
CPUE_Weight	0	0.017	0.010	**0.028**	0.018	0.018	-	0.002	0.001	0.003	0.002	0.001
Sargo breams												
CPUE_N	0	0.235	0.428	0.511	**0.720**	0.493	-	0.030	0.043	0.054	0.074	0.026
CPUE_weight	0	0.063	0.076	0.092	**0.161**	0.101	-	0.008	0.008	0.010	0.017	0.005
Others												
CPUE_N	0	0.412	0.233	0.253	**0.759**	0.410	-	0.053	0.023	0.027	0.078	0.022
CPUE_Weight	0	0.234	0.127	0.104	**0.703**	0.295	-	0.030	0.013	0.011	0.072	0.016
Total												
CPUE_N	0	0.778	0.773	0.922	**1.579**	1.029	-	0.100	0.078	0.097	0.162	0.055
CPUE_Weight	0	0.331	0.267	0.242	**0.889**	0.439	-	0.043	0.027	0.025	0.091	0.024

3.10.4 CATCH COMPOSITION

In the course of this study 856 individuals, with a total weight of 274.76 kg, were caught (all seasons and all the regions of study).

Catch composition indicates that 33 different species were caught. Special attention should be considered for *Cynoscion regalis* (squeteague) that has been recently reported as an invasive species in Portugal. The white seabream (*Diplodus sargus*) was the most captured species in this study, both in number and in weight, with 325 individuals corresponding to 86.07 kg. The gilhead seabream (*Sparus aurata*) was the second most captured specie in weight, and the third most captured species in number (97 individuals; 72.93 kg). The spotted seabass (*Dicentrarchus punctatus*) was the third most captured species in terms of weight, and the second most captured specie in number (106 individuals; 22.37 kg).

It is important to emphasize the importance of the *Sparidae* family in this study with 8 species targeted, corresponding to 183.71 kg, 65.62% of the total captured weigh (Table 12).

Table 12 - Species captured during the course of this study in all seasons of sampling, (Alentejo and Algarve). Number of specimen (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (consumption, offer, release and sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	N Total	(cm)	S.E	Consumption	Offer	Release	Sell
Pisces		**274.76**	**856**	**32.79**	**1.50**	-	-	-	-
Diplodus sargus	White seabream	86.07	325	22.78	0.29	84.00	0	16.00	0
Sparus aurata	Gilthead seabream	72.23	97	35.15	0.79	89.69	0	6.19	4.12
*Dicentrarchus punctatus**	Spotted seabass*	22.37	106	27.02	0.47	89.62	0	10.38	0
Pomatomus saltatrix	Bluefish	21.26	29	45.21	1.05	100.00	0	0	0
*Dicentrarchus labrax**	European seabass*	19.64	31	36.92	1.77	96.77	0	0	3.23
Diplodus vulgaris	Common two banded seabream	10.49	64	19.64	0.54	70.31	0	29.69	0
Diplodus bellottii	Senegal seabream	7.65	69	16.80	0.38	62.32	0	37.68	0
Scomber colias	Chub mackerel	5.63	34	26.88	0.40	100.00	0	0	0
Diplodus annularis	Annular seabream	3.54	25	18.18	0.68	40.00	0	60.00	0
Belone belone	Needlefish	3.54	15	55.47	3.12	73.33	0	26.67	0
Sarpa salpa	Salema	3.16	7	30.00	0.00	71.43	0	28.57	0
Balistes capriscus	Grey triggerfish	2.39	4	35.58	3.08	75.00	25.00	0	0
Muraena helena	Mediterranean moray	2.12	1	100.00	-	100.00	0	0	0
Diplodus spp.	Sargo breams	1.94	4	28.25	2.84	100.00	0	0	0
Trachinotus ovatus	Pompano	1.90	3	40.00	0.00	100.00	0	0	0
Labrus bergylta	Ballan wrasse	1.75	6	25.30	2.76	83.33	0	16.67	0
Phycis phycis	Forkbeard	1.63	3	36.00	2.00	100.00	0	0	0
Chelon labrosus	Thicklip grey mullet	1.37	3	33.33	3.76	66.67	0	33.33	0
Oblada melanura	Saddled seabream	1.29	5	26.40	1.57	100.00	0	0	0
Cynoscion regalis	Squeateague	1.09	2	37.50	2.50	100.00	0	0	0
Conger conger	Conger eel	0.80	1	100.00	-	100.00	0	0	0
Liza spp.	Mullets	0.58	2	32.15	2.15	50.00	0	50.00	0
Halobatrachus didactylus	Lusitadian toadfish	0.51	2	25.00	0.00	100.00	0	0	0
Diplodus cervinus	Zebra seabream	0.50	1	30.00	-	100.00	0	0	0
Lithognathus mormyrus	Sand steenbras	0.42	2	25.00	5.00	50.00	0	50.00	0
Boops boops	Bogue	0.31	4	20.00	0.00	0	0	100.00	0
Trachinus spp.	Weeverfish	0.28	6	18.50	0.96	0	0	100.00	0
Serranus cabrilla	Comber	0.10	1	20.00	-	100.00	0	0	0
Scorpaena spp.	Scorpionfish	0.09	1	15.00	-	0	0	100.00	0
Trachinus draco	Greater weever	0.07	1	23.00	-	0	0	100.00	0
Blennidae	Blennies	0.05	2	11.50	1.50	0	0	100.00	0
Cephalopoda		**3.49**	**4**	**13.95**	**0.38**	-	-	-	-
Octopus vulgaris	Common octopus	3.49	4	13.95	0.38	100.00	0	0	0
Crustacea		**1.67**	**1**	**21.00**	-	-	-	-	-
Maja squinado	Spider crab	1.67	1	21.00	-	0	100.0	0	0
TOTAL		**279.92**	**861.00**	-	-	-	-	-	-

*DCF Specie

Considering the captures of the NUTS II separately, in the Alentejo region, 257 individuals were caught, with a total weight of 70.97 kg. The white seabream (*Diplodus sargus*) was the most captured species, in number and weight, followed by the gilthead seabream (*Sparus aurata*) and the common two banded seabream (*Diplodus vulgaris*).The white seabream (*Diplodus sargus*) was, by far, the most captured specie in 2018, with 174 caught individuals, corresponding to 46.89 kg (Table 13).

Table 13 – Species captured during the course of this study in all seasons of sampling (Alentejo). Number of specimen (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (consumption, offer, release and sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	N Total	(cm)	S.E.	Consumption	Offer	Release	Sell
Pisces		**70.97**	**257**	**31.35**	**1.01**	-	-	-	-
Diplodus sargus	White seabream	46.89	174	23.06	0.38	85.06	0	14.94	0
Sparus aurata	Gilthead seabream	4.22	7	34.29	0.94	100.00	0	0	0
Diplodus vulgaris	Common two banded seabream	3.62	18	21.66	0.92	83.33	0	16.67	0
Sarpa salpa	Salema	3.16	7	30.00	0.00	71.43	0	28.57	0
*Dicentrarchus punctatus**	Spotted seabass*	2.58	16	26.19	0.64	100.00	0	0	0
*Dicentrarchus labrax**	European seabass*	1.73	8	27.58	1.41	100.00	0	0	0
Labrus bergylta	Ballan wrasse	1.72	5	27.60	1.86	100.00	0	0	0
Phycis phycis	Forkbeard	1.63	3	36.00	2.00	100.00	0	0	0
Chelon labrosus	Thicklip grey mullet	1.15	2	36.50	3.50	100.00	0	0	0
Balistes capriscus	Grey triggerfish	0.80	1	44.30	-	0	100.0	0	0
Conger conger	Conger eel	0.80	1	100.00	-	100.00	0	0	0
Diplodus spp.	Sargo breams	0.53	2	24.00	0.00	100.00	0	0	0
Diplodus cervinus	Zebra seabream	0.50	1	30.00	-	100.00	0	0	0
Oblada melanura	Saddled seabream	0.42	2	25.00	0.00	100.00	0	0	0
Lithognathus mormyrus	Sand steenbras	0.38	1	30.00	-	100.00	0	0	0
Boops boops	Bogue	0.31	4	20.00	0.00	0	0	100.00	0
Liza spp.	Mullets	0.27	1	34.30	-	100.00	0	0	0
Scomber colias	Chub mackerel	0.12	1	25.00	-	100.00	0	0	0
Serranus cabrilla	Comber	0.10	1	20.00	-	100.00	0	0	0
Blennidae	Blennies	0.05	2	11.50	1.50	0	0	100.00	0
Cephalopoda		**3.49**	**4**	**13.95**	**0.38**	-	-	-	-
Octopus vulgaris	Common octopus	3.49	4	13.95	0.38	100.00	0	0	0
Crustacea		**1.67**	**1**	**21.00**	-	-	-	-	-
Maja squinado	Spider crab	1.67	1	21.00	-	0	100.0	0	0
TOTAL		**76.14**	**262.00**	-	-	-	-	-	-

*DCF SPECIE

At the Algarve, 599 individuals were caught, with a total weight of 203.79 kg, The gilthead seabream (*Sparus aurata*) was the most captured specie in terms of weight, followed by the white seabream (*Diplodus sargus*), that was the most captured species in number, and the by the Bluefish (*Pomatomus saltatrix*) (Table 14).

In this region the catch of a non-indigenous specie, the squeateague (*Cynoscion regalis*), recently reported for the Portuguese waters, was observed.

Table 14 - Species captured during the course of this study in all seasons of sampling (Algarve). Number of specimen (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (consumption, offer, release and sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	N Total	(cm)	S.E.	Consumption	Offer	Release	Sell
Pisces		**203.79**	**599**	**31.20**	**1.24**	-	-	-	-
Sparus aurata	Gilthead seabream	68.02	90	35.22	0.84	88.89	0	6.67	4.4
Diplodus sargus	White seabream	39.18	151	22.45	0.45	82.78	0	17.22	0
Pomatomus saltatrix	Bluefish	21.26	29	45.21	1.05	100.00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	19.79	90	27.17	0.54	87.78	0	12.22	0
*Dicentrarchus labrax**	European seabass*	17.91	23	40.17	1.92	95.65	0	0	4.3
Diplodus bellottii	Senegal seabream	7.65	69	16.80	0.38	62.32	0	37.68	0
Diplodus vulgaris	Common two banded seabream	6.87	46	18.85	0.63	65.22	0	34.78	0
Scomber colias	Chub mackerel	5.51	33	26.94	0.41	100.00	0	0	0
Diplodus annularis	Annular seabream	3.54	25	18.18	0.68	40.00	0	60.00	0
Belone belone	Needlefish	3.54	15	55.47	3.12	73.33	0	26.67	0
Muraena helena	Mediterranean morey	2.12	1	100.00	-	100.00	0	0	0
Trachinotus ovatus	Pompano	1.90	3	40.00	0.00	100.00	0	0	0
Balistes capriscus	Grey triggerfish	1.58	3	32.67	1.45	100.00	0	0	0
Diplodus spp.	Sargo breams	1.41	2	32.50	3.50	100.00	0	0	0
Cynoscion regalis	Squeateaguel	1.09	2	37.50	2.50	100.00	0	0	0.0
Oblada melanura	Saddled seabream	0.87	3	27.33	2.67	100.00	0	0	0
Halobatrachus didactylus	Lusitadian toadfish	0.51	2	25.00	0.00	100.00	0	0	0
Liza spp.	Mullets	0.30	1	30.00	-	0	0	100.00	0
Trachinus spp.	Weeverfish	0.28	6	18.50	0.96	0	0	100.00	0
Chelon labrosus	Thicklip grey mullet	0.22	1	27.00	-	0	0	100.00	0
Scorpaena spp.	Scorpionfish	0.09	1	15.00	-	0	0	100.00	0
Trachinus draco	Greater weever	0.07	1	23.00	-	0	0	100.00	0
Lithognathus mormyrus	Sand steenbras	0.04	1	20.00	-	0	0	100.00	0
Labrus bergylta	Ballan wrasse	0.04	1	13.80	-	0	0	100.00	0
TOTAL		**203.79**	**599**	**31.20**	**1.24**	-	-	-	-

* DCF Specie

3.10.5 SIZE COMPOSITION OF THE CATCHES

For the species/group of species more representative in terms of catches by weight/number, a comparison with the legal minimum landing size of the was undertaken (Table 15).

Table 15 - Minimum catch size (cm) of the species/groups of species most relevant in this study, according to the NUTS II. Minimum landing size presented (in cm).

NUTS II	Alentejo	Standard error	Algarve	Standard error	Minimum landing size (cm)
Species/groups of species	Mean size (cm)		Mean size (cm)		
Common two banded seabream (*D. vulgaris*)	22	0.92	19	0.63	15.00
European seabass (*D. labrax)*	28	1.41	40	2.10	36.00
Gilthead seabream (*S. aurata*)	34	0.94	35	0.84	19.00
Sargo breams *(Diplodus* spp.*)*	24	0.00	33	3.50	15.00
Spotted seabass (*D. punctatus*)	26	0.64	27	0.54	20.00
Squeteague (*C. regalis) ***	-	-	38	2.50	No minimum landing size
White seabream (*D. sargus*)	23	0.38	23	0.45	15.00

Note: **Non-indigenous specie

In almost every species/groups of species in this study, the mean catch size is superior to the legal Minimum Landing Size. Nevertheless, in the Alentejo region, the mean catch size of the European seabass (*Dicentrarchus labrax*) was of 27.56 cm, and the Minimum Landing Size (MLS) is 36 cm.

In Fig.1 (View annex V), the length-frequency distribution of the most captured species in the study is presented: seabass, spotted seabass, white seabream and gilthead seabream. Also, the percentage of caught individuals below the MLS is indicated. For most of the species, the percentage of fish caught above Minimum Landing Size (MLS)is almost 100%, with the exception of the European seabass (*Dicentrachus labrax*), where 50% of the individuals caught are below the MLS.

3.10.6 SEASONAL CATCH COMPOSITION

3.10.6.1 WINTER SEASON

Winter was the season that registered the lowest catches. In the two regions of study, only 98 individuals were caught, representing a total catch weight of 19.06 kg. The white seabream (*Diplodus sargus*) was the most captured species in number and weight. The number and weight of other species catches can be considered as insignificant when compared to the white seabream. In fact, in second and third place, both with only 2

individuals caught, are the sargo breams (*Diplodus* spp.) and the European seabass (*Dicentrarchus labrax*), with a total weight below two kg (Table 1 - Annex I).

Considering the Alentejo region, only 47 individuals were caught, with a total weight of 9.13 kg. The white seabream (*Diplodus sargus*) remains as the most captured species, in number and weight, representing more than 86% of the total catches (Table 2 - Annex I).

The Algarve region follows the same catch pattern, with a low number of caught individuals (N=51) (Table 26 - view annex). Representing almost 50.00% of the total catches, the white seabream (*Diplodus sargus*), and the Sparidae family (71.20%) were the most targeted this season (Table 3- Annex I).

The European seabass (*Dicentrarchus labrax*) and the spotted seabass (*Dicentrarchus punctatus*) were the only DCF species caught.

3.10.6.2 SPRING SEASON

In Spring, regarding all regions of study, 320 individuals were caught, with a total weight of 109.58 kg. These results show a significant increase in terms of number and total weight of individuals caught, when comparing this season with the previous one. The white seabream (*Diplodus sargus*) and the gilthead seabream (*Sparus aurata*) were, as in the previous season, the most captured species in number and weight, respectively. The Sparidae family maintains its importance in terms of total catches, representing 58.68% (Table 1 - Annex II).

Regarding the DCF species, the European seabass (*Dicentrarchus labrax*) and the spotted seabass (*Dicentrarchus punctatus*) where the only DCF species registered.

Considering the captures of the NUTS II separately, in the Alentejo region, 84 individuals were caught, with a total weight of 20.52 kg. When comparing spring with the winter season, recreational catches double their numbers. The white seabream (*Diplodus sargus*) remains as the most captured specie, followed by the common two banded seabream (*Diplodus vulgaris*) and the gilthead seabream (*Sparus aurata*). As in the previous season, a high representation of the Sparidae family in noted (Table 2 - Annex II).

Following the same tendency of Alentejo, in the Algarve the recreational catches increased exponentially in numbers and in weight. A total of 236 individuals were caught, (89.05 kg), which represents an increase of 9.89 times in weight registered for previous season, and 4.63 times increase in number of fishes caught. The gilthead seabream (*Sparus aurata*) was the most captured specie in weight, followed by the bluefish (*Pomattomus saltatrix*) and the white seabream (*Diplodus sargus*), once again the most caught species in number (Table 3- Annex II).

3.10.6.3 SUMMER SEASON

Regarding all the species captured during the season (all the NUTS II), a total of 263 individuals were caught, weighing 94.32 kg. These results show a slight decrease in terms of number and total weight of individuals captured in comparison with the previous season.

The white seabream (*Diplodus sargus*) was again the most captured specie in terms of number, however, the gilthead seabream (*Sparus aurata*) was the most captured species in weight. Again, as in previous seasons, it is important to emphasize the importance that the Sparidae family have, representing a total of 60.55 kg, representing more than half the total catches (64.20%) (Table 1 - Annex III).

In terms of DCF species, and as in the previously season, only the European seabass (*Dicentrarchus labrax*) and the spotted seabass (*Dicentrarchus punctatus*) were caught.

During summer season, in Alentejo, 62 individuals were caught, with a total weight of 23.00 kg. The results show that the values maintained constant regarding last season. The white seabream (*Diplodus sargus*) was, again, the most captured specie in this region, followed by the common two banded seabream (*Diplodus vulgaris*) and the salema (*Sarpa salpa*) (Table 2- Annex III).

In the Algarve, 201 individuals were caught, with a total weight of 71.32 kg, representing a slight decrease in weight and number of fishes caught, when comparing with the previous season. The gilthead seabream (*Sparus aurata*) remained as the most captured species in weight and number, followed by the European seabass (*Dicentrarchus labrax*) and the white seabream (*Diplodus sargus*) (Table 3 - Annex III).

The squeteague (*Cynoscion regalis*, a non-indigenous specie, was caught in the Algarve during this season.

3.10.6.4 AUTUMN SEASON

Considering all the species captured during the spring season (all the NUTS II), 175 individuals were registered, with a total weight of 51.80 kg. These results indicate a decrease in terms of number and total weight of individuals captured, when comparing with the previous season. This decrease was registered since the spring season, which was the season that had the most catches. The white seabream (*Diplodus sargus*) was, the most captured species in terms of number (again) and in weight, followed by the gilthead seabream (*Sparus aurata*) and the spotted seabass (*Dicentrarchus punctatus*). The Sparidae family had, once again, a significant role in the species catch composition this season, with a total of 43.05 kg, representing an impressive 83.11% of the total catches (Table 1 - Annex IV).

The European seabass (*Dicentrarchus labrax*) and the spotted seabass (*Dicentrarchus punctatus*) were the only DCF species caught during this season, and during all the sampling year.

In the Alentejo region 64 individuals were caught, with a total weight of 18.32 kg. These results reveal that the values were constant when comparing with the previous season, being the white seabream (*Diplodus sargus*) the most captured specie, followed by the spotted seabass (*Dicentrarchus punctatus*) and the thicklip grey mullet (*Chelon labrosus*) (Table 2 - Annex IV).

In the Algarve, a total of 111 individuals were caught, weighing 33.48 kg, and representing a slight decrease in weight and number of fishes caught. The gilthead seabream (*Sparus aurata*) was the most captured species this season in weight and number, followed by the white seabream (*Diplodus sargus*) and the spotted seabass (*Dicentrarchus punctatus*) (Table 3 - Annex IV).

4. ANNUAL CATCH ESTIMATES

The catch estimates were calculated according to the total catches (including discards) and the retained catches - harvest (excluding discards) (Table 29 & 30).

Within scenario 1, the highest recreational catch was estimated. For 2018, a total of 2640.56 tons of retained fish was estimated for all the regions of study (Alentejo and

Algarve). The species/groups of species with the highest catch estimates were, by far, the sargo breams (*Diplodus* spp.), with a total estimated harvest of 532.43 tons, followed by the European seabass (*Dicentrarchus labrax*), with 109.13 tons and the spotted seabass (*Dicentrarchus punctatus*), with 83.23 tons (Table 17).

For scenario 2, the retained catches in 2018 accounted for an estimated total of 1992.48 tons of harvested fish, and the lowest recreational catch estimates considering all the scenarios. Within this scenario, the sargo breams (*Diplodus* spp.) continue to be the species/group of species with the highest number of total estimated harvest, 463.81 tons, followed by the European seabass (*Dicentrarchus labrax*), with 116.40 tons, and the spotted seabass (*Dicentrarchus punctatus*), with 80.22 tons.

For scenario 3, the retained catches amounted to 2037.52 tons of estimated harvested fish (2018, all sampling regions). The most captured species/groups of species were, by far, the sargo breams (*Diplodus* spp.), with a total estimated harvest of 440.61 tons, followed by the European seabass (*Dicentrarchus labrax*), with 119.03 tons, and the spotted seabass (*Dicentrarchus punctatus*), with 82.03 tons.

The Algarve was the region that registered the higher catch estimates in almost all of the studied species/groups of species. Only the catch estimates of the sargo breams (*Diplodus* spp.), were higher for the Alentejo region.

Table 16 - Different scenarios considered for the annual catch estimates for 2018, regarding the total catches (ton) for marine recreational fishing in the regions of Alentejo and Algarve, for shore-based angling and the species/groups of species considered of interest.

Species/Groups of species	European seabass (ton)			Spotted seabass (ton)			Sargo Breams (ton)			Others (ton)			Total		
NUTS II	Scenarios			Scenarios			Scenarios			Scenarios			Scenarios		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Alentejo	7.74	9.06	-	16.86	14.32	-	360.5	318.08	-	91.98	77.99	-	477.08	419.45	-
Algarve	71.34	94.76	-	67.27	68.21	-	221.91	204.36	-	1807.9	1126.83	-	2168.42	1494.16	-
Alentejo+Algarve	91.92	116.4	119.03	86.26	82.88	42.45	569.25	463.81	476.57	1951.41	1372.33	1410.11	2698.84	2035.42	2048.16

Table 17 - Different scenarios considered to the annual catch estimates for 2018, regarding the retained catches (HARVEST) (ton) for marine recreational fishing in the regions of Alentejo and Algarve, for the shore-based angling and the species/groups of species considered of interest.

Species/Groups of species	European seabass (ton)			Spotted seabass (ton)			Sargo breams (ton)			Others (ton)			Total		
NUTS II	Scenarios			Scenarios			Scenarios			Scenarios			Scenarios		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Alentejo	7.74	9.06	-	16.86	14.32	-	349.96	309.29	-	83.7	71.28	-	458.26	403.95	-
Algarve	71.34	94.76	-	63.11	63.9	-	196.37	181.03	-	1797.99	1118.13	-	2128.81	1457.82	-
Alentejo+Algarve	109.13	116.4	119.03	83.23	80.22	82.03	532.43	430.86	440.61	1932.98	1365	1395.86	2657.77	1992.48	2037.53

The premises that scenario 2 follows in the calculations of the total catches' estimates are considered the most adequate to the reality of the Algarve and Alentejo marine recreational fishing. This scenario considers all the stratifications possible, except for the CPUE's *per* avidity class, which, in theory, allows higher accuracy when the CPUEs are calculated for a population with a reduced number of anglers (as is the case in some avidity classes of this study).

5. ESTIMATES FOR DIRECT EXPENDITURES OF THE SHORE-BASED MARINE RECREATIONAL FISHING SECTOR

The direct expenditures estimates were calculated using the scenarios considered for the catch estimates. The expenses that the surveyed anglers stated to spend in each fishing event were considered.

For the expenditures estimates *per* fishing episode, the following expenses were considered: car fuel, bait, fishing gear bought for the fishing event in question, restaurants (food), accommodation (hotel) and other expenditures made specifically for the fishing event in question.

In each fishing episode of 2018, anglers of Alentejo and Algarve spent, in average, 5.18 euros in car fuel, 2.01euros in accommodation, 2.27 euros in food, 6.34 euros in bait, 0.75 euros in fishing gear and 0.13 euros in other related expenditures (Table 31).

Table 18 - Average estimates for annual (2018) expenditures (in euros) for all regions of study (Alentejo and Algarve). Standard Error (S.E.) presented. N=349.

	Direct fishing expenditures (in euros)					
	Car fuel	Hotel	Food	Bait	Fishing gears	Other
Average	5.18 €	2.01 €	2.27 €	6.34 €	0.75 €	0.13 €
S. E.	0.43 €	0.77 €	0.36 €	0.34 €	0.32 €	0.04 €

The direct shore-based angling annual direct expenditures estimates for the NUTS II regions of study (Algarve and Alentejo) were calculated and are presented in Table 19.

Considering the scenario 2, a total of 1.67 million euros were estimated as direct expenditures made by marine recreational shore anglers in the regions of Algarve and Alentejo during 2018.

Table 19 - Different scenarios for the shore-based angling direct annual expenditures estimates, regarding the NUTS II regions of Algarve and Alentejo.

Direct expenditures (millions of euros)		
SCENARIOS		
1	2	3
1.64 M€	1.67 M€	1.51 M€

6. COMPARISON WITH THE COMMERCIAL FISHING LANDINGS

The comparison of recreational fishing catch estimates values and commercial fishing landings was developed for each of the considered scenarios (for the study regions). The commercial data was obtained through the official statistics provided by INE (https://www.ine.pt), and used for the calculation of the average values of nominal captures according to the species/groups of species of interest, between the years of 2007 and 2017, by NUTS II (Table 20).

Table 20 – Comparison between commercial fishing landings (tons), and estimated retained catches for the recreational fishing (tons), for the considered scenarios and regarding the seabasses (*D. labrax* + *D. punctatus*) and the sargo breams (*Diplodus* spp.).

	NUTS II	Alentejo		Algarve		Alentejo + Algarve	
Scenarios	Species/groups of species of interest	Recreational fishing estimates (tons)	Commercial fishing landings (tons)	Recreational fishing estimates (tons)	Commercial fishing landings (tons)	Recreational fishing estimates (tons)	Commercial fishing landings (tons)
1	Seabasses (*D.labrax + D.punctatus*)	24.6	38	134.45	52	192.36	90
2		23.38	38	158.66	52	196.62	90
3		-	-	-	-	201.06	90
1	Sargo breams (*Diplodus* spp.)	349.96	-	196.76	-	546.72	-
2		303.29	-	181.03	-	484.32	-
3		-	-	-	-	440.61	-

Taking into consideration that scenario 2 was the one considered as the most adequate to represent the reality of the marine recreational fishing in the studied area, the comparison with the commercial fishing landings were carried using the calculated estimates values for this scenario.

The total estimated catches of the seabasses consider the combination of the estimated catches of European seabass (*Dicentrarchus labrax*) and spotted seabass (*Dicentrarchus punctatus*) because this is the level of detail of the official landings' statistic for the commercial fishing. The sargo breams family (*Diplodus* spp.) represent the combination of all of the species of the genus Diplodus (*Diplodus sargus, Diplodus vulgaris, Diplodus annularis, Diplodus bellottii* and *Diplodus cervinus*).

For the Alentejo, 23.38 tons of caught seabass was estimated for the marine recreational fishing shore anglers (2018). The commercial fishing sector has declared to have caught 38 tons of seabass in the region of study. The recreational fishing estimates represent 38.09% of the total catches (Recreational + Commercial) in this region of study. Regarding the seabream family (*Diplodus* spp.), 303.29 tons of sargo breams were estimated to be caught by marine recreational anglers during 2018. The commercial fishing landings statistics available do not have the NUTS II level of detail, so it is not possible to make a comparison for the study area. Nevertheless, the calculated recreational fishing value for the seabream catch estimates in 2018 (303.29 tons), which represents 35.47% of the national commercial landings.

The Algarve region marine recreational anglers are estimated to have caught 158.66 tons of seabass during 2018, while the commercial fishing sector has declared to have caught 52 tons of seabass in the region. The marine recreational estimated catches for this species are 3.05 times higher than the commercial fishing landings in the same region. Regarding the sargo breams, a total of 158.66 tons were estimated to have been caught by marine recreational shore anglers in 2018, representing 18.56% of the national commercial landings for the species in analysis.

7. DISCUSSION

7.1 MARINE RECREATIONAL FISHING IN PORTUGAL

Recent estimates indicate that the participation rate of MRF in Portugal is 1.67% (Hyder *et al.,* 2018). Arlinghaus *et al.* (2014) tested the hypothesis that the participation rate is positively correlated with the cultural importance of fish and fishing of a certain country and with the consumption of fish *per* capita. Portugal has an undeniable sea cultural heritage and is amongst the countries with the highest consumption of fish *per* capita, with values > 50 kg fish/year (FAO, 2017). This can contribute to explaining the high participation rates of Portugal.

The high participation rate highlights the importance of managing Portuguese fisheries using only not only on commercial fishing but considering also the recreational part of total removals (Gordoa *et al.,* 2019).

7.2 RESPONSE RATE

The EU Data Collection Framework highlights member states mandatory collection regarding specific data, including estimates of recreational catches for selected species (EU, 2001). Nevertheless, obtaining data from the recreational fishing sector is only possible through (on and or offsite) surveys, which credibility is highly depended on the response rates of the surveyed individuals (Pollock *et al.,* 1994). Also, there is a certain degree of uncertainty regarding the acceptance of these surveys by the angler's community, highly dependent on the anglers' profiles (Rangel, 2003). This may lead to the underestimation of certain portions of a population. In fact, e.g., more avid anglers tend to be more suspicious and, therefore, have a higher probability of not being included in surveys which, therefore, report smaller participation rates (Pollock *et al.,* 1994).

In this study, the response rates were considered representative of the targeted population in both study regions, being 85.71% for the Alentejo region and 86.89% for the Algarve. Rangel (2003) and Veiga *et al*. (2010) obtained response rates of 99% and 95% respectively. The decrease in response rates for MRF survey along the years may be

correlated with the fact that in 2006 some restriction measures were implemented in Portugal, such as mandatory licensing, minimum landing sizes and daily quotas and closures (Portaria nº868/2006). Nevertheless, the response rates of the present study seem representative of the anglers' population in the study area.

7.3 SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERIZATION OF SHORE-BASED ANGLING IN SOUTH AND SOUTHWEST PORTUGAL

The sampled marine recreational anglers' population is almost entirely composed by males (98.57%), which is in accordance with all previous studies regarding MRF in Portugal (Rangel, 2003; Lima, 2006; Diogo, 2007; Erzini *et al*., 2008; Marcelino, 2010; Diogo & Pereira, 2013).

The typical marine angler of the south and southwest Portugal is a male (98.57%), with an age ranging between 41 and 70 years old (62.46%), married (67.62%), professionally active (65.62%), with an average monthly income of 501€ to 750€ and with a low educational level.

The male gender dominance for MRF fisheries population is a known fact in Portugal (Rangel, 2003; Lima, 2006; Diogo, 2007; Erzini *et al*., 2008; Marcelino, 2010; Diogo & Pereira, 2013) and around the world (Arlinghaus & Mehner, 2002; Pawson *et al*., 2007; Zarautz *et al.*, 2015; Pita *et al.*, 2018; Pita and Villasante, 2019). As stated by Erzini *et al.*, (2008), it is important to emphasize that there were no registered changes in anglers' gender proportion over the last years. This does not necessarily mean that all of the recreational anglers are males, but it clearly indicates that males are more avid anglers (Steffe & Chapman, 2003), having a higher probability of being surveyed.

A wide range of angler's age was registered in the region of Algarve and Alentejo, which varies from 5 to 85 years, as also observed by Rangel (2003) in the north of Portugal, Diogo (2007) in the islands of Faial and Pico (Azores), and Erzini *et al*., (2008) in the Algarve and most of Alentejo. Despite being a considerably wide range, the most common age class of the sampled population varies between 41 and 70 years old, with a mean age of 52.42 years for Alentejo and 51.58 years for Algarve. This range of ages

seems to be directly connected with the reported number of years of experience in the recreational activity.

Algarve and Alentejo have a highly experienced angler's population, with almost 35% of the surveyed individuals having more than 40 years of experience in the recreational activity. These high values in experience years are probably connected with the fact that there is an associated cultural heritage, where the parents (mostly the father) initiates his descendants in recreational fishing since an early age (*pers. obs.*, 2018). The average number of experience years of fishing, considering both the regions, is 22.53 years, similar with the ones registered by Erzini *et al*., (2008) for the same study area (23 years of experience).

Some believe that recreational fishing is practiced mainly by retired and unemployed individuals. Nevertheless, in this study, the non-active individuals do not seem to represent the angler's population. From 349 surveyed anglers, 65.61% reported to be employed (active) and only 4.87% were unemployed. There is, however, an important portion of the population that is retired (27.22%). According to PORDATA (2019), 35% of Portugal's population is inactive, corresponding approximately to the proportion referred to in this study (32.09%).

For the regions of study, the educational level of the surveyed anglers is, in general, low. In the Algarve region, however, a higher educational level was observed when compared with the one reported for the Alentejo region. This may be due to the fact that the Algarve is the most famous Portuguese tourist area (Cruz, 2014), attracting anglers from other parts of the country and even from other countries, and thus reflecting different realities. Nonetheless, the generically low educational level is probably connected with the fact that the population in study comprehends a generation of people with mandatory schooling only until the primary school level.

The educational level is, in most cases, directly connected with monthly incomes (Alves *et al*., 2010). This is an important hypothesis to consider, given that the sampled population has low educational level, and also due to the fact that most of the interviewed anglers stated monthly earnings ranging between [501-750]. Rangel (2003) and Erzini *et al*., (2008) studies corroborate the hypothesis because both had a sampled population with both low educational level and low monthly incomes rates.

Most of the surveyed anglers (from the Alentejo and Algarve) lived in the area where they were interviewed (67.62%), whereas 22.35% were on vacations. The Alentejo region has registered a higher percentage of vacation anglers when compared to the Algarve region, 26.19%, and 21.13% respectively. As previously stated, the Algarve region is well recognized as the favourite Portuguese vacation hotspot (Cruz, 2014). However, it is possible that people who choose to spend vacations in the Algarve went to the beach for sun and sea, whereas vacationists that choose the Alentejo to spend their holidays engaged in the fishing activity.

A high number of anglers from the south side of Algarve were surveyed fishing in the southwest coast of Algarve and even in the Alentejo region. According to Erzini *et al.*, (2008), this could be explained by a possible perception of marine resources reduction in the south coast of Algarve, forcing anglers to search for better fishing spots. Cox *et al*. (2002) refer that wider amplitude of angler's dispersion can represent a response to the decline of a certain resource.

While analysing the economics of the recreational fishing activity, an average angler expenditure of 13.06 euros *per* fishing trip was calculated (direct expenditure), from which 6.89 € was spent in bait, 5.36 € in transportation and 0.81 € in fishing gear. The average value of 13.06 € spent *per* fishing trip is similar to the average 13.30 € calculated for direct expenditures in the study of Erzini *et al.*, (2008) for the same regions. It was estimated that the marine recreational anglers for the region of Alentejo and Algarve spend a total of 1.67 million euros annually, only in direct expenditures. There are no figures to compare these values to the national level, but, Hyder *et al*. 2018 reported an average of 796 euros spent by Portuguese anglers/year.

7.4 ANGLERS TEMPORAL AND SPACE DISTRIBUTTION

One of the main reasons that explain why recreational fishing has so many participants, is the quality time spent with family and/or friends during a fishing trip (Duda *et al.*, 1999). From the 349 fishing events in analysis, 52.15% reported to be lonely fishers and 47.56% were included in groups of families/friends (0.29% did not answer this question). Some of the anglers that were fishing alone revealed that they do not like

to share fishing spots with other anglers, even if they are friends, to maximize the total number of fish caught.

Most of the surveyed anglers reported fishing during the entire year, having no clear preference for a particular month or season. Some of them stated that they fish more often during the winter and spring months, even though the atmospheric and sea conditions may difficult (or even impede) fishing events (*per. obs.*, 2018). Nevertheless, fishers that do not fish during the entire year seem to prefer the months of June, July, and September to engage in the activity. These are summer months that, usually, have better weather conditions and more daylight hours, which allows anglers to have better fishing conditions. These results are in consonance with the ones obtained in the studies of Vale (2003), Rangel (2003) and Erzini *et al.*, (2008), that report fishers that also refer the summer months as the most targeted to practice marine recreational fishing. It should be highlighted that the summer month of August was not included in the preferred months, probably due to the fact of being the Portuguese public services holiday month. This fact, combined with the Algarve and Alentejo being touristic hotspots (Cruz, 2014), may lead to a concentration of people that can discourage the recreational fishing activity.

It is important to emphasise that during the summer months, fishing in concessioned beaches is forbidden, leading marine recreational anglers to fish predominantly in jetties (Erzini *et al.*, 2008) or outside the hours of concession (from 9pm to 9am).

7.5 PERCEPTIONS AND ATTITUDES TOWARDS MANAGEMENT MEASURES

The opinions of stakeholders about the state of the marine resources, at the beginning of their fishing activity and nowadays, and about different aspects of the activity, is considered increasingly important for decision-making, in order to promote compliance and to share responsibilities regarding common resource (Mackinson *et al.*, 2011).

The first regulatory law for MRF was implemented in 1957 (Decreto-lei 41444/1957), nevertheless this fishing activity was an open access activity until 2006, having no restrictions (Rangel & Erzini, 2007; Erzini *et al.*, 2008). The first regulatory

measures were implemented in 2006, together with the first restrictions to the activity (Portaria 868/2006 de 29 de Agosto). During our study, the great majority of the anglers stated to know the legislation and the associated management measures (87.68%).

It should be emphasised that some specific legislation measures are in place for the Alentejo, such as a seasonal closure for white seabream (*Diplodus sargus*) (Portaria nº115-B/2011). Most of the surveyed anglers reported to be reasonably satisfied with the ongoing legislation, but when asked about this specific legislation, most of them referred to be strongly against this seasonal closure, given that it only prohibits shore-based marine recreational fishing and not commercial fisheries, spearfishers and boat-based anglers. Erzini *et al.*, (2008) conduced his field sampling immediately after the implementation of the first restrictions on MRF (Portaria 868/2006 de 29 de Agosto), and probably due to the recent implementation of the legislative measures (at the time), more than 50% of the population were against this legislation. The present study was undertaken 13 years after the implementation of this legislative regulation, which probably gave time to the anglers to consider the benefits of this management measures in the improvement of their fisheries and targeted resources.

In order to take into account, the perceptions and opinions of fishers regarding marine resources, the surveyed anglers were asked to share their opinion regarding the current state of these resources. Anglers were unanimous in reporting a steady decay in their abundance. When asked who to blame for this decline, the great majority of the anglers choose not to answer. For those who answered, pollution and commercial fishing were pointed out as the main causes. This is in agreement with the studies of Vale (2003) and Erzini *et al*., (2008), which also referred to pollution and commercial fishing as responsible for the decline of marine resources.

7.6 CATCH ANALYSIS

The analysis of the fishing events revealed that the number of events with catches was higher than the number of events without catches. A successful fishing day is normally associated with the catch of one or more fishes, which according to Rangel (2003) implies that fishers will continue to engage in this activity.

During the fishing events monitored in this study, 33 different species were caught, even though the total catches were dominated by white seabream (*Diplodus sargus*), which represented 30.66% of the total weight, and 37.75% of the total number of catches. If we combine the catches of all species of the taxa *Diplodus* spp. (including white seabream), they will correspond to 39.39% of the total weight and 56.78% of the total number. This type of dominance of a few groups of species in recreational fisheries has already been identified in the literature (Pradervand & Baird, 2002; Pradervand, 2004), and is considered as an indicator of abundance and of a specific target species (Pradervand, 2004; Erzini *et al.*, 2008). However, the composition of the catches is not a faithful descriptor of the systems species composition (Gordoa *et al.*, 2019), given that the fishers consume only a portion of the catches (Arlinghaus *et al.*, 2009) and they are known to be selective towards species with culinary value (Lewin *et al.*, 2006).

The white seabream is one of the most valued and abundant in Portugal (Gonçalves *et al*., 2007; 2006) and, its importance is noticed as it is one of the most targeted species by recreational anglers. The gilthead seabream (*Sparus aurata*), the white seabream (*Diplodus sargus*) and the European seabass (*Dicentrarchus labrax*) were the most targeted species reported in this study. Some species, however, may be absent from the most desired, not due to the anglers, but due its scarcity and difficulty to catch (Erzini *et al.*, 2008). This scarcity of some species may lead recreational anglers not to comply with, e.g., the Minimum Landing Size (MLS) legislation (*pers. obs.*, 2018). In the present study, most of the species sizes complied with this regulation, however for one European seabass (*Dicentrarchus labrax*), 50% of the individuals caught were below the MLS (36 cm). This result may indicate scarcity, or the high importance given to this species, promoting fishers to retain them disregarding the size.

It should be highlighted that the night period was not considered for analysis, as occurred in other Portuguese MRF's studies: Rangel (2003), Erzini *et al*., (2008); Marcelino (2010). This may lead to a sampling underestimation of some species that are most active at night, such as the conger eel and the moray eel.

From the top five discarded species, four belong to the Sparidae family: *Diplodus sargus* (33.99%), *Diplodus bellottii* (16.99%), *Diplodus vulgaris* (12.42%) and *Diplodus annularis* (9.80%); and one is a DCF species (*Dicentrarchus punctatus* - 6.71%) (Table 1 – View Annex VI).

Most of the discards do not included species with low commercial value, as in the studies of Marcelino (2010), Erzini *et al.*, (2008) and Rangel (2003), but some of the most targeted species of the study. This probably indicates compliance with the current legislation. The most common reasons referred by anglers top discarding was undersized fish, and lack of interest regarding species with no (or low) commercial value.

7.7 FISHING EFFORT AND CATCH *PER* UNIT OF EFFORT

Marine recreational fishing is an important and popular recreational activity in the south of Portugal (Veiga *et al.*, 2010). Most of the anglers referred to fishing throughout the year, whenever possible. Anglers from both the studied regions reported to go fishing, on average, 47 days *per* year. When comparing between regions, the Alentejo anglers are more avid anglers than the ones from the Algarve (59 days and 44 days *per* year, respectively). Hyder *et al.* (2018) compiled effort data from several European countries and estimated that the average Portuguese marine recreational angler fish in 36.83 days *per* year.

In terms of seasonal effort, a highest number of surveyed anglers was registered during the Spring and the Summer for the Alentejo region, and the Summer for the region of Algarve. As previously stated, the Summer months have better conditions for the practice of recreational fishing which could explain the preference for this period. The Spring however could be one of the most preferred seasons for the Alentejo anglers because, as quoted by Erzini *et al.*, (2008), there is a phenomenon called "arribação", where the Sparidae species, and mostly the white seabream, come close to shore to spawn. Sparidae are known to form spawning aggregations, and the white sargo breams spawning period extends from March to May, with a peak in the months of March and April (Mouine *et al.*, 2007). This may lead to increased chances of catching this fish, and probably to the higher number of anglers encountered during this time period.

It must be emphasized that, for calculation purposes, fishing days (effort) were stratified *per* avidity class (considering the different scenarios presents – view section 3.8 from the results); Avidity class 1 (inactive) – 0 fishing days; Avidity class 2 (occasional)

– 6 fishing days; Avidity class 3 (regular) – 20 fishing days; Avidity class 4 (frequent fishers) – 46 fishing days; Avidity class 5 (very frequent) – 106 fishing days;

The catch rates during this study were weighted according to the avidity class of each angler, this was a novel an innovative approach for Portuguese MRF studies, but it also implies that this approach cannot be compared with any other national study. However, one can argue that the CPUE's are comparable with those registered by Erzini *et al*., (2008) for the same study area. Erzini *et al.*, (2008), for the species in focus in this study, calculated the following CPUEs, in weight and number, respectively: European seabass (*Dicentrarchus labrax*) 0.020 kg/hour and 0.011N/hour; white seabream (*Diplodus sargus*), 0.401kg/hour and 0.101 N/hour; spotted seabass (*Dicentrarchus punctatus*), 0.002 kg/hour and 0.013 N/hour. Whereas, in the present study, the overall CPUE's calculated in weigh and number were: European seabass (0.025 kg/hour and 0.039 N/hour), spotted seabass (0.018 kg/hour and 0.086 N/hour), sargo breams (0.101 kg/hour and 0.493 N/hour) and others (0.295 kg/hour and 0.410 N/hour).

The Alentejo region, registered the highest value of CPUE for the sargo breams (*Diplodus* spp.), both in number (N) and in weight (W) and registered also the highest CPUE regarding the total species caught in the study in number (N). While the Algarve had higher catch rates for the European seabass (*Dicentrarchus labrax*), spotted seabass (*Dicentrarchus punctatus*) and "Others species" (all of the species caught in the study, with the exception of the sargo breams and the seabasses) both in number (N) and in weight (W) and regarding the CPUE in weight (W) for the Total species caught. The existence of a Natural Park, which covers a great percentage of the Alentejo coastline and encompasses the preferential habitat type preferences of the sargo breams, probably lead to the high contribution of these species to the catch composition.

7.8 CATCH ESTIMATES

The estimated annual total catches for the regions of Algarve and Alentejo revealed to be much higher that the estimates for the same regions by Erzini *et al*., (2008). As expected, and considering the most targeted species in this study, the sargo breams (*Diplodus* spp.) had the highest annual harvest estimates with 430.86 tons, while for the DCF species, the European seabass and the spotted seabass had 116.40 tons and 82.88 tons of fish annually retained, respectively.

The CPUEs calculated in this study are very similar to the ones in Erzini *et al.*, (2008), however, the catch estimates are much higher. To estimate total recreational catch, the CPUEs (or the catch rates) were multiplied by the fishing effort (in number of fishing days), using a different method than Erzini *et al.*, (2008) for the effort calculation. Also, the total catch estimate of scenario 2 in which the CPUE was not stratified (contrarily to the fishing effort) was considered the best representative of the Portuguese reality. Erzini *et al.*, (2008) used fishers' instantaneous counts (using aerial surveys) for fishing effort calculation, which is not comparable with the fishing effort method used for this study, which was based on the fishing hours, the number of licenses and the number of reported fishing days for the previous 12 months. The method used in the present study may have caused some overestimation in the total catch estimates because of the high fishing effort calculated, given that the CPUEs were not considered *per* avidity class (and are quite similar to those of previous studies in the same area, such as Erzini *et al.*, 2008).

By requiring the recall on the number of days that the interviewers spent fishing in the previous 12 months, the survey may have been subjected to bias, since previous research have shown that recall periods higher than two months may significantly overestimate quantitative catch and effort data (Teixeira *et al*., 2016). Even though during this study, and to reduce bias, a correction factor available in literature were used, the final outcomes in number of days that the anglers referred to have been fishing in the last 12 months (specially for the most avid ones), are still higher than the values that exist in the available literature for the Atlantic European countries. Erzini *et al*., (2008) referred an average of 65 fishing days *per* year, Pita *et al.* (2018) calculated 29.64 days for Spanish fishers, and for other European countries, fishing effort values indicated are of 36.8 days (Hyder *et al.*, 2018). Nonetheless, it is important to emphasise that, when using the effort estimates (expressed in number of days) of Hyder *et al.* (2018) for Portugal (36.8 days) – scenario 3 – the estimated annual catches are even higher than those considered as most reliable (scenario 2).

The potential bias of the present study is probably due to the influence of more avid anglers in the sampled population. Onsite survey methods tend to overestimate the sample population of the most avid anglers, since they go fishing more often, and spend more time in the fishing spots, having thus a higher probability of being surveyed (Armstrong *et al*., 2013; Teixeira *et al*., 2016; Bellanger & Levrel, 2017; Pita *et al*., 2018).

The proportion of anglers by avidity class was (DGRM, 2016): Avidity 1 (inactive anglers) - 1.15%; fishing effort: 0 days; Avidity 2 (occasional anglers) – 17.19%; fishing effort: 6 days; Avidity 3 (regular anglers) – 28.37%; fishing effort: 20 days; Avidity 4 (frequent anglers) – 25.79%; fishing effort: 46 days and Avidity 5 (very frequent anglers) – 27.51%; fishing effort: 106 days. Within this proportion, an overestimation of the catch estimates was probably due to the high proportion of most avid anglers in the surveyed anglers' population.

When comparing the catch estimates with those presented by Erzini *et al.*, (2008) for the same regions, a possible overestimation of the present study's values regarding fishing effort calculations should be considered. However, the catch estimates reported by Erzini *et al*., (2008) are likely to be underestimated (also because of the effort calculation methods). The most realistic values for the shore-based MRF annual catch estimates for the study regions probably range between both studies.

7.9 RECREATIONAL CATCHES VS COMMERCIAL FISHING LANDINGS

There are undeniable conflicts between the recreational and the commercial fishing sector. Given the global decline in aquatic resources, these conflicts have been accentuating over the past decades (Cooke & Cowx, 2006; Pawson *et al*., 2008).

When comparing the average recreational angler fishing, with a commercial trawler, recreational fishing appears not to have any impact at all. Nevertheless, considering the global panorama, the number of recreational anglers exceeds in great part the number of commercial fishers (Cooke & Cowx, 2006).

One of the main objectives of this study was to conduct a comparative analysis between shore based MRF and the commercial fishing landings in the regions of Algarve and Alentejo. Probably due to the apparent overestimation of the catch estimates, for both the study areas, the MRF estimates of the annual catches exceed in more than 10% the commercial fishing landings, in all the proposed scenarios. According to Veiga (2010), this 10% value is a threshold from which it is necessary to include MRF catch estimates in stock assessment studies.

Analysing catch estimates by regions, the Alentejo seabasses (*Dicentrarchus labrax* + *Dicentrarchus punctatus*) annual catch estimates represent 38% of the annual total catches (recreational and commercial). For sargo breams (*Diplodus* spp.) MRF annual estimates cannot be compared with the total annual catches, because the official statistics on commercial fishing nominal catch landings are nor detailed on a NUTS II level. Nevertheless, when analysing the sargo breams catch estimates of Alentejo and the national sargo breams commercial landings, the recreational catches correspond to 35.47% of the national sargo breams commercial landings.

In the Algarve, seabasses recreational catch represents 75% of the total annual catches (recreational and commercial), and the sargo breams recreational catches represent 21.17% of the national sargo breams commercial landings.

Nevertheless, we need to consider that the official commercial landings may be underestimated due to unreported catches, especially on the species with high commercial value, like the sargo breams and the seabasses (Cabral *et al.*, 2003). As previously stated, the recreational catch estimates calculated for this study can be overestimated (see – Catch Estimates, above) and, thus, the importance of MRF can be significantly high, when compared with commercial landings. Regarding the seabasses, if we take in consideration only the total European seabass (*Dicentrachus labrax*) recreational catch estimates, and compare them to the total commercial landings for this species, these represent "only" 57.03% of the annual total catches (recreational and commercial). This may indicate that probably the low commercial landings of the spotted seabass (*Dicentrarchus punctatus*), when incorporated in the *Dicentrarchus* genus catches, promotes an overestimation error for the seabasses contribution comparison (MRF with all fisheries). In certain species, literature states that recreational can exceed commercial catches (Cooke & Cowx, 2006), especially due to the preference of certain species for shallow coastal areas that are inaccessible to commercial fishing.

8. FINAL CONSIDERATIONS AND FUTURE RECOMMENDATIONS

The present study was one of the few to contribute with up-to-date information regarding the Portuguese marine recreational fishing sector in recent years. An innovative approach was considered to calculate catch estimates, which can be used as a baseline for future studies and serve as a tool to current management. The presented values are specific to a particular region and time period, and since it is the first time that some methodologies are being used, the results should be interpreted and weighted with care.

The sustainable management of a complex socio-ecological system like recreational fishing is not easy and requires a regular data collection to improve both the understanding and management of MRF. Anglers' participation in studies of this nature is crucial, to ensure the viability of these and future studies, and to monitor assessments. This study should serve as an incentive to continue collection of information on a periodical basis, on a national level or specific regions, as well as different fishing modes.

A way to promote future needed studies would be to use a portion of the revenue coming from fishing licenses to finance new projects and continuous monitoring of the activity.

The socioeconomic characterization is also very important for the study of MRF. One of the key impediments in resource allocation processes, in fisheries management and policy development, is the difficulty in quantifying the contribution of recreational fishing to society (Pita *et al*., 2018). This need led to the socio-demographic and economic characterization of the fishers interviewed in this study. The sampled marine recreational anglers' population is almost entirely composed by males (98.57%), with an age ranging between 41 and 70 years old (62.46%), married (67.62%), professionally active (65.62%), with an average monthly income of 501€ to 750€ and with a low educational level. These patterns are in accordance with all previous studies regarding MRF in Portugal (Rangel, 2003; Lima, 2006; Diogo, 2007; Erzini *et al*., 2008; Marcelino, 2010; Diogo & Pereira, 2013).

The methodological approach (face-to-face questionnaires) revealed to be adequate and accurate for the calculation of CPUE's, with low associated standard errors. Nevertheless, this approach is not so effective when providing estimates for the fishing

effort. Due to the lack of scientific support and the innovative approach, it was not possible to compare the fishing effort with other national studies. The continuous use of this methodology is recommended for future studies and should be complemented with off-site methods (web or phone surveys with a panel of fishers) to address a possible overestimation of the fishing effort. The off-site methods are important to obtain robust and adequate avidity classes, being able to attain correction factors to calibrate and validate the fishing effort. Revising the categorization of the fishing licenses, using the periodicity and the area of operation, is urgent to prevent biased information. The NUTS II division of fishing licences is crucial to access fishing effort and should be re-implemented, allowing the scientists and the policy makers to have a more realistic estimate for the allocation of recreational angler's effort.

Catch estimates and the comparison with the commercial fishing sector have highlighted the importance of MRF in the Portuguese fishing sector, having similar and, in some cases, higher catches than commercial fishing. Despite the probable overestimation of the annual catch estimates, the comparison between the recreational and the commercial fishing sectors can be considered as a baseline for management, providing up-to-date scientific knowledge.

The collection of the angler's opinions and perceptions regarding e.g. the existing regulation was one of the objectives of this study. As so, important themes such as catch tendency, current state of the marine resources, legislative and management measures, among others, were approached in this study. Considering all the obtained results, it is important to conduct satisfaction surveys regarding the stakeholders and all of the marine-related authorities (scientists, managers, and policy-makers) in an attempt to review and adequate some legislation aspects that may not be in consonance with the current state of the recreational activity.

To promote adequate and effective management, it is mandatory to enhance monitoring and enforcement of the legislative measures. Most of the surveyed anglers referred that they were never approached by the competent authorities while fishing. If there is no police enforcement, it is not possible to ensure that the legislation and management measures are being followed.

In general, this study allow us to conclude that MRF is a very important activity in the Portuguese fishing panorama, and should be studied, evaluated and monitored on

a regular basis. Studies that are isolated in time are excellent “first impressions”, however they do not reflect the interannual nature of the activity.

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ANNEX I – WINTER RESULTS: CATCH *PER* UNIT OF EFFORT

Table 1 Annex I – Species captured during the winter season (Alentejo and Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weigh t	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**19,06**	**98**	**26,00**	**1,39**	**-**	**-**	**-**	**-**
Diplodus sargus	White seabream	12,69	64	20,10	0,75	90,63	0	9,38	0
Diplodus spp.	Sargo breams	1,41	2	32,50	3,50	100,00	0	0	0
*Dicentrarchus labrax**	European seabass*	1,27	2	38,50	0,50	100,00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	0,92	5	26,46	3,64	100,00	0	0	0
Conger conger	Conger eel	0,80	1	100,0	-	100,00	0	0	0
Diplodus vulgaris	Common two-banded seabream	0,52	7	15,43	1,21	71,43	0	28,57	0
Halobatrachus didactylus	Lusitadian toadfish	0,51	2	25,00	0,00	100,00	0	0	0
Boops boops	Bogue	0,31	4	20,00	0,00	0	0	100,00	0
Sparus aurata	Gilthead seabream	0,20	2	19,00	2,00	100,00	0	0	0
Diplodus bellottii	Senegal seabream	0,12	3	12,67	0,78	100,00	0	0	0
Serranus cabrilla	Comber	0,10	1	20,00	-	100,00	0	0	0
Scorpaena spp.	Scorpionfish	0,09	1	15,00	-	0	0	100,00	0
Blennidae	Combtooth blennies	0,05	2	11,50	1,50	0	0	100,00	0
Lithognathus mormyrus	Sand steenbras	0,04	1	20,00	-	0	0	100,00	0
Labrus bergylta	Ballan wrasse	0,04	1	13,80	-	0	0	100,00	0
TOTAL		**19,06**	**98**	**-**	**-**	**-**	**-**	**-**	**-**

* DCF SPECIES

Table 2 Annex I – Species captured during the winter season (Alentejo). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**9,13**	**47**	**34,45**	**0,78**	**-**	**-**	**-**	**-**
Diplodus sargus	White seabream	7,87	39	20,74	0,83	87,18	0	12,82	0
Conger conger	Conger eel	0,80	1	100,00	-	100,00	0	0	0
Boops boops	Bogue	0,31	4	20,00	0,00	0	0	100,00	0
Serranus cabrilla	Comber	0,10	1	20,00	-	100,00	0	0	0
Blennidae	Combtooth blennies	0,05	2	11,50	1,50	0	0	100,00	0
TOTAL		**9,13**	**47**	**-**	**-**	**-**	**-**	**-**	**-**

* DCF SPECIES

Table 3 Annex I – Species captured during the winter season (Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**9,93**	**51**	**21,59**	**1,63**	**-**	**-**	**-**	**-**
Diplodus sargus	White seabream	4,82	25	19,09	1,42	96,00	0	4,00	0
Diplodus spp.	Sargo breams	1,41	2	32,50	3,50	100,00	0	0	0
*Dicentrarchus labrax**	European seabass*	1,27	2	38,50	0,50	100,00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	0,92	5	26,46	3,64	100,00	0	0	0
Diplodus vulgaris	Common two-banded	0,52	7	15,43	1,21	71,43	0	28,57	0
Halobatrachus didactylus	Lusitadian toadfish	0,51	2	25,00	0,00	100,00	0	0	0
Sparus aurata	Gilthead seabream	0,20	2	19,00	2,00	100,00	0	0	0
Diplodus bellottii	Senegal seabream	0,12	3	12,67	0,78	100,00	0	0	0
Scorpaena spp.	Scorpionfish	0,09	1	15,00	-	0	0	100,00	0
Lithognathus mormyrus	Sand steenbras	0,04	1	20,00	-	0	0	100,00	0
Labrus bergylta	Ballan wrasse	0,04	1	13,80	-	0	0	100,00	0
TOTAL		**9,93**	**51**	**-**	**-**	**-**	**-**	**-**	**-**

* DCF SPECIES

ANNEX II – SPRING RESULTS: CATCH *PER* UNIT OF EFFORT

Table 1 Annex II – Species captured during the spring season (Alentejo and Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**109,58**	**320**	**32,34**	**1,01**	**-**	**-**	**-**	**-**
Sparus aurata	Gilthead seabream	27,17	25	40,38	1,66	92,00	0	4,00	4,00
Diplodus sargus	White seabream	25,82	99	22,65	0,52	83,84	0	16,16	0
Pomatomus saltatrix	Bluefish	19,11	26	45,04	1,16	100,00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	14,05	60	27,68	0,62	95,00	0	5,00	0
Diplodus bellottii	Senegal seabream	7,03	60	17,10	0,41	66,67	0	33,33	0
*Dicentrarchus labrax**	European seabass*	6,60	15	33,43	2,08	93,33	0	0	6,67
Diplodus vulgaris	Common two banded seabream	3,41	20	20,40	1,01	70,00	0	30,00	0
Muraena helena	Mediterranean moray	2,12	1	100,00	-	100,00	0	0	0
Balistes capriscus	Grey triggerfish	1,58	3	32,67	1,45	100,00	0	0	0
Sarpa salpa	Salema	0,90	2	30,00	0,00	0	0	100,00	0
Liza spp.	Mullets	0,58	2	32,15	2,15	50,00	0	50,00	0
Diplodus cervinus	Zebra seabream	0,50	1	30,00	-	100,00	0	0	0
Diplodus annularis	Annular seabream	0,37	2	20,50	0,50	100,00	0	0	0
Chelon labrosus	Thicklip grey mullet	0,22	1	27,00	-	0	0	100,00	0
Trachinus draco	Greater weever	0,07	1	23,00	-	0	0	100,00	0
Trachinus spp.	Weeverfish	0,04	2	15,50	0,50	0	0	100,00	0
TOTAL		**109,58**	**320**	-	-	-	-	-	-

* DCF SPECIES

Table 2 Annex II – Species captured during the spring season (Alentejo). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**20,52**	**84**	**28,12**	**0,92**	-	-	-	-
Diplodus sargus	White seabream	11,45	51	21,70	0,68	80,39	0	19,61	0
Diplodus vulgaris	Common two banded seabream	2,75	14	21,42	1,18	78,57	0	21,43	0
Sparus aurata	Gilthead seabream	2,47	4	34,63	1,55	100,00	0	0	0
*Dicentrarchus labrax**	European seabass*	1,57	7	27,94	1,57	100,00	0	0	0
Sarpa salpa	Salema	0,90	2	30,00	0,00	0	0	100,00	0
*Dicentrarchus punctatus**	Spotted seabass*	0,60	4	25,00	0,54	100,00	0	0	0
Diplodus cervinus	Zebra seabream	0,50	1	30,00	-	100,00	0	0	0
Liza spp.	Mullets	0,27	1	34,30	-	100,00	0	0	0
TOTAL		**20,52**	**84**	-	-	-	-	-	-

* DCF SPECIES

Table 3 Annex II – Species captured during the spring season (Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**89,05**	**236**	**32,86**	**1,17**	-	-	-	-
Sparus aurata	Gilthead seabream	24,70	21	41,48	1,87	90,48	0	4,76	4,76
Pomatomus saltatrix	Bluefish	19,11	26	45,04	1,16	100,00	0	0	0
Diplodus sargus	White seabream	14,37	48	23,65	0,79	87,50	0	12,50	0
*Dicentrarchus punctatus**	Spotted seabass*	13,46	56	27,87	0,66	94,64	0	5,36	0
Diplodus bellottii	Annular seabream	7,03	60	17,10	0,41	66,67	0	33,33	0
*Dicentrarchus labrax**	European seabass*	5,02	8	38,23	2,71	87,50	0	0	12,50
Muraena helena	Mediterranean moray	2,12	1	100,00		100,00	0	0	0
Balistes capriscus	Grey triggerfish	1,58	3	32,67	1,45	100,00	0	0	0
Diplodus vulgaris	Common two banded seabream	0,66	6	18,00	1,63	50,00	0	50,00	0
Diplodus annularis	Senegal seabream	0,37	2	20,50	0,50	100,00	0	0	0
Liza spp.	Mullets	0,30	1	30,00		0	0	100,00	0
Chelon labrosus	Thicklip grey mullet	0,22	1	27,00		0	0	100,00	0
Trachinus draco	Greater weever	0,07	1	23,00		0	0	100,00	0
Trachinus spp.	Weeverfish	0,04	2	15,50	0,50	0	0	100,00	0
TOTAL		**89,05**	**236**	-	-	-	-	-	-

* DCF SPECIES

ANNEX III – SUMMER RESULTS: CATCH *PER* UNIT OF EFFORT

Table 1 Annex III – Species captured during the summer season (Alentejo and Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**94,32**	**263**	**32,17**	**1,39**	-	-	-	-
Sparus aurata	Gilthead seabream	30,33	52	32,69	0,84	88,46	0	7,69	3,85
Diplodus sargus	White seabream	23,55	81	24,23	0,43	82,72	0	17,28	0
*Dicentrarchus labrax**	European seabass*	10,49	11	41,82	3,73	100,00	0	0	0
Scomber colias	Chub mackerel	5,05	31	26,74	0,41	100,00	0	0	0
Diplodus vulgaris	Common twobanded seabream	4,85	23	21,26	0,82	86,96	0	13,04	0
Belone belone	Needlefish	3,15	11	60,00	3,30	100,00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	2,67	10	28,10	1,59	90,00	0	10,00	0
Sarpa salpa	Salema	2,26	5	30,00	0,00	100,00	0	0	0
Pomatomus saltatrix	Bluefish	2,15	3	46,67	1,67	100,00	0	0	0
Trachinotus ovatus	Pompano	1,90	3	40,00	0,00	100,00	0	0	0
Phycis phycis	Forkbeard	1,63	3	36,00	2,00	100,00	0	0	0
Labrus bergylta	Ballan wrasse	1,47	4	28,25	2,25	100,00	0	0	0
Diplodus annularis	Annular seabream	1,31	10	18,30	0,73	30,00	0	70,00	0
Cynoscion regalis	Weakfish	1,09	2	37,50	2,50	100,00	0	0	0
Oblada melanura	Saddled seabream	0,87	3	27,33	2,67	100,00	0	0	0
Balistes capriscus	Grey triggerfish	0,80	1	44,30	-	0	100,00	0	0
Diplodus bellottii	Senegal seabream	0,51	6	15,83	0,70	0	0	100,00	0
Trachinus spp.	Weeverfish	0,24	4	20,00	0,00	0	0	100,00	0
Cephalopoda		**3,49**	**4**	**13,95**	**0,38**	-	-	-	-
Octopus vulgaris	Common octopus	3,49	4	13,95	0,38	100,00	0	0	0
Crustacea		**1,67**	**1**	**21,00**	-	-	-	-	-
Maja squinado	Common spider crab	1,67	1	21,00	-	0	100,00	0	0
TOTAL		**99,48**	**268**	-	-	-	-	-	-

* DCF SPECIES

Table 2 Annex III – Species captured during the summer season (Alentejo). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**23,00**	**62**	**32,15**	**1,21**	-	-	-	-
Diplodus sargus	White seabream	15,98	47	25,53	0,58	85,11	0	14,89	0
Sarpa salpa	Salema	2,26	5	30,00	0,00	100,00	0	0	0
Phycis phycis	Forkbeard	1,63	3	36,00	2,00	100,00	0	0	0
Labrus bergylta	Ballan wrasse	1,47	4	28,25	2,25	100,00	0	0	0
Balistes capriscus	Grey triggerfish	0,80	1	44,30	-	0	100,00	0	0
Sparus aurata	Gilthead seabream	0,71	1	36,00	-	100,00	0	0	0
*Dicentrarchus labrax**	European seabass*	0,16	1	25,00	-	100,00	0	0	0
Cephalopoda		**3,49**	**4**	**13,95**	**0,38**	-	-	-	-
Octopus vulgaris	Common octopus	3,49	4	13,95	0,38	100,00	0	0	0
Crustacea		**1,67**	**1**	**21,00**	-	-	-	-	-
Maja squinado	Common spider crab	1,67	1	21,00	-	0	100,00	0	0
TOTAL		**28,16**	**67**	-	-	-	-	-	-

* DCF SPECIES

Table 3 Annex III – Species captured during the summer season (Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**71,32**	**201**	**31,45**	**1,39**	-	-	-	-
Sparus aurata	Gilthead seabream	29,63	51	32,63	0,85	88,24	0	7,84	3,92
*Dicentrarchus labrax**	European seabass*	10,33	10	43,50	3,68	100,00	0	0	0
Diplodus sargus	White seabream	7,57	34	22,44	0,51	79,41	0	20,59	0
Scomber colias	Chub mackerel	5,05	31	26,74	0,41	100,00	0	0	0
Diplodus vulgaris	Common twobanded seabream	4,85	23	21,26	0,82	86,96	0	13,04	0
Belone belone	Needlefish	3,15	11	60,00	3,30	100,00	0	0	0
*Dicentrarchus punctatus**	Spotted seabass*	2,67	10	28,10	1,59	90,00	0	10,00	0
Pomatomus saltatrix	Bluefish	2,15	3	46,67	1,67	100,00	0	0	0
Trachinotus ovatus	Pompano	1,90	3	40,00	0,00	100,00	0	0	0
Diplodus annularis	Annular seabream	1,31	10	18,30	0,73	30,00	0	70,00	0
Cynoscion regalis	Weakfish	1,09	2	37,50	2,50	100,00	0	0	0
Oblada melanura	Saddled seabream	0,87	3	27,33	2,67	100,00	0	0	0
Diplodus bellottii	Senegal seabream	0,51	6	15,83	0,70	0	0	100,00	0
Trachinus spp.	Weeverfish	0,24	4	20,00	0,00	0	0	100,00	0
TOTAL		**71,32**	**201**	-	-	-	-	-	-

* DCF SPECIES

ANNEX IV – AUTUMN RESULTS: CATCH *PER* UNIT OF EFFORT

Table 1 Annex IV – Species captured during the autumn season (Alentejo and Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**51,80**	**175,00**	**28,37**	**1,05**	-	-	-	-
Diplodus sargus	White seabream	24,00	81	23,60	0,59	80,25	0	19,75	0
Sparus aurata	Gilthead seabream	14,53	18	36,81	1,45	88,89	0	5,56	5,56
*Dicentrarchus punctatus**	Spotted seabass*	4,72	31	25,48	0,68	77,42	0	22,58	0
Diplodus annularis	Senegal seabream	1,86	13	17,74	1,19	38,46	0	61,54	0
Diplodus vulgaris	Common two banded seabream	1,71	14	18,00	0,98	42,86	0	57,14	0
*Dicentrarchus labrax**	European seabass*	1,29	3	35,33	1,45	100,00	0	0	0
Chelon labrosus	Thicklip grey mullet	1,15	2	36,50	3,50	100,00	0	0	0
Scomber colias	Chub mackerel	0,58	3	28,33	1,67	100,00	0	0	0
Diplodus spp.	Sargo breams	0,53	2	24,00	0,00	100,00	0	0	0
Oblada melanura	Saddled seabream	0,42	2	25,00	0,00	100,00	0	0	0
Belone belone	Needlefish	0,39	4	43,00	0,00	0	0	100,00	0
Lithognathus mormyrus	Sand steenbras	0,38	1	30,00	-	100,00	0	0	0
Labrus bergylta	Ballan wrasse	0,25	1	25,00	-	100,00	0	0	0
TOTAL		**51,80**	**175,00**	-	-	-	-	-	-

* DCF SPECIES

Table 2 Annex IV – Species captured during the autumn season (Alentejo). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**18,32**	**64**	**27,16**	**0,84**	-	-	-	-
Diplodus sargus	White seabream	11,58	37	24,24	0,82	89,19	0	10,81	0
*Dicentrarchus punctatus**	Spotted seabass*	1,98	12	26,58	0,81	100,00	0	0	0
Chelon labrosus	Thicklip grey mullet	1,15	2	36,50	3,50	100,00	0	0	0
Sparus aurata	Gilthead seabream	1,04	2	32,75	0,25	100,00	0	0	0
Diplodus vulgaris	Common two banded seabream	0,87	4	22,50	0,50	100,00	0	0	0
Diplodus spp.	Sargo breams	0,53	2	24,00	0,00	100,00	0	0	0
Oblada melanura	Saddled seabream	0,42	2	25,00	0,00	100,00	0	0	0
Lithognathus mormyrus	Sand steenbras	0,38	1	30,00	-	100,00	0	0	0
Labrus bergylta	Ballan wrasse	0,25	1	25,00	-	100,00	0	0	0
Scomber colias	Chub mackerel	0,12	1	25,00	0,82	100,00	0	0	0
TOTAL		**18,32**	**64**	-	-	-	-	-	-

* DCF SPECIES

Table 3 Annex IV – Species captured during the autumn season (Algarve). Number (N), total weight (kg), total length (TL), mean total length (cm), Standard error (S.E) and Destinations of the captures (Consumption, Offer, Release and Sell).

Scientific name	Common name	Total weight	N	Mean TL	TL	Destination (%)			
		(kg)	Total N	(cm)	S. E	Consumption	Offer	Release	Sell
Pisces		**33,48**	**111**	**28,43**	**0,86**	-	-	-	-
Sparus aurata	Gilthead seabream	13,49	16	37,31	1,59	87,50	0	6,25	6,25
Diplodus sargus	White seabream	12,42	44	23,07	0,85	72,73	0	27,27	0
*Dicentrarchus punctatus**	Spotted seabass*	2,74	19	24,78	0,97	63,16	0	36,84	0
Diplodus annularis	Senegal seabream	1,86	13	17,74	1,19	38,46	0	61,54	0
*Dicentrarchus labrax**	European seabass*	1,29	3	35,33	1,45	100,00	0	0	0
Diplodus vulgaris	Common two banded seabream	0,84	10	16,20	0,80	20,00	0	80,00	0
Scomber colias	Chub mackerel	0,45	2	30,00	0,00	100,00	0	0	0
Belone belone	Needlefish	0,39	4	43,00	0,00	0	0	100,00	0
TOTAL		**33,48**	**111**	-	-	-	-	-	-

* DCF SPECIES

ANNEX V – LENGTH-FREQUENCY DISTRIBUTIONS OF THE MOST IMPORTANT SPECIES

Figure 1 Annex V – Length-frequency distribution of the catches of European seabass (*Dicentrarchus labrax*), regarding all sampled season, and for both regions of study (Alentejo and Algarve).

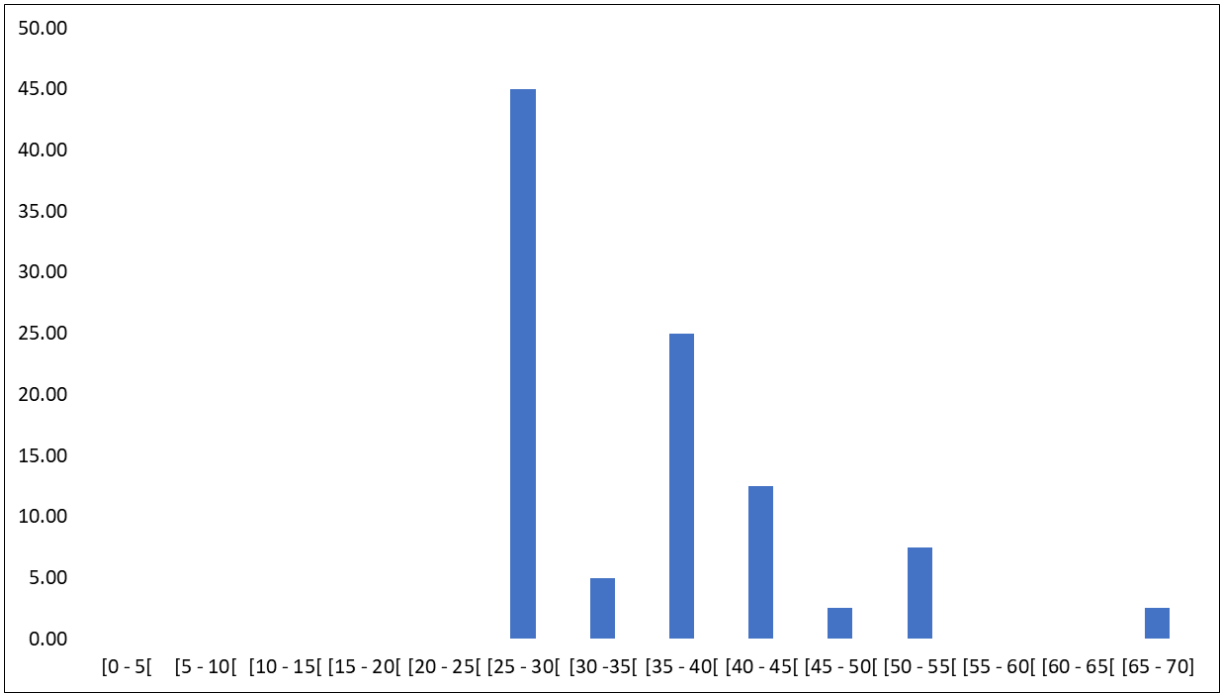


Figure 2 Annex V – Length-frequency distribution of the catches of spotted seabass (*Dicentrarchus punctatus*), regarding all sampled season, and for both regions of study (Alentejo and Algarve).

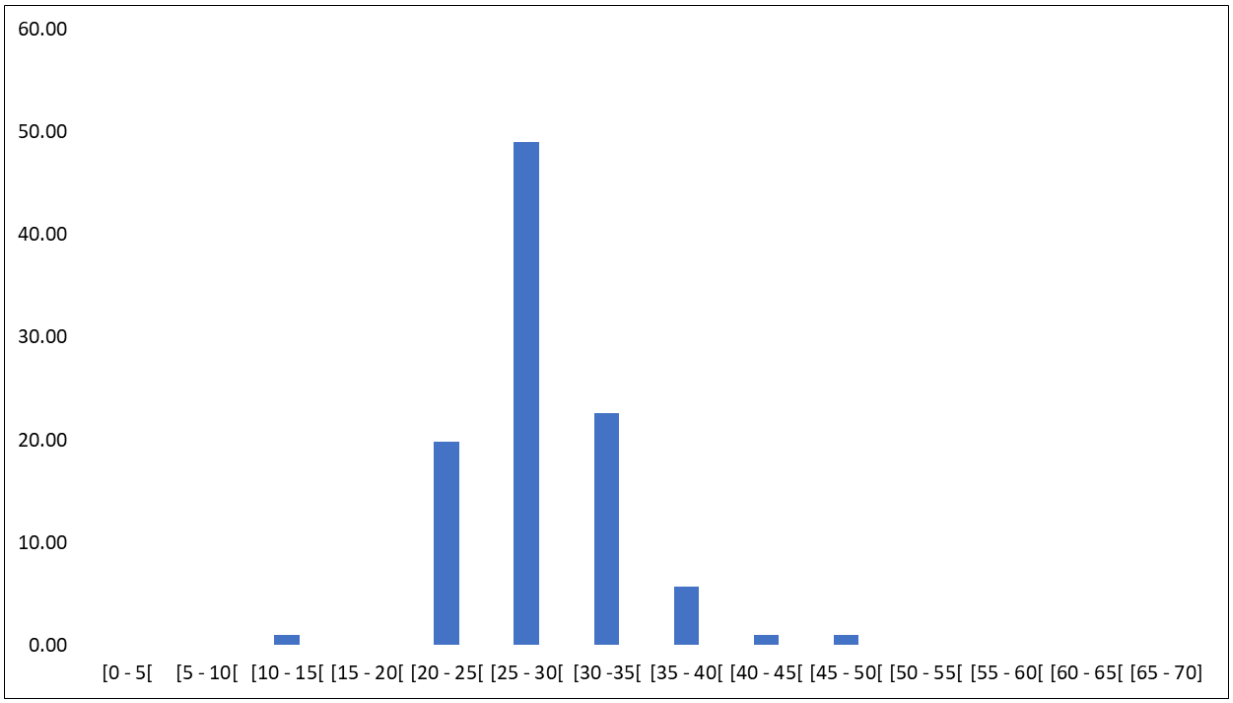


Figure 3 Annex V – Length-frequency distribution of the catches of white seabream (*Diplodus sargus*), regarding all sampled season, and for both regions of study (Alentejo and Algarve).

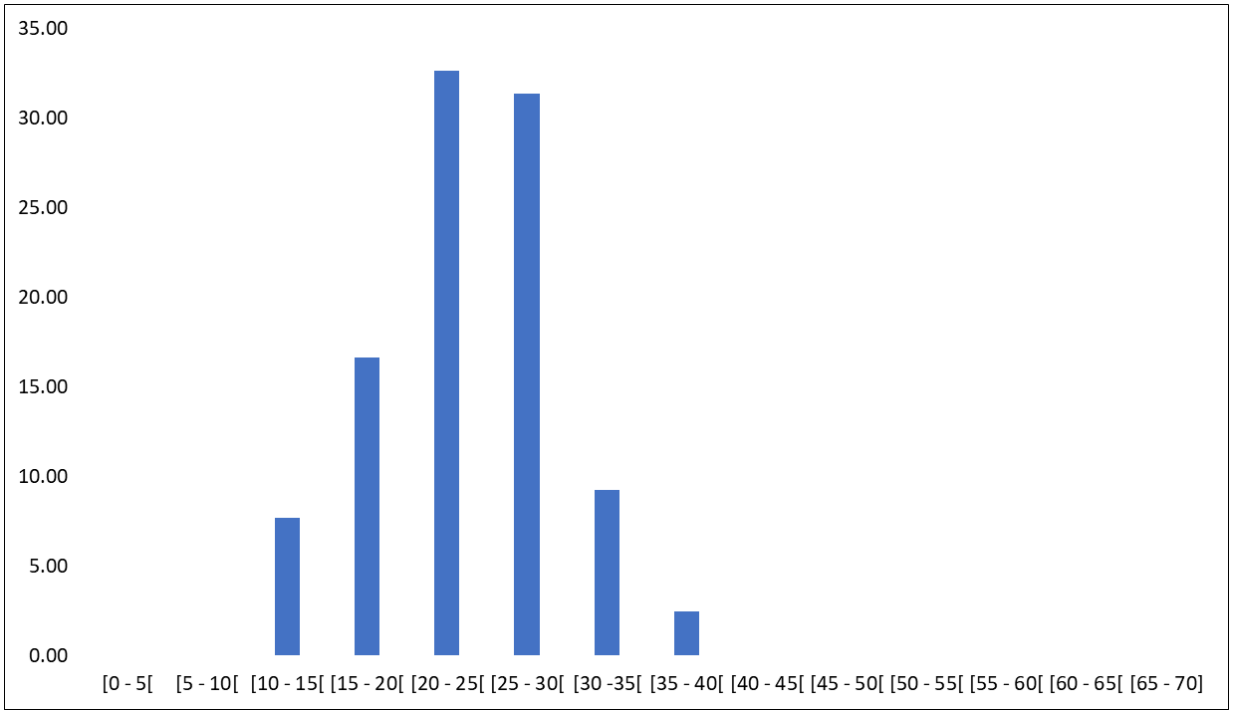
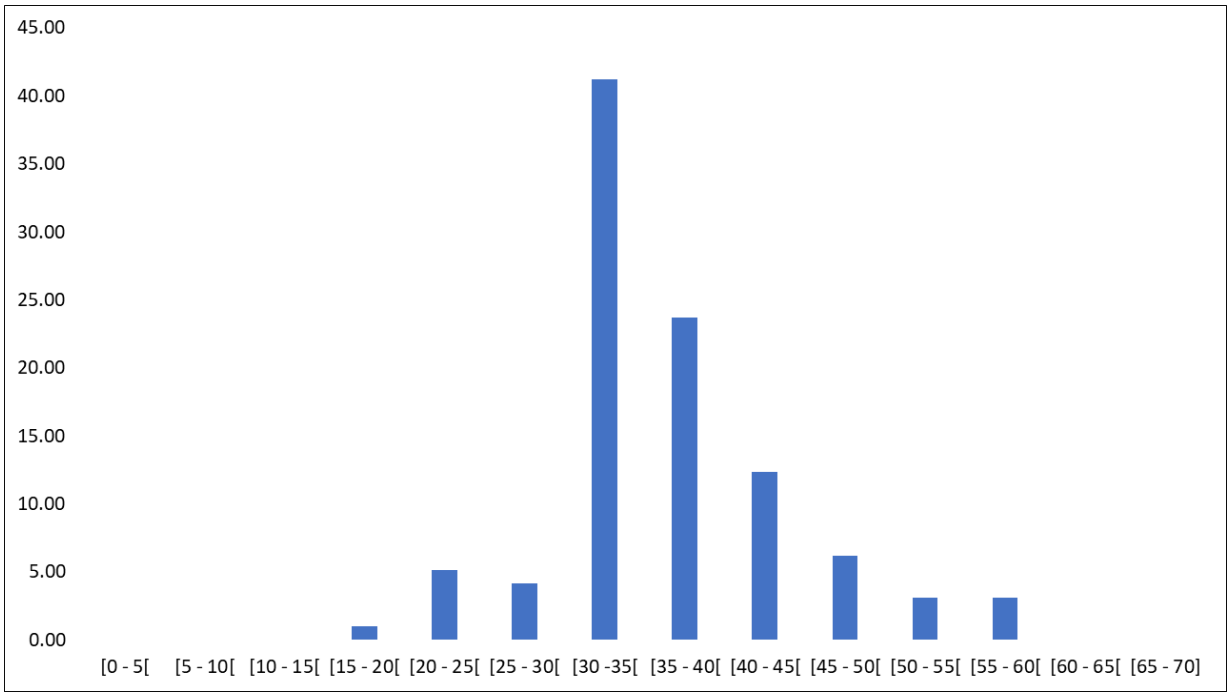


Figure 4 Annex V – Length-frequency distribution of the catches of gilthead seabream (*Sparus aurata*), regarding all sampled seasons, and for both regions of study (Alentejo and Algarve).



ANNEX VI – DISCARD SPECIES

Table 1 Annex VI - Species discarded in all sampled seasons in both regions of study (Algarve and Alentejo). Number of specimen (N and %), total weight (kg and %), and captured area.

Scientific name	Common name	Captured area	Number		Weight	
			N	%	Kg	%
Diplodus sargus	White seabream	Both	57	34.76	5.01	34.29
Diplodus bellottii	Senegal seabream	Algarve	26	15.85	1.51	10.35
Diplodus vulgaris	Common two banded seabream	Both	19	11.59	1.25	8.58
Diplodus annularis	Annular seabream	Algarve	15	9.15	1.32	9.01
Dicentrarchus punctatus	Spotted seabass	Algarve	11	6.71	1.07	7.35
Trachinus spp.	Weeverfish	Algarve	9	5.49	0.46	3.17
Sparus aurata	Gilthead seabream	Algarve	7	4.27	1.34	9.20
Boops boops	Bogue	Both	6	3.66	0.53	3.62
Belone belone	Needlefish	Algarve	4	2.44	0.39	2.67
Blennidae	Combtooth blennies	Alentejo	2	1.22	0.05	0.33
Sarpa salpa	Salema	Alentejo	2	1.22	0.90	6.18
Chelon labrosus	Thicklip grey mullet	Algarve	1	0.61	0.22	1.50
Labrus bergylta	Ballan wrassw	Algarve	1	0.61	0.04	0.26
Lithognathus mormyrus	Sand steenbras	Algarve	1	0.61	0.04	0.27
Liza spp.	Mullets	Algarve	1	0.61	0.30	2.08
Scorpaena spp.	Scorpionfish	Algarve	1	0.61	0.09	0.63
Trachinus draco	Greater weever	Algarve	1	0.61	0.07	0.51
Total			**164**	**100**	**14.60**	**100**

ANNEX VII – QUESTIONNAIRE

O presente questionário pretende recolher dados para a caracterização da pesca recreativa em Portugal Continental no âmbito do projecto Pescardata. Os resultados serão analisados em conjunto e a sua resposta é confidencial. Obrigada pela colaboração!

Nota: as opções NC (-66) – Não compreende / NA (-77) – não aplicável / NS (-88) – Não sabe / NR (-99) – Não responde devem ser aplicadas sempre que se justifiquem e de forma a não deixar nenhuma resposta em branco

ID do Questionário:

DATA_NUT_GRID_NINQU_NTREVISTADOR: _____

Inq /dia nº: _____ Hora de início: _____ Hora de fim: _____

Entrevistador: _____ NUTII: _____ GRID: _____

Semana ou FDS? _____ Manhã ou Tarde? _____

Observações _____

Modalidade praticada hoje:

(1) Pesca com cana de costa
(2) Pesca com cana embarcada
(3) Pesca submarina de costa
(4) Pesca submarina embarcada

SECÇÃO 1 (A) – CARACTERIZAÇÃO GERAL DA ACTIVIDADE

1. **Qual a sua principal razão para pescar nesta área (NUTS II)?** _____
2. **A pesca recreativa para si é...**

(escolher uma opção)

(1) A actividade de lazer mais importante (mas pratico outras)
(2) A actividade de lazer mais importante (e única)
(3) A 2ª actividade de lazer mais importante
(4) A principal actividade de lazer
(5) A 3ª actividade de lazer mais importante
(6) Apenas mais uma actividade de lazer
(7) Outra? Qual?

3. **Qual a principal razão para praticar pesca recreativa:**

(escolher uma opção)

(1) Para estar ao ar livre/descontrair
(2) Lazer familiar
(3) Experimentar coisas novas e diferentes
(4) Estar em contacto com o mar
(5) Apanhar peixe para comer
(6) Pela adrenalina da captura
(7) Apanhar peixe para vender
(8) Para estar com os amigos
(8) Pelo desafio do desporto
(10) Pela quantidade de peixes capturados
(11) Pelo tamanho dos peixes capturados
(12) Para capturar um troféu

4. **Em que meses do ano gosta mais de pescar?** _____
5. **Para a modalidade que está hoje a praticar, quantas vezes pescou nos últimos 12 meses (aproximadamente):**

Estação o ano	Nesta região (NUTS II)	Portugal Continental (resto do pais)
7.1 Na primavera		
7.2 No verão		
7.3 No outono		
7.4 No inverno		
7.5 NS		
7.6 NR		

Se não tiver houver resposta para o grau de detalhe indique por favor, para a modalidade que está hoje a praticar, quantas vezes pescou nos últimos 12 meses (aproximadamente):

Nesta NUTS II: _____ No resto do país: _____

6. **Qual é a fase da maré em que prefere pescar?** *(perguntar cada 5 inquéritos)*
(1) Cheia
(2) Enchente
(3) Estofo da enchente
(4) Vazia
(5) Vazante
(6) Estofo da vazante
(7) Tanto faz
(8) NS
(9) NR

7. **Qual é a fase da lua em que prefere pescar?** *(perguntar cada 5 inquéritos)*
(1) Cheia
(2) Quarto crescente
(3) Quarto minguante
(4) Nova
(5) Tanto faz
(6) NS
(7) NR

8. **Quando prefere começar a pescar (madrugada, manhã, meio do dia, tarde, crepúsculo, noite)?** *(perguntar cada 5 inquéritos)*
8.1 Na primavera: _____
8.2 No verão: _____
8.3 No outono: _____
8.4 No inverno: _____

9. **Pratica pesca recreativa há quantos anos (exclua anos que não praticou)?** _____

10. **Praticou pesca desportiva quantos anos (exclua anos que não praticou)?** _____

11. **Há quantos anos pesca recreativamente nesta região (NUTII) específica?** _____

12. **Pratica Pesca de água doce em Portugal?** ( ) Sim ( ) Não

13. **Pratica Pesca de água doce nesta região (NUT II)?** ( ) Sim ( ) Não

14. **Pratica apanha recreativa em Portugal?** ( ) Sim ( ) Não

15. **Pratica apanha recreativa nesta região (NUT II)?** ( ) Sim ( ) Não

16. **Se sim, a apanha recreativa é dirigida principalmente a quê? (resposta aberta):**
_____

17. **Se sim, esta apanha é para:**
(1) Isco para a sua pesca (2) Consumo
(3) Venda (4) Outro (5) NS (6) NR

18. **Quantas horas pesca habitualmente numa saída de pesca?**
18.1 Na primavera: _____
18.2 No verão: _____
18.3 No outono: _____
18.4 No inverno: _____

19. **Em geral, considera que a quantidade de pescado nesta região (NUTII) específica aumentou ou diminuiu?**

	Aumentou	Diminuiu	Manteve	NS	NR	Porquê?
12.1 No último ano	( )	( )	( )	( )	( )	12.1.1: _____
12.2 Últimos 10 anos	( )	( )	( )	( )	( )	12.2.1: _____
12.3 Últimas décadas	( )	( )	( )	( )	( )	12.3.1: _____

20. **Na sua opinião qual a influência de cada um dos seguintes factores na presença e abundância de peixe** *(perguntar cada 5 inquéritos)*

	Alta	Média	Baixa	Nenhuma	NS	NR
13.1 Tipo de fundo						
13.2 Temperatura						
13.3 Salinidade						
13.4 Turbidez						
13.5 Chuva						
13.6 Corrente						
13.7 Vento						
13.8 Lua						
13.9 Ondulação						
13.10 Poluição						
13.11 Outros						

SECÇÃO 2 (B) – PESCARIA

1. Está cá de:
   (1) Fim-de-semana
   (2) Férias
   (3) Residente (neste NUTS II)
   (4) Outro (qual: _____)

2. Hoje veio pescar:
   (1) Sozinho
   (2) Com familiares
   (3) Com amigos
   (4) Em grupos organizados (e.g., pesca turística)

3. A pescaria de hoje foi a sua principal razão desta deslocação? ( ) Sim ( )Não
4. Se NÃO, qual foi a sua principal razão?
5. A pescaria de hoje é:
   (1) De lazer
   (2) Desportiva – 8.1) Prova:
   (3) De lazer, no âmbito de pesca turística (charter)
6. Que distância viajou por terra hoje para chegar ao local da pescaria (ou do embarque) (ida e volta)? _____ m / Km
7. Que distância viajou por mar hoje para chegar ao local da pescaria (ida e volta)? _____ milhas *(Pesca Apesda: NA)*
8. De onde saiu de barco (de que marina): _____ *Pesca apeada: NA*
9. Início da pesca (linha na água): _____ H _____ min
10. Fim da pesca (equipamento fora de água): _____ H _____ min
11. Saída de pesca com hora final ( ) Previsível ( ) Real
12. Saída completa? ( ) Sim ( )Não *(a preencher pelo entrevistador)*
13. Nesta pescaria quanto gastou em:

13.1 – Combustível (para terra): _____
13.2 – Combustível (barco): _____ PA: NA
13.3 – Isco e engodo: _____ PSub: NA
13.4 – Equipamento: _____
13.5 – Restauração: _____
13.6 – Hotelaria: _____
13.7 – Aluguer barco: _____ PA: NA
13.8 – Outro_____
13.8.1)_____

14. Quantas pessoas pescaram consigo hoje? _____ *(número total a contar com o entrevistado)*
15. Dividiu alguma despesa?
    15.2 Nenhuma: ( ) Sim ( )Não ( ) NS ( ) NR
    Se alguma:
    15.2.1) Despesa: _____ 15.2.2) Nº de pescadores: ____
    15.3.1) Despesa: _____ 15.3.2) Nº de pescadores: ____
    15.4.1) Despesa: _____ 15.4.2) Nº de pescadores: ____
16. Qual a primeira, segunda e terceira espécie-alvo (há a hipótese de "nenhuma"?
    19.1) _____
    19.2) _____
    19.3) _____
17. Qual a modalidade de pesca praticada hoje durante mais tempo (escolher uma opção)?

☐ 1 Pesca grossa
☐ 1.1 Peixes de bico
☐ 1.2 Atuns
☐ 1.3 Tubarões
☐ 1.4 Outras espécies
☐ 2. Pesca ao corrico
☐ 3. Palangrote
☐ 4. Pesca a grande profundidade
☐ 5. Pesca à boia / sentir / chumbadinha / tendo
☐ 6. Pesca à pluma (à mosca)
☐ 7. De lançamento
☐ 8. Ao fundo
☐ 9. Spinning (amostra)
☐ 10 Espera agachon
☐ 11 Espera à índio
☐ 13. Na espuma
☐ 14. Outra: _____

18. Em quantos locais pescou hoje? (indicar o número de locais)
19. Relativamente ao local onde pescou ONDE PRATICOU A MAIOR PARTE DO TEMPO DA SUA PESCARIA hoje indique:
    19.1 Nome do pesqueiro: resposta aberta (tipo: praia dos arrifes): _____
    19.2 Características específicas: _____
    (apontar características tipo: arriba, praia, pontão, praia com ervas marinhas, ..)
    19.3 Localização específica: _____
    19.4 Tipo de fundo:

☐ Rochoso	☐ Lodoso
☐ Arenoso	☐ Algas/ervas marinhas
☐ Interface rocha/areia	☐ Cascalho

    19.5 Profundidade local:_____

Equipamento – 2.1 (C) Pesca embarcada

20 Que barco utiliza e qual o nome do barco?
21 Quantos anos tem?
22 A quem pertence?
23 Quanto custou?
24 No barco utilizado indicar:

24.1 Arqueação:	<u>Electrónica a bordo:</u>
24.2 Potência:	(indique se tem) SIM/NAO
24.3 Convés aberto / fechado (opção)	24.7 Sonda
24.4 Comprimento de fora a fora:	24.8 GPS
24.5 Lotação:	24.9 Plotter / Chat Plotter
	24.10 Rádio VHF
24.6 Categoria de matricula (zona de navegação):	_____

Equipamento – 2.2 (D) Pesca com cana

25. Qual o número de canas total utilizado? _____ (número inteiro)
26. Qual o número de montagens utilizado? _____ (número inteiro)
27. Peso total das chumbadas: _____ (g decimal)
28. Peso bóia: _____ (g decimal)
29.1 Perdeu quantos conjuntos de chumbos e linhas? _____ (número inteiro)
29.2 perdeu quantos anzóis? _____ (número inteiro)
29. Utilizou engodo? ( ) Sim ( )Não
30. Está usar isco natural ou artificial?
    31.1 Artificial ( ) Sim ( )Não
    31.2 Natural ( ) Sim ( )Não

PARA QUEM RESPONDE ARTIFICIAL

32. Se está a utilizar isco ARTIFICIAL qual é o tipo?
    32.1) Amostra (tipo rapala)
    32.2) Vinil
    32.3) Zagaia
    32.4 amostra borracha

PARA QUEM RESPONDE NATURAL

33. Se está a usar isco NATURAL, qual é o tipo?
    33.1) _____
    33.2) _____
    33.3) _____

34. Por montagem quantos anzóis utilizou?
    34.1 Montagem 1: _____ 34.2 Montagem 2: _____

34.3 Montagem 3: _____ 34.4 Montagem 4: _____

35. Por tipo de anzol:

Anzol	35.1 Anzol 1	35.2 Anzol 2	35.3 Anzol 3
1) Número de anzóis usados:			
2) Modelo:			
3) Número:			
4) Comprimento (cm/medido):			
5) Largura (cm/medido):			
6) Barbela:	( ) Sim ( )Não	( ) Sim ( )Não	( ) Sim ( )Não

Equipamento 2.3 (E) Pesca submarina

36. Número de armas utilizadas

37. Para cada arma:

Arma	35.2 Arma 1	35.3 Arma 2	35.3 Arma 3
1) Material:			
2) Tamanho:			
3) Tipo:	( ) Ar comprimido ( ) Elástico	( ) Ar comprimido ( ) Elástico	( ) Ar comprimido ( ) Elástico
4) Tipo de arpão			

PARTE 2.4 (F) - Captura

38. Costuma utilizar régua para ver a medida das suas capturas? ( ) Sim ( ) Não ( ) Às vezes
observações _____

39. Costuma utilizar balança para ver o peso das suas capturas? ( ) Sim ( ) Não ( ) Às vezes
observações _____

40 Descreva a sua captura

	Espécie	CT	Destino	Porquê (destino)	1) vivo 2) morto 3) moribundo
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

*Opções destino: 1) Consumo; 2) Oferta; 3) Reposição Ao Mar; 4) Venda; 5) NS; 6) NR

41. Se encontrou lixo no local de pesca	42. Se pescou lixo
41.1 o que encontrou? _____ 41.2 Quantidade? 1) menos de 5 itens 2) entre 5 e 10 itens 3) mais de 10 itens	42.1 O quê pescou _____ 42.2 Quantidade? 1) menos de 5 itens 2) entre 5 e 10 itens 3) mais de 10 itens

43. Como classifica o resultado da pesca de hoje?

☐ Muito bom ☐ Bom ☐ Médio ☐ Mau ☐ Péssimo ☐ NS ☐ NR

SECÇÃO 3 (G) – LEGISLAÇÃO

1. Tem licença de pesca? ( ) Sim ( ) Não
2. Se SIM, de que tipo de licença:
   a) Modalidade(s) (apeada, embarcada, submarina, lúdica geral, águas interiores): _____
   b) Período (diária, mensal, anual): _____
2.2 Se SIM, tem outra licença:
   a) Modalidade(s) (apeada, embarcada, submarina, lúdica geral, águas interiores): _____
   b) Período (diária, mensal, anual): _____
3. Tem conhecimento da existência actual de regulamentação para a pesca recreativa?
   ( ) Sim ( ) Não
4. Já leu ou teve conhecimento das medidas incluídas na actual regulamentação da pesca recreativa? ( ) Sim ( ) Não
5. Como se considera informado relativamente ao conhecimento da nova legislação? *(escolher ma opção)*
   a) Nada informado
   b) Pouco informado
   c) Razoavelmente informado
   d) Muito informado
   e) Plenamente informado
6. Qual o seu grau de satisfação em relação à actual regulamentação da pesca recreativa em Portugal? *(escolher uma opção)*
   a) Nada satisfeito
   b) Pouco satisfeito
   c) Razoavelmente satisfeito
   d) Muito Satisfeito
   e) Plenamente satisfeito
7. Porquê? _____
8. Indique por favor os principais aspectos que mudaria (começando pelo mais importante)?
   8.1 - _____
   8.2 - _____
   1.3 - _____
9. Diga 5 espécies de que sabe o tamanho mínimo, indique o mesmo e se concorda com ele:
   9.1a nome_____ 9.1b tamanho_____ 9.1c concorda? _____
   9.2a nome_____ 9.2b tamanho_____ 9.2c concorda? _____
   9.3a nome_____ 9.3b tamanho_____ 9.3c concorda? _____

10. Identifique as seguintes espécies (Figuras e espécies indicadas de acordo com a modalidade praticada)

Pesca de cana apeada (FIG. 1)	Pesca embarcada (FIG. 1)	Pesca submarina (FIG. 1)	Pesca grossa (FIG. 2)
a) Baila (2)	a) Baila (2)	a) Baila (2)	a) Atum bonito (4)
b) Sargo-legítimo (1)	b) Sargo-legítimo (1)	b) Sargo-legítimo (1)	b) Tintureira (1)
c) Dourada (8)	c) Pargo-legítimo (3)	c) Dourada (8)	c) Espadarte (7)
d) Safia (5)	d) Robalo (4)	d) Robalo (4)	d) Atum voador (9)
e) Robalo (4)	e) Goraz (6)	e) Tainha (7)	e) Espadim-azul (8)

11. Quantas vezes foi abordado por um agente de autoridade marítima (AM) nos últimos 2 anos? _____
12. Quantas vezes observou um agente da AM a abordar um pescador lúdico nos últimos 2 anos? _____
13. Já teve algum acidente relacionado com a prática de pesca recreativa? ( ) Sim ( ) Não
14. Se SIM, requereu hospitalização? ( ) Sim ( ) Não

SECÇÃO 4 (H) – CARACTERIZAÇÃO ECONÓMICA DA ACTIVIDADE

1. Nos últimos 12 meses quanto gastou no total em (responder em cada opção):
   1.1) Canas e carretos _____
   1.2) Isco e engodo _____
   1.3) Arma e arpões de pesca submarina _____
   1.4) Roupa para a pesca _____
   1.5) Fatos / equipamentos de pesca submarina _____
   1.6) Informação relacionada com pesca (revistas, assinaturas de websites na área) _____
   1.7) Outro equipamento de pesca _____
   1.8) Licença _____
   1.9) Seguro (não relacionado com embarcação) _____
   1.10) Associação de pesca
   1.11) Outro equipamento de pesca _____ 1.11b) Qual _____
2. Tem um barco que use para a pesca? () sim () não
3. SE SIM, Comprou: ( ) novo ( ) usado
4. Quanto custou aproximadamente?
5. Gastos aproximados com a embarcação (por ano) em (responder em cada opção):
   5.1 Reparações _____ 5.2 Amortização (em caso de empréstimo) _____
   5.3 Associação de pesca _____ 5.4 Licenças de navegação / selo _____
   5.5 Parqueamento _____ 5.6 Seguro _____
   5.7 Combustível _____ 5.8a Outros _____ 5.8b O quê? _____
6. Pertence a um clube / associação de pesca? ( ) Não ( ) Sim
7. Qual clube / associação? _____
8. Onde se localiza o clube? _____

SECÇÃO 5 (I) – DEMOGRAFIA

1. Já alguma vez respondeu a este questionário? ( ) Sim ( ) Não
2. Se sim foi para relativamente à mesma modalidade? ( ) Sim ( ) Não
3. Se não, a que modalidade se referiu?
4. Idade: _____
5. Estado civil: _____
6. Género: ( ) Masc. ( ) Fem.
7. Agregado familiar:
8. Grau de escolaridade (último ano que completou): _____
9. Rendimento mensal líquido (escolher uma opção)
   ( ) 0€ ( ) 751- 1000€ ( ) 1751-2000€
   ( ) 1-250€ ( ) 1001-1250€ ( ) 2001-2500€
   ( ) 251-500€ ( ) 1251-1500€ ( ) >2500€
   ( ) 501-750€ ( ) 1501-1750€ ( ) NS ( ) NR
10. Situação profissional:
( ) Activo/empregado ( ) Desempregado ( ) Estudante
( ) Reformado ( ) NR ( ) NA
11. Profissão: _____
12. Nacionalidade (para Portuguesa escrever apenas Pt): _____
13. Residência:
12.1 País (para PORTUGAL escrever apenas Pt): _____
12.2 Localidade: _____
12.3 código postal [primeiros 4 dígitos]) : _____
14. Nome (opcional): _____
15. Telefone (opcional): _____
16. Hora para ligar (de x a x): _____
16. Email (opcional): _____
17. Tem mais algum comentário adicional ou sugestão: (ou outras do entrevistador)

Hora de fim do questionário: ___ H ___ MIN Coordenadas GPS: _____

MUITO OBRIGADA PELA SUA COLABORAÇÃO! CHEGAMOS AO FIM DO QUESTIONÁRIO!

FIG 1

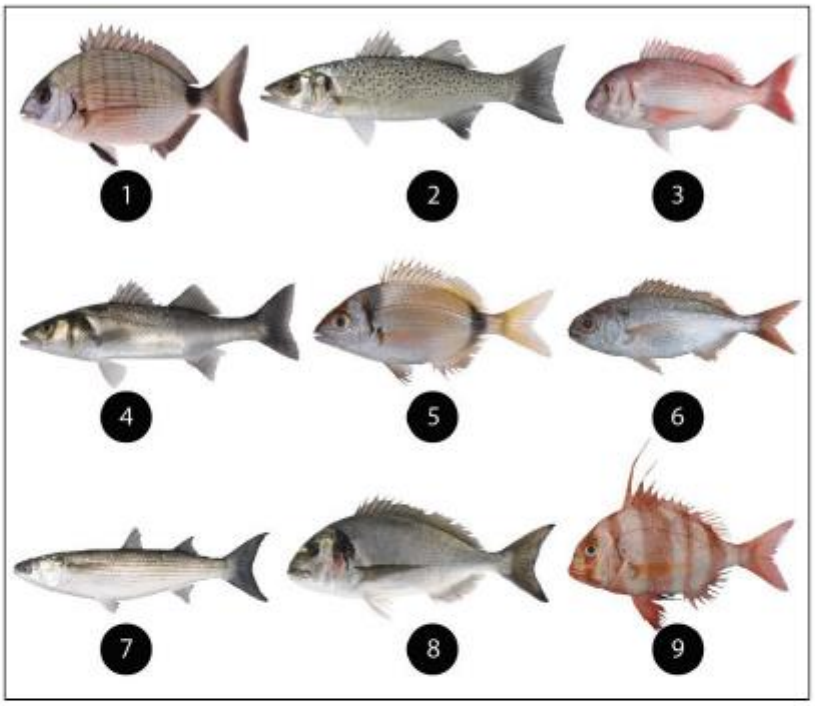


FIG 2