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State of Marine Recreational Fisheries in Catalonia



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This document presents the results of the continuous monitoring study on marine recreational fishing in Catalonia during 2023 in comparison with 2020-2022. It was produced by the Catalan Institute of Research for the Governance of the Sea (ICATMAR), which is a cooperation organ between the Directorate-General of Climate Action, Food and Rural Agenda of the Government of Catalonia and the *Institut de Ciències del Mar* (ICM) of the Spanish National Research Council (CSIC).

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Glossary

CL: Cephalotorax Length

CPUE: Catch Per Unit Effort

GFCM: General Fisheries Commission for the Mediterranean GSA: Geographical Sub-Area

GSI: gonadosomatic index

GT: Gross Tonnage

LF: Length Frequency

LPUE: Landing Per Unit Effort

MAP: Multi-Annual Plan

MCRS: Minimum Conservation Reference Size

MCRW: Minimum Conservation Reference Weight

OTB: Bottom Otter Trawl

PCA: Principal Component Analysis

PSA: Productivity and Susceptibility Analysis

STECF: Technical and Economic Committee for Fisheries

TL: Total Length

VL: Vessel Length

VMS: Vessel Monitoring System

WF: Weight Frequency

WMS: Geoserver a Web Map Service

1

Introduction



Since 2020, ICATMAR (the cooperation organ between the *Institut de Ciències del Mar* ICM-CSIC and the Catalan government) has been collecting data to address the demands posed by new European regulations regarding catch reporting on recreational fisheries. The objective is to tackle these uncertainties in the most efficient and practical manner, while also ensuring the transfer of knowledge and transparency with the sector. In this context, the Regulation (EC) No 1004/2017 (Council of the European Union, 2017) obliges EU member states to collect data on marine recreational fisheries (MRF) catches following the framework of the Common Fisheries Policy (EC, 2008, 2011). Additionally, Implementing Decision (EU) 2019/909 (European Commission, 2019) sets out the species on which data collection is mandatory. However, this data collection framework only considers annual recreational catches of a few species in the delimited fishing areas for FAO in 2020. Recently, several European countries and regions have initiated their own continuous sampling programmes for certain MRF target species (Strehlow et al., 2012; Herfaut et al., 2013; Michailidis et al., 2020).

MRF is a non-professional activity practised for leisure by approximately 350 million people around the world (Arostegui et al., 2021). Despite being one of the most popular coastal leisure activities worldwide, there is a historical lack of knowledge about its impacts (McPhee et al., 2002), as well as a general lack of data collection, sampling and assessment systems for the activity (Cooke and Cowx, 2005; Hyder et al., 2018; Brownscombe et al., 2019).

This trend is understandable given that MRF is an extractive practice that frequently intersects with commercial fishing interests. They share the same fishery resources as the professional fishing sector. This underscores the importance of integrating recreational catch data into the assessment and management of fish stocks, as well as allocating specific catch quotas for MRF.

Over the past decade, several Autonomous Communities in Spain have launched multispecies studies to monitor MRF activity (Ruiz et al., 2014; IFOP, 2018; ICATMAR 2020a), and the scale and composition of catches have been described at a national level (Gordoa et al., 2019; Dedeu et al., 2019). In 2023, Andalusia became the only region in the country to issue an updated regulation for MRF. In Catalonia, the establishment of an ongoing data collection has facilitated the development of specific studies, such as investigations into the behaviors of fishers on social media (Vitale et al., 2021). Moreover, the creation of the co-management roundtable has been promoted to discuss all these uncertainties and work together with the stakeholders towards updated regulation.

Long-term collection of MRF data will enable the creation of a temporal data series on catches and species records, forming a reliable and robust information source for decision-making in potential management strategies. The combined methodological approach employed in this study utilises data from the most appropriate sources. While online surveys have the potential to reach a significant proportion of the total recreational fisher population, onsite surveys can target specific locations, seasons, catch identifications, and methods to obtain more detailed catch data.

The methodological approach used in ICATMAR annual reports incorporates information from two different sources, online and onsite surveys. The online surveys are optimal for obtaining a large number of anonymous responses. They are also an adequate tool for detecting fisher avidity patterns and identifying user trends. The large data input also allows estimating the spatial and seasonal distribution of the activity. The main lacking point of the online methodology is the low reliability of catch data, which can be overcome by the complementary onsite survey designed to estimate catch compositions from direct observations of the different coastline typologies within the Catalan coastline.

Due to past limitations in managing online surveys, the previous report on the monitoring of MRF in Catalonia (ICATMAR, 23-04) analysed and compared data collected during 2021 and 2022. The present report examines data collected from the period January 2020 to December 2022 and throughout 2023. Specifically, it analyses the data from 2023 in comparison to the average from 2020-2022 for onsite data and the average from 2021-2022 for online data. The study area included the entire Catalan coastline divided into 11 zones, as noted in previous reports (Figure 1).

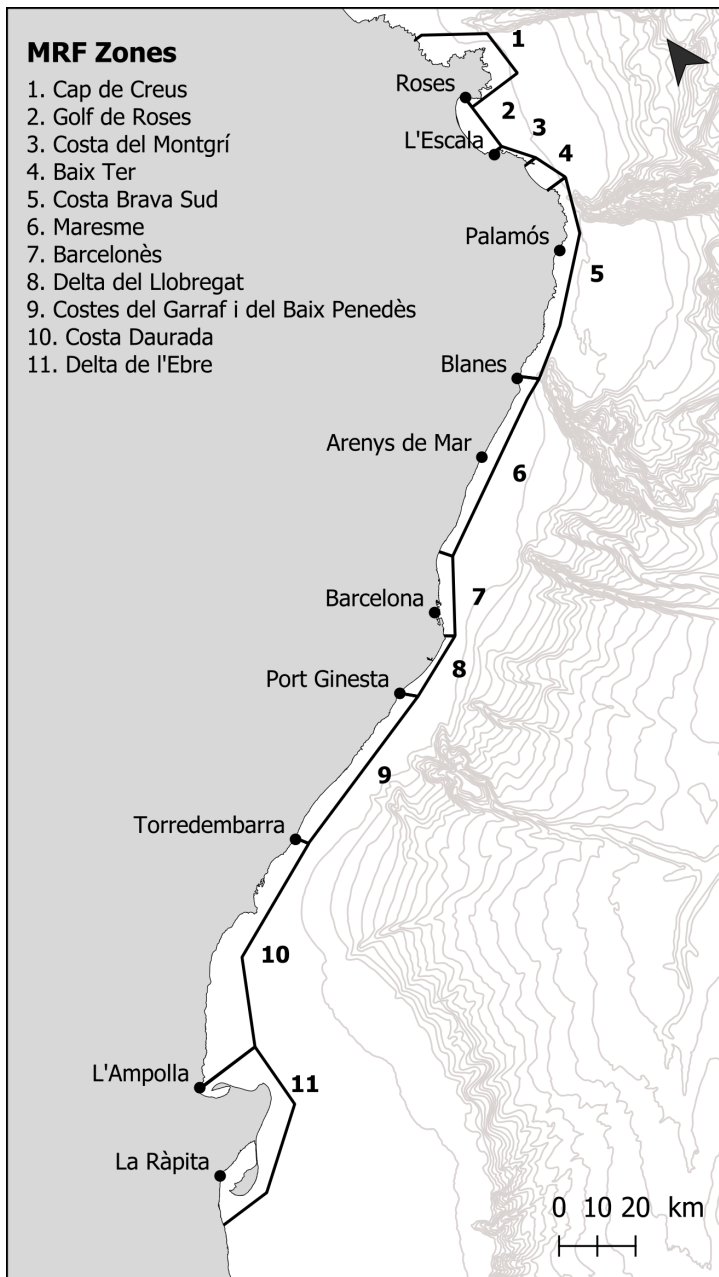
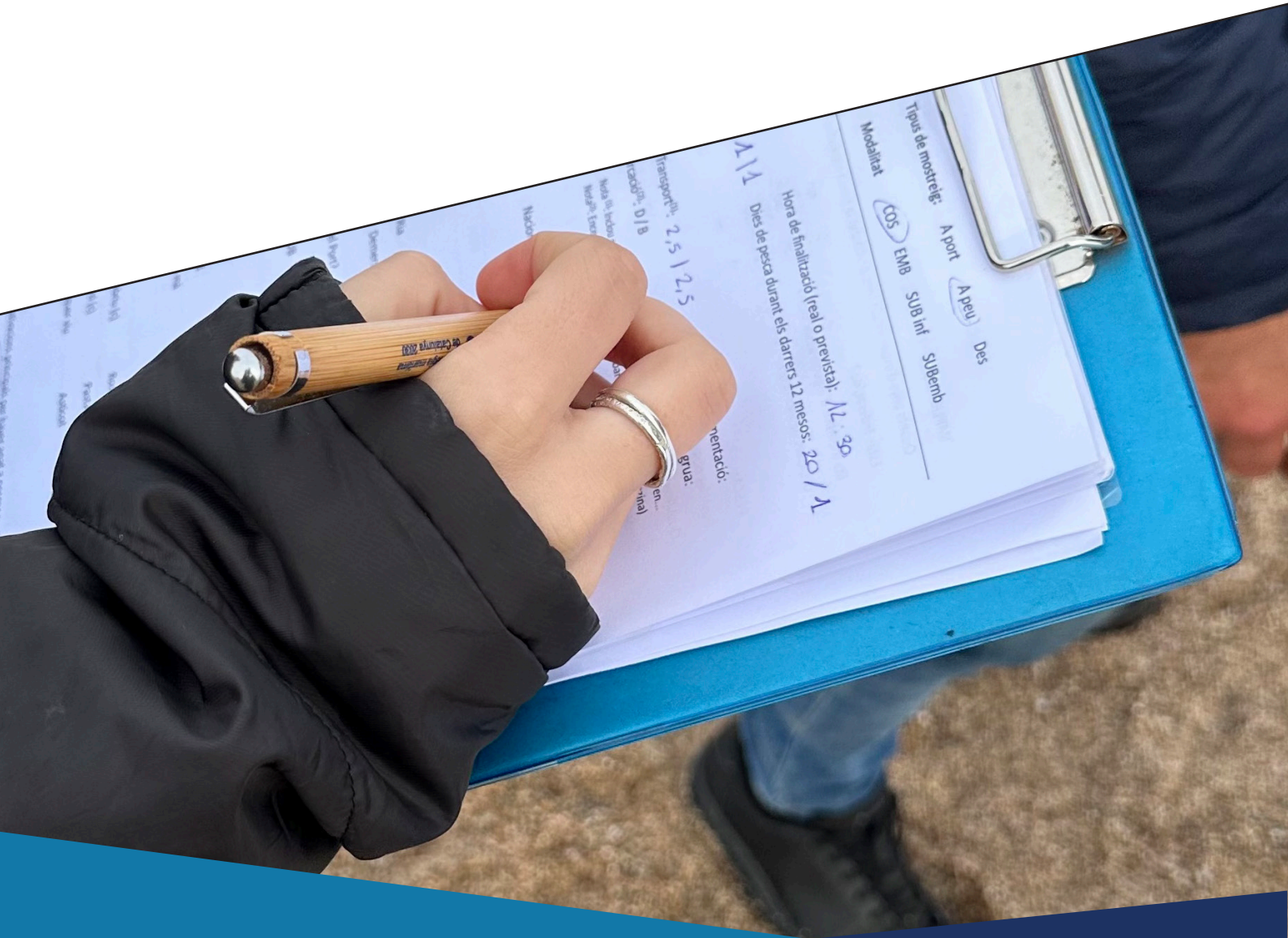


Figure 1. Division of the Catalan coastline and model of zone aggregation.

2

Method



Tipus de mostreig: A port A peu Des

Modalitat: COS EMB SOB Int SUBemb

1/1 Hora de finalització (real o d'estímul): 11:30
Dies de pesca durant els darrers 12 mesos: 20/1

transport: 2,5 / 2,5
craçador: 0/8

1. Data collection

As described in previous reports, the onsite and online surveys were designed to address the same questions regarding fishing modality, fishing effort, fishing yield, target species and species catch, fishing trip expenditures, socio-economic profile and Division of the Catalan coastline and model of zone aggregation. dimensions of the fishers. Online surveys additionally collected information on yearly expenditures, and onsite surveys included direct observations of the catch, as well as questions specifically regarding the fishing technique and fishing gear used. Online and onsite survey format, dissemination and structure are thoroughly described in previous reports (ICATMAR, 23-04). The changes made to the online survey content in 2023 involve the removal of questions about social media, as well as the number of and weight of catches.

In the case of onsite surveys, in 2023 a total of 108 sampling days per year were ensured. The sampling days were randomly assigned, with 30% on weekdays and 70% on weekends or holidays. Theoretically, the port surveys targeted boat and spearfishers, while foot and boat surveys focused on shore anglers and spearfishers, adapting to accessibility and underwater conditions. Each trip lasted 6 hours, targeting peak fishing times.

Besides the online and onsite surveys to individual fishers, we are working on data collection from fishing charters, which is a guided fishing trip run by a professional charter captain. The charter typically provides everything the customer needs for a fishing trip, including the boat, captain, bait, and equipment. In Catalonia, there are approximately 30 registered charters (with collective licences). In 2020, when the continuous sampling started, the presence of charters was taken into account and a voluntary form was created and sent to fishers when they registered as a collective licence charter so they could report catches. However, this initiative was not successful. Three years later, in 2022, meetings were arranged with charterers (charter owners) to explain the importance of data collection in marine recreational fishing and the future management measures established by the EU regarding recreational fishing. They were asked to collaborate by adapting the catch report form and adding a survey for charter customers. These forms and surveys started to be sent out in September 2022 and are still being used. In May 2023, participatory workshops were held in order to involve the sector in the decision-making process, and the charters were well represented and expressed their opinion. Since then, 5 charters have reported back. Efforts are currently underway to look at the description of the data collected and to explore the extent of the sector.

2. Data processing and analysis

The data collected from online and onsite survey methods was stored in a database and submitted to a process of quality control. Extreme and implausible values were identified and removed from the study. First, the data analysed gathered from the three methodologies (onsite surveys, online surveys, and licence registry) were combined in order to produce the estimated values used in the analysis.

The study combined data from onsite and online surveys with licence registries to estimate freshwater and marine recreational fishing participation in Catalonia. Due to a common “surface angling” licence, online survey proportions were applied to total active licences to estimate participation (for all data analyses information see ICATMAR, 22-04). MRF participants were categorized by angling type (shore or boat) based on survey responses. Licences varied from one day to several years (see section 4, Table 1), with spearfishing requiring an annual licence. Unlicensed participants were not included in the totals, but a pilot study with police and rural officers estimated these activities (see section 6).

The geographical distribution of fishing effort by season was estimated using the online effort results of the aggregate number of trips per zone. This allowed extrapolating values of total catch per season to each of the 11 zones (see Figure 1). Currently, work is being done on the estimation of frequency of annual fishing days (see section 4.2).

Both surveys classified fishers in each modality into one of five different avidity classes based on their responses regarding annual effort. Avidity classification is still being refined, and is presented in the present report as follows:

- zero avidity: fishers who reported not having practised the activity for at least one year
- sporadic avidity: attributed to all one-day fishing licence-holders and to those who declared fishing up to twice a year
- low avidity: attributed to those who reported fishing between 3 and 19 days during the past year
- medium avidity: those who reported fishing between 20 and 49 days during the past year
- high avidity: those who reported fishing more than 50 days during the past year

Information on Catch Per Unit Effort (CPUE) was estimated for each avidity group within each season, by using daily catch rate information from the onsite surveys with kg per day. The calculations were carried out taking into account the nature of the catch, i.e. harvest (individuals effectively taken from the sea and brought for consumption), discard (individuals caught and disposed of at sea), and catch and release (C&R; individuals caught and released alive). The present report incorporates data on C&R for the first time.

Similarly, effort estimates were produced for each avidity class within each season using effort values from the online survey (the monthly effort values were extrapolated to the total seasonal activity by adding the three months that comprise each season of the year). A value of total catch per average fisher of each avidity class within each season was estimated as the product of the CPUE and effort values of these crossed categories. Then, the volume of participants attributed to each avidity class was estimated as the product of the total participation by modality and the percentage of each avidity class based on the online responses. This allowed estimating a value of total catch for each avidity class within each modality and for each season. Total seasonal modality catches were then distributed by species using the seasonal catch compositions obtained from the onsite survey.

3

Response to the surveys



1. Response to the onsite surveys

During the first three years of the monitoring program (2020 to 2022) there are 299 survey days with a total of 3 958 onsite surveys. This represents an annual average of 100 survey days and 1 319 onsite surveys. In 2023, the 122 survey days obtained a total of 1 819 survey responses (Figure 2). Of the total survey respondents in the first three years, 93% resided in Catalonia, 5% outside of Spain and 2% in other parts of Spain. In 2023, 89% of the fishers resided in Catalonia, 3% resided outside of Spain and the percentage of fishers from other parts of Spain increased to 8%.

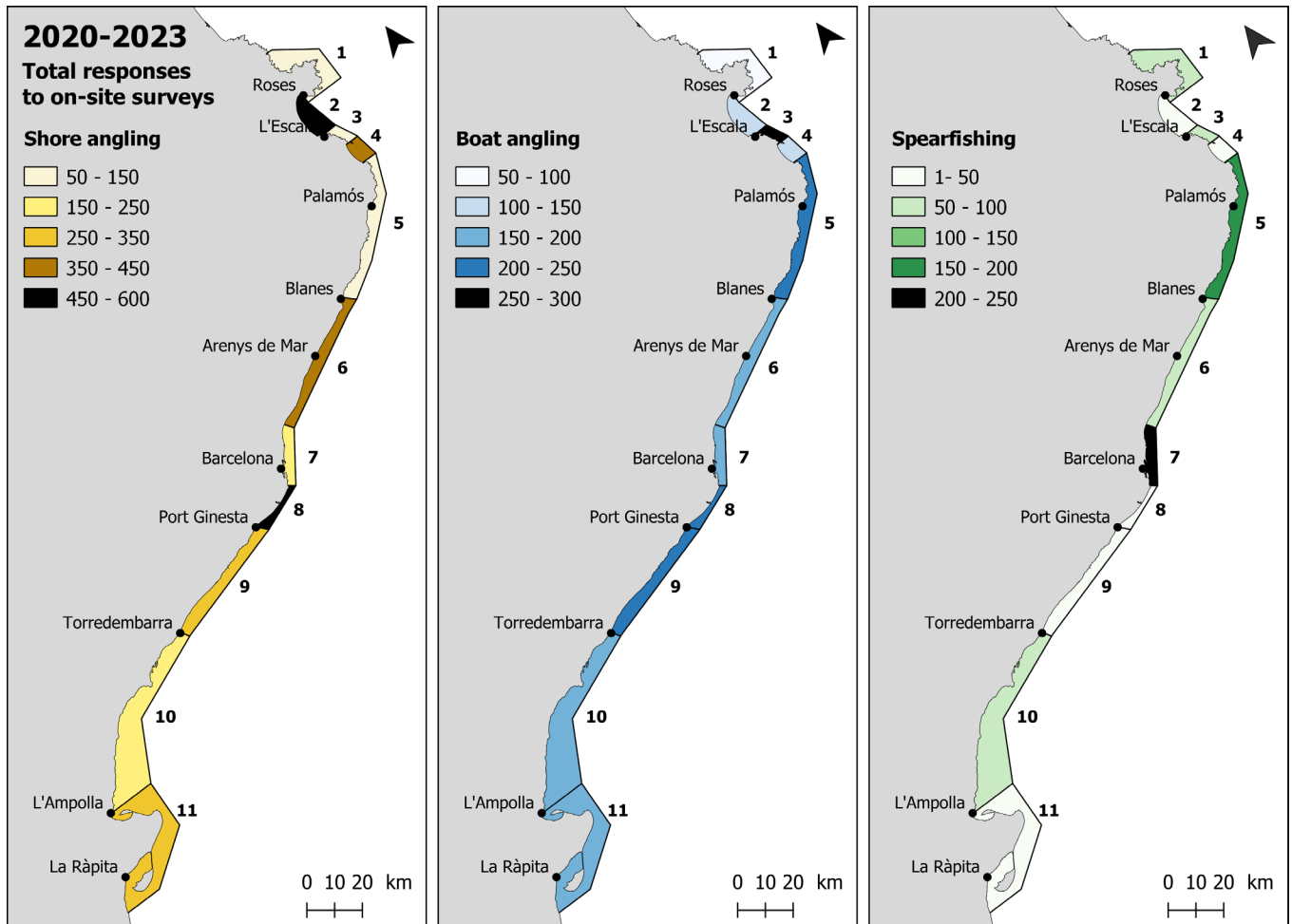


Figure 2. Number of responses for each fishing modality in the onsite surveys conducted in each of the 11 zones during the period 2020-2023(right): 1. *Cap de Creus*, 2. *Golf de Roses*, 3. *Costa del Montgrí*, 4. *Baix Ter*, 5. *Costa Brava Sud*, 6. *Maresme*, 7. *Barcelonès*, 8. *Delta del Llobregat*, 9. *Costes del Garraf*, 10. *Costa Daurada* and 11. *Delta de l'Ebre*.

As for the onsite survey responses in 2023 there were 933 responses from shore anglers, 618 from boat anglers and 268 from spearfishers. From the period 2020 to 2022, there were total of 2 132 responses from shore anglers, 1 329 from boat anglers, and 497 from spearfishers (Figure 3). One average annually, there were 711 responses from shore angling, 443 from boat angling and 166 from spearfishing.

Regarding the nationalities of the onsite survey respondents, in 2023 83.1% of the respondents were from Spain, 11.3% from the rest of Europe (mainly from France, Italy, and UK), 3.4% from African countries (i.e., Morocco and Algeria), 1.6% from South American countries (i.e., Colombia and Argentina) and 0.2% from Asian countries. In the period 2020-2022, 90.5% in average were from Spain, 6.8% from the rest of Europe (mainly from France), 1.8% from African countries (i.e., Morocco and Algeria), 0.6% from South American countries and 0.2% from Asian countries (i.e., Russia and China; Figure 4).

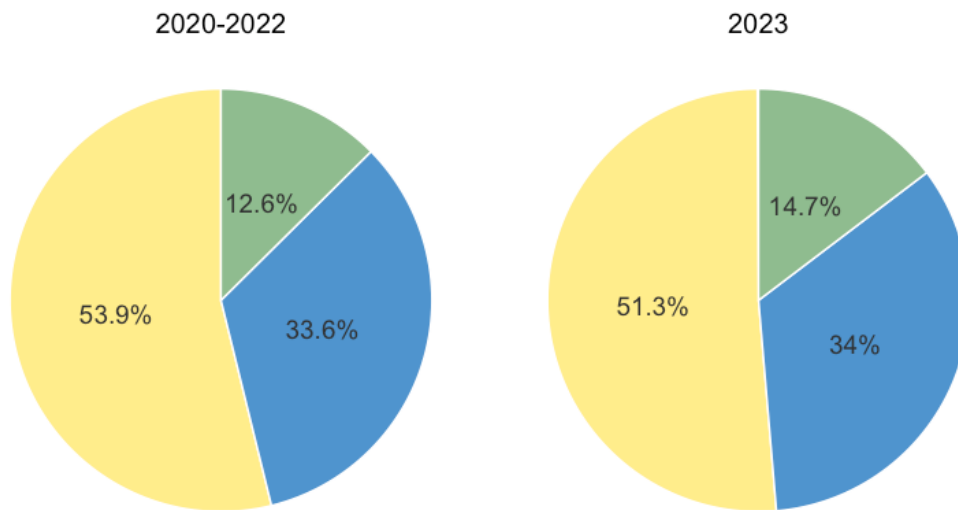


Figure 3. Percentage of the three fishing modalities of the fishers surveyed in the onsite sampling. Yellow: hore angling; blue: boat angling; green: spearfishing.

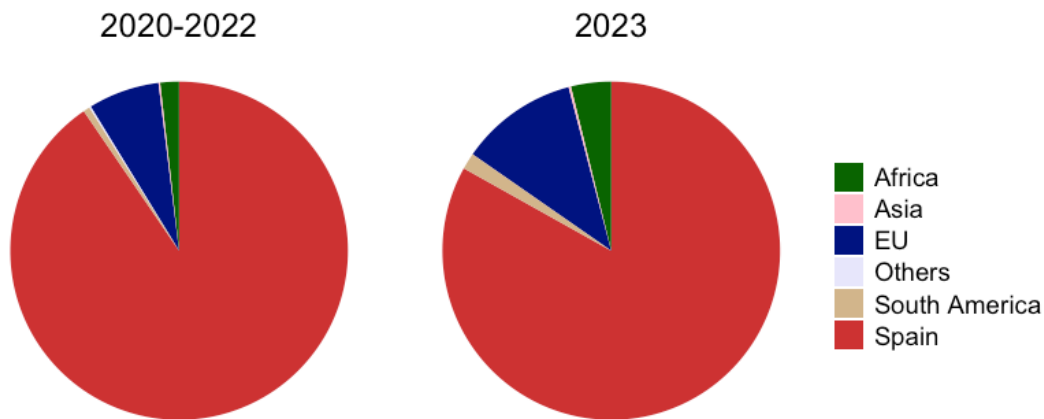


Figure 4. Percentage of the nationalities of the fishers surveyed in the onsite sampling. Green: Africa (i.e., Morocco and Algeria); rose: Asia (i.e., Russia and China); navy: EU; brown: South American countries; red: Spain; grey: others (i.e. UK (United Kingdom) and North America).

2. Response to the online surveys

Regarding online surveys, in 2023 a total of 9 388 online surveys were responded: 6 647 of the respondents declared practising mostly MRF (70.79%), while 2 742 declared practising mainly continental recreational fishing (29.21%). On the other hand, a total of 21 740 online surveys in 2021 to 2022, averaging 10 870 annually. The results are practically the same for the years compared, although some slight differences are present. In detail, we obtained: 7 720 of the respondents declared practising primarily MRF (71.01%) and 3 151 practised mostly freshwater recreational fishing (28.99%; Figure 5).

In 2021, 2022 and 2023, MRF respondents mainly answered the survey from devices that were physically located in Catalonia, but many others responded from other locations; namely, from the most populated regions of Spain, and from the south of France (Figure 6; for more information on the international response location see Annex I). In 2021-2022 there was a higher concentration of answers located in the region of Valencia, north of Spain, different spots throughout the area of France, Italy and in Belgium, while in 2023 more answers were registered in the rest of Europe (i.e. Denmark, Netherlands or Austria) and in different spots throughout the Spain region, like the Canary and Balearic Islands.

From the average 7 720 online survey responses classified into MRF in 2021-2022, 251 users did not continue

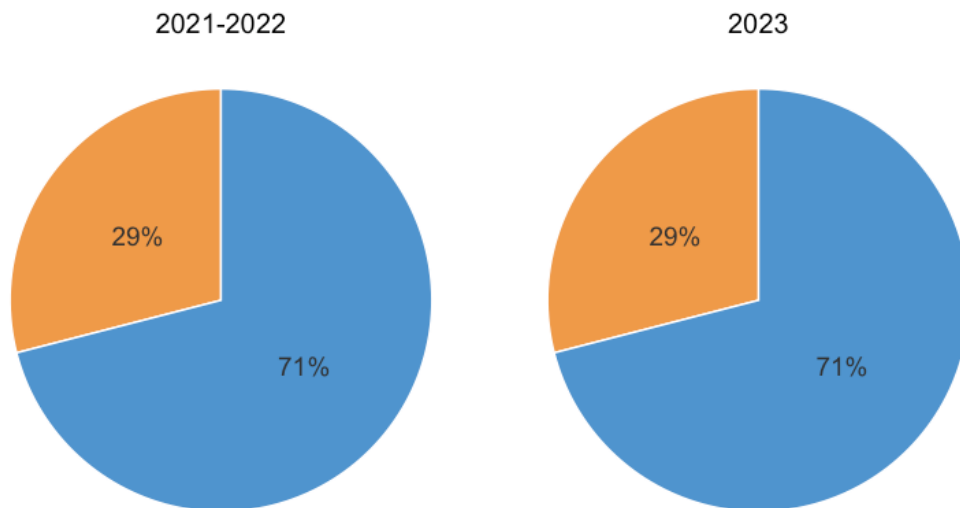


Figure 5. Percentage of answers to online surveys. Orange: continental recreational fishing; blue: marine recreational fishing (MRF).

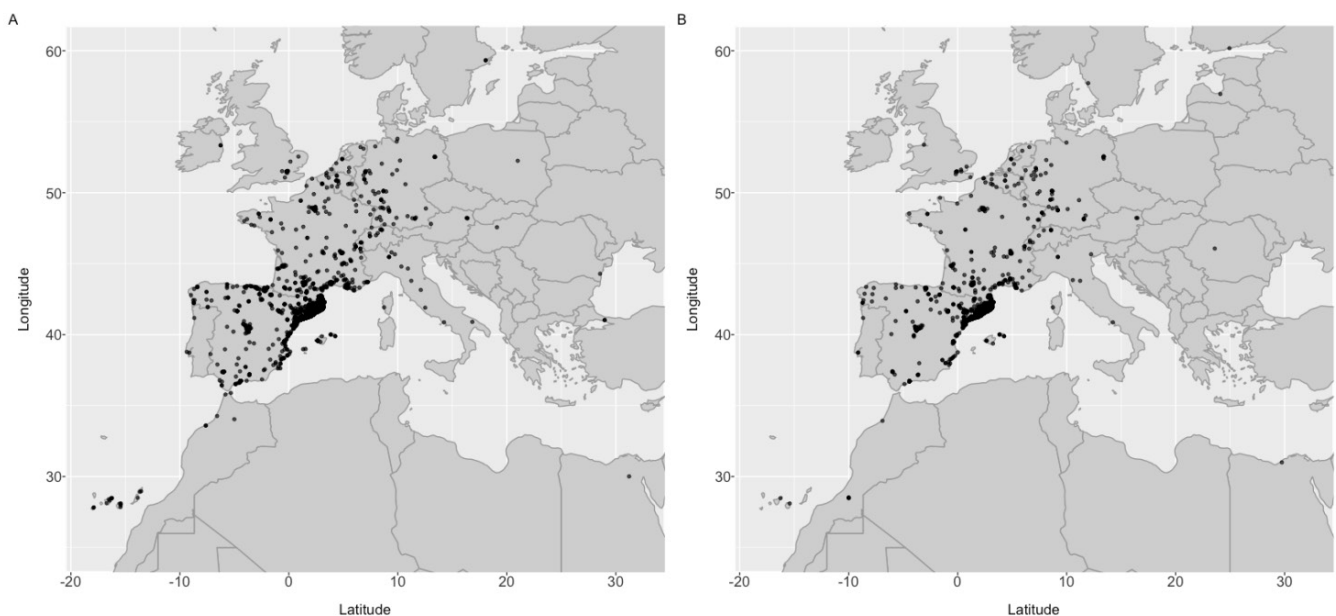


Figure 6. Location of devices used to respond to MRF online surveys: (A) in 2021-2022 and (B) 2023.

the survey past the first question and could not be further classified into a fishing modality, whereas in 2023 out of the 6 646 responses classified into MRF, 199 responses were discarded for the same reason (Figure 7). The remaining surveys, 7 469 and 6 447 for 2021-2022 and 2023 respectively, provided enough information to estimate the proportions of fishing modalities. An average of 248 respondents in 2021-2022 and 205 in 2023 declared practising the three modalities (i.e., shore angling, boat angling and spearfishing).

In 2023 a total 4 761 respondents declared practising shore angling, of which 2 491 also practised boat fishing, and 922 also spearfished. A total 2 491 responses were obtained from boat fishers, of which 345 respondents practised both boat fishing and spearfishing. The total amount of responses from spearfishers was 922. In contrast, in 2021-2022 an average of 5 740 respondents declared practising shore angling, of which 1 409 also practised boat fishing, and 442 also spearfished. A total 2 628 responses were obtained from boat fishers, of which 382 respondents practised both boat fishing and spearfishing. The total amount of responses from spearfishers was 1 093.

About the main fishing modality declared by the respondents, in 2023 4 105 respondents declared shore angling as their main modality (63.7%), 1 688 declared it was boat angling (26.2%) and 654 spearfishing (10.1%).

On the other hand, in average 2021-2022 4 987 answers were from shore anglers (66.8%), 1 700 from boat anglers (22.8%) and 783 from spearfishers (10.4%) (Figure 8).

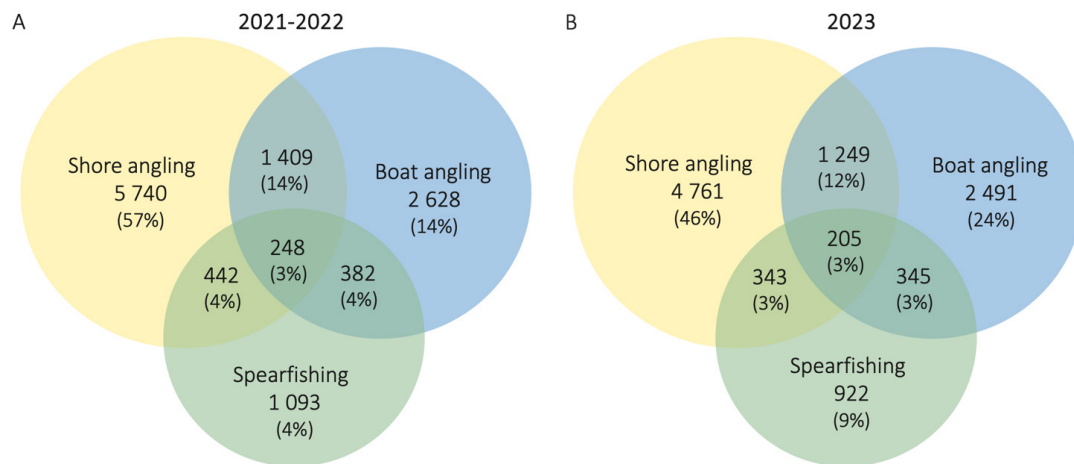


Figure 7. Number of marine recreational fishers by modality from the online surveys in (A) 2021-2022 and (B) 2023.

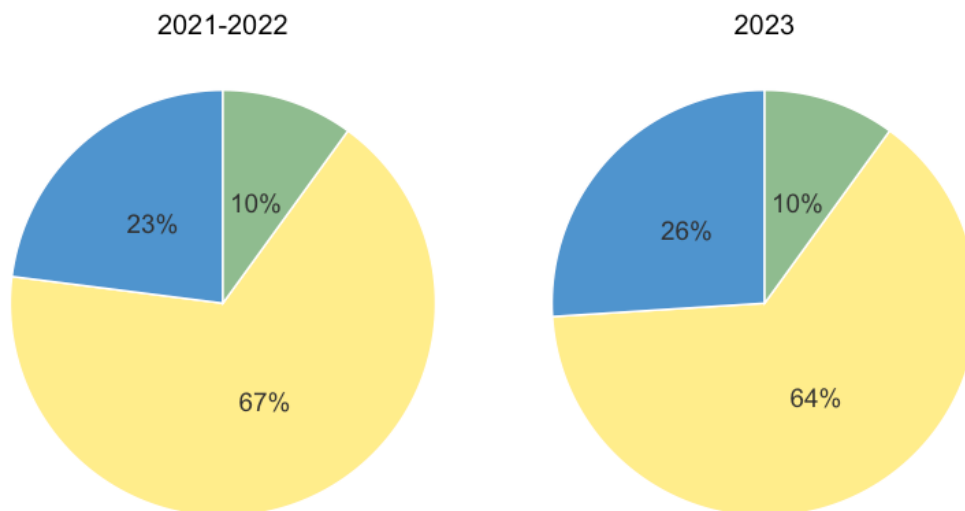


Figure 8. Percentage of practitioners based on the main fishing modality of each respondent in the period 2021-2022 (left) and 2023 (right).

4

Activity volume



1. Analysis of recreational fishers in Catalonia through the licence register

It is worth noting the increase in the number of licences emitted in 2023 for each modality compared with 2021-2022. This can be in part due to the dual licences being considered starting in 2023. The total number of active surface angling, both marine and freshwater, and spearfishing licences emitted during 2023 was 64 124 and 3 477, respectively. Using the proportion of freshwater to marine responses from the first scanning question of the online survey, a total 45 528 surface angling licences were estimated to be used primarily for MRF while 18 596 corresponded to freshwater fishers. Of the MRF licences, the proportion of licences attributed to shore and boat angling were 71 and 29% respectively. In summary, a total of 49 005 MRF licences were emitted: 32 325 corresponded to shore anglers, 13 203 to boat anglers and 3 477 to spearfishers.

On the other hand, the average number of active surface angling, both marine and freshwater, and spearfishing licence during 2021-2022 was 59 807 and 2 872, respectively. Using the proportion of freshwater to marine responses from the first scanning question of the online survey, a total 42 441 surface angling licences were estimated to be used primarily for MRF while 17 366 corresponded to freshwater fishers. Of the MRF licences, the proportion of shore and boat angling (74 and 26% respectively) was obtained from the second classifying question and was used to estimate the surface licences that could be attributed to each modality. Spearfishing values were obtained directly from the specific spearfishing licence registry. In the years 2020, 2021 and 2022, it should be noted that not all fishers with dual licences, both surface angling and spearfishing licences, were taken into account. In summary, in 2021-2022 an average of 45 353 MRF licences were emitted: 31 406 corresponded to shore anglers, 11 035 to boat anglers and 2 872 to spearfishers (see Table 1).

Table 1. Classification (type of licence) of the total surface licences aimed at marine recreational fishers.

| | Shore angling | | Boat angling | | Spearfishing | |
|-----------------------------|---------------|---------------|---------------|---------------|--------------|--------------|
| | 2021-2022 | 2023 | 2021-2022 | 2023 | 2021-2022 | 2023 |
| One day | 2 550 | 3 240 | 896 | 1 324 | | |
| Two days | 824 | 1 339 | 290 | 547 | | |
| Fifteen days | 2 126 | 4 121 | 747 | 1 683 | | |
| Annual | 20 937 | 19 777 | 7356 | 8 078 | 2 872 | 3 477 |
| Pluriannual (up to 4 years) | 4 970 | 3 848 | 1 746 | 1 572 | | |
| Total | 31 406 | 32 325 | 11 035 | 13 203 | 2 872 | 3 477 |

The estimate of active marine recreational fishers considers fishers with 2, 3 and 4 years licences issued prior to the years studied, respectively. This is influenced by the percentage, not included in this report, of recreational fishers with a licence issued in a different autonomous community (10.7%, a percentage analysed in the regional police pilot study).

2. Analysis of fishing days by avidity class on marine recreational fishers

The average number of yearly fishing days by modality is obtained from the declared fishing days- in the surveys. This value is depicted to assess the consistency across years and the differences between them. The data is gathered through responses to the question, “How many days have you gone fishing in the last 12 months?”. In 2021, the average (\pm standard error) days declared for going fishing was 21.2(\pm 0.39) for shore angling, 27.3(\pm 0.71) for boat angling, and 23.7(\pm 0.85) for spearfishing. There is a general increase in all three modalities in 2022, 24.0(\pm 0.50), 30.1(\pm 0.81), and 26.3(\pm 1.02), respectively. However, in 2023, there is a slight decrease in 22.2(\pm 0.46), 28.5(\pm 0.72), and 24.3(\pm 0.96; Figure 9).

Figure 10 represents the average number of declared annual fishing days from onsite surveys. Clearly, we obtain responses from fishers who fish more frequently since it is easier to encounter them during the onsite sampling in the first place. In 2020, 44.6(\pm 1.96) days of shore angling, 37.7(\pm 2.01) days of boat fishing, and 35.3(\pm 1.60) days of spearfishing were reported. There is an annual consistent decline in reported fishing days. In

both 2021 and 2022, the results were a little different, with averages of 34.1(±1.09) and 37.7(±0.90) for shore angling, 32.7(±0.65) and 36.7(±1.10) for boat angling, and 35.6(±1.71) and 35.6(±1.71) respectively for each year. Specifically, in 2023, the averages were remarkably lower 34.2(±0.91), 20.8(±0.84), and 28.4(±0.77), respectively.

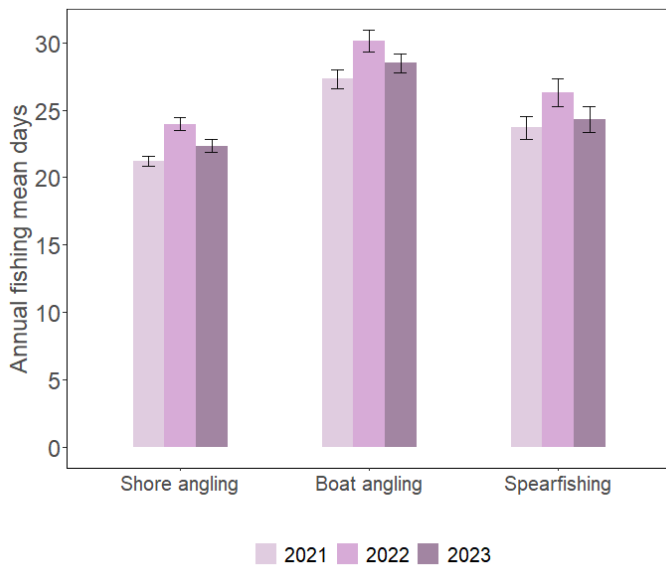


Figure 9. Average annual fishing days from online surveys by fishing modalities for each year: 2021 (light purple), 2022 (purple) and 2023 (dark purple).

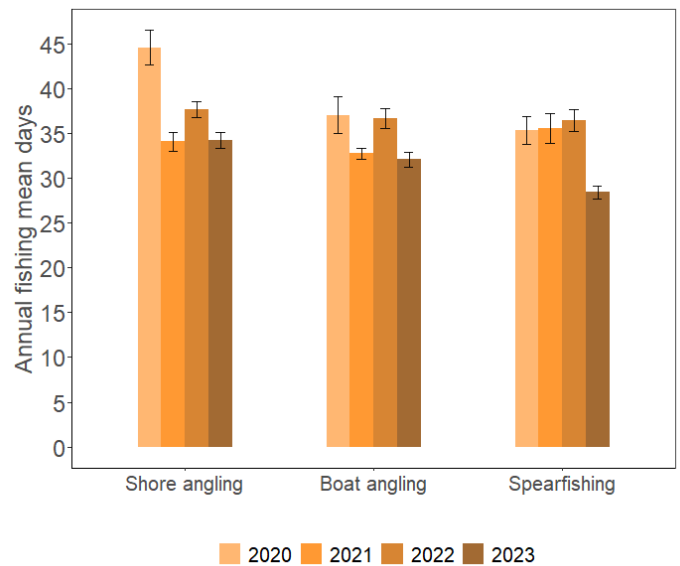


Figure 10. Average annual fishing days from onsite surveys by fishing modalities for each year: 2020 (light orange), 2021 (orange), 2022 (mid-dark orange) and 2023 (dark orange).

Figure 11 displays how often marine recreational fishers reported going fishing within the last year, based on surveys conducted online in 2023. It includes responses to the question, “How many days have you gone fishing in the last 12 months?” Notably, it shows a wide range of fishing frequencies, including those who didn’t fish at all (avidity class 0), those fishing less than 20 days annually (a low avidity class), and even those who reported up to 150 days of fishing. In comparison, Figure 11 also represents data from onsite surveys conducted in 2023, where the question about fishing frequency was similarly asked. Since onsite surveys tend to capture more frequent fishers, there’s a notable presence of individuals in the medium to high avidity classes (between 20 and 50 days per year), with some of them reporting as many as 360 fishing days annually.

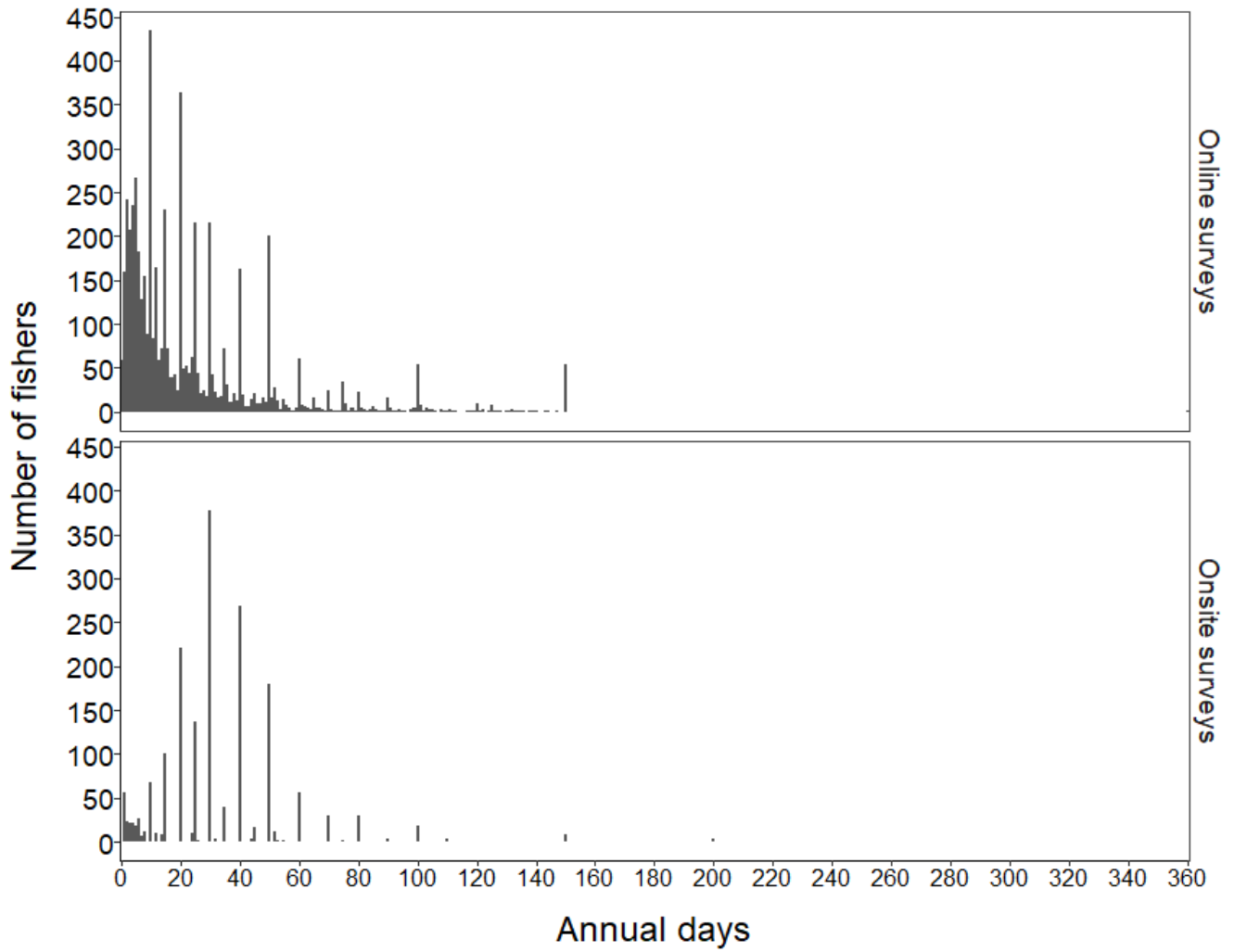


Figure 11. The fishing days on marine recreational fishers collected during online and onsite surveys in 2023. Bars, number of marine recreational fishers.

5

Modality analysis



Shore angling

1. Fishing effort

The shore angling fishing effort results are based on annual effort distributions from the online surveys, which allowed to classify respondents into avidity classes based on their declared fishing effort during the past 12 months (see Annex II). The online survey only represents licence-holders. Therefore, the effort distributions from the online surveys were extrapolated only to licenced fishers.

The results showed a considerable proportion of individuals holding a recreational fishing licence who did not make any use of it during the period 2021-2022 and 2023 (15% and 11%, respectively). For the two periods, the majority of anglers showed low avidity effort patterns (44% and 45%, respectively). The medium avidity class was 23% for 2021-2022 and 24% for 2023, whereas the response rate for high avidity shore anglers was 11% and 12% for 2021-2022 and 2023, respectively (Table 2).

Table 2. Online avidity class distribution of licenced fishers for shore recreational anglers.

| | 2021-2022 | 2023 |
|----------------------|-----------|------|
| Zero | 15% | 11% |
| Sporadic (1 -2 days) | 7% | 8% |
| Low (3 -19 days) | 44% | 45% |
| Medium (20 -49 days) | 23% | 24% |
| High (+50 days) | 11% | 12% |

The responses of the percentages obtained from the surveys were extrapolated to the number of active fishers to estimate the number of anglers by avidity category. The year-to-year variation was very small, around 3% (Table 3).

Table 3. Estimate total number of shore anglers during 2021-2022 (average) and 2023.

| | 2021-2022 | 2023 | Variation | % variation |
|----------------------|---------------|---------------|------------|-------------|
| Zero | 3 902 | 2 702 | -1 200 | -44,4 |
| Sporadic (1 -2 days) | 5 275 | 6 363 | 1 088 | 17,1 |
| Low (3 -19 days) | 13 504 | 14 779 | 1 275 | 8,6 |
| Medium (20 -49 days) | 5 901 | 5 669 | -232 | -4,1 |
| High (+50 days) | 2 825 | 2 812 | -13 | -0,5 |
| Total | 31 406 | 32 325 | 919 | 2,8 |

Reported annual fishing effort for shore anglers who went fishing at least once 2023 showed an average of 21 fishing days per year, also with a similar periodicity through the different seasons ranging from 3 days per year in winter to 7 days per year in summer. Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2021-2022 showed an average of 17 fishing days per year. In detail, the average values for the different seasons ranged from 2 days per year in winter to 6 days in summer.

The evaluation of the frequency of fishing days was conducted using online surveys answering the question: “How many times have you gone fishing in the last 4 weeks?”. To ensure the precision of the data, the average by avidity class per season is presented for the average 2021-2022 and in 2023 (Table 4; see Annex II for the monthly average by avidity class).

There is a similar trend for both periods, with the highest average corresponding to the high avidity class, and a decrease as the class progresses towards the sporadic category.

Table 4. Seasonal average frequency of fishing days for shore angling from online surveys for the period 2021-2022.

| Year 2021-2022 | Zero | Sporadic | Low | Medium | High |
|----------------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.15±(0.2) | 0.86±(0.9) | 3.97±(2.5) | 14.53±(5.6) |
| Spring | 0 | 0.36±(0.3) | 2.72±(1.4) | 7.88±(2.9) | 20.33±(5.4) |
| Summer | 0 | 0.75±(0.4) | 4.40±(2.0) | 11.09±(3.9) | 23.74±(6.4) |
| Autumn | 0 | 0.10±(0.2) | 1.99±(1.6) | 6.20±(2.8) | 19.34±(6.0) |

Table 5. Seasonal average frequency of fishing days for shore angling from online surveys for 2023.

| Year 2023 | Zero | Sporadic | Low | Medium | High |
|-----------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.40±(0.4) | 1.25±(1.1) | 4.44±(2.3) | 15.82±(6.0) |
| Spring | 0 | 0.97±(0.5) | 3.46±(1.7) | 7.87±(2.9) | 22.95±(6.1) |
| Summer | 0 | 0.73±(0.4) | 5.45±(2.1) | 11.65±(3.5) | 22.47±(6.6) |
| Autumn | 0 | 0.32±(0.3) | 2.63±(1.7) | 6.97±(2.6) | 19.34±(5.7) |

1.1. Effort distribution

The northern part of Catalonia (from Cap de Creus to Costa Brava) is characterised by its rocky coastline and a relative scarcity of sandy beaches. During 2023, 26% of shore anglers spent their fishing days in northern Catalonia during winter, while this value was 30% in spring, 24% in summer, and 27% in autumn. The central and southern sandy zones of the Catalan coastline (from Maresme to Delta de l'Ebre) remained more frequented by shore anglers. During winter, 74% of shore anglers spent their fishing days in these zones, whereas this value was 70% in spring, 76% in summer, and 73% in autumn. The areas accumulating the most fishing days were Costa Daurada, Delta de l'Ebre, Costes del Garraf, and Maresme, with 94 806, 87 997, 86 624, and 81 197 fishing days during 2023, respectively (Figure 12). In most areas, summer continued to be the most popular season for shore angling, with 214 342 fishing days per year. Overall, shore angling effort accumulated an estimated 606 208 fishing trips per year.

Following the same analytical pattern, during 2021-2022, in winter, 27% of shore anglers spent their fishing days in northern Catalonia, while in spring it was 26%, and in summer and autumn, it was 23%. The central and southern sandy zones of the Catalan coastline (from Maresme to Delta de l'Ebre) were much more frequented by shore anglers, accounting for 75% of fishing days. The areas with the highest number of fishing days were Costes del Garraf, Costa Daurada, Delta de l'Ebre, and Maresme, with 80 147, 79 451, 79 550, and 75,876 fishing days during the period 2021-2022, respectively. In most areas, summer was the most popular season for shore angling, with up to 195 801 fishing days per year. During the bathing season (June 15th to September 15th), beaches do not allow fishing during daytime hours, generally restricting fishing to more isolated and unregulated sandy beaches and other coastal areas such as breakwaters and rocky shores (Figure 12). Overall, shore angling effort accumulated an estimated 533 975 fishing trips per year.

In 2023, the average daily shore angling trips per kilometre continued to reflect the uneven distribution of this fishing activity across temporal and geographical scales (Figure 13; Annex II). The most intensely fished area again corresponds to the densely populated beaches in the city of Barcelona and its metropolitan surroundings, with a yearly average of 8.2 fishing trips per kilometre (Figure 12). Seasonal differences notwithstanding, the spatial distribution of shore fishers remains fairly consistent throughout the year.

The average daily shore angling trips per kilometre for the average 2021-2022 illustrate the uneven distribution of this fishing activity both temporally and geographically (Figure 13; Annex II). The most intensely fished area coincides with the most densely populated beaches in the city of Barcelona and its metropolitan surroundings, exhibiting a yearly average of 7.0 fishing trips per kilometre. Despite variations in seasonal activity, the spatial distribution of shore fishers remains relatively consistent across different seasons.

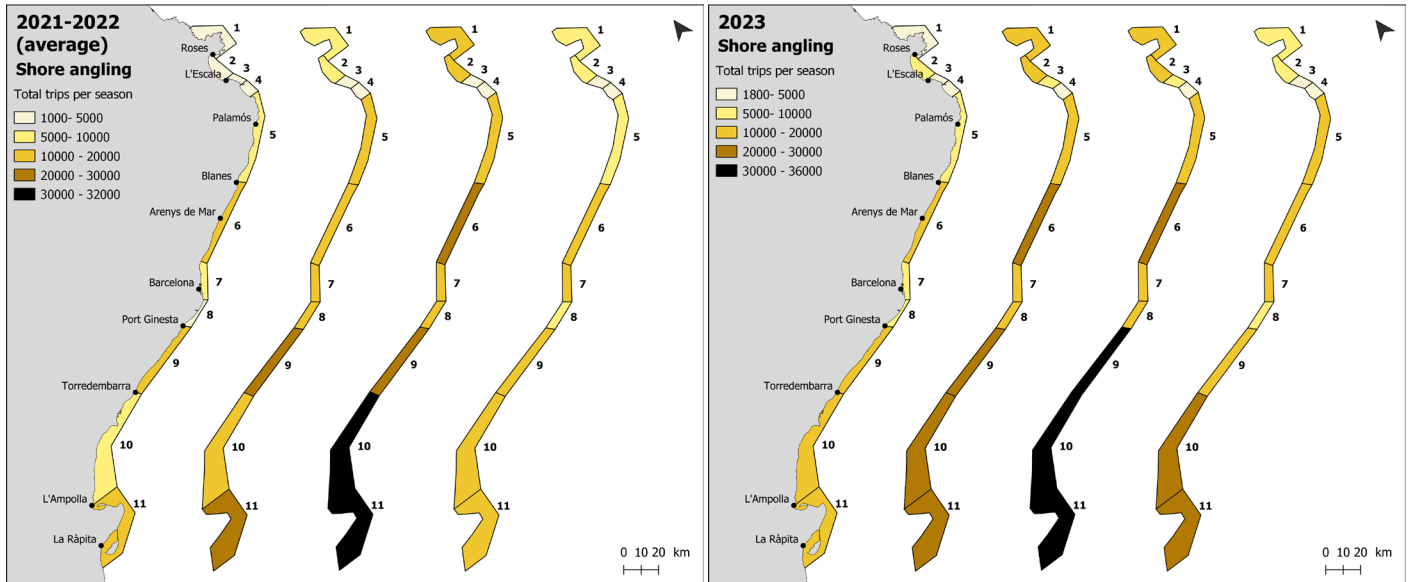


Figure 12. Total shore fishing trips during 2021-2022 (left) and in 2023 (right) per zone during each season. In this analysis we do not consider the areas where fishing is not allowed.

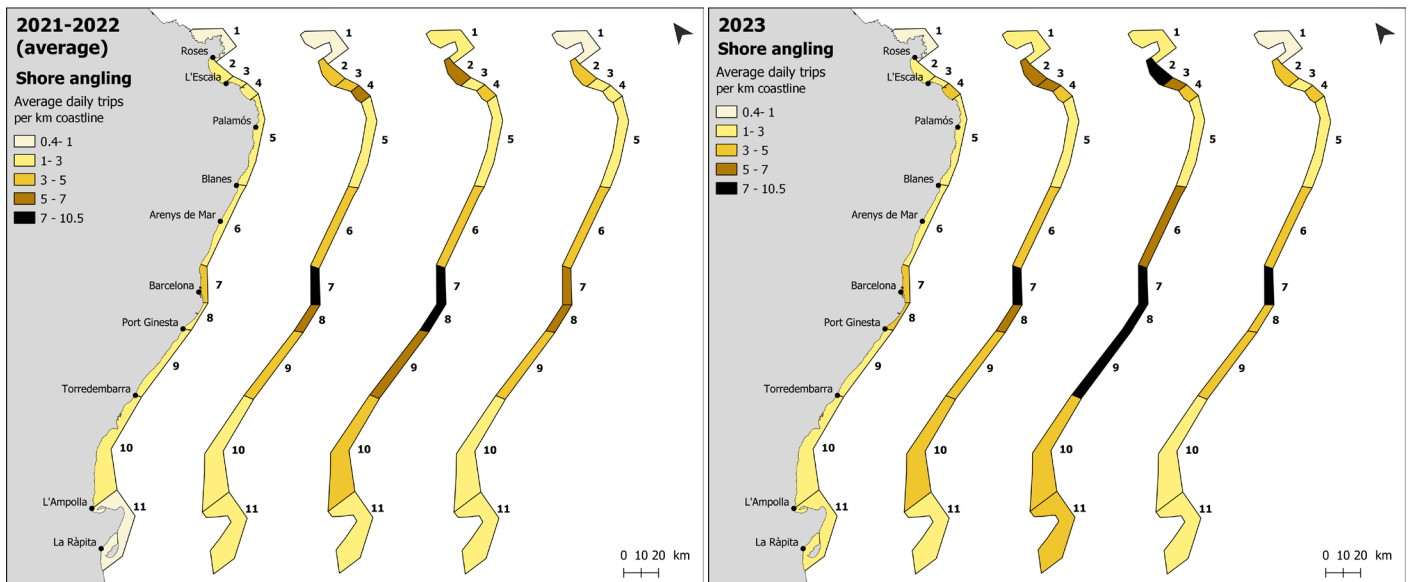


Figure 13. Average number of daily fishing trips during 2021-2022(left) and in 2023 (right) per kilometre coastline within each season.

2. Fishing yield

Fishing yield was analysed using catch per unit effort (CPUE) measured in kilograms caught per day fished. The fishing yield values for shore anglers showed the lowest fishing productivity for both years (0.42 ± 0.03 kg/day and 0.48 ± 0.04 kg/day in average 2020-2022 and 2023, respectively; Figure 14), followed by boat anglers and spearfishing, as detailed in Annex V. The fishing yield values from shore angling significantly differed from the other two fishing modalities (p -value <0.002). Information on CPUE values from the three fishing modalities together for each year can be found in Annex III.

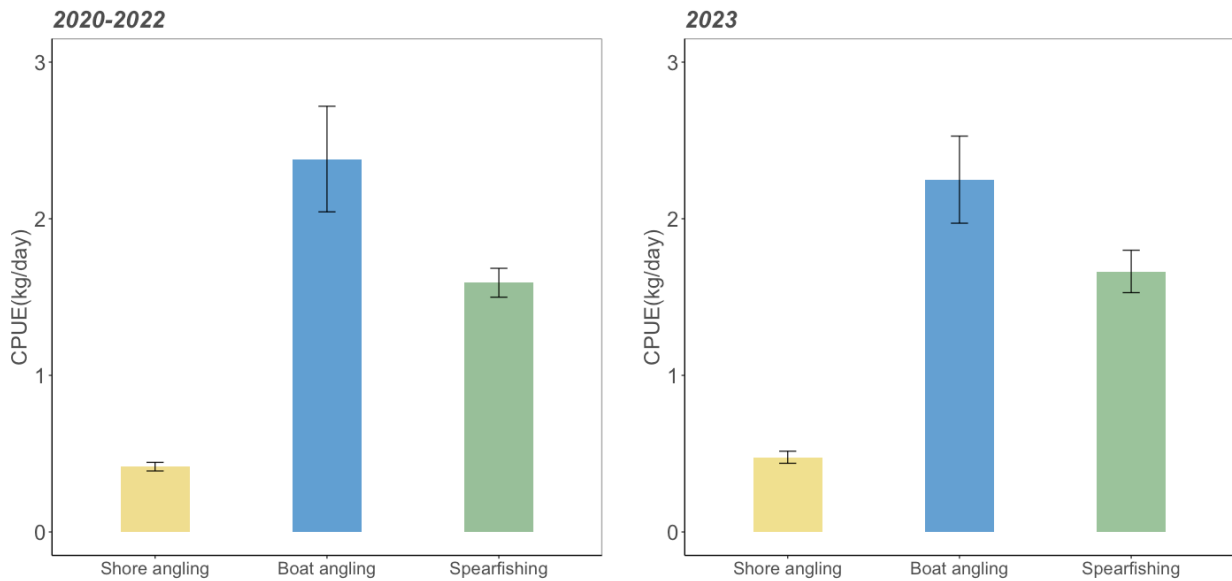


Figure 14: CPUE by modality in the period 2020-2022 (left) and 2023 (right). The colour bars indicate the average, and the black line indicates the standard error.

Comparing the two periods studied, there was a significant difference between the years 2022 to 2020,2021 and 2023 (p-value=0.0038). Therefore, there was a difference in CPUE for shore angling fishing between the two years studied. In detail, the average CPUE in 2020-2022 average was lower (0.42 ± 0.03) than that from 2023 (0.48 ± 0.04 ; Figure 15). However, there were no significant differences (p-value=2.02) in CPUE for shore angling fishing among seasons in the period 2020-2022. In detail, the average CPUE was 0.26 ± 0.05 , 0.52 ± 0.09 , 0.42 ± 0.04 and 0.42 ± 0.05 for winter, spring, summer and autumn, respectively (Figure 16). In contrast, there were significant differences (p-value=0.05) in CPUE for shore angling fishing among seasons in 2023. Significant differences were found between winter and summer, and between winter and autumn (p-value=0.033 in both cases). In detail, the average CPUE was 0.14 ± 0.05 , 0.35 ± 0.12 , 0.43 ± 0.05 and 0.63 ± 0.08 for winter, spring, summer and autumn, respectively (Figure 16).

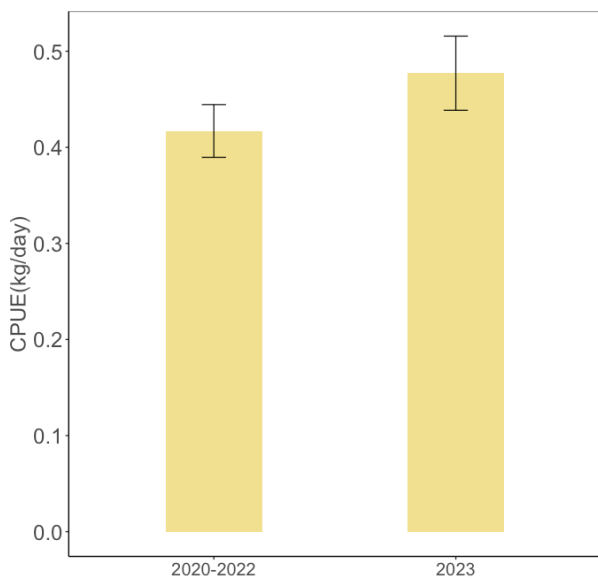


Figure 15. CPUE for the period 2020 - 2022 and 2023 for shore angling. The yellow bars indicate the average, and the black line indicates the standard error.

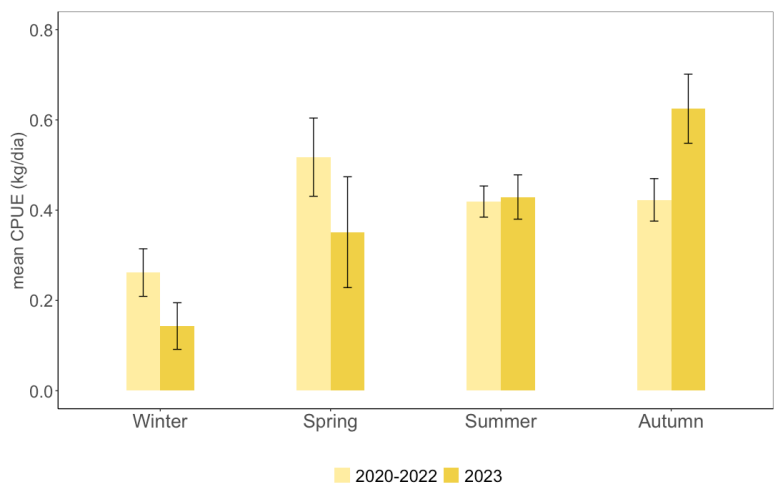


Figure 16. CPUE by season in the period 2020-2022 (light yellow) and 2023 (dark yellow). The bars indicate the average, and the black line indicates the standard error.

3. Seasonal catch composition

In the onsite sampling, a total 2 514 individual catches from shore fishing were identified from a total 58 different species during the studied years. Catch composition results show the actual catch estimates obtained from the onsite surveys. They contrast with results from target species, and it is clear that for all three fishing modalities, there is a difference between species' desirability and their actual catchability. Species' catch seasonality may also be observed, as different species are more or less available, or more or less desired during different times of the year.

The species catch compositions of shore angling represented a total of 56 different species throughout the period 2020-2022. The highest catch diversity was found in the spring, with 42 different species observed, followed by summer with 41, autumn with 35 and winter with 33 different species (Figure 17).

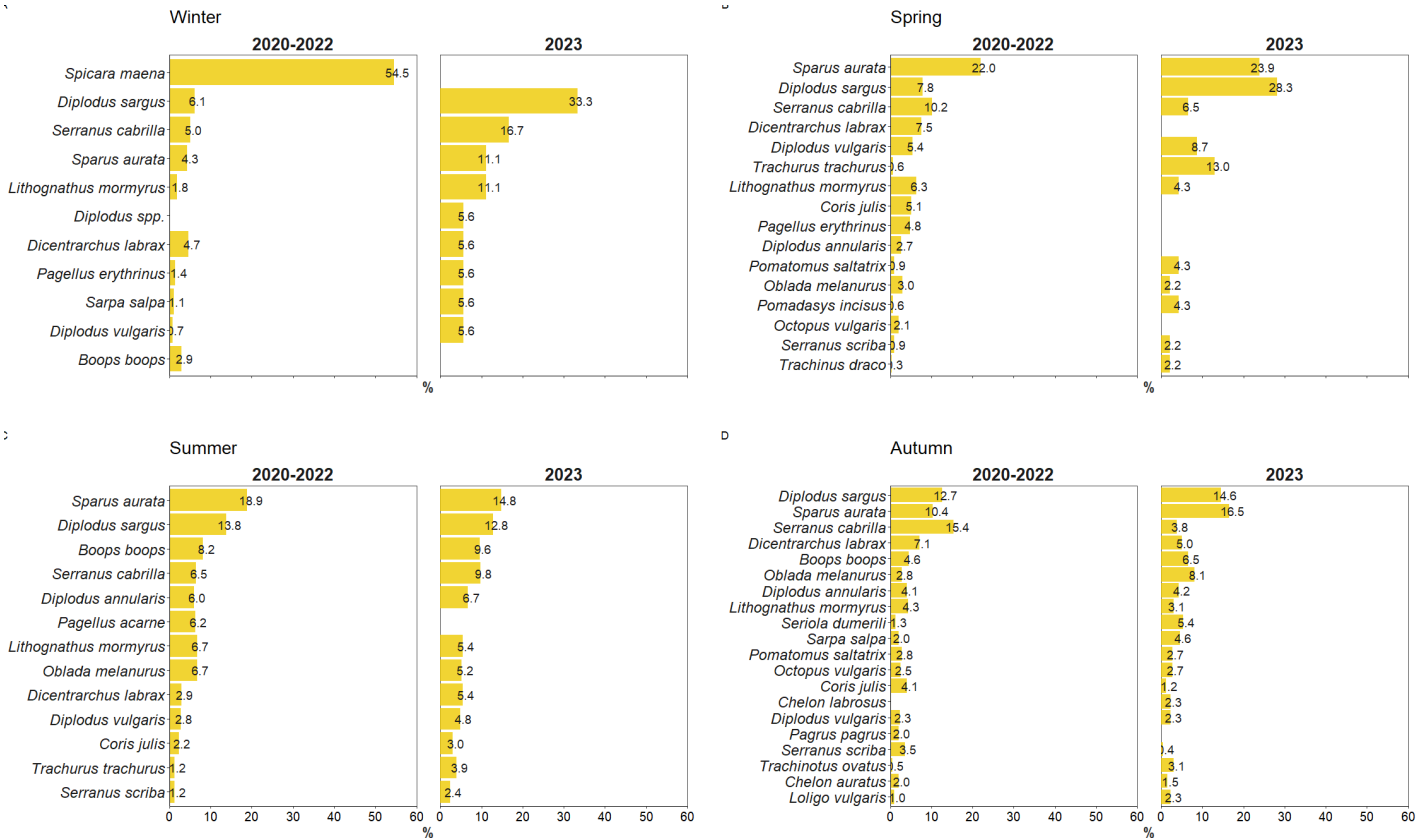


Figure 17. Seasonal catch composition (in percentage of individuals number) for onsite shore angling sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2022 (left) and in 2023 (right). Only species representing over 2% of the total catch are shown.

In 2023, shore angling yielded a total of 42 different species. However, the diversity of species caught was notably low due to challenges in sampling. Summer was found to be the season with the highest biodiversity, with 36 different species observations (Figure 16), followed by autumn with 31, followed by spring with 11, and finally winter with 9 different species. This greater diversity during the warmer months may be explained by the greater number of observations obtained during months with greater fishing activity. However, the discrepancies in sampling days during winter and spring highlighted these gaps.

Catch composition results show the actual catches obtained from the onsite surveys. In winter 2020-2022, The catches of *Spicara maena* accounted for 54.5% of the total. It is important to determine whether this high catch rate is a random occurrence or if this species is predominantly caught only in winter. In winter 2023, no catches of *S. maena* were recorded. Instead, *Diplodus sargus* made up 33.3% of the catch, followed by *Serranus cabrilla* at 16.7%, and *Sparus aurata* at 11.1%. In spring, the top caught species were *S. aurata*, *D. sargus* and *S. cabrilla* for both years whereas in summer, the two top species were *S. aurata* and *Diplodus sargus*, and in lower representation *Boops boops*. The autumn shows more differences between the two years depending on the percentage of representation. For example, *S. cabrilla* is only present (3.8%) in 2023 while in 2020-2022 it is represented by 15.4%. On the other hand, *D. sargus* and *S. aurata* are still very equally represented between the two periods. For

some species, their occurrence has to be analysed to distinguish whether it is recurrent in certain seasons or it could be the result of chance, as only a handful of these anglers were found during the surveys, but all of them had had particularly productive outings. (Figure 17).

4. Total annual catch

Estimates of total annual catches used catch data from the onsite surveys and effort values from the online surveys and were estimated first for each avidity class within each season, after which they were added into seasonal total catch values for the whole modality. In 2023, the top species showed similar values than the period 2020-2022, i.e. *Sparus aurata* (96 009 kg). However, other abundantly caught species were, in order of total annual catches, *Pomatomus saltatrix* (73 420 kg), *Diplodus sargus* (26 803 kg), *Dicentrarchus labrax* (22 276 kg), and *Serranus cabrilla* (14 665 kg). The average annual catch of the species during the period 2020-2022 was *Sparus aurata* (68 768 kg), *Diplodus sargus* (27 873 kg), *Dicentrarchus labrax* (25 177kg), *Octopus vulgaris* (15 315 kg) and *Lithognathus mormyrus* (9 660 kg; Figure 18). The role of *Octopus vulgaris* in the shore angling catches had been previously documented (ICATMAR, 2022), Caution is recommended in the use of all total catch results, as its identified potential overrepresentation in the onsite surveys could cause the extrapolation of the total catches to grossly overestimate total catch values.

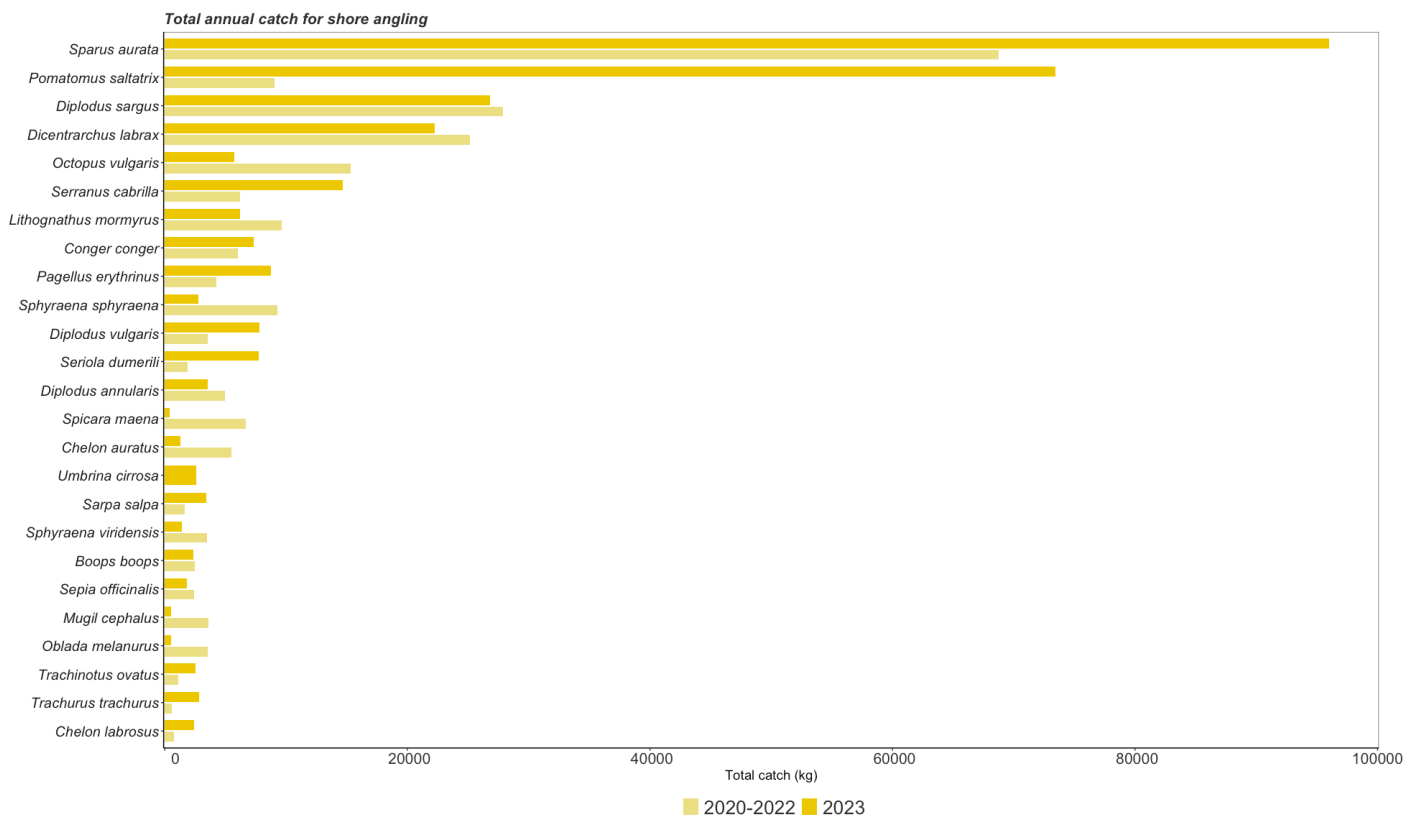


Figure 18. Total annual catch by species for shore angling in the period 2020-2022 (light yellow) and in 2023 (dark yellow).

5. Spatial distribution of the total annual catch

The zones with more catches are very similar between both studied years, with generally higher values in 2023 than in the period 2021-2022. The spatial distribution of the annual catches evidences the ranging fishing impacts (Figure 19). In general, the most populated areas such as *Costa Daurada* (49 242 and 35 685, respective), *Delta de l'Ebre* (45 780 and 35 730, respective), *Costes del Garraf* (44 922 and 36 059, respective) and *Maresme* (42 391 and 34 164, respective) and it is adjacent zones yield the highest amount of catches on a per kilometre basis. Population density and fishing extraction are particularly related in the case of shore angling.

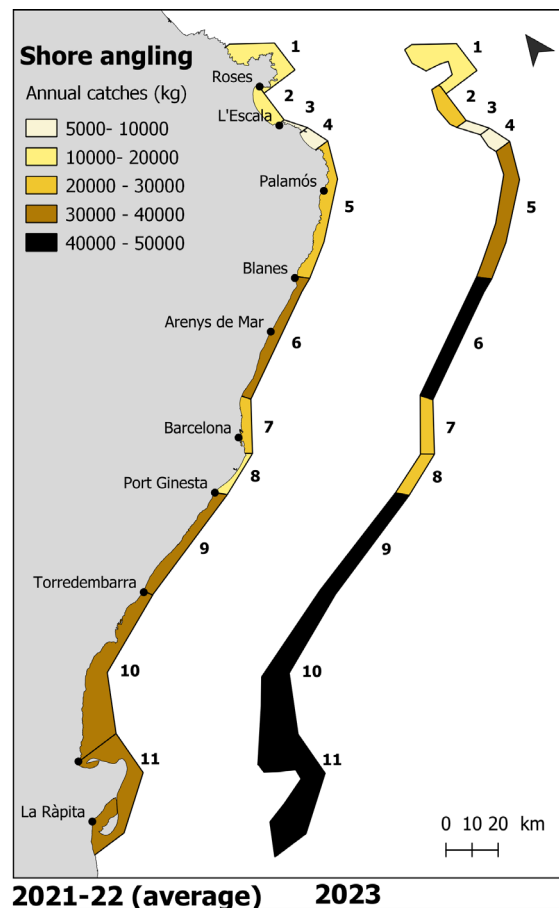


Figure 19: Distribution of total annual catch for shore angling in the period 2021-2022 (left) and 2023 (right).

6. Inequality in the distribution of the total annual catches

Shore recreational anglers are very heterogeneous in their fishing characteristics. They present a diverse range of avidity habits and practise a number of fishing techniques (see ICATMAR, 2021) that combine with experience and fishing motivations to influence fishing effort, fishing yields, and total catches. The different avidity groups designed in this study (see section 4) are responsible for very different proportions of the total catches. Below are the figures corresponding to shore angling modality in 2021-2022 and 2023, where the number of anglers in each avidity class is directly associated with their relative contributions to the total modality catch. Relative individual impacts show wide variations in relation to their avidity patterns. These amount to remarkable differences in the aggregate impact of each avidity class. It is worth noting that the values presented are the product of estimations based on extrapolations that, although consistent with the avidity class model, are not based on direct observations, and should therefore be observed with caution.

For shore angling, over 72% of the anglers took less than 20 fishing trips during the 2021-2022 period, jointly contributing 21,4% of the total modality catch. The remaining 28% who fished more than 20 days per year, of which 9% took over 50 trips, caught 78% of the total shore fishing catch. These inequalities in the relative contributions to the total catch are explained by the positive synergy between avidity and catch rates. This results in the stark observed differences in annual catch extractions between avidity classes. While sporadic avidity anglers caught on average a mere 0.33kg, the low avidity recreational anglers extracted approximately 4 kg biomass during the one-year period. Conversely, medium avid class anglers extracted almost 11 kg per year, and the most avid anglers extracted an average of 44 kg throughout 2021-2022 (Figure 20).

In 2023, over 74% of the shore anglers took less than 20 fishing trips during the 2023 period, jointly contributing 16% of the total modality catch. The remaining 26% who fished more than 20 days per year, of which 9% took over 50 trips, caught 60% of the total boat fishing catch. As a result, while sporadic avidity anglers caught on average a mere 0.15 kg, the low avidity recreational anglers extracted approximately 3 kg biomass during the

one-year period. Conversely, medium avid class anglers extracted almost 13 kg per year, and the most avid anglers extracted an average of 68 kg throughout 2023 (Figure 21).

1. Fishing effort

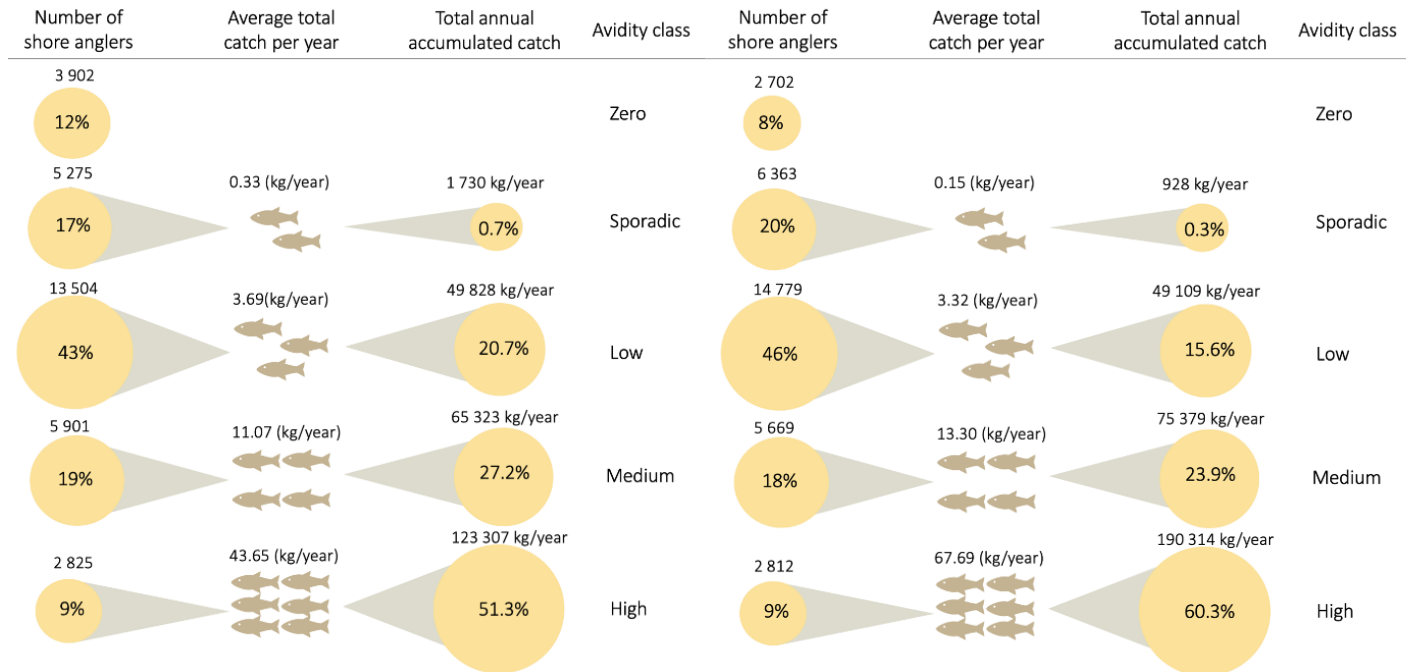


Figure 20. Number and proportion of shore anglers average individual fishing intensity, and total accumulated catch per avidity group in average by 2021-2022.

Figure 21. Number and proportion of shore anglers, average individual fishing intensity, and total accumulated catch per avidity group during 2023.

Boat angling

The results of the boat angling effort were based on annual effort distributions from the online surveys, which allowed to classify respondents into avidity classes based on their declared fishing effort during the past 12 months (Table 6). Since the online survey only represents licence, the effort distributions from the online surveys were extrapolated only to licenced fishers.

Table 6. Avidity class distribution of licenced boat recreational anglers

| | 2021-2022 | 2023 |
|----------------------|-----------|------|
| Zero | 9% | 6% |
| Sporadic (1 -2 days) | 3% | 3% |
| Low (3 -19 days) | 38% | 38% |
| Medium (20 -49 days) | 33% | 35% |
| High (+50 days) | 17% | 17% |

The results showed a slightly lower proportion of individuals holding a recreational fishing licence that did not make use of it during the period 2021-2022 and 2023 in which their marine recreational fisher licence was active (9% and 6%, respectively; Table 6). For the sporadic avidity class, the percentage was the same (3%; Table 6). For the two years, most anglers showed the same avidity effort pattern (38%). Boat anglers with medium avidity class were similar between years (33% and 35% in 2021-2022 and 2023, respectively). Altogether, 17% for both periods of boat recreational anglers were highly avid.

The responses of the percentages obtained from the surveys were extrapolated to the number of active fishers to estimate the number of anglers by avidity category. The year-to-year variation was around 16.4% (Table 7). Reported annual fishing effort for boat anglers who went fishing at least once during 2023 showed an average of 26 fishing days per year, with a similar periodicity through the different seasons: 9 days per year in summer, 7 days per year in spring, followed by autumn with 6 days per year and 4 days per year in winter. Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2021-2022 showed an average of 25 fishing days per year, with a similar periodicity through the different seasons, ranging from 9 days per year in summer to 4 days per year in winter, each season.

Table 7. Estimate total number of boat anglers each year.

| | 2021-2022 | 2023 | Variation | % variation |
|----------------------|---------------|---------------|--------------|-------------|
| Zero | 800 | 585 | -215 | -36,8 |
| Sporadic (1 -2 days) | 1 476 | 2 182 | 706 | 32,4 |
| Low (3 -19 days) | 4 234 | 5 372 | 1 138 | 21,2 |
| Medium (20 -49 days) | 2 960 | 3 410 | 450 | 13,2 |
| High (+50 days) | 1 565 | 1 654 | 89 | 5,4 |
| Total | 11 035 | 13 203 | 2 168 | 16,4 |

In order to accurately estimate the frequency of fishing days, it was analysed using the monthly average by avidity class per season in 2021-2022 (Table 8) and in 2023 (Table 9). There is a similar trend for both years, with the highest average obtained from the high avidity class, and a decrease as the class progresses towards the sporadic category.

Table 8. Seasonal average frequency of fishing days for boat angling from online surveys for the period 2021-2022.

| Year 2021-2022 | Zero | Sporadic | Low | Medium | High |
|----------------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.36±(0.4) | 1.32±(1.1) | 3.79±(1.9) | 15.48±(6.1) |
| Spring | 0 | 0.95±(0.5) | 2.49±(1.4) | 6.16±(2.3) | 21.06±(5.8) |
| Summer | 0 | 0.59±(0.4) | 5.13±(2.2) | 12.53±(3.9) | 25.03±(5.3) |
| Autumn | 0 | 0.20±(0.3) | 2.10±(1.4) | 8.26±(2.7) | 22.23±(6.2) |

Table 9. Seasonal average frequency of fishing days for boat angling from online surveys for 2023.

| Year 2023 | Zero | Sporadic | Low | Medium | High |
|-----------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.00 | 1.40±(1.1) | 4.41±(1.8) | 16.51±(5.1) |
| Spring | 0 | 0.17±(0.3) | 3.47±(1.5) | 9.20±(2.8) | 19.98±(5.2) |
| Summer | 0 | 1.57±(0.5) | 5.90±(2.0) | 12.84±(3.9) | 21.87±(5.2) |
| Autumn | 0 | 0.37±(0.4) | 2.70±(1.5) | 8.68±(3.0) | 19.74±(5.2) |

1.1. Effort distribution

The areas where most fishing days were spent in 2023 were *Delta de l'Ebre*, the south of *Costa Brava*, *Golf de Roses*, *Cap de Creus* and *Costa Daurada*, followed by *Costes del Garraf* and *Maresme* (Figure 22), portraying a very similar spatial distribution as that found for shore angling. In most areas, the season when most people went fishing was summer, with about 115 074 fishing days. Most boat angling trips in 2023 were taken in the central and southern zones of the Catalan coastline (43% in the north of Catalonia and 57% the rest). Overall, the boat angling effort accumulated an estimate of 325 905 fishing trips per year.

Following the same analytical pattern, in 2021-2022 were *Delta de l'Ebre*, the south of *Costa Brava* and *Costa Daurada* followed by *Cap de Creus*, *Costes del Garraf* and *Maresme* (Figure 22), portraying a very similar spatial distribution as that found for shore angling. In most areas, the season when most people go fishing is in summer, with 98 823 fishing days. Most boat angling trips were taken in the central and southern zones of the Catalan coastline. Approximately 51% of the boat fishing activity was spent in the northern zones of the Catalan coast. In detail, the northern zone of *Cap de Creus* and *Costa Brava* are the most intensively fished per kilometre (Figure 23). In summer, this activity increases as the population rises with the presence of tourists. Overall, the boat angling effort is estimated in 262 256 fishing trips per year.

The average daily boat angling trips per kilometre in 2023 show the degree to which fishing activity is unevenly distributed at a temporal and geographical level (Figure 23; Annex III). Boat fishing intensity in the *Golf de Roses* area was the highest throughout the seasons, with a yearly average of 4.4 fishing trips per kilometre, followed by *Barcelonès*, with a yearly average of 3.7 fishing trips per kilometre (see below Figure 23). There was seasonal variability in *Costa del Montgrí*, *Baix Ter* and *Costes del Garraf*, which have a very reduced activity during the colder seasons. Conversely, boat fishing intensity was notably stable in the zones of *Golf de Roses* and *Barcelonès*.

The average daily boat angling trips per kilometre during the period 2021-22 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales (Figure 23; Annex III). Boat fishing intensity in the *Barcelonès* and *Golf de Roses* area was the highest throughout the seasons, with a yearly average of 2.3 and 2.5 fishing trips per kilometre respectively (Figure 23). There was seasonal variability in *Delta de l'Ebre*, *Costa Daurada*, *Cap de Creus* and *Costa Brava* zones, which activity was reduced during the colder seasons.

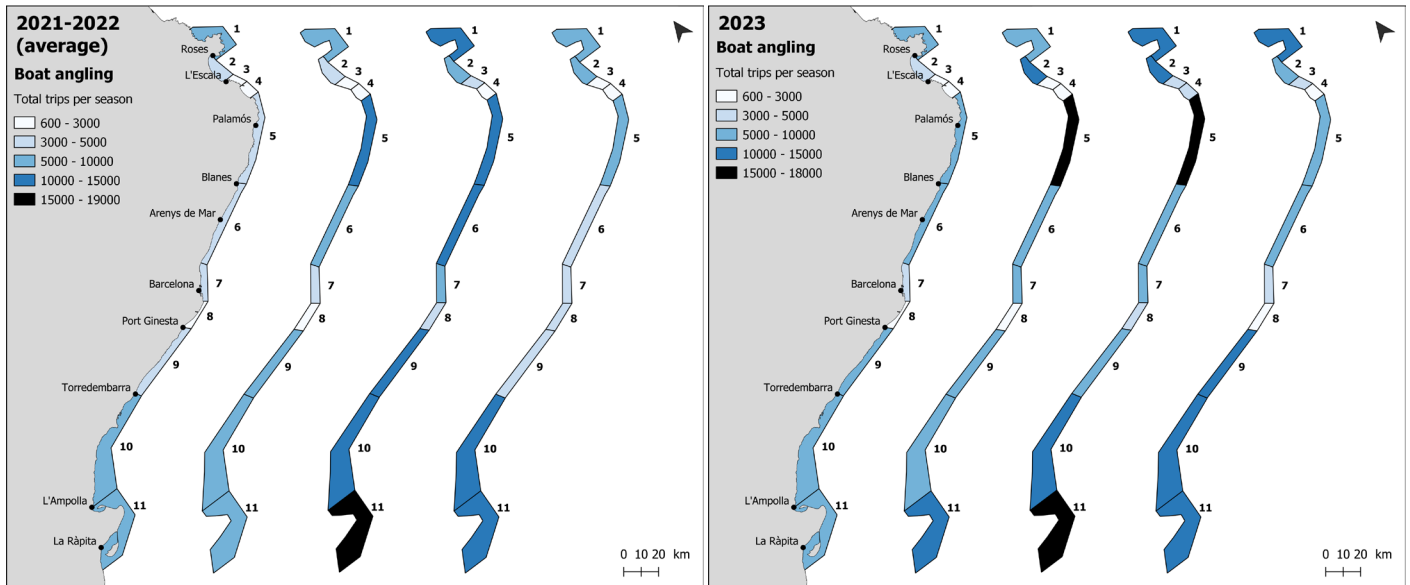


Figure 22. Total boat fishing trips during 2021-2022 (left) and 2023 (right) per zone during each season. In this analysis we do not take into account areas where fishing is not allowed.

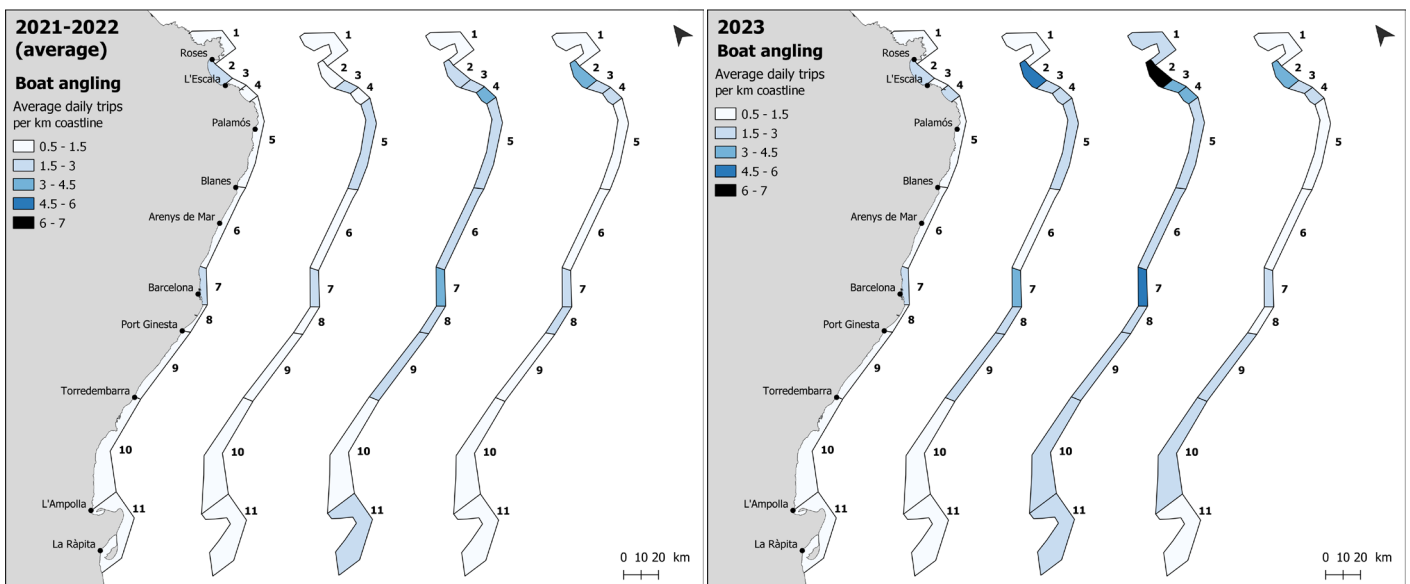


Figure 23. Average number of daily fishing trips during 2021-2022 (left) and 2023 (right) per kilometre coastline within each season.

2. Fishing yield

The fishing yield was analysed using catch per unit effort (CPUE) measured in kilograms caught per day fished. Comparing the two periods studied we see that there was a non-significant difference (p -value >0.05) using a *Wilcoxon rank* with continuity correction. The average CPUE for boat anglers was very similar for both years studied (2.38 ± 0.34 kg/day and 2.25 ± 0.28 kg/day in 2020-2022 and 2023, respectively), as detailed in Figure 24.

Seasonally, there were no significant differences in CPUE for boat angling fishing between spring - winter, spring - summer, autumn - spring and autumn - winter in the period 2020-2022. There were significant differences (p -value <0.05) between winter - summer and autumn - summer. In detail, the average CPUE from spring was the highest (3.36 ± 0.59) followed by summer (2.70 ± 0.73), then autumn (2.04 ± 0.35) and winter (0.60 ± 0.08 ; Figure 25). Similarly, there were no significant differences (p -value=0.08) in CPUE for boat angling fishing among seasons in 2023. In detail, winter had the lowest average CPUE (0.35 ± 0.13), which was different than summer (3.03 ± 0.54). Spring (1.39 ± 0.45) and autumn (1.85 ± 0.34 ; p -value=0.04) were also different than summer (Figure 25).

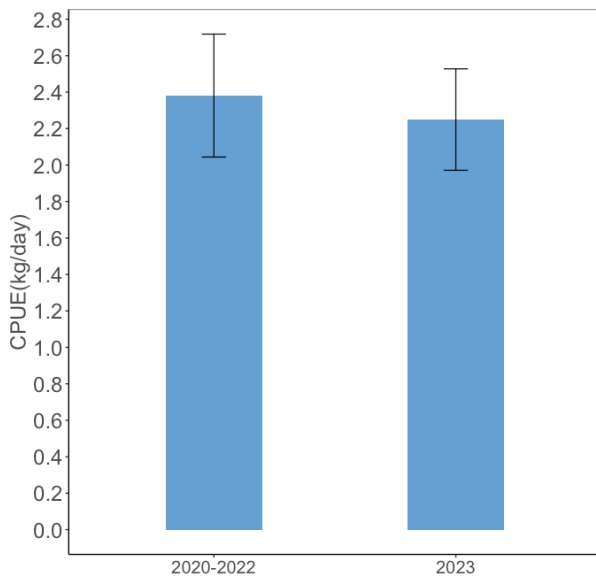


Figure 24. CPUE for the period 2020-2022 and 2023 for boat angling. The blue bars indicate the average and the black line indicates the standard error.

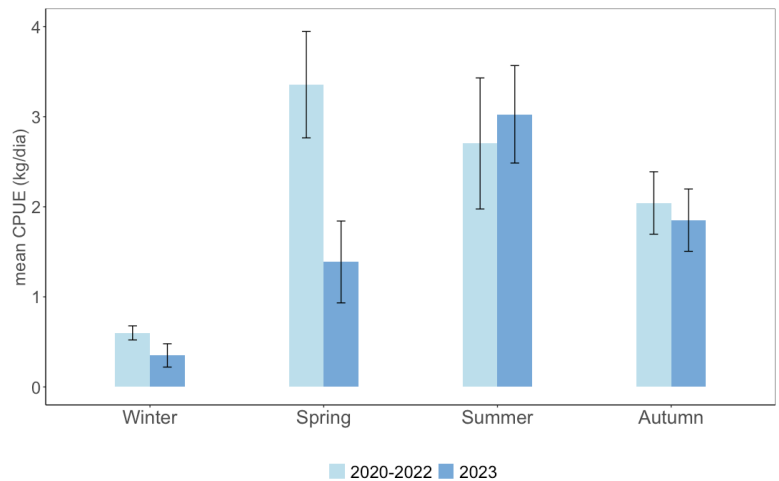


Figure 25: CPUE by season in the period 2020 to 2022 (light blue) and 2023 (dark blue). The bars indicate the average and the black line indicates the standard error.

3. Seasonal catch composition

In the onsite sampling for all years, a total 6 766 individual catches from boat fishing were identified from a total 69 different species during the studied years. Catch composition results show the actual catch estimates obtained from the onsite surveys. They contrast with results from target species, and it is clear that for all three fishing modalities, there is a difference between species' desirability and their actual catchability. Species' catch seasonality may also be observed, as different species are more or less available, or more or less desired during different times of the year.

The diversity patterns of boat fishing catches are much higher than those of spearfishing and shore angling (with a smaller difference). The highest diversity values are found in summer (53 different species observed), followed by spring with 38, then autumn with 32 and the lowest values are found in winter with 29 out of a total of 62 different species observed for boat angling. It should be noted that the total number of species in this modality is much higher than in the others (2 541 shore angling and 1 292 spearfishing). Regarding the number of surveys conducted, it is lower than shore angling (2 132 for shore angling and 829 for boat angling, all years together), and it could be argued that boat angling diversity would surpass that of shore angling if the same number of observations was attained. The results in 2023 were very similar, summer was found to be the season with the highest biodiversity, with 45 different species observations followed by autumn with 36, then spring with 35 and finally, the lowest values are found in winter with 8 out of a total of 57 different species observed for boat angling (Figure 26).

In winter, the two most captured species differ between the studied years: for the period 2020-2022, they were *Serranus cabrilla* (40.6%) and *Loligo vulgaris* (20.8%), while in 2023, they were *Serranus cabrilla* (25%) and *Loligo vulgaris* (10%). Another species represented was *Pagellus acarne*, accounting for 25% of the catches in 2020-22 and 1.3% in 2023. However, other important species caught in 2020-2022 (i.e., *Sepia officinalis* and *Pagellus bogaraveo*) were absent in 2023. In spring, there was a great difference between the top caught species according to year, being *Pagellus erythrinus* (22.7%) and *Pagellus bogaraveo* (23.1%) the main catches in 2023 but *S. cabrilla* (20.8%) in the period of 2020-2022. Summer also showed great differences depending on the year. In 2020-2022, the catch was dominated by *S. cabrilla* (19.2%) followed by *Scomber scombrus* (10.7%), whereas in 2023, the dominant species were *P. erythrinus* (19.6%) and *Euthynnus alletteratus* (12.9%). In autumn, nearly one-third of the catches were attributed to *L. vulgaris* (30.8%) during the 2020-2022 period, while a quarter were attributed to *S. officinalis* (20.2%) in 2023 (Figure 26).

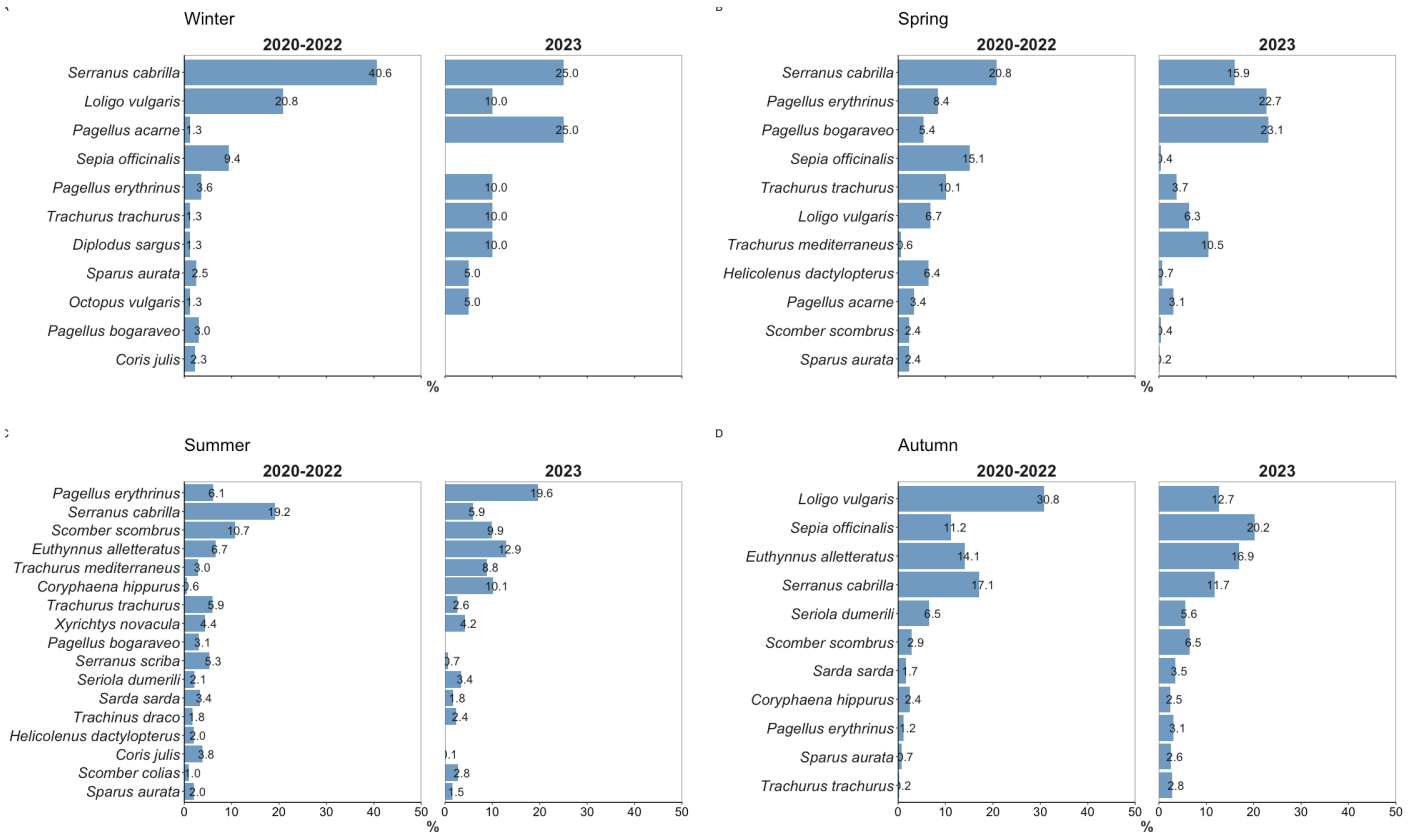


Figure 26: Seasonal catch composition (in percentage of individuals number) for onsite boat angling sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2022 (left) and in 2023 (right). Only species representing over 2% of the total catch are shown.

4. Total annual catch

The main species caught by boat in 2023, four of the top five species varied being *Euthynnus alletteratus* the most important in catches (84 041 kg). Other abundantly caught species were, in order of total annual catches, *T. thynnus* with 81 920 kg, followed by *L. vulgaris* with 50 120 kg, followed by *Pagellus erythrinus* with 34 743 kg, and *Coryphaena hippurus* with 34 266 kg annually. The previous section showed how seasonality patterns are highly influential on species catches, but it is also worth noting the great variety of different fishing techniques of this modality. The results here presented are the product of a survey design that has made its best effort to capture the variety of techniques, seasonal and geographical patterns, but nonetheless, specific practices may be over- or underrepresented in the surveys causing cascading effects onto the total catch per species results. Particularly vulnerable activities to temporal sources of bias are the catches of all the temporary species. Moreover, sampling difficulties such as caution or unwillingness to declare part of the catches could have an influence on results, potentially underrepresenting big pelagic catches. It is likely that the onsite sampling method is only adequate to observe legal fishing practices, as the surveyors have no inspection authority. This assumption could be applied for all three fishing modalities but may be especially relevant for the surveys conducted in ports, as they require fishers to actively disembark the catch from the boat for the surveyors to observe. Some of the marine resource extractions may therefore remain out of sight for our surveyors, and this could potentially have effects of an unknown magnitude on the total catch volumes per species here presented. In the period of 2020-2022 was *Thunnus thynnus* with 227 554 kg caught annually, followed by *Sepia officinalis* with 47 162 kg, and *Seriola dumerili* with 41 803 kg (Figure 27).

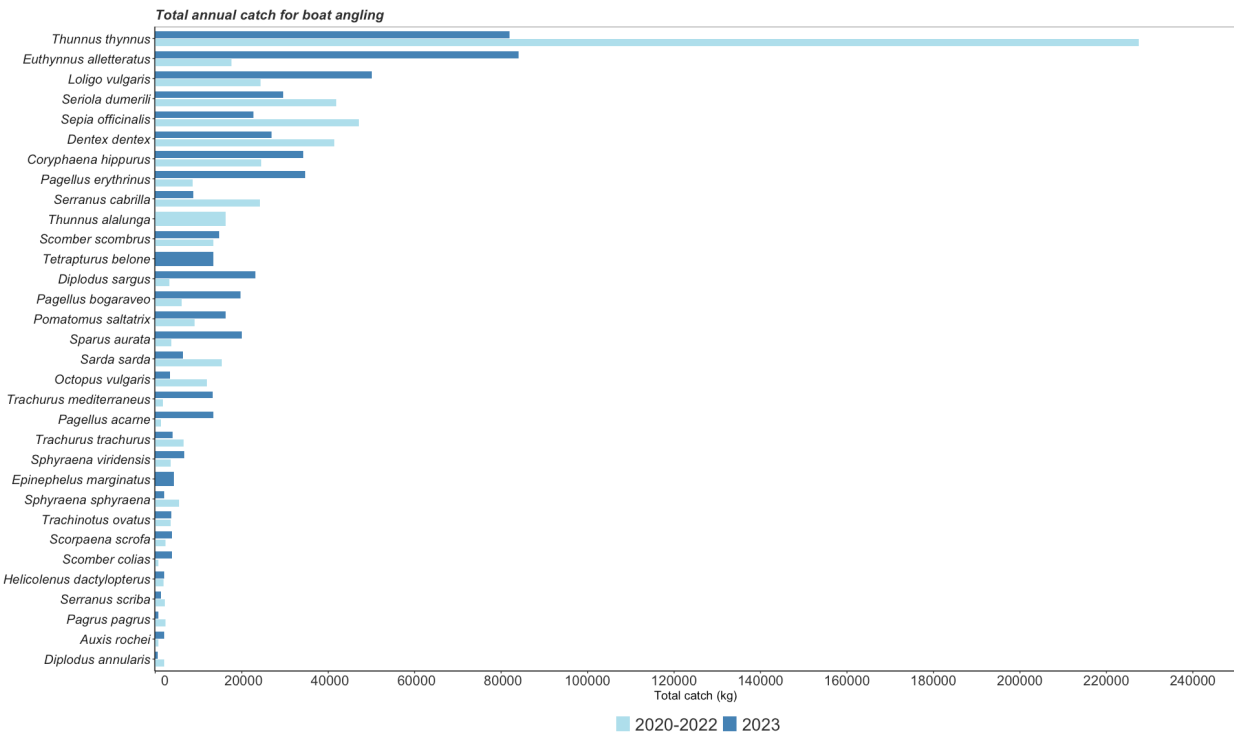


Figure 27. Total annual catch per species for boat angling in average 2020-2022 (light blue) and in 2023 (dark blue).

5. Spatial distribution of the total annual catch

The spatial distribution of the catches is very similar between both studied periods. However, in 2021-2022, there are more annual catches, in general, compared to 2023. The zones where the annual catches increased were *Delta de l'Ebre* (97 863 and 83 204, respective), *Costa Brava sud* (90 341 and 78 386, respectively), *Costa Daurada* (77 813 and 67 335, respectively) and *Cap de Creus* (69 721 and 64 029, respectively; Figure 40).

6. Inequality in the distribution of the total annual catches

Boat recreational anglers are very heterogeneous in their fishing characteristics. They present a diverse range of avidity habits and practice a number of fishing techniques that combine with experience and fishing motivations to influence fishing effort, fishing yields, and total catches. The different avidity groups designed in this study are responsible for very different proportions of the total catches. Below are the figures corresponding to boat angling modality in 2021-2022 and 2023, where the number of anglers in each avidity class is directly associated with their relative contributions to the total modality catch. Relative individual impacts show great variations in relation to their avidity patterns. These amount to massive differences in the aggregate impact of each avidity class. It must be considered that the values presented are the product of estimations based on extrapolations that, although consistent with the avidity class model, are not based on direct

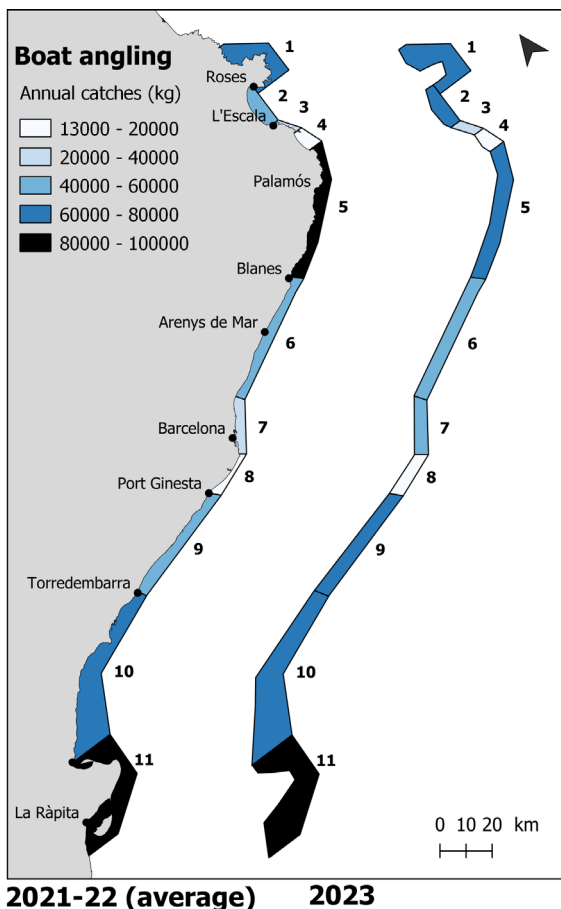


Figure 28: Distribution of total annual catch for boat angling in 2021-2022 (left) and 2023 (right).

observations and should therefore be observed with caution.

For boat angling, over 59% of the anglers took less than 20 fishing trips during the 2021-2022 period, jointly contributing 9% of the total modality catch. The remaining 41% who fished more than 20 days per year, of which 14% took over 50 trips, caught just under 50% of the total boat fishing catch. These inequalities in the relative contributions to the total catch are explained by the positive synergy between avidity and catch rates. This results in the stark observed differences in annual catch extractions between avidity classes. While sporadic avidity anglers caught on average a mere 1.01 kg, the low avidity recreational anglers extracted approximately 11 kg biomass during the one-year period. Conversely, medium avid class anglers extracted almost 85 kg per year, and the most avid anglers extracted an average of 183 kg throughout 2021-2022 (Figure 29).

In 2023, over 62% of the boat anglers took less than 20 fishing trips during the 2023 period, jointly contributing 9% of the total modality catch. The remaining 38% who fished more than 20 days per year, of which 13% took over 50 trips, caught 81% of the total boat fishing catch. As a result, while sporadic avidity anglers caught on average a mere 2.63 kg, the low avidity recreational anglers extracted approximately 8.5 kg biomass during the one-year period. Conversely, medium avid class anglers extracted almost 101 kg per year, and the most avid anglers extracted an average of 103 kg throughout 2023 (Figure 42).

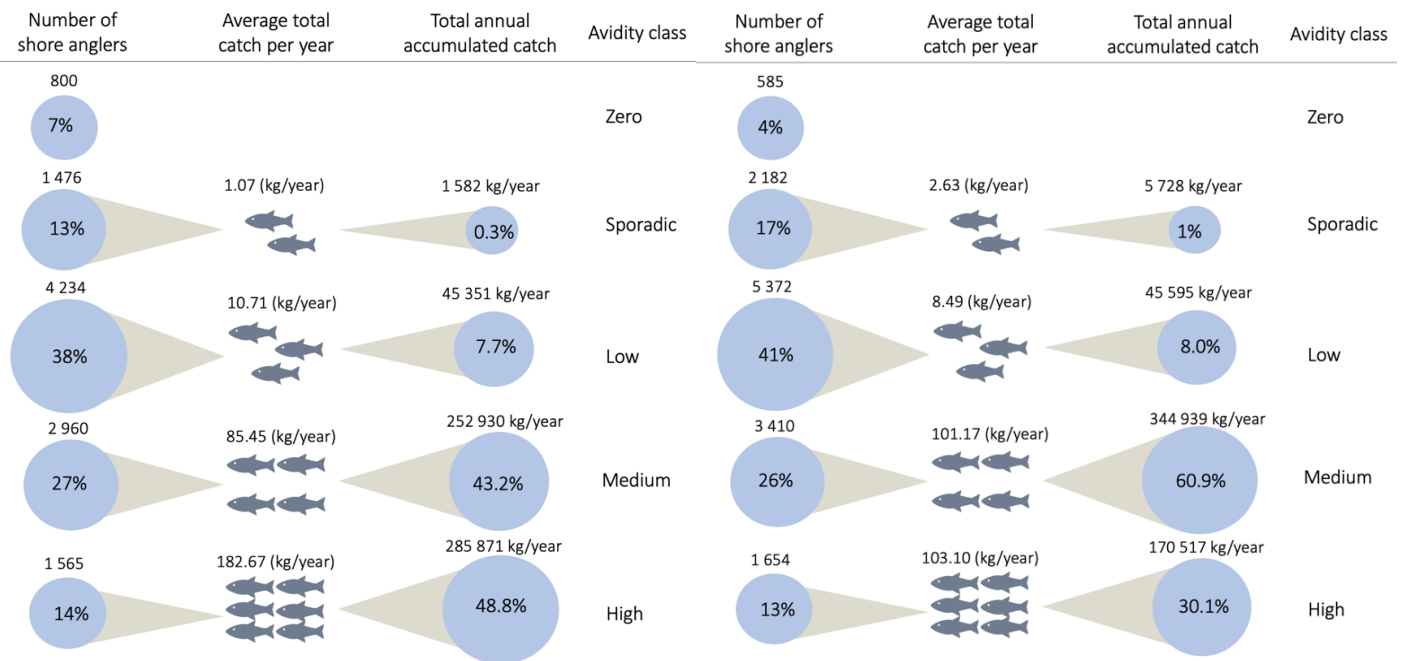


Figure 29. Number and proportion of boat anglers average individual fishing intensity, and total accumulated catch per avidity group in average by 2021-2022.

Figure 30. Number and proportion of boat anglers, average individual fishing intensity, and total accumulated catch per avidity group during 2023.

Spearfishing

1. Fishing effort

The results of the spearfishing effort were based on annual effort distributions from the online surveys, which allowed to classify respondents into avidity classes based on their declared fishing effort during the past 12 months for each year (Table 10). The online survey only represents licence-holders. Therefore, the effort distributions from the online surveys were extrapolated only to licenced fishers.

Table 10. Avidity class distribution of licenced for spearfishers.

| | 2021-2022 | 2023 |
|----------------------|-----------|------|
| Zero | 6% | 6% |
| Sporadic (1 -2 days) | 3% | 4% |
| Low (3 -19 days) | 43% | 41% |
| Medium (20 -49 days) | 34% | 37% |
| High (+50 days) | 13% | 12% |

The results showed a low proportion of individuals holding a recreational fishing licence who did not make any use of it during both period 2021-2022 and 2023 (6%; Table 10). In the case of the sporadic avidity class, the percentage was the lowest and very similar for both period (3% in 2021-2022 and 4% 2023). The majority of spearfishers showed low avidity effort patterns (43% and 41% in 2021-2022 and 2023, respectively) followed by medium avidity class (34% and 37% in 2021-2022 and 2023, respectively). Highly avid spearfishers accounted for 12% in both studied periods.

The percentage responses obtained from the surveys were extrapolated to the number of active fishers to estimate the number of fishers by avidity category. In previous analyses, fishers who took out both a subaquatic and a surface licence (508 fishers in 2023) were not considered. For the present report, we recalculated the number of active fishermen taking into account the percentage of dual licences. This explains the 17.4% variation between the period 2021-2022 and 2023 (Table 11).

Table 11. Estimate total number of spearfishers of each year.

| | 2021-2022 | 2023 | Variation | % variation |
|----------------------|--------------|--------------|------------|-------------|
| Zero | 166 | 218 | 52 | 23,9 |
| Sporadic (1 -2 days) | 100 | 138 | 38 | 27,5 |
| Low (3 -19 days) | 1 247 | 1 420 | 173 | 12,2 |
| Medium (20 -49 days) | 986 | 1 282 | 296 | 23,1 |
| High (+50 days) | 373 | 420 | 47 | 11,2 |
| Total | 2 872 | 3 477 | 605 | 17,4 |

Reported annual fishing effort for spearfishers who went fishing at least once during 2021-2022 showed an average of 24 fishing days per year, with a similar periodicity through the different seasons, ranging from 5 days per year in summer to 3 days per year in winter.

Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2023 showed an average of 28 fishing days per year, also with a similar periodicity through the different seasons ranging from 12 days per year in summer, 7 days per year in spring, 5 days per year in autumn and 4 days per year in winter.

The evaluation of the frequency of fishing days from the online surveys by answering the question: “How many times have you gone fishing in the last 4 weeks?” is reported as a monthly average by avidity class per season in 2021-2022 and in 2023 (Table 11). There is a similar trend for both periods, with the highest average obtained from the high avidity class, and a decrease as the class progresses towards the sporadic category.

Table 12. Seasonal average frequency of spearfishing days for shore angling from online surveys for the period 2021-2022.

| Year 2021-2022 | Zero | Sporadic | Low | Medium | High |
|----------------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.15±(0.2) | 0.86±(0.9) | 3.97±(2.5) | 14.53±(5.6) |
| Spring | 0 | 0.36±(0.3) | 2.72±(1.4) | 7.88±(2.9) | 20.33±(5.4) |
| Summer | 0 | 0.75±(0.4) | 4.40±(2.0) | 11.09±(3.9) | 23.74±(6.4) |
| Autumn | 0 | 0.10±(0.2) | 1.99±(1.6) | 6.20±(2.8) | 19.34±(6.0) |

Table 13. Seasonal average frequency of spearfishing days for shore angling from online surveys for 2023.

| Year 2023 | Zero | Sporadic | Low | Medium | High |
|-----------|------|------------|------------|-------------|-------------|
| Winter | 0 | 0.40±(0.4) | 1.25±(1.1) | 4.44±(2.3) | 15.82±(6.0) |
| Spring | 0 | 0.97±(0.5) | 3.46±(1.7) | 7.87±(2.9) | 22.95±(6.1) |
| Summer | 0 | 0.73±(0.4) | 5.45±(2.1) | 11.65±(3.5) | 22.47±(6.6) |
| Autumn | 0 | 0.32±(0.3) | 2.63±(1.7) | 6.97±(2.6) | 19.34±(5.7) |

1.1. Effort distribution

The areas with the highest total fishing effort were the south of *Costa Brava*, followed by *Costa del Garraf*, *Cap de Creus* and *Costa Daurada* in both periods (Figure 31). In this modality, the most popular season was summer, with a total of 28 845 and 39 338 annual fishing days in 2021-2022 and 2023, respectively. Spearfishing was notably concentrated in the zones that are characterised by a rocky coastline and the presence of underwater reefs (*Costa Brava*, *Costas del Garraf*, *Cap de Creus*, *Costa del Mongrí* and *Costa Daurada*). Overall, the spearfishing effort in 2021-2022 accumulated an estimate of 67 643 fishing trips per year. Following the same analytical pattern, in 2023 the areas with most fishing days are the south of *Costa Brava*, *Costas del Garraf* and *Cap de Creus* (Figure 31). In most areas, the season when most people go fishing is in summer and spring with around 21 641 fishing days. Most spearfishing trips are taken in the northern and central zones of the Catalan coastline (61%). Overall, the spearfishing effort accumulated an estimate of 92 271 fishing trips per year.

The average daily spearfishing trips per kilometre in 2023 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales (Figure 31; Annex IV). The *Montgrí Coast* and *Costes del Garraf* hold the highest yearly average, with 1.4 and 0.9 fishing trips per kilometre, respectively (Figure 32). This might be due to two factors: first, the question in the online surveys may be misunderstood by the fishers because by predefining zones, it may not be clear what territory belongs to each zone; second, this area has an important but small point with breakwaters and rocks, turning it into a hotspot for spearfishers. Considering the differences in seasonal activity, the spatial distribution of spearfishers is fairly consistent across seasons. The average daily spearfishing trips per kilometre in 2021-2022 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales (Figure 32; Annex IV). The most intensely fished zone is also the one with the rockiest areas of the Catalan coast, i.e. *Montgrí Coast*, with a yearly average of 0.9 fishing trips per kilometre, and *Delta del llobregat*, with a yearly average of 0.7 fishing trips per kilometre (see below Figure 32).

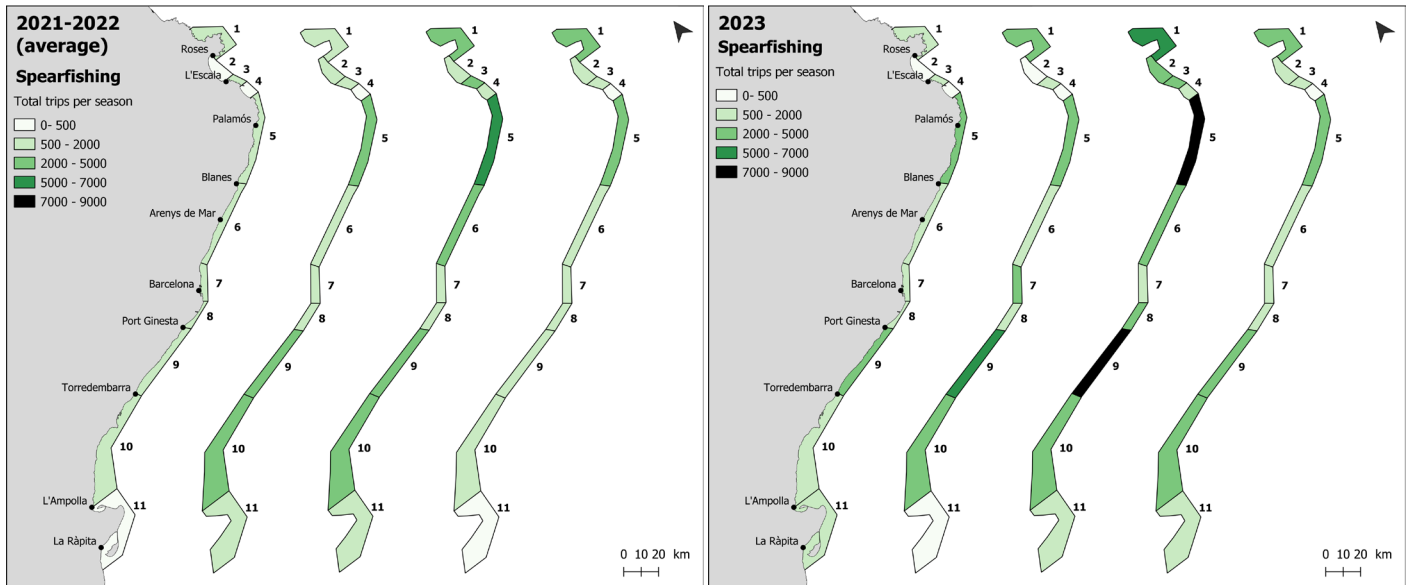


Figure 31. Total spearfishing trips during 2021-2022 (left) and in 2023 (right) per zone during each season. In this analysis we do not take into account areas where fishing is not allowed.

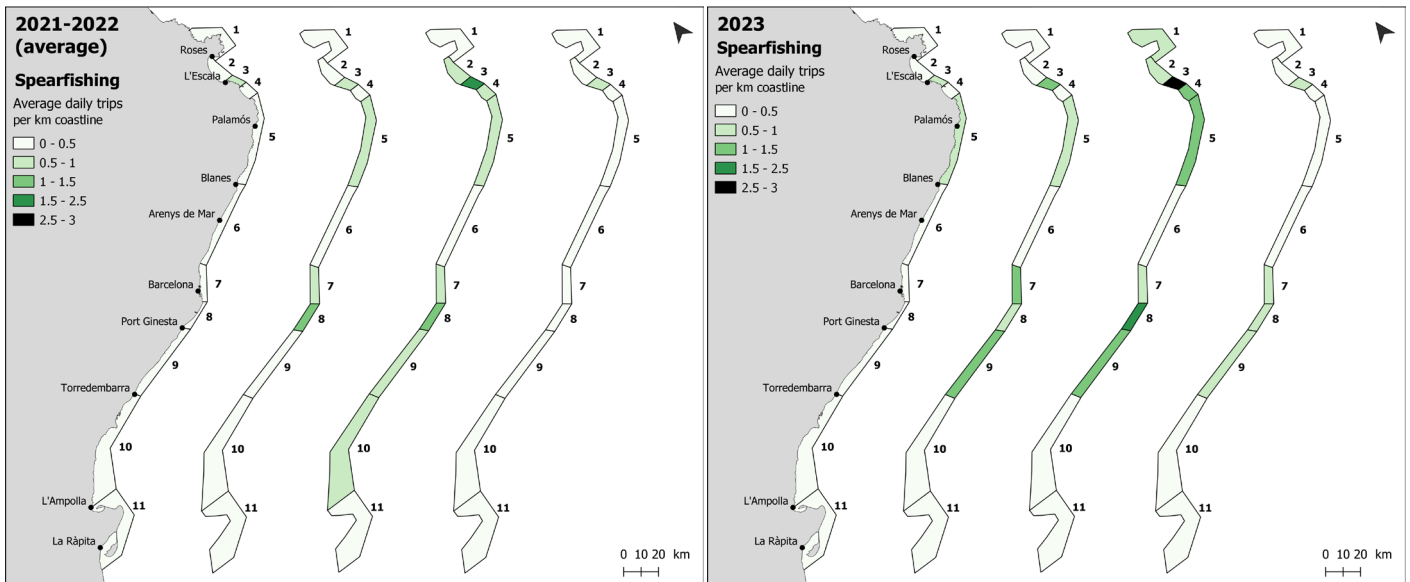


Figure 32. Average number of daily fishing trips during 2021-2022 (left) and 2023 (right) per kilometre coastline within each season.

2. Fishing yield

Fishing yield was analysed using catch per unit effort (CPUE) measured in kilograms caught per day fished. Comparing the two years studied, there were no significant differences using a Wilcoxon rank with continuity correction. In detail, the average of CPUE in 2023 was higher (1.66 ± 0.1) than that from 2020-2022 (1.59 ± 0.1 ; Figure 33).

There were significant differences (p -value=0.012) in CPUE for spearfishing among seasons in 2020-2022. In detail, the difference was between winter and summer (p -value=0.006), winter and spring (p -value=0.007) and winter and autumn (p -value=0.003). The average CPUE was 1.70 ± 0.21 , 1.69 ± 0.17 , 1.65 ± 0.16 , and 1.24 ± 0.20 for spring, autumn, summer and winter, respectively (Figure 34). Also, there were significant differences (p -value=0.005) in CPUE for spearfishing among seasons in 2023 (non-data in winter). In detail, the differences were found between spring and summer (p -value=0.003) and summer and autumn (p -value=0.002). The average of CPUE was 2.33 ± 0.47 , 1.89 ± 0.23 and 1.33 ± 0.17 for spring, autumn and summer, respectively (Figure 34).

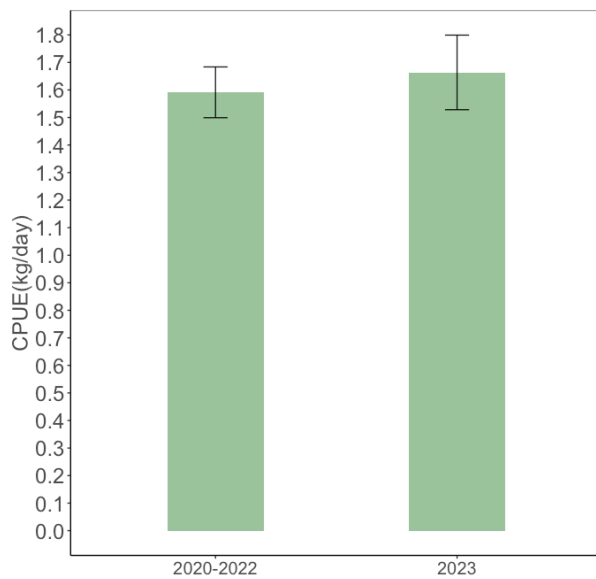


Figure 33. CPUE for the period 2020-2022 and 2023 for spearfishing. The green bars indicate the average and the black line indicates the standard error.

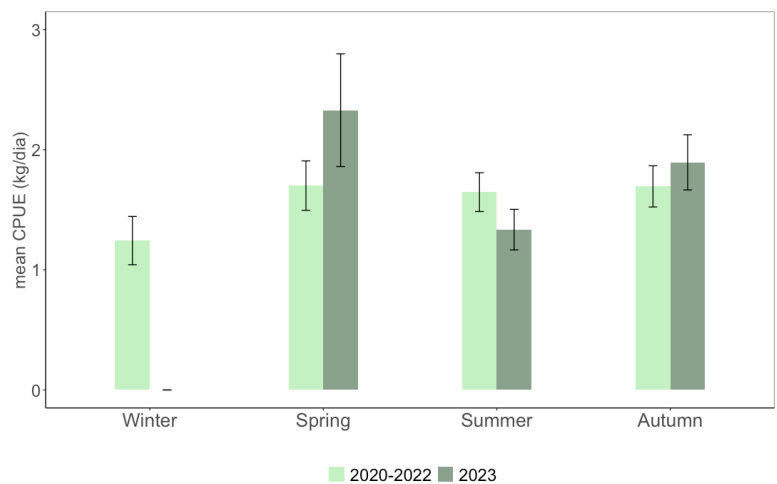


Figure 34. CPUE by season in average 2020 to 2022 (light green) and 2023 (dark green). The bars indicate the average and the black line indicates the standard error.

3. Seasonal catch composition

In the onsite sampling, a total 1 292 individual from spearfishing were identified from a total 37 different species during the studied years. Catch composition results show the actual catch estimates obtained from the onsite surveys. They contrast with results from target species, and it is clear that for all three fishing modalities, there is a difference between species desirability and their actual catchability. Species' catch seasonality may also be observed, as different species are more or less available, or more or less desired during different times of the year.

During 2020-2022 the seasonal species catch composition differences can also be observed for spearfishing. Summer was found to be the season with the highest biodiversity, with 27 different species observations, followed by spring with 25, autumn with 24 and finally winter with 21 different species out of the 34 total different species observed. In 2023, summer was again found to be the season with the highest biodiversity, with 28 different species observations, followed by autumn with 27 and finally spring with 15 different species out of the 34 total different species observed. It is worth noting the data gap in the winter of 2023 (January, February and March) due to administrative problems. Lower catch diversity is expected for spearfishing, as it is a more selective activity. However, it must be noted that contrasting spearfishing catch diversity with the other two fishing modalities is compromised by the considerably lower number of surveys conducted for spearfishing (497 surveys, all years together).

Catch composition results show the actual estimates obtained from the onsite surveys. There were no surveys during winter season but *Paracentrotus lividus* represented more than a third (33.6%) of the total catch during the period of 2020-2022. In spring, *S. officinalis* was the main species in 2020-2022 (21.5%) but it was absent in 2023. The dominant species from 2023 was *Diplodus sargus*, with 32.6%. In summer, one of the main species was *D. sargus* (30.1% and 17.2% for 2020-2022 and 2023, respectively, *M. surmuletus* (15.4% and 18.5% for 2020-2022 and 2023, respectively). During autumn, there was a variation in species composition between the two periods. *P. lividus* was absent during the period of 2020-2022 but represented 27.3% of the total catch in 2023, making it the most captured species (Figure 35).

4. Total annual catch

Estimates of total annual catches were derived from catch data collected during onsite surveys and effort values obtained from online surveys. In 2023, estimates of total annual catches were based on catch data collected during onsite surveys and effort values obtained from online surveys. The main total catches in the spearfishing modality in 2023 (Figure 35), *Seriola dumerili* led with (21 998 kg). The second most notable species was *Epinephelus marginatus* with total annual catches of 19 993 kg, followed by *Dentex dentex* with 10 119 kg, and

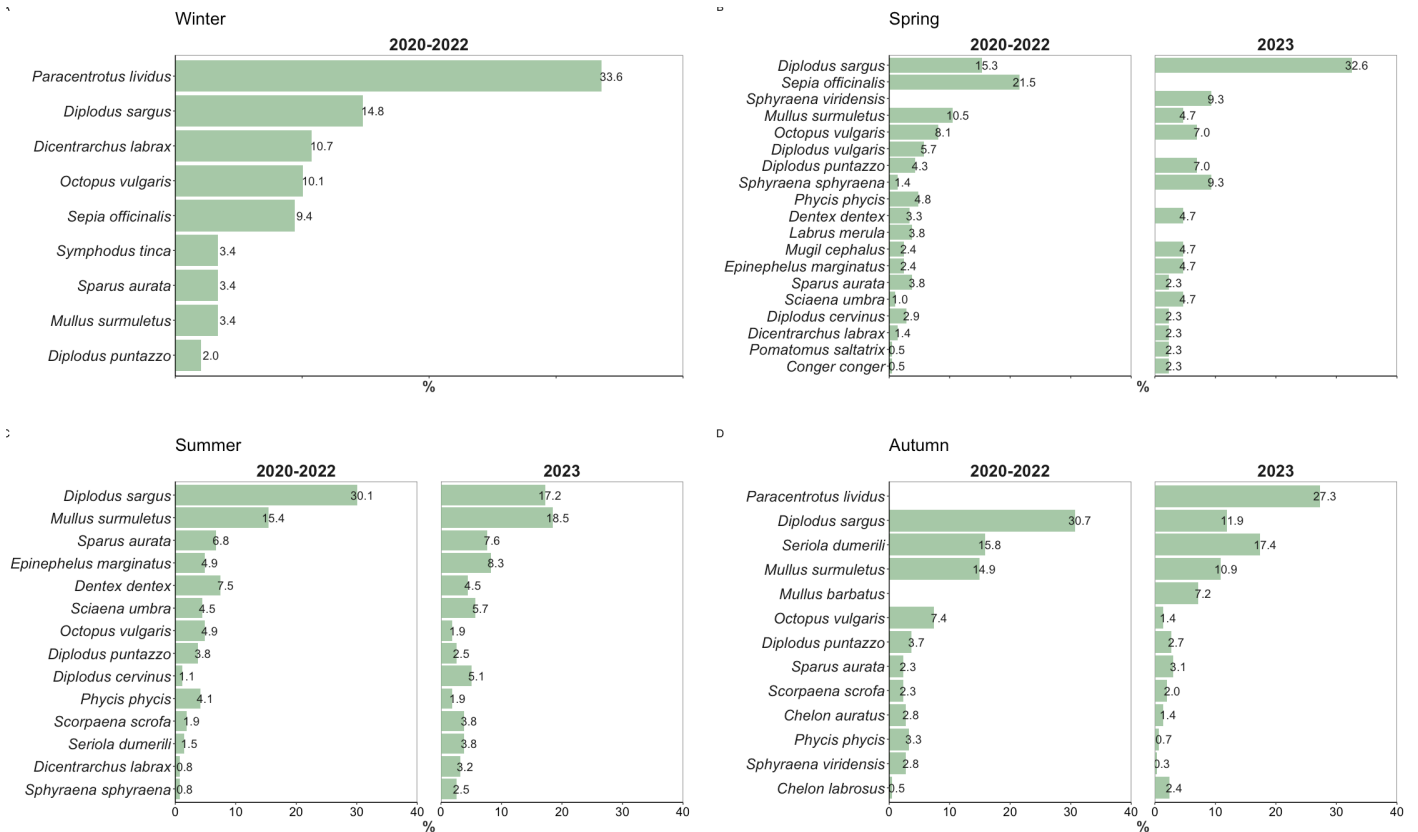


Figure 35. Seasonal catch composition (in percentage of individuals number) for onsite spearfishing sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2022 (left) and in 2023 (right). Only species representing over 2% of the total catch are shown.

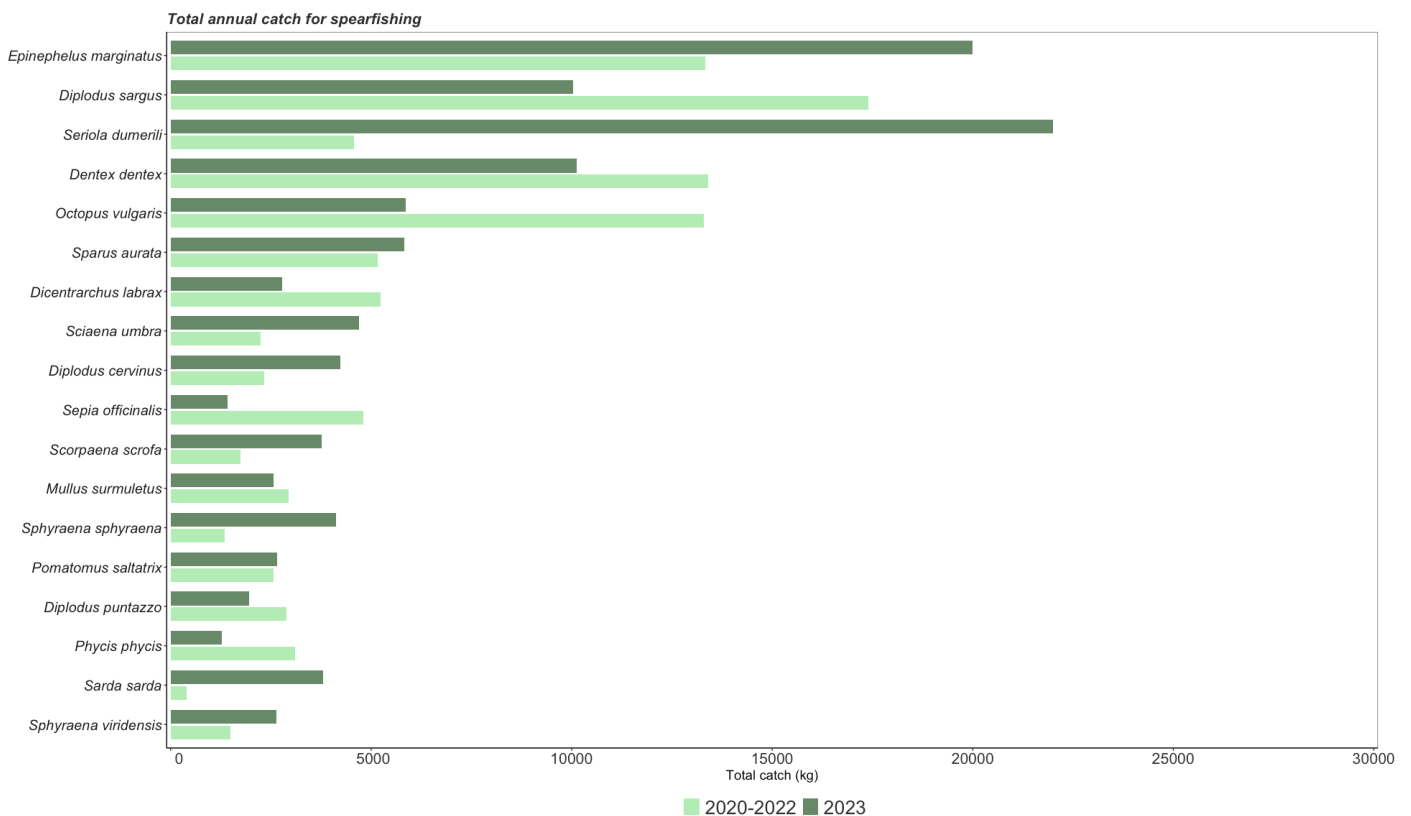


Figure 36. Total annual catch per species for spearfishing in average 2020-2022 (light green) and in 2023 (dark green). Only species with a relative weight above 2% of the total catch are shown. The graph shows 98% of the total catch.

Diplodus sargus with 10 031 kg.

Regarding the main total catches in the spearfishing modality during the period of 2020-2022 (Figure 36), *Diplodus sargus* accounted for 17 388 kg. The second most notable species were *Dentex dentex* and *Epinephelus marginatus*, with total annual catches of 13 403 kg and 13 326 kg respectively. Notably high catch values were recorded for *Octopus vulgaris* (13 292 kg), which significantly differ from findings in previous studies (ICATMAR, 2022; ICATMAR 2020a; Dedeu et al., 2019).

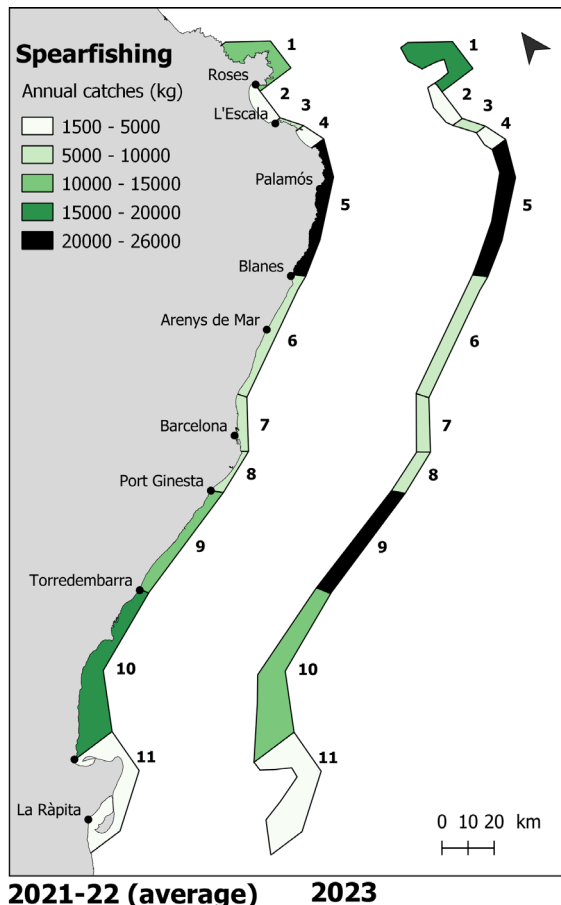


Figure 37: Distribution of total annual catch for spearfishing in 2021-2022 (left) and 2023 (right).

5. Spatial distribution of the total annual catch

The zones with more catches are very similar between both studied periods. However, in 2023, there are more annual catches, in general, compared to 2021-2022, especially in the areas south of *Costa Brava* (25 607 and 22 975, respective), *Costes del Garraf* (23 370 and 13 380, respective), and *Cap de Creus* (19 178 and 14 502, respective). The spatial distribution of the annual catches evidences the ranging fishing impacts (Figure 37). In general, the most populated areas such as Barcelona and its adjacent zones yield the highest number of catches on a per kilometre basis.

6. Inequality in the distribution of the total annual catches

Spearfishing is one of the most selective and efficient forms of fishing. In the division of the typology of fishers according to their avidity class to go fishing in the online surveys, we found, in both years, a small percentage who got their licence but did not go fishing or went only a few days. The different avidity groups designed in this study are responsible for very different proportions of the total catches. Below are the figures corresponding to spearfishing modality in 2021-2022 and 2023, where the number of anglers in each avidity class is directly associated with their relative contributions to the total modality catch. Relative individual impacts vary enormously in relation to their avidity patterns. These amount to massive differences in the aggregate impact of each avidity class. It must be considered that the values presented are the product of estimations based on extrapolations that, although consistent with the avidity class model, are not based on direct observations and should therefore be observed with caution.

For spearfishing, over 52% of the fishers took less than 20 fishing trips during the 2021-2022 period, jointly contributing 13.4% of the total modality catch. The remaining 47% who fished more than 20 days per year, of which 13% took over 50 trips, caught 87% of the total spearfishing catch. As a result, while sporadic avidity anglers caught on average a mere 3 kg, the low avidity recreational anglers extracted approximately 11 kg biomass during the one-year period. Conversely, medium avid class anglers extracted almost 45 kg per year, and the most avid anglers extracted a median of 126 kg throughout 2021-2022 (Figure 38).

For 2023, spearfishing also shows a similar catch trends among the different avidity classes, with the 51% of the spearfishers who fished less than 20 days per year contributing a 24% of the total modality catch, while the more avid 49% who took than 20 fishing trips throughout the year jointly accumulate the remaining 76%. Notoriously, the estimated 420 (12%) most avid recreational spearfishers individually caught an average 62 kg throughout the natural year, accounting for over half (44.5%) of the total annual catches for the whole modality and contributing significantly to the total catch for the overall MRF activity (Figure 39).

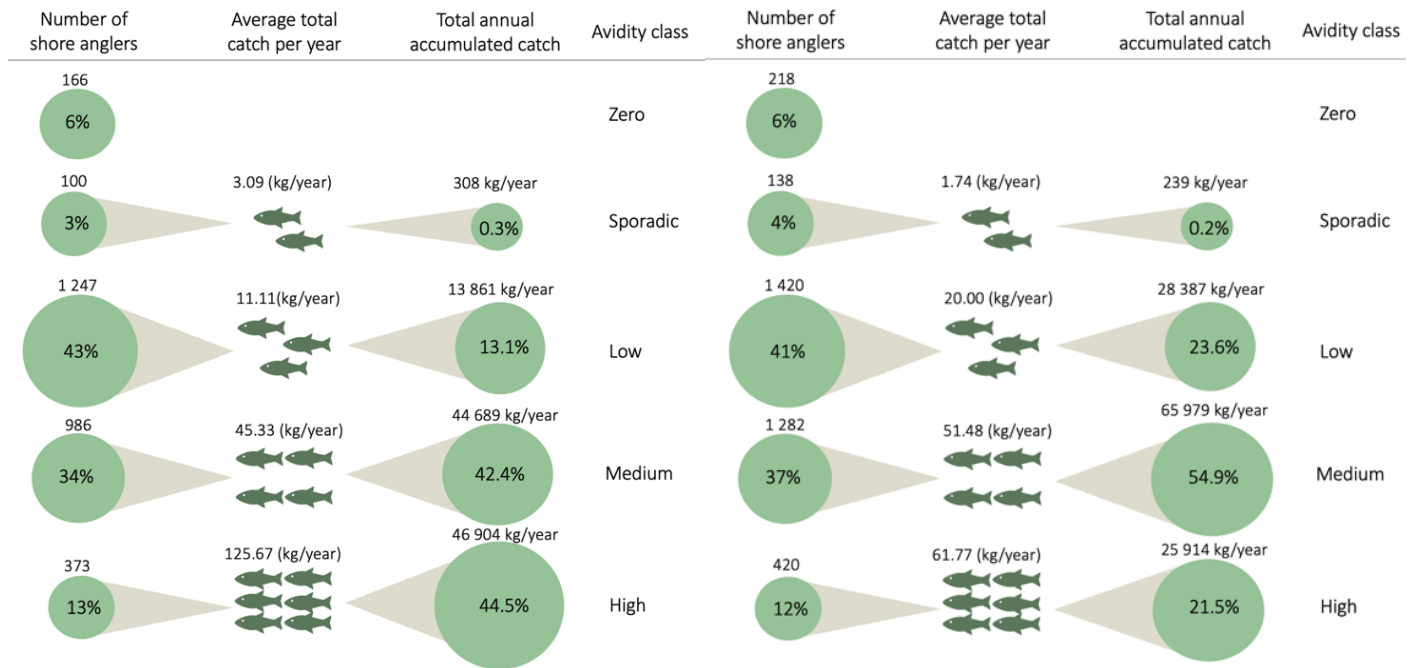


Figure 38. Number and proportion of spearfishers, average individual fishing intensity, and total accumulated catch per avidity group in average by 2021-2022.

Figure 39. Number and proportion of spearfishers, average individual fishing intensity, and total accumulated catch per avidity group during 2023.

7. Distribution the total annual catch by modalities

Estimates of total annual catches used catch data from the onsite surveys and effort values from the online surveys and were estimated first for each avidity class within each season, after which they were added into seasonal total catch values for the whole modality. The total annual catch for shore angling in the period was 240 189 kg per year and, in 2023 increased to 315 730 kg per year. Boat angling accumulated 585 734 kg per year in 2020-2022 and, in 2023 declined to 566 778 kg per year. Finally, for spearfishing in the average period was 105 454 kg per year and, in 2023 decreased to 120 279 kg per year.

The spatial distribution of the annual catches evidences the ranging fishing impacts of the different fishing modalities along the Catalan coast (Figures 40). Overall, catches by shore and boat angling increased in 2023 compared to 2021-2022 on virtually the entire coastline. As for spearfishing, a slight increase in catches was recorded in two zones, in the *Costa Brava Sud* and *Costes del Garraf* zones. In both periods, spearfishing catches were considerably lower in all zones dominated by sandy bottoms (*Delta de l'Ebre*, the *Golf de Roses* and *Delta del Llobregat*).

Regarding the nature of the catch, all three modalities were combined to visualise the contribution of harvest (retained catch), discard (catch which is disposed of) and catch and release (C&R, individuals which are released alive). Over the studied periods, both harvest and C&R have decreased in 2023 in favor of discard, which shows an increase in 10 points with respect to the average 2020-2022 (Figure 41).

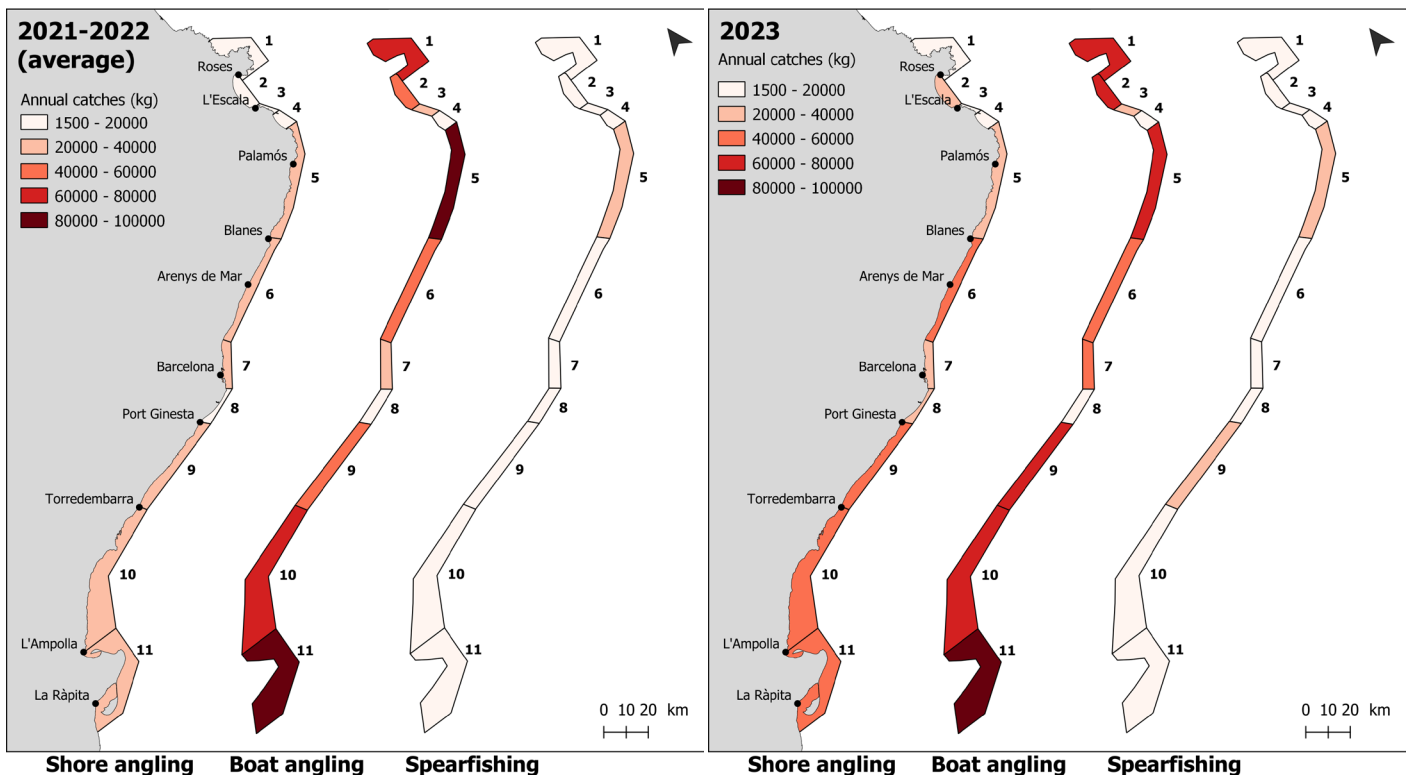


Figure 40. Distribution of total annual catch by modalities during the period 2020-2022 (left) and 2023 (right).

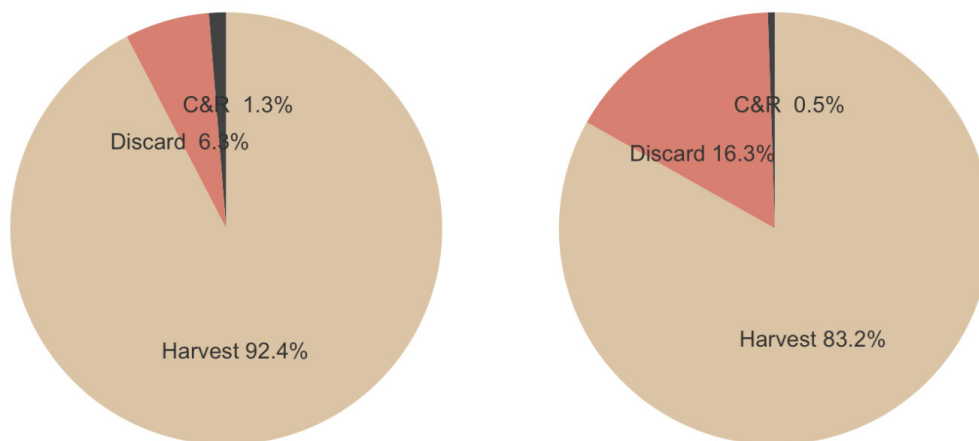
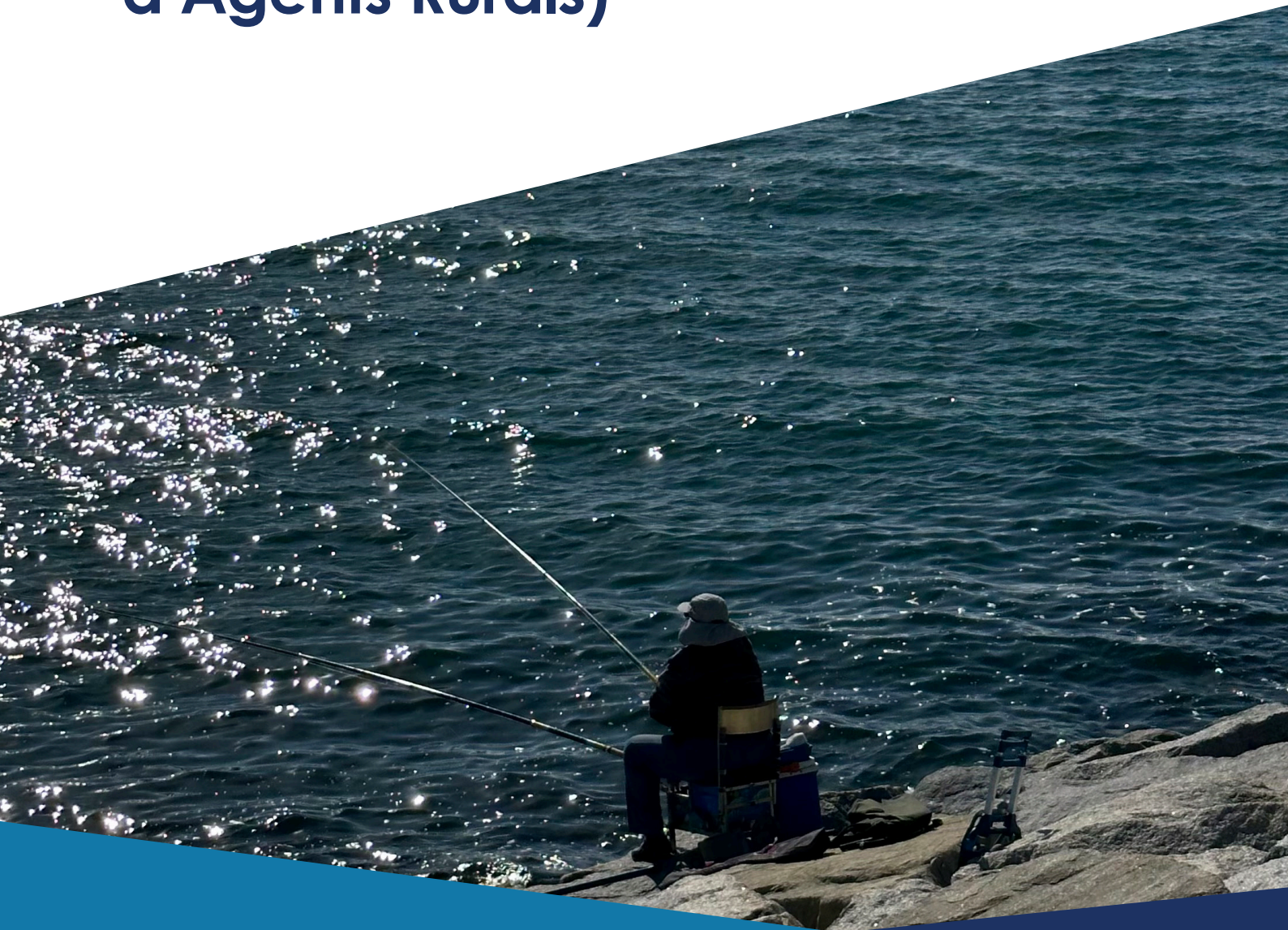


Figure 41. Percentages of catch distribution in harvested, released (C&R) and discarded for all three modalities combined during the period 2020-2022(A) and 2023 (B).

6

Data from the police control actions of CME (Cossos Mossos d'Esquadra) and CAR (Cossos d'Agents Rurals)



A coordinated and target control campaign on recreational marine fisheries was conducted by the Catalan Directorate-General of Maritime Policy and Sustainable Fisheries (DGPMPS) with the regional police (CME) and the Rural Agents Corps (CAR) together. The first inspection campaign was in October 2022, carried out for 15-day along the Catalan coast with the aim of intercepting unlicensed marine recreational fishers. During this campaign, 688 marine recreational fishers were intercepted, 635 of whom were in possession of a licence. Of these, 562 had their licences emitted in Catalonia and 73 outside of it (12.0%). Of the 615 marine recreational fishers intercepted in Catalonia, 436 belonged to shore anglers, 142 to boat anglers and 37 to spearfishers. Regarding the unlicensed recreational marine fishers intercepted, 43 were shore anglers (9.9%), 6 were boat anglers (4.2%) and 4 were spearfishers (10.8%; see table 12).

The second inspection campaign was carried out in June 2023, resulting in the interception of 498 marine recreational fishers, 471 of whom were in possession of a licence. Of these, 418 had their licences emitted in Catalonia and 53 outside of it (11.3%). Of the 445 marine recreational fishers intercepted in Catalonia, 285 belonged to shore anglers, 102 to boat anglers and 58 to spearfishers. Regarding the unlicensed recreational marine fishers intercepted, 10 were shore anglers (4%), 3 were boat anglers (3%) and 14 were spearfishers (24%; see table 14).

Finally, for the third campaign in January 2024, 416 marine recreational fishers were intercepted, 401 of whom were in possession of a licence. Of these, 363 had their licences emitted in Catalonia and 38 outside of it (9.0%). Of the 378 marine recreational fishers intercepted in Catalonia, 207 belonged to shore anglers, 149 to boat anglers and 22 to spearfishers. Regarding the unlicensed recreational marine fishers intercepted, 6 were shore anglers (3%), 9 were boat anglers (6%) and 0 were spearfishers (see table 14).

Comparing these data to the percentages of unlicensed marine recreational fishers numbers found in the pilot test in 2019 – 23% for shore angling, 10% for boat angling and 20% for spearfishing – the previous data were higher because the surveys were addressed to the entire population (ICATMAR, 2020a), that is, the online survey link was shareable.

Table 14. Number of interceptions during the three campaigns in each year.

| | October 2022 | | June 2023 | | January 2024 | |
|---------------|--------------|------------|-----------|------------|--------------|------------|
| | Licensed | Unlicensed | Licensed | Unlicensed | Licensed | Unlicensed |
| Shore angling | 393 (90%) | 43 (10%) | 275 (96%) | 10 (4%) | 201 (97%) | 6 (3%) |
| Boat angling | 136 (96%) | 6 (4%) | 99 (97%) | 3 (3%) | 140 (94%) | 9 (6%) |
| Spearfishing | 33 (89%) | 4 (11%) | 44 (76%) | 14 (24%) | 22 (100%) | 0 (0%) |

7

Social profile of marine recreational fishers



Recreational fishing in Catalonia is a highly gendered activity as most participants are men, with women only taking a marginal role in the activity. During 2023, the results of the onsite surveys start to show the indeterminate category: 1 691 fishers identified as men, there was an increase in the number of women to 121 and 7 as indeterminate (Figure 42). As for the online surveys, 4 673 fishers identified as men, 270 as women and 32 as indeterminate in 2023 (Figure 43).

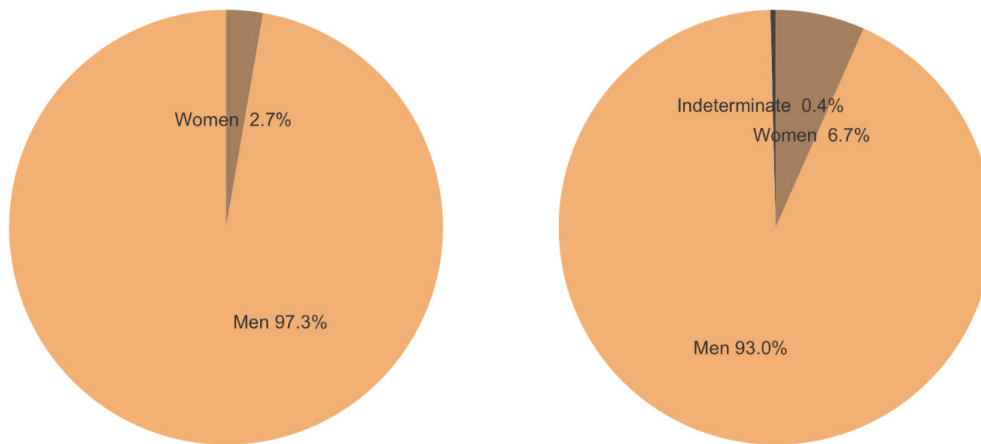


Figure 42: Percentage of responses by gender from onsite surveys in the period 2020-2022 (A) and 2023 (B).

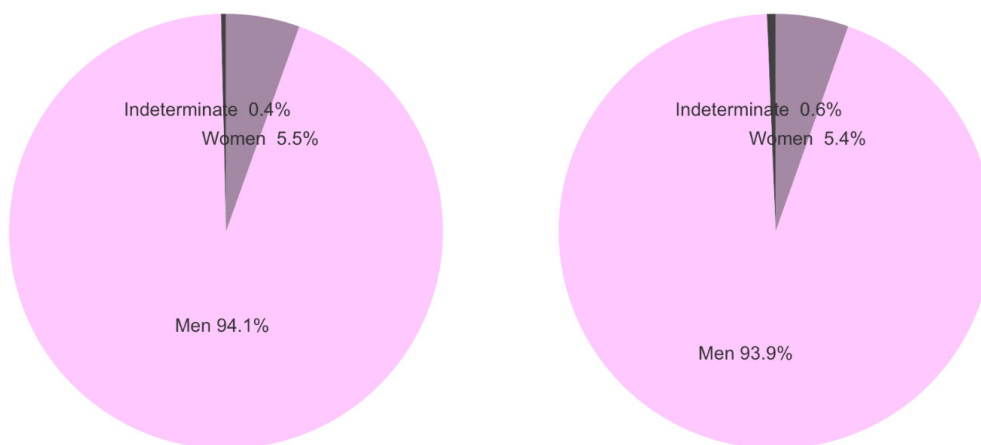


Figure 43: Percentage of responses by gender from online surveys in the period 2021-2022 (A) and 2023 (B).

During the period 2020-2022 the total onsite surveys, 3 843 fishers identified as men and only 108 as women (Figure 42). As for the online surveys during the period 2021-2022, a total of 9 928 fishers identified as men, 578 as women and 40 as indeterminate (Figure 43). These results are highly consistent with those of the latest report (ICATMAR, 2022) and the pilot study (ICATMAR, 2020a).

As for the language selected by fishers to fill the online survey, in both 2021-2022 and 2023, the most chosen language was Spanish, followed by Catalan, French and finally English.

Regarding the average age of marine recreational fishers, the difference between both periods is minimal for the onsite and the online surveys. In the onsite surveys the average age was 45 and 46 for 2020-2022 and 2023 respectively, and in the online surveys it was 48 and 49, respectively. This suggests that the online dissemination strategy may allow to significantly reduce the electronic age bias effect. As for the average age for each modality,

in the 2023 onsite surveys the average age for shore anglers was 46, for boat anglers it was 54 and for spearfishers it was 38. In the 2023 online surveys, the average ages were 48, 54 and 46 for shore angling, boat angling, and spearfishing respectively (Figure 44B). The results were similar for 2020-2022. In the 2020-2022 onsite surveys the average age for shore anglers was 47, for boat anglers it was 51 and for spearfishers it was 38. In the 2021-2022 online surveys, the average ages were 47, 53 and 46 for shore angling, boat angling, and spearfishing respectively (Figure 44A). These results are consistent with previous findings in Catalonia and Spain, which found boat anglers to be, on average, the oldest participants, and spearfishers the youngest (Gordoa et al., 2019; ICATMAR, 2020a; ICATMAR, 2022).

The years of experience practicing the activity was another question in the onsite and online surveys. As expected, boat anglers were the most experienced fishers in the average period with 25 and 28 years of experience in the onsite and online surveys respectively. In 2023, boat anglers were also the most experienced fishers with an average of 26 years of experience in the onsite and 28 in the online surveys. For shore fishers, the average years of experience in 2020-2022 was around 23 in both the onsite and online surveys and in the two periods compared. On the other hand, spearfishing responses showed the largest experience gap between the onsite and online responses, with 18 and 24 years of experience in 2021-2022 respectively (Figure 45A). For 2023, the gap between the two surveys responses was similar, with an average of 17 years of experience in the onsite and 23 in the online surveys (Figure 45B).

Results from the onsite surveys in both periods showed that most fishers practice the activity with other people (83% and 81% respectively). This underlines the predominantly social nature of MRF in Catalonia. There were important differences in the sociability response between both types of survey for which we could not provide an explanation.

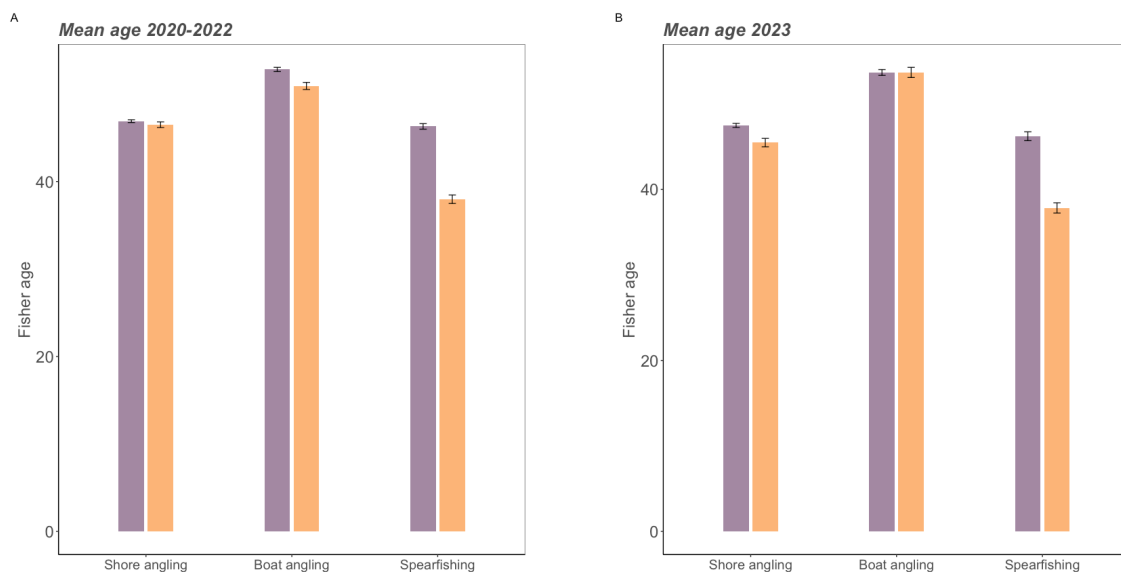


Figure 44. Recreational fishers age in 2020-2022(A) and in 2023(B) obtained from the onsite surveys (in orange) and the online surveys (in purple). Bars represent the average and vertical black lines represent standard error values.

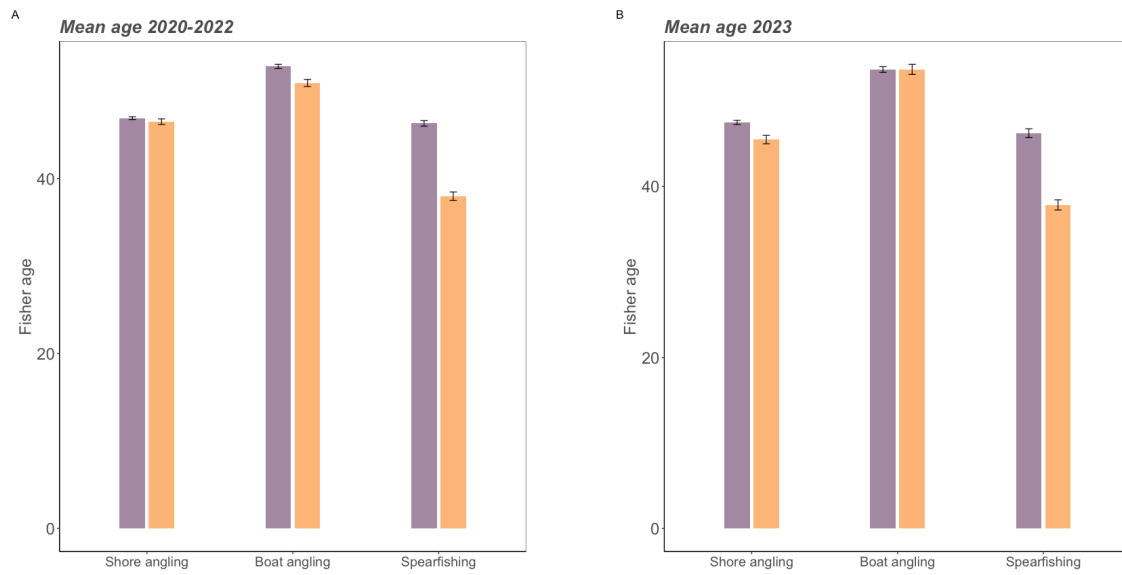


Figure 45. Recreational fishers experience in 2020-2022 (A) and in 2023 (B) obtained from the onsite surveys (in orange) and the online surveys (in purple) during 2023. Bars represent the average and vertical black lines represent standard error values.

8

Economic impact of marine recreational fishing



The direct and indirect economic impacts of MRF were estimated using daily and annual expenditure data from the online surveys. Information on daily expenditure was requested for the latest fishing trip, in the cases where the respondent declared recalling the trip well. The daily information requested included costs of transport, bait and fishing materials, fuel for the boat (if applicable), port services (if applicable) and meals. The daily expenditure declared by each fisher on their latest fishing trip was extrapolated to their annual fishing days to obtain an individual annual estimate of their total expendable expenditure for their annual trips. Expenditure relating to periods longer than the immediate fishing trip were asked on an annual basis. These include more permanent fishing materials, boat maintenance and port services (if applicable), fishing holidays, fishing licences, insurances, club memberships, boat rentals and other annual expenses. Expenses related to the purchase of boats have been omitted from this study, and only those related to the use of the boat have been attributed to the practice of MRF. Information on charter fishing has been omitted from the analysis as we are currently focusing on the analysis of the charter fleet.

In terms of per-capita expenditures, shore-based fishing activities incurred considerably lower expenses, with shore angling having the lowest economic impact, followed by shore-initiated spearfishing. Boat angling and boat-initiated spearfishing entailed considerably higher expenses, most of which were related to the maintenance and use of the vessel. In the tables 15 and 17, we described the daily expenses include consumable gear, boat fuel (if applicable) and other daily expenses. Consumable gear includes expenses typically done multiple times a year and in preparation for upcoming fishing trips, including bait, hooks, weights, floats and lines. Other daily expenses aggregate expenses related to meals and travel (public transportation tickets, fuel, tolls and parking). Long-term expenses are estimated on a yearly basis, and include permanent gear, boat services and boat maintenance (if applicable), fishing holidays, fishing licences, insurances, club memberships, boat rentals and other annual expenses. Permanent gear includes expenses in fishing materials bought on a larger time-scale, and includes fishing rods, reels, spears, wetsuits, clothes for fishing and other fishing accessories. Fishing holidays include all expenses for trips made with the main purpose of practicing MRF. Other annual expenses relate to all long-term expenses not included in previous sections, such as fishing apps, maps, guides, subscriptions and others.

In 2023, the results of the estimate daily expenses per angler showed an average expenditure of 27.87€ per fishing trip for shore anglers, 48.07€ for boat anglers, 17.41€ for spearfishers initiating the activity from land, and 45.86€ for spearfishers who initiate the activity from a boat. Daily expenses were annualised using fisher effort data, and were added to the expenses that were measured on an annual basis. Average annual expenditures amounted to 788.66€ for shore fishing, 3 162.22€ for boat fishing, 864.01€ for spearfishing mainly initiating the activity from land, and 3 516.84€ for spearfishers initiating the activity mainly from a boat (Table 17).

In the period 2021-2022, the results of the estimated daily expenditures per fisher showed an average expenditure of 29.03€ per fishing trip for shore anglers, 60.39€ for boat anglers, 24.49€ for shore-initiated spearfishers, and 45.60€ for boat-initiated spearfishers. Daily expenditures were annualised using fisher effort data, and added to the expenses that were measured on an annual basis. Average annual expenditures amounted to 849.70€ for shore angling, 3 970.20€ for boat angling, 1 164.20€ for spearfishers mainly starting the activity from land, and 3 323.8€ for spearfishers mainly starting the activity from a boat (Table 15).

The average annual expenditure per fisher was multiplied by the total estimated number of recreational fishers for each of the fishing modalities to obtain an estimate of the total activity expenditure. During 2023, the total of 29 623 shore anglers was estimated to have generated an economic impact of 23.3M€ (Table 18). The main expenditure in shore angling was on fishing gear (3.5M€ on consumables and 8M€ on permanent gear), followed by fishing holidays (2.4M€) and other daily expenses such as transportation and meals (8.4M€). An increase was recorded in the period of 2021-2022, when it was estimated that 31 396 shore anglers have generated a total expenditure of 26.7M€ (Table 16). The main expenditure in shore angling was on fishing gear (4.6M€ on consumables and 8.4M€ on permanent gear), followed by fishing holidays (3.8M€) and other daily expenses such as transportation and meals (8,9M€).

In 2023, the total of 12 618 boat anglers was estimated to have generated an economic impact of 36.8M€ (Table 18). The main expenditures of boat angling were on maintenance and port services, totalling 15.3M€ (9M€ on port services and 6.3M€ on boat maintenance). The other expenditures of this modality were very diversified: 1.1M€ were spent on fishing holidays, 3.6M€ on boat fuel and 6.1M€ on fishing gear (2M€ on consumables and 4.1M€ on permanent gear). In regards to 21-22, it was estimated that 11 045 boat anglers generated an economic

impact of 40.9M€ (Table 16). The main expenditure for boat angling was on maintenance and port services, totalling 14.7M€ (8.8M€ on port services and 5.9M€ on boat maintenance). The other expenses of this modality were very diversified: 2.2M€ were spent on fishing holidays, 4.8M€ on boat fuel and 7.7M€ on fishing gear (4M€ on consumables and 3.7M€ on permanent gear).

In the case of spearfishing, the results were separated between spearfishers who start fishing from the shore and those who start fishing from a boat. In total, there were 3 269 recreational spearfishers during 2023, of which 2 356 started primarily from shore and 913 primarily from a boat (see table 17). It was estimated that shore-initiated spearfishers generated a total expenditure of 2M€ (Table 18). Their main expenditure was on other daily expenses (0.9M€), followed by fishing holidays (0.4M€), and fishing gear 0.5M€ (0.2M€ on consumables and 0.3M€ on permanent gear; see Table 17). Boat-initiated spearfishers were estimated to generate a total expenditure of 3.2M€. In this case, there were additional costs associated with fuel (0.4M€), boat maintenance and port services (1.2M€ altogether). In the period 21-22, there were 2 867 recreational spearfishers, of which 2 128 started primarily from shore and 739 primarily from a boat. Shore-initiated spearfishers were estimated to generate an economic impact of 2.5M€ (Table 15). Their main expenditure was on other daily expenses (1.1M€), followed by fishing gear 0.7M€ (0.3M€ on consumables and 0.4M€ on permanent gear) and fishing holidays (0.5M€; see Table 15). On the other hand, boat-initiated spearfishers were estimated to generate a total economic impact of 2.5M€ (Table 16). In this case, there were additional costs associated with fuel (0.4M€) boat maintenance and port services (0.9M€ altogether).

Expenditures were classified as direct economic impacts of the activity on materials that can be obtained from fishing gear shops, or as indirect impacts, which refer to expenditures incurred outside the recreational fishing service provision sector, such as fishing holidays, meals, transport, boat renting, maintenance and port services. During 2021-2022, the total expenditure of shore angling was estimated to be 13€ million for direct impacts, and 26.7€ million including all costs associated with the activity (Table 16). Direct expenditure on boat-based fishing gear and materials was estimated at 7.7M€, while the total direct plus indirect costs of the activity amounted to 40.9M€. Shore and boat-initiated spearfishing had direct economic impacts on fishing gear of 0.65M€ and 0.29M€ respectively. The total direct and indirect impacts of the activity were estimated at 2.5M€ and 2.4M€ respectively, totalling 5.9M€ for spearfishing activity as a whole.

Table 16. Estimates of total direct annual expenditure on fishing materials and gear, and total annual expenditure related to the fishing activity including indirect expenses for each MRF modality during the period 2021-2022.

| 2021-2022 | Fishing gear | Total activity |
|------------------------|---------------------|---------------------|
| Shore angling | 13.018.278 € | 26.689.465 € |
| Boat angling | 7.691.494 € | 40.924.375 € |
| Spearfishing from land | 651.928 € | 2.500.447 € |
| Spearfishing from boat | 291.024 € | 2.460.098 € |
| Total | 21.652.724 € | 72.574.385 € |

In 2023, total expenditures of shore angling were estimated at 11.6M€ for direct impacts, and 23.4M€ including all costs associated with the activity (Table 18). Direct expenditure on boat-based fishing gear and materials were estimated at 6.2M€, while the total direct plus indirect expenses of the activity amounted to 36.7M€. Shore and boat-initiated spearfishing had direct economic impacts on fishing gear of 0.54M€ and 0.35M€ respectively. The total direct and indirect impacts were estimated at 2M€ and 3.2M€ respectively, amounting to a total 5.2M€ for the spearfishing activity as a whole.

The areas with the highest economic impact in the period 2021-2022 for all three modalities of MRF were the *Costa Brava Sud*, *Costes del Garraf* and *Costa Daurada* (Figure 46). Shore angling and boat angling were also highly impactful on the *Delta de l'Ebre* and *Cap de Creus* zones, while shore angling produced most of its expenditure in the *Costes del Garraf* and *Maresme* zones. In 2023, where there was a lower total expenditure

Table 15. Estimates of average expenses per recreational fisher (RF) and total activity expenses in Catalonia for each modality during the period 2021-2022.

| | Shore angling | | Boat angling | | Spearfishing | |
|-----------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
| | Annual expenditure per RF | Total activity expenditure | Annual expenditure per RF | Total activity expenditure | Annual expenditure per RF | Total activity expenditure |
| | Initiating from land | Initiating from land | Initiating from land | Initiating from land | Initiating from boat | Initiating from boat |
| Consumable gear | 147,0 € | 4.613.802,7 € | 357,4 € | 4.026.775,1 € | 127,3 € | 92.587,8 € |
| Boat fuel | | | 434,3 € | 4.803.632,3 € | 478,3 € | 350.916,9 € |
| Other daily expenses | 284,1 € | 8.925.972,5 € | 766,6 € | 8.556.811,7 € | 588,8 € | 432.472,9 € |
| Permanent gear | 267,6 € | 8.404.475,7 € | 335,4 € | 3.664.718,7 € | 264,2 € | 198.436,2 € |
| Port services | | | 950,7 € | 8.783.603,7 € | 738,2 € | 550.249,2 € |
| Boat maintenance | | | 640,4 € | 5.908.005,5 € | 529,1 € | 394.701,3 € |
| Holidays | 119,8 € | 3.763.262,5 € | 203,6 € | 2.289.576,8 € | 357,3 € | 262.681,0 € |
| License | 18,0 € | 564.280,8 € | 19,5 € | 215.685,9 € | 32,0 € | 23.708,0 € |
| Insurances | 3,5 € | 111.306,7 € | 151,3 € | 1.678.149,3 € | 105,7 € | 78.488,1 € |
| Clubs memberships | 3,6 € | 111.546,5 € | 37,5 € | 412.134,2 € | 44,0 € | 32.853,0 € |
| Other annual expenses | 6,2 € | 194.818,1 € | 31,9 € | 352.269,4 € | 42,7 € | 32.713,8 € |
| Boat rentals | | | 41,6 € | 233.012,5 € | 13,8 € | 10.290,3 € |
| TOTAL ANNUAL | 849,7 € | 26.689.465,4 € | 3.970,2 € | 40.924.375,0 € | 1.164,2 € | 2.500.446,7 € |
| | | | | | | 3.323,8 € |
| | | | | | | 2.460.098,3 € |

Table 17. Estimates of average expenses per recreational fisher (RF) and total activity expenses in Catalonia for each modality during 2023.

| | Shore angling | | Boat angling | | Spearfishing | |
|-----------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
| | Annual expenditure per RF | Total activity expenditure | Annual expenditure per RF | Total activity expenditure | Annual expenditure per RF | Total activity expenditure |
| | Initiating from land | Initiating from land | Initiating from land | Initiating from land | Initiating from boat | Initiating from boat |
| Consumable gear | 119,63 € | 3.543.845 € | 161,82 € | 2.041.808 € | 172,52 € | 157.424 € |
| Boat fuel | | | 288,76 € | 3.643.565 € | 439,53 € | 401.084 € |
| Other daily expenses | 286,04 € | 8.473.422 € | 632,75 € | 7.984.089 € | 672,00 € | 613.213 € |
| Permanent gear | 271,32 € | 8.037.192 € | 328,24 € | 4.141.791 € | 214,14 € | 195.408 € |
| Port services | | | 861,61 € | 9.023.565 € | 859,53 € | 784.336 € |
| Boat maintenance | | | 600,92 € | 6.293.403 € | 624,06 € | 569.470 € |
| Holidays | 81,93 € | 2.427.000 € | 89,01 € | 1.123.091 € | 349,92 € | 319.310 € |
| License | 17,46 € | 517.210 € | 19,48 € | 245.833 € | 37,69 € | 34.388 € |
| Insurances | 2,06 € | 61.163 € | 148,51 € | 1.873.842 € | 108,73 € | 99.214 € |
| Clubs memberships | 4,05 € | 119.973 € | 16,15 € | 203.830 € | 34,13 € | 31.149 € |
| Other annual expenses | 6,17 € | 182.774 € | 6,40 € | 80.789 € | 4,60 € | 4.193 € |
| Boat rentals | | | 8,56 € | 108.012 € | NA | NA |
| TOTAL ANNUAL | 788,66 € | 23.362.579 € | 3.162 € | 36.763.620 € | 2.027.388 € | 3.209.190 € |
| | | | | 864 € | 3.517 € | |

compared with 2021-2022, the areas with the highest economic impact for all three modalities of MRF were the *Costa Brava Sud* and *Costa Daurada* (Figure 46). Shore angling was also highly impactful on the *Maresme* and *Costes del Garraf* zones, while boat angling produced most of its expenditure in the *Delta de l'Ebre* *Costa Brava Sud* and *Cap de Creus* zones.

Table 18. Estimates of total direct annual expenditure on fishing materials and gear, and total annual expenditure related to the fishing activity including indirect expenses for each MRF modality during 2023.

| 2023 | Fishing gear | Total activity |
|------------------------|---------------------|---------------------|
| Shore angling | 11.581.037 € | 23.362.579 € |
| Boat angling | 6.183.600 € | 36.763.620 € |
| Spearfishing from land | 543.614 € | 2.027.388 € |
| Spearfishing from boat | 352.832 € | 3.209.190 € |
| Total | 18.661.083 € | 65.362.776 € |

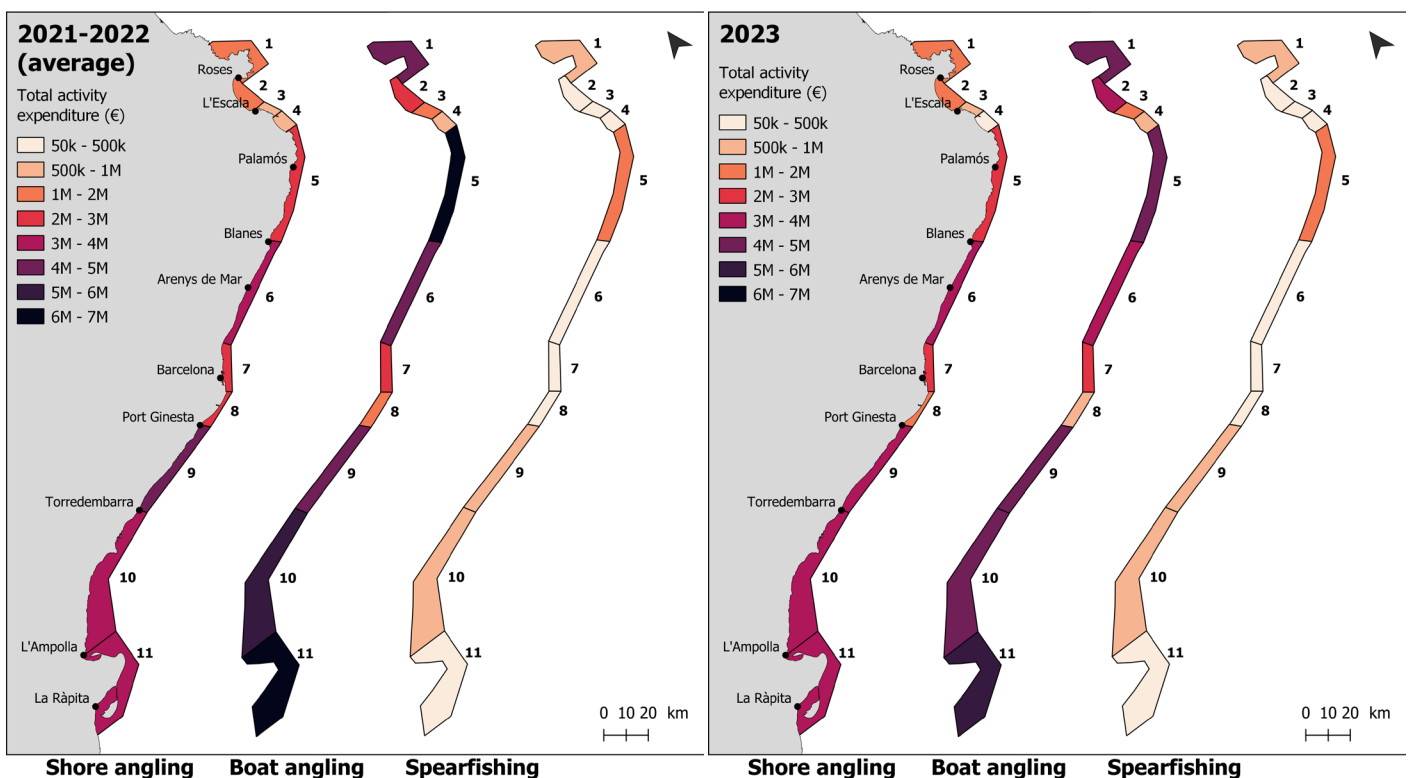


Figure 46. Estimate of total annual expenditure related to fishing activity for each MRF modality per zone in the period 2021-2022 (left) and in 2023 (right).

9

Conclusions



In Catalonia, marine recreational fishing was practised by an estimated 45 313 fishers in 2021-2022, and by 49 005 fishers in 2023. MRF is predominantly practised by middle-aged men with at least a decade of experience, although the different fishing modalities are represented by slightly different age groups, with boat anglers being the oldest, and spearfishers the youngest. In the onsite surveys conducted in 2023, the percentage of female marine recreational fishers has increased. In both studied periods, the most practised fishing modality by online surveys was shore angling, followed by boat angling and, to a lesser extent, spearfishing. MRF is a highly seasonal activity, strongly influenced by good weather and high temperatures, with the main bulk of the activity taking place during the months of May to September.

The main taxonomic groups targeted by MRF are species of the Sparidae family, but the main catches for each modality varied significantly. Shore angling catches include mainly the gilthead seabream (*Sparus aurata*), different seabream species of the genera *Diplodus*, and European bass (*Dicentrarchus labrax*). Boat angling mostly extracts biomass of common dentex, *Dentex dentex*, pelagic species such as *Euthynnus alletteratus*, *Seriola dumerili* and *Scomber scombrus*, common cuttlefish (*Sepia officinalis*) and European squid (*Loligo vulgaris*). Spearfishing catches mainly include the dusky grouper *Epinephelus marginatus*, along with a variety of sparids and the common octopus (*Octopus vulgaris*).

The total annual extraction of marine resources in 2021-2022 was estimated in 931 T for MRF as a whole, while in 2023, the total annual extraction increased to 1 003 T. This total catch would represent 3% of the commercial fishing catch in Catalonia (ICATMAR, 2020b).

It is necessary to caution that the nature of this study is heavily dependent on voluntary surveys and interpretation of the results presented here should not ignore the existence of unavoidable method-driven biases that have been outlined throughout the text. Although the combined methodology of online and onsite surveys allowed to overcome some of the shortcomings of each survey method, it is likely that inherent self-selection, perception and memory biases affect the indicators that require fishers to correctly recall their past experiences.

The overview of MRF activity represented by this study can be made more reliable year after year to become a major contribution to inform multidisciplinary decision-making aimed at a good management of the sector. Thus, the continuity of a series producing accurate annual data will be essential to maintain a sufficient body of knowledge to allow MRF to be included in fisheries assessments in the near future. This is considered a cornerstone in the progress toward informed decision-making for the sustainability of Catalan fisheries.

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Annexes



ANNEX I

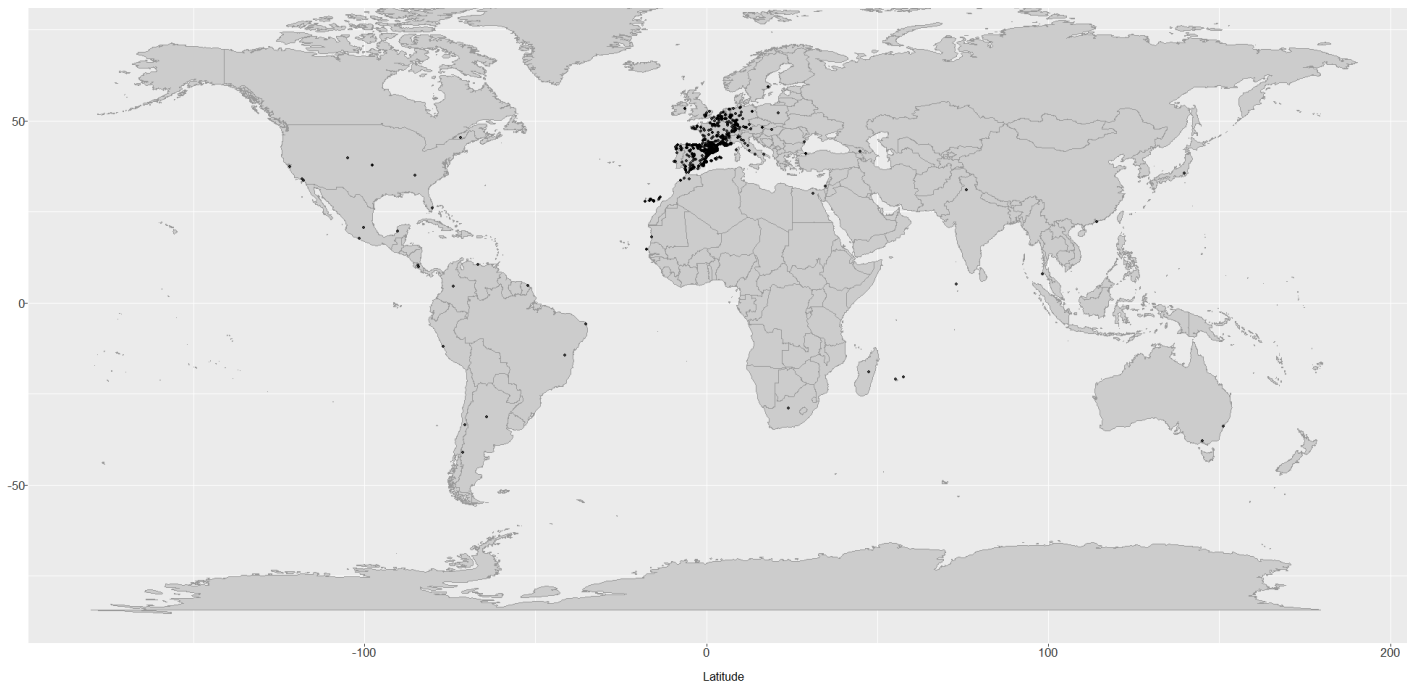


Figure 47. Locations of all responses to online surveys conducted by marine recreational fishers during 2021-2022.

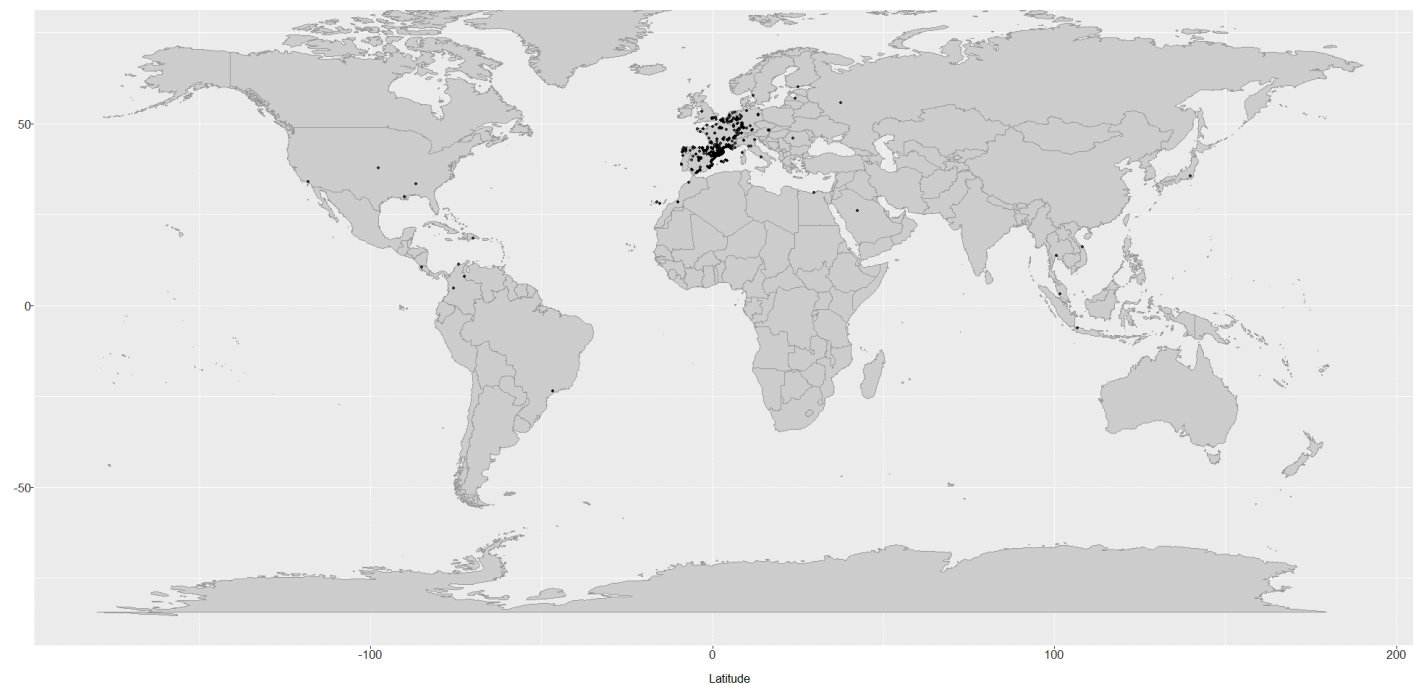


Figure 48. Locations of all responses to online surveys conducted by marine recreational fishers during 2023.

ANNEX II: Fishing effort shore angling

Table 19. Monthly average fishing effort calculated from online surveys data in the period 2021-2022 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| 2021-2022 | Zero | Sporadic | Low | Medium | High |
|-----------|------|------------|------------|------------|------------|
| January | 0 | 0.01±(0.1) | 0.30±(1.1) | 1.30±(2.8) | 6.13±(7.0) |
| February | 0 | 0.08±(0.3) | 0.27±(1.0) | 1.57±(2.7) | 3.83±(4.5) |
| March | 0 | 0.05±(0.3) | 0.30±(0.9) | 1.09±(2.1) | 4.57±(4.6) |
| April | 0 | 0.10±(0.3) | 0.76±(1.4) | 1.77±(2.2) | 6.51±(5.6) |
| May | 0 | 0.12±(0.3) | 0.83±(1.3) | 2.89±(3.1) | 6.61±(5.6) |
| June | 0 | 0.15±(0.4) | 1.13±(1.6) | 3.22±(3.1) | 7.22±(5.1) |
| July | 0 | 0.20±(0.4) | 1.32±(1.8) | 3.22±(3.4) | 8.02±(6.0) |
| August | 0 | 0.30±(0.5) | 1.92±(2.4) | 4.47±(4.6) | 8.49±(6.9) |
| Septembre | 0 | 0.25±(0.4) | 1.16±(1.7) | 3.40±(3.6) | 7.23±(6.5) |
| October | 0 | 0.04±(0.2) | 1.01±(2.1) | 2.40±(3.0) | 7.26±(6.3) |
| November | 0 | 0.02±(0.1) | 0.63±(1.3) | 2.20±(2.6) | 6.47±(6.2) |
| December | 0 | 0.04±(0.2) | 0.35±(0.9) | 1.59±(2.6) | 5.61±(5.6) |

Table 20. Monthly average fishing effort calculated from online surveys data in the year 2023 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| 2021-2022 | Zero | Sporadic | Low | Medium | High |
|-----------|------|------------|------------|------------|------------|
| January | 0 | 0.01±(0.1) | 0.30±(1.1) | 1.30±(2.8) | 6.13±(7.0) |
| February | 0 | 0.08±(0.3) | 0.27±(1.0) | 1.57±(2.7) | 3.83±(4.5) |
| March | 0 | 0.05±(0.3) | 0.30±(0.9) | 1.09±(2.1) | 4.57±(4.6) |
| April | 0 | 0.10±(0.3) | 0.76±(1.4) | 1.77±(2.2) | 6.51±(5.6) |
| May | 0 | 0.12±(0.3) | 0.83±(1.3) | 2.89±(3.1) | 6.61±(5.6) |
| June | 0 | 0.15±(0.4) | 1.13±(1.6) | 3.22±(3.1) | 7.22±(5.1) |
| July | 0 | 0.20±(0.4) | 1.32±(1.8) | 3.22±(3.4) | 8.02±(6.0) |
| August | 0 | 0.30±(0.5) | 1.92±(2.4) | 4.47±(4.6) | 8.49±(6.9) |
| Septembre | 0 | 0.25±(0.4) | 1.16±(1.7) | 3.40±(3.6) | 7.23±(6.5) |
| October | 0 | 0.04±(0.2) | 1.01±(2.1) | 2.40±(3.0) | 7.26±(6.3) |
| November | 0 | 0.02±(0.1) | 0.63±(1.3) | 2.20±(2.6) | 6.47±(6.2) |
| December | 0 | 0.04±(0.2) | 0.35±(0.9) | 1.59±(2.6) | 5.61±(5.6) |

Table 21. Distribution of shore angling effort in 2021-2022.

| Zones | Winter | Spring | Summer | Autumn |
|----------------------------|--------|--------|--------|--------|
| <i>Cap de Creus</i> | 6% | 6% | 6% | 5% |
| <i>Golf de Roses</i> | 6% | 6% | 6% | 7% |
| <i>Costa del Montgrí</i> | 2% | 3% | 2% | 2% |
| <i>Baix Ter</i> | 1% | 3% | 2% | 2% |
| <i>Costa Brava Sud</i> | 11% | 8% | 8% | 8% |
| <i>Maresme</i> | 15% | 13% | 14% | 15% |
| <i>Barcelonès</i> | 10% | 9% | 8% | 9% |
| <i>Delta del Llobregat</i> | 6% | 8% | 8% | 8% |
| <i>Costes del Garraf</i> | 16% | 16% | 15% | 14% |
| <i>Costa Daurada</i> | 13% | 13% | 16% | 16% |
| <i>Delta de l'Ebre</i> | 13% | 14% | 16% | 15% |

Table 22. Total estimate number of shore angling trips per kilometre per season in 2021-2022.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 51 | 87 | 114 | 55 | 307 |
| <i>Golf de Roses</i> | 22.78 | 191 | 350 | 477 | 348 | 1366 |
| <i>Costa del Montgrí</i> | 14.2 | 108 | 347 | 242 | 194 | 890 |
| <i>Baix Ter</i> | 9.75 | 105 | 481 | 352 | 232 | 1170 |
| <i>Costa Brava Sud</i> | 79.1 | 108 | 145 | 202 | 121 | 577 |
| <i>Maresme</i> | 60.22 | 197 | 319 | 456 | 288 | 1260 |
| <i>Barcelonès</i> | 18.4 | 410 | 663 | 870 | 598 | 2541 |
| <i>Delta del Llobregat</i> | 19.5 | 236 | 614 | 806 | 473 | 2129 |
| <i>Costes del Garraf</i> | 52.7 | 238 | 423 | 553 | 307 | 1521 |
| <i>Costa Daurada</i> | 83.06 | 118 | 232 | 379 | 228 | 957 |
| <i>Delta de l'Ebre</i> | 113.8 | 89 | 177 | 274 | 159 | 699 |

Table 23. Distribution of shore angling effort in 2023.

| Zones | Winter | Spring | Summer | Autumn |
|----------------------------|--------|--------|--------|--------|
| <i>Cap de Creus</i> | 4% | 6% | 5% | 6% |
| <i>Golf de Roses</i> | 6% | 8% | 7% | 6% |
| <i>Costa del Montgrí</i> | 2% | 4% | 3% | 2% |
| <i>Baix Ter</i> | 3% | 2% | 1% | 2% |
| <i>Costa Brava Sud</i> | 10% | 10% | 8% | 10% |
| <i>Maresme</i> | 15% | 13% | 13% | 13% |
| <i>Barcelonès</i> | 9% | 10% | 8% | 10% |
| <i>Delta del Llobregat</i> | 7% | 7% | 6% | 5% |
| <i>Costes del Garraf</i> | 15% | 12% | 16% | 13% |
| <i>Costa Daurada</i> | 16% | 14% | 17% | 15% |
| <i>Delta de l'Ebre</i> | 13% | 14% | 15% | 16% |

Table 24. Total estimate number of shore angling trips per kilometre per season in 2023.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 40 | 104 | 113 | 76 | 332 |
| <i>Golf de Roses</i> | 22.78 | 239 | 551 | 658 | 372 | 1820 |
| <i>Costa del Montgrí</i> | 14.2 | 131 | 461 | 493 | 224 | 1309 |
| <i>Baix Ter</i> | 9.75 | 309 | 280 | 282 | 308 | 1179 |
| <i>Costa Brava Sud</i> | 79.1 | 118 | 221 | 208 | 177 | 723 |
| <i>Maresme</i> | 60.22 | 219 | 362 | 465 | 302 | 1348 |
| <i>Barcelonès</i> | 18.4 | 421 | 890 | 937 | 749 | 2996 |
| <i>Delta del Llobregat</i> | 19.5 | 323 | 616 | 705 | 372 | 2015 |
| <i>Costes del Garraf</i> | 52.7 | 258 | 388 | 668 | 329 | 1644 |
| <i>Costa Daurada</i> | 83.06 | 171 | 282 | 439 | 249 | 1141 |
| <i>Delta de l'Ebre</i> | 113.8 | 106 | 201 | 277 | 190 | 773 |

ANNEX IV: Fishing effort spearfishing

Table 25. Monthly average fishing effort calculated from online surveys data in the period 2021-2022 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| Year 2021-2022 | Zero | Sporadic | Low | Medium | High |
|----------------|------|-------------|-------------|-------------|-------------|
| January | 0 | 0.25±(0.45) | 0.41±(1.17) | 1.13±(1.94) | 4.98±(6.02) |
| February | 0 | 0.00 | 0.50±(1.18) | 1.35±(1.89) | 6.48±(7.25) |
| March | 0 | 0.11±(0.33) | 0.42±(1.09) | 1.31±(1.96) | 4.03±(4.49) |
| April | 0 | 0.29±(0.49) | 0.51±(1.11) | 1.96±(2.45) | 7.13±(7.49) |
| May | 0 | 0.33±(0.52) | 0.82±(1.22) | 2.06±(2.51) | 5.91±(4.03) |
| June | 0 | 0.33±(0.51) | 1.16±(1.86) | 2.14±(2.04) | 8.02±(5.22) |
| July | 0 | 0.17±(0.39) | 1.66±(2.25) | 3.85±(3.86) | 8.60±(5.94) |
| August | 0 | 0.22±(0.44) | 2.14±(2.10) | 4.97±(4.33) | 9.55±(5.14) |
| Septembre | 0 | 0.20±(0.42) | 1.32±(2.28) | 3.71±(3.19) | 6.88±(4.15) |
| October | 0 | 0.20±(0.42) | 1.25±(1.94) | 2.93±(2.74) | 8.61±(6.59) |
| November | 0 | 0.00 | 0.61±(1.09) | 2.65±(2.82) | 7.34±(6.70) |
| December | 0 | 0.00 | 0.25±(0.64) | 2.67±(2.63) | 6.28±(5.46) |

Table 26. Monthly average fishing effort calculated from online surveys data in the year 2023 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| Year 2023 | Zero | Sporadic | Low | Medium | High |
|-----------|------|-------------|-------------|-------------|-------------|
| January | 0 | 0.00 | 0.46±(1.03) | 1.18±(1.66) | 3.79±(3.12) |
| February | 0 | 0.00 | 0.65±(1.57) | 1.68±(2.12) | 7.32±(7.55) |
| March | 0 | 0.00 | 0.29±(0.71) | 1.56±(1.82) | 5.40±(4.52) |
| April | 0 | 0.00 | 0.95±(1.24) | 2.38±(2.50) | 6.58±(6.11) |
| May | 0 | 0.17±(0.41) | 1.22±(1.62) | 3.35±(3.79) | 5.87±(3.83) |
| June | 0 | 0.00 | 1.30±(1.63) | 3.47±(2.24) | 7.53±(5.93) |
| July | 0 | 0.67±(0.50) | 2.13±(1.85) | 3.55±(2.73) | 6.54±(3.20) |
| August | 0 | 0.40±(0.56) | 1.96±(2.39) | 4.68±(3.84) | 8.14±(6.33) |
| Septembre | 0 | 0.50±(0.58) | 1.81±(1.64) | 4.61±(4.72) | 7.19±(5.52) |
| October | 0 | 0.20±(0.45) | 1.39±(1.86) | 3.43±(3.20) | 6.13±(3.33) |
| November | 0 | 0.00 | 0.65±(1.20) | 3.07±(3.47) | 7.37±(6.17) |
| December | 0 | 0.17±(0.41) | 0.66±(1.19) | 2.17±(2.19) | 6.25±(5.86) |

Table 27. Distribution of boat angling effort in 2021-2022.

| Zones | Winter | Spring | Summer | Autumn |
|---------------------|--------|--------|--------|--------|
| Cap de Creus | 14% | 8% | 12% | 14% |
| Golf de Roses | 9% | 5% | 6% | 9% |
| Costa del Montgrí | 4% | 3% | 3% | 4% |
| Baix Ter | 3% | 2% | 3% | 2% |
| Costa Brava Sud | 12% | 22% | 14% | 14% |
| Maresme | 10% | 12% | 11% | 7% |
| Barcelonès | 7% | 6% | 6% | 6% |
| Delta del Llobregat | 2% | 1% | 4% | 5% |
| Costes del Garraf | 11% | 11% | 11% | 7% |
| Costa Daurada | 14% | 14% | 11% | 16% |
| Delta de l'Ebre | 14% | 16% | 19% | 16% |

Table 28. Total estimate number of boat angling trips per kilometre per season in 2021-2022.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 58 | 55 | 123 | 96 | 331 |
| <i>Golf de Roses</i> | 22.78 | 159 | 136 | 255 | 280 | 830 |
| <i>Costa del Montgrí</i> | 14.2 | 128 | 138 | 218 | 173 | 657 |
| <i>Baix Ter</i> | 9.75 | 112 | 115 | 278 | 151 | 656 |
| <i>Costa Brava Sud</i> | 79.1 | 62 | 174 | 171 | 124 | 531 |
| <i>Maresme</i> | 60.22 | 72 | 126 | 180 | 81 | 460 |
| <i>Barcelonès</i> | 18.4 | 168 | 198 | 337 | 227 | 930 |
| <i>Delta del Llobregat</i> | 19.5 | 47 | 43 | 219 | 163 | 472 |
| <i>Costes del Garraf</i> | 52.7 | 90 | 133 | 206 | 93 | 522 |
| <i>Costa Daurada</i> | 83.06 | 70 | 108 | 126 | 130 | 434 |
| <i>Delta de l'Ebre</i> | 113.8 | 49 | 86 | 167 | 97 | 400 |

Table 29. Distribution of boat angling effort in 2023.

| Zones | Winter | Spring | Summer | Autumn |
|----------------------------|--------|--------|--------|--------|
| <i>Cap de Creus</i> | 11% | 8% | 12% | 13% |
| <i>Golf de Roses</i> | 8% | 12% | 12% | 10% |
| <i>Costa del Montgrí</i> | 1% | 4% | 4% | 4% |
| <i>Baix Ter</i> | 3% | 3% | 3% | 3% |
| <i>Costa Brava Sud</i> | 13% | 18% | 14% | 10% |
| <i>Maresme</i> | 12% | 9% | 8% | 10% |
| <i>Barcelonès</i> | 8% | 9% | 8% | 6% |
| <i>Delta del Llobregat</i> | 3% | 4% | 3% | 2% |
| <i>Costes del Garraf</i> | 13% | 12% | 8% | 13% |
| <i>Costa Daurada</i> | 14% | 8% | 12% | 15% |
| <i>Delta de l'Ebre</i> | 15% | 14% | 16% | 14% |

Table 30. Total estimate number of boat angling trips per kilometre per season in 2023.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 58 | 72 | 144 | 104 | 378 |
| <i>Golf de Roses</i> | 22.78 | 175 | 456 | 630 | 355 | 1615 |
| <i>Costa del Montgrí</i> | 14.2 | 47 | 209 | 344 | 237 | 837 |
| <i>Baix Ter</i> | 9.75 | 136 | 228 | 334 | 207 | 906 |
| <i>Costa Brava Sud</i> | 79.1 | 84 | 192 | 198 | 97 | 570 |
| <i>Maresme</i> | 60.22 | 99 | 123 | 146 | 127 | 495 |
| <i>Barcelonès</i> | 18.4 | 216 | 403 | 496 | 232 | 1347 |
| <i>Delta del Llobregat</i> | 19.5 | 68 | 152 | 184 | 69 | 473 |
| <i>Costes del Garraf</i> | 52.7 | 119 | 183 | 186 | 196 | 684 |
| <i>Costa Daurada</i> | 83.06 | 82 | 76 | 165 | 143 | 466 |
| <i>Delta de l'Ebre</i> | 113.8 | 64 | 104 | 158 | 95 | 421 |

ANNEX V: Fishing yield by fishing modality

Table 31. Monthly average fishing effort calculated from online surveys data in the period 2021-2022 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| Year 2021-2022 | Zero | Sporadic | Low | Medium | High |
|----------------|------|-------------|-------------|-------------|-------------|
| January | 0 | 0.00 | 0.39±(0.82) | 0.97±(1.55) | 2.06±(2.82) |
| February | 0 | 0.50±(0.58) | 0.31±(0.77) | 1.18±(1.96) | 4.48±(3.73) |
| March | 0 | 0.00 | 0.64±(2.19) | 1.08±(1.53) | 4.21±(4.93) |
| April | 0 | 0.00 | 0.39±(0.86) | 1.76±(1.86) | 5.71±(2.50) |
| May | 0 | 0.00 | 1.15±(1.61) | 2.00±(2.26) | 3.38±(3.62) |
| June | 0 | 0.33±(0.58) | 1.72±(1.47) | 3.61±(3.15) | 5.38±(4.06) |
| July | 0 | 0.40±(0.52) | 2.43±(2.61) | 3.57±(3.40) | 8.77±(5.39) |
| August | 0 | 0.11±(0.33) | 2.23±(2.51) | 5.18±(5.10) | 9.25±(6.55) |
| Septembre | 0 | 0.00 | 1.22±(2.00) | 3.79±(4.41) | 6.33±(3.24) |
| October | 0 | 0.00 | 0.82±(1.84) | 2.15±(2.77) | 6.72±(4.79) |
| November | 0 | 0.33±(0.58) | 0.49±(1.04) | 1.38±(1.81) | 3.71±(3.96) |
| December | 0 | 0.00 | 0.29±(0.63) | 1.84±(2.56) | 5.12±(4.12) |

Table 32. Monthly average fishing effort calculated from online surveys data in the year 2023 by answering the question: “How many times have you gone fishing in the last 4 weeks?” Standard error is indicated in parentheses.

| Year 2023 | Zero | Sporadic | Low | Medium | High |
|-----------|------|-------------|-------------|-------------|-------------|
| January | 0 | 0.00 | 0.80±(2.08) | 1.52±(1.86) | 6.43±(9.76) |
| February | 0 | 0.00 | 0.47±(0.77) | 1.21±(1.93) | 3.20±(3.03) |
| March | 0 | 0.00 | 0.30±(0.66) | 1.57±(1.47) | 4.57±(4.61) |
| April | 0 | 0.33±(0.58) | 0.65±(1.17) | 1.58±(1.93) | 7.00±(4.24) |
| May | 0 | 0.20±(0.45) | 0.56±(1.21) | 1.60±(1.84) | 1.33±(1.54) |
| June | 0 | 0.00 | 2.65±(1.95) | 2.71±(2.21) | 12.0±(5.65) |
| July | 0 | 0.00 | 2.35±(2.50) | 4.55±(4.04) | 6.67±(6.11) |
| August | 0 | 0.00 | 3.56±(3.52) | 5.43±(5.00) | 9.00±(4.81) |
| Septembre | 0 | 0.50±(0.71) | 2.13±(2.94) | 3.90±(2.88) | 8.33±(4.50) |
| October | 0 | 0.00 | 0.67±(1.20) | 3.05±(2.67) | 8.00±(6.16) |
| November | 0 | 0.00 | 0.92±(1.38) | 1.81±(1.54) | 4.71±(4.53) |
| December | 0 | 0.00 | 0.45±(0.86) | 1.69±(1.88) | 2.29±(2.75) |

Table 33. Distribution of spearfishing effort in 2021-2022.

| Zones | Winter | Spring | Summer | Autumn |
|----------------------------|--------|--------|--------|--------|
| <i>Cap de Creus</i> | 13% | 9% | 14% | 19% |
| <i>Golf de Roses</i> | 4% | 4% | 5% | 5% |
| <i>Costa del Montgrí</i> | 9% | 4% | 7% | 9% |
| <i>Baix Ter</i> | 1% | 3% | 3% | 1% |
| <i>Costa Brava Sud</i> | 20% | 23% | 22% | 20% |
| <i>Maresme</i> | 8% | 5% | 7% | 8% |
| <i>Barcelonès</i> | 9% | 5% | 4% | 5% |
| <i>Delta del Llobregat</i> | 9% | 12% | 7% | 4% |
| <i>Costes del Garraf</i> | 11% | 14% | 12% | 12% |
| <i>Costa Daurada</i> | 12% | 14% | 15% | 15% |
| <i>Delta de l'Ebre</i> | 3% | 6% | 3% | 2% |

Table 34. Total estimate number of spearfishing trips per kilometre per season in 2021-2022.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 12 | 16 | 42 | 26 | 95 |
| <i>Golf de Roses</i> | 22.78 | 16 | 29 | 64 | 30 | 139 |
| <i>Costa del Montgrí</i> | 14.2 | 57 | 46 | 148 | 79 | 330 |
| <i>Baix Ter</i> | 9.75 | 9 | 45 | 83 | 13 | 150 |
| <i>Costa Brava Sud</i> | 79.1 | 23 | 50 | 80 | 34 | 186 |
| <i>Maresme</i> | 60.22 | 12 | 14 | 35 | 17 | 78 |
| <i>Barcelonès</i> | 18.4 | 44 | 47 | 62 | 37 | 190 |
| <i>Delta del Llobregat</i> | 19.5 | 42 | 101 | 100 | 29 | 270 |
| <i>Costes del Garraf</i> | 52.7 | 19 | 45 | 68 | 31 | 163 |
| <i>Costa Daurada</i> | 83.06 | 13 | 29 | 53 | 23 | 118 |
| <i>Delta de l'Ebre</i> | 113.8 | 2 | 10 | 9 | 2 | 23 |

Table 35. Distribution of spearfishing effort in 2023.

| Zones | Winter | Spring | Summer | Autumn |
|----------------------------|--------|--------|--------|--------|
| <i>Cap de Creus</i> | 12% | 18% | 17% | 14% |
| <i>Golf de Roses</i> | 3% | 1% | 5% | 4% |
| <i>Costa del Montgrí</i> | 6% | 7% | 10% | 5% |
| <i>Baix Ter</i> | 1% | 0% | 3% | 0% |
| <i>Costa Brava Sud</i> | 28% | 17% | 22% | 20% |
| <i>Maresme</i> | 6% | 3% | 6% | 7% |
| <i>Barcelonès</i> | 6% | 10% | 4% | 7% |
| <i>Delta del Llobregat</i> | 5% | 4% | 7% | 7% |
| <i>Costes del Garraf</i> | 17% | 28% | 18% | 14% |
| <i>Costa Daurada</i> | 11% | 11% | 8% | 16% |
| <i>Delta de l'Ebre</i> | 4% | 1% | 1% | 5% |

Table 36. Total estimate number of spearfishing trips per kilometre per season in 2023.

| Zones | Km coastline | Winter | Spring | Summer | Autumn | Total annual |
|----------------------------|--------------|--------|--------|--------|--------|--------------|
| <i>Cap de Creus</i> | 97.46 | 17 | 40 | 67 | 26 | 151 |
| <i>Golf de Roses</i> | 22.78 | 16 | 10 | 88 | 28 | 143 |
| <i>Costa del Montgrí</i> | 14.2 | 58 | 113 | 266 | 63 | 501 |
| <i>Baix Ter</i> | 9.75 | 19 | 0 | 103 | 0 | 122 |
| <i>Costa Brava Sud</i> | 79.1 | 48 | 47 | 108 | 45 | 248 |
| <i>Maresme</i> | 60.22 | 14 | 11 | 38 | 21 | 84 |
| <i>Barcelonès</i> | 18.4 | 45 | 113 | 82 | 63 | 302 |
| <i>Delta del Llobregat</i> | 19.5 | 38 | 47 | 142 | 66 | 293 |
| <i>Costes del Garraf</i> | 52.7 | 45 | 114 | 134 | 49 | 341 |
| <i>Costa Daurada</i> | 83.06 | 19 | 28 | 39 | 34 | 120 |
| <i>Delta de l'Ebre</i> | 113.8 | 5 | 2 | 4 | 8 | 19 |

Table 37. Average fishing yield (in kg/day) and standard deviations per fishing modality and per year.

| | Shore angling | | Boat angling | | Spearfishing | |
|-----------------------|---------------|-------|--------------|-------|--------------|-------|
| | 2020-2022 | 2023 | 2020-2022 | 2023 | 2020-2022 | 2023 |
| Average fishing yield | 0.42 | 0.48 | 2.37 | 2.25 | 1.60 | 1.66 |
| sd | ±1.11 | ±0.98 | ±12.2 | ±6.90 | ±2.02 | ±2.18 |
| se | ±0.03 | ±0.04 | ±0.34 | ±0.28 | ±0.09 | ±0.14 |
| ic | 0.05 | 0.08 | 0.66 | 0.55 | 0.18 | 0.27 |

ANNEX VI: Intended target species

Recreational fishers mostly have a specific catch or set of catches in which they are interested. It must be considered the intended target species are merely a declaration of intentions, and do not necessarily reflect the eventual outcome of a fishing trip, but they can be considered an important motivation axis setting the expectations for a given fishing trip.

Accordingly, the main species group of interest of shore fishing were the Sparidae family, mainly *Sparus aurata*, different species of the genus *Diplodus spp.*, and other sparids such as *Dentex dentex*. The second most coveted intended target catch was *Dicentrarchus labrax*. Other target species include cephalopods, such as *Sepia officinalis*, and *Octopus vulgaris*. The intended target species answers from all the average 2020-2022 and 2023 are shown in Figure 49.

Fishing by boat allows for more mobility than other modalities, giving boat fishers greater access to a range of fishing environments. Besides, the different fishing techniques available to boat fishers allow accessing species of varying characteristics. In the both years, boat anglers from the Catalan coast aimed to catch the most popular cephalopods, *Sepia officinalis* generated an especially high interest. Still, *Dicentrarchus labrax* was the overall most coveted catch for boat. Another feature of this modality is catching large pelagic fish such as tuna (*T. thynnus* or *T. alalunga*), and other great pelagic species such as *Sarda sarda* and *Coryphaena hippurus*. It is worth mentioning that due to specific fishery regulations for tuna, these species can only be caught and released. Other smaller pelagic fish catches of interest include *Trachurus trachurus* and *Scomber scombrus*.

Spearfishing is a particularly selective activity, and this selectivity is highly determined by the different spearfishing strategies that can be used underwater. High catch selectivity allows the spearfishing activity to be much more targeted towards certain desirable catches, but it is also restricted to more coastal species.

The main intended target species in both studied periods is *Sparus aurata*, followed by *Dicentrarchus labrax*, and *Dentex dentex*. Also, the main cephalopod caught is the common *Octopus vulgaris*. There is also interest to catch *Epinephelus marginatus*, *Sciaena umbra*, and *Phycis phycis*. The intended target species from 2023 are very similar between both studied periods, 2020-2022, aiming to catch *Sparus aurata*, followed by *Dentex dentex*, and *Dicentrarchus labrax*. As a difference, in 2023 *Octopus vulgaris* is also shown as a species of interest (Figure 49).

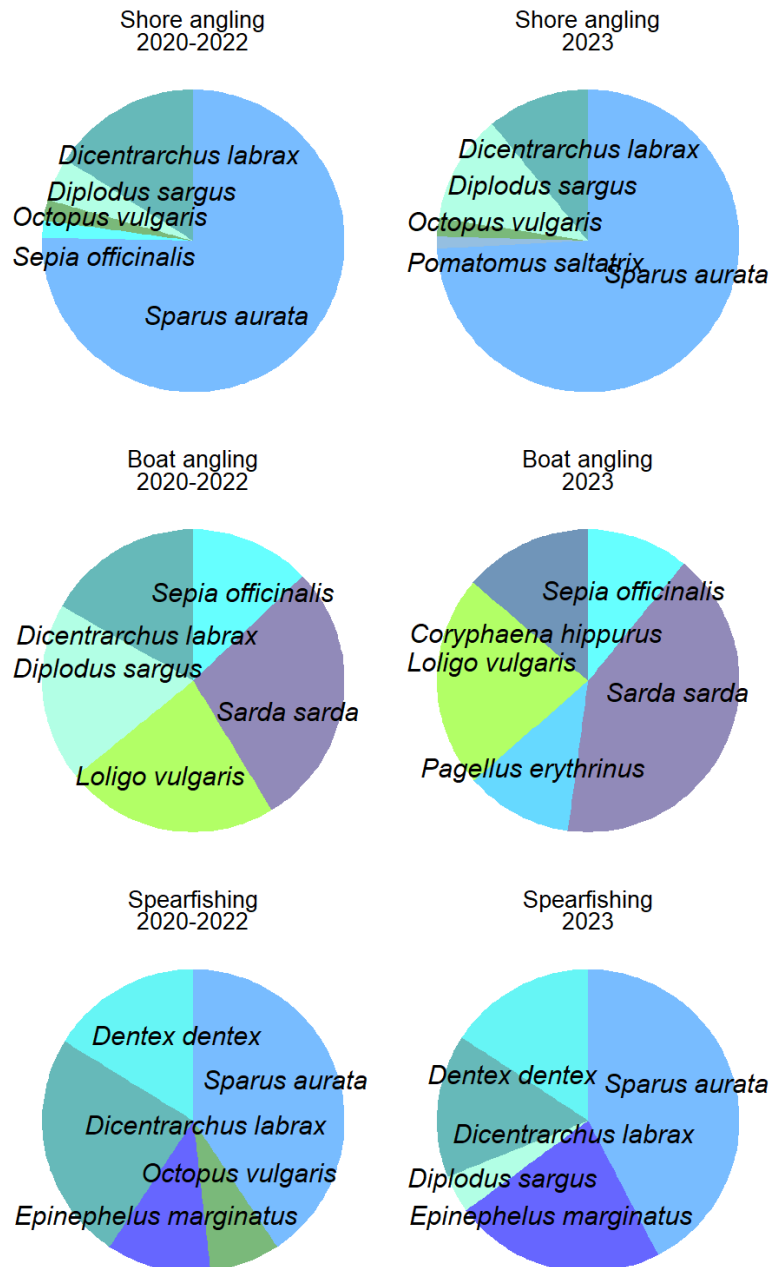


Figure 49. Proportion of species declared as target in onsite surveys in the period 2020-2022 and in 2023 by fishing modalities.

ANNEX VII: Distribution of the total activity expenditure

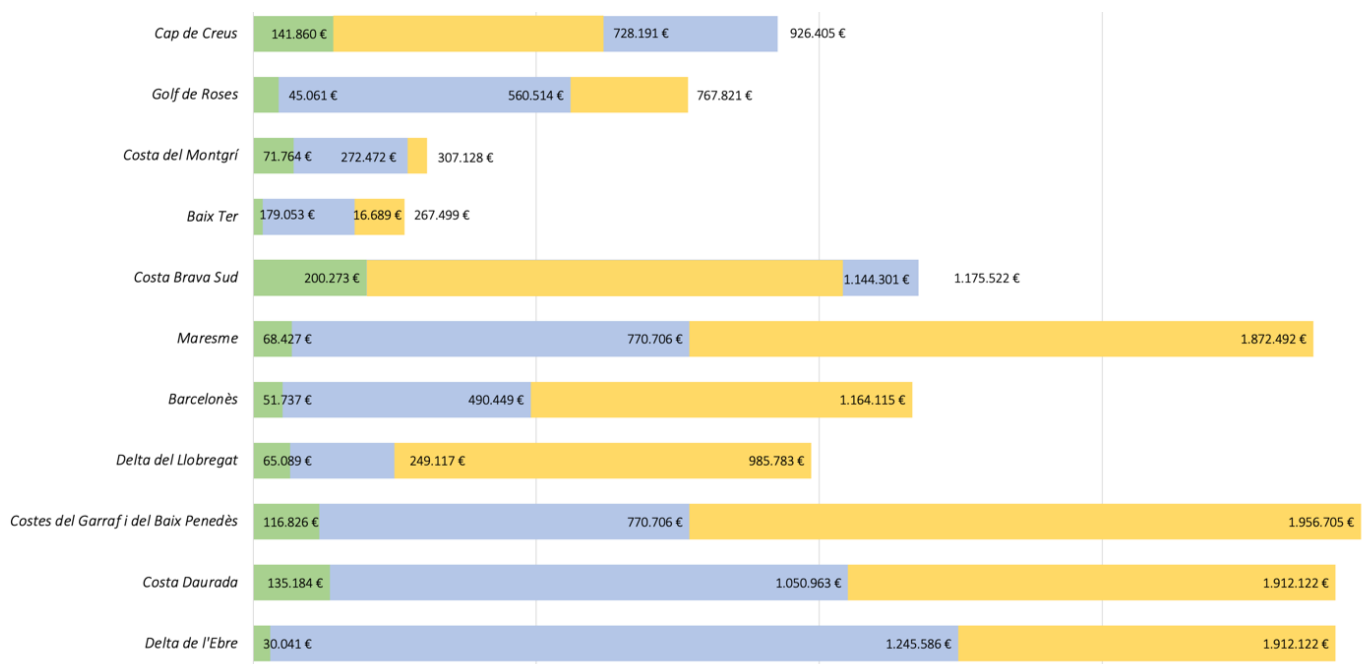


Figure 50. Estimate of total annual fishing gear related to fishing activity for each modality by zone during the period 2021-2022.

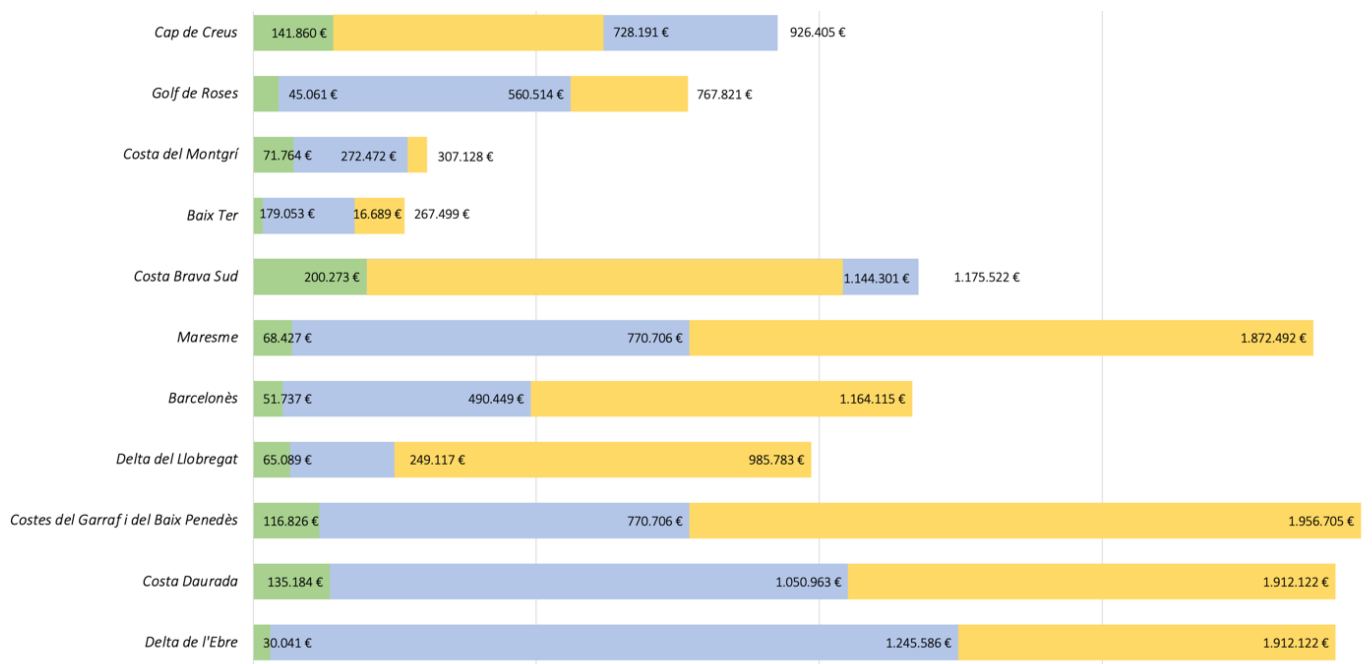


Figure 51. Estimate of total annual fishing gear related to fishing activity for each modality by zone during 2023.

ANNEX VIII: List of species

Table 38. Alphabetic list of all species observed with scientific and common names.

| Scientific name | Catalan common name | Spanish common name | English common name |
|----------------------------------|-------------------------|----------------------|----------------------------|
| <i>Anguilla anguilla</i> | Anguila | Anguila | Common eel |
| <i>Anthias anthias</i> | Forcadella | Tres colas | Swallowtail seaperch |
| <i>Auxis rochei</i> | Melva | Melva | Bullet tuna |
| <i>Belone belone</i> | Peix agulla | Aguja | Garfish |
| <i>Boops boops</i> | Boga | Boga | Bogue |
| <i>Bothus podas</i> | Tacó | Podas | Wide-eyed flounder |
| <i>Brama brama</i> | Castanyola | Palometa negra | Atlantic pomfret |
| <i>Caranx crysos</i> | Sorell del sud | Jurel azul | Blue runner |
| <i>Chelon auratus</i> | Llissa galta-roja | Lisa dorada | Golden grey mullet |
| <i>Chelon labrosus</i> | Llissa vera | Lisa | Thicklip grey mullet |
| <i>Chromis chromis</i> | Castenyoleta | Castañuela | Damselfish |
| <i>Conger conger</i> | Congre | Congrio | European conger |
| <i>Coris julis</i> | Donzella, juliola | Doncella, julia | Rainbow wrasse |
| <i>Coryphaena hippurus</i> | Llampuga | Llampuga | Common dolphinfish |
| <i>Dentex dentex</i> | Déntol | Dentón | Common dentex |
| <i>Dicentrarchus labrax</i> | Llobarro | Lubina | European seabass |
| <i>Diplodus sargus</i> | Sard, sarg | Sargo | White seabream |
| <i>Diplodus cervinus</i> | Sard imperial, rom | Sargo imperial | Zebra seabream |
| <i>Diplodus vulgaris</i> | Variada, vidriada | Sargo común, mojarra | Common two-banded seabream |
| <i>Diplodus puntazzo</i> | Morruda | Sargo picudo | Sharpsnout seabream |
| <i>Diplodus annularis</i> | Esparrall | Raspallón | Annular seabream |
| <i>Epinephelus marginatus</i> | Mero, nero, anfós | Mero | Dusky grouper |
| <i>Euthynnus alletteratus</i> | Bacoreta | Bacoreta | Atlantic black skipjack |
| <i>Helicolenus dactylopterus</i> | Penegal, serrà imperial | Gallineta, pollo | Blackbelly rosefish |
| <i>Labrus merula</i> | Tord negre, tord massot | Merlo | Brown wrasse |
| <i>Labrus viridis</i> | Grívia, tord verd | Tordo verde | Green wrasse |
| <i>Lichia amia</i> | Palomida | Palometón | Leerfish |
| <i>Lithognathus mormyrus</i> | Marbre, mabre | Herrera, mabre | Sand steenbras |
| <i>Loligo vulgaris</i> | Calamar comú | Calamar común | European squid |
| <i>Merluccius merluccius</i> | Lluç | Merluza | European hake |
| <i>Mugil cephalus</i> | Llissa llobarrera | Mugil | Flathead grey mullet |
| <i>Mullus surmuletus</i> | Moll de roca, roger | Salmonete de roca | Surmullet |
| <i>Mullus barbatus</i> | Moll de fang | Salmonete de fango | Red mullet |
| <i>Muraena helena</i> | Morena | Morena | Mediterranean moray |
| <i>Oblada melanura</i> | Oblada | Oblada | Saddled seabream |
| <i>Octopus vulgaris</i> | Pop roquer | Pulpo común | Common octopus |
| <i>Pagellus acarne</i> | Besuc blanc, calet | Aligote | Axillary seabream |
| <i>Pagellus bogaraveo</i> | Besuc de la piga | Besugo | Blackspot seabream |

Table 38 (cont.). Alphabetic list of all species observed with scientific and common names.

| | | | |
|--------------------------------|---|-------------------------|--|
| <i>Pagellus erythrinus</i> | Pagell | Breca, pagel | Common pandora Red porgy, common seabream |
| <i>Pagrus pagrus</i> | Pagre | Pargo, pagro | seabream |
| <i>Paracentrotus lividus</i> | Garota | Erizo de mar | Stony sea urchin |
| <i>Phycis blennoides</i> | Mòllera de fang | Brótola | Greater forkbeard |
| <i>Phycis phycis</i> | Mòllera, brótola | Brótola de roca | Forkbeard |
| <i>Pomadasys incisus</i> | Roncador o xerla | Roncador | Bastart grunt |
| <i>Pomatomus saltatrix</i> | Tallahams, lliri | Anjova | Bluefish |
| <i>Sarda sarda</i> | Bonítol | Bonito del Sur | Atlantic bonito |
| <i>Sarpa salpa</i> | Salpa | Salema | Salema |
| <i>Sciaena umbra</i> | Corball de roca | Corvallo | Brown meagre |
| <i>Scomber scombrus</i> | Verat, cavalla | Caballa | Atlantic mackerel |
| <i>Scomber colias</i> | Bis | Estornino | Pacific chub mackerel |
| <i>Scorpaena notata</i> | Escórpora | Esórpora | Small red scorpionfish |
| <i>Scorpaena scrofa</i> | Escórpora de cap roig | Cabracho | Red scorpionfish |
| <i>Scorpaena porcus</i> | Escórpora, rufí | Rascacio | Black scorpionfish |
| <i>Sepia officinalis</i> | Sèpia, sípia | Sepia común | Common cuttlefish |
| <i>Seriola dumerili</i> | Círvia | Pez limón | Greater amberjack |
| <i>Serranus cabrilla</i> | Serrà | Cabrilla | Comber |
| <i>Serranus scriba</i> | Vaca serrana | Vaquita, cabrilla | Painted comber |
| <i>Solea solea</i> | Llenguado | Lenguado | Dover sole |
| <i>Sparus aurata</i> | Orada | Dorada | Gilthead seabream |
| <i>Sphyaena sphyraena</i> | Espet | Espetón | European barracuda |
| <i>Sphyaena viridensis</i> | Espet | Espetón boca amarilla | Yellowmouth barracuda |
| <i>Spicara maena</i> | Xucla | Chucla | Blotched picarel |
| <i>Spondyliosoma cantharus</i> | Càntera | Chopa | Black seabream |
| <i>Symphodus cinereus</i> | Tamborer | Bodion | Grey wrasse |
| <i>Symphodus tinca</i> | Tord lloro, llavió | Tordo verde, bodión | East Atlantic peacock wrasse |
| <i>Symphodus mediterraneus</i> | Tord porcellana, canari, tord roquer | Vaqueta | Axillary wrasse |
| <i>Synodus saurus</i> | Llangardagix | Pez lagarto | Lizard fish |
| <i>Tetrapturus belone</i> | Marlí de la Mediterrània | Marlín del Mediterráneo | Mediterranean spearfish |
| <i>Thunnus thynnus</i> | Tonyina | Atún | Atlantic bluefin tuna |
| <i>Thunnus alalunga</i> | Bacora | Atún blanco | Albacore |
| <i>Trachinotus ovatus</i> | Palometa | Palometa blanca | Pompano |
| <i>Trachurus trachurus</i> | Sorell | Jurel | Atlantic horse mackerel |
| <i>Trachurus mediterraneus</i> | Sorell blanc | Jurel mediterráneo | Mediterranean horse mackerel |
| <i>Trisopterus capellanus</i> | Capellà | Capellan | Poor cod |
| <i>Umbrina cirrosa</i> | Corball de sorra | Verrugato | Shi drum |
| <i>Xyrichtys novacula</i> | Raor, llorito | Galán, lorito | Pearly razorfish |
| <i>Zeus faber</i> | Gall de Sant Pere | Pez de San Pedro | John Dory |



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