icat mar
Institut Català de Recerca per a la Governança del Mar

State of Marine Recreational Fisheries in Catalonia 2024

www.icatmar.cat

Co-funded by the European Union
Generalitat de Catalunya
CSIC Consejo Superior de Investigaciones Científicas
Institut de Ciències del Mar

This report presents the results average four year of a continuous monitoring study on marine recreational fishing in Catalonia during 2024 in comparison with 2020-2023. 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).

© Institut Català de Recerca per a la Governança del Mar

Direcció General de Política Marítima i Pesca Sostenible

Generalitat de Catalunya

DOI: 10.20350/digitalCSIC/17642

Data for this report came from:

- ICATMAR's considerations on fisheries management supported by data from its continuous monitoring programme.
- Project "Transfer of knowledge and fisheries biological monitoring of the main commercial species of the Catalan coast (CGCAT)", European Maritime and Fisheries Fund (EMFF), Government of Catalonia and The Catalan Institute of Research for the Governance of the Sea (ICATMAR)

The working group involved in this report included:

Scientific coordination: Marta Pujol-Baucells, Eve Galimany, Patricia Poch, Marta Carreton, Laura Recasens, Joan B. Company

Co-management working group: Victor Rubio, Llibori Martinez, Oriol Ribalta, Joan Ramon Vidal, Joan Ylla, Christian Buscemi, Marta Pujol-Baucells, Patricia Poch, Eve Galimany, Laura Recasens, Joan B. Company

How to cite this document:

Institut Català de Recerca per la Governança del Mar (ICATMAR). State of marine recreational fisheries in Catalonia 2024: report on the monitoring of the marine recreational fishing (ICATMAR, 25-08), 76pp., Barcelona. DOI: 10.20350/digitalCSIC/17642

www.icatmar.cat

All image credits © Marta Pujol-Baucells

Index

Index of figures

Index of tables

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, 2017). 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 (Herfaut et al., 2013; Michailidis et al., 2020).

In this context, MRF is a widely practiced leisure activity, engaging over 350 million people globally (Arlinghaus et al., 2021). Despite its popularity, the sector has historically suffered from a lack of systematic data collection, standardized monitoring, and integrated assessment frameworks (Arlinghaus & Cooke, S. J., 2005; Brownscombe et al., 2019; Hyder et al., 2018; P. McPhee et al., 2002). This trend is understandable given that MRF often overlaps with commercial fisheries, sharing the same resources, which underscores the need of integrating recreational catch data into stock assessments and management plans. 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. Recent studies emphasize that effective governance of marine recreational fisheries is critical to maximize societal benefits and ensure sustainable use of resources (Grati et al., 2025).

Over the past decade, several Autonomous Communities in Spain have launched multispecies studies to monitor MRF activity (ICATMAR, 2023; Morales-Nin et al., 2005), and the scale and composition of catches have been described at a national level (Dedeu, 2019; Gordoa et al., 2019). In 2023, Andalusia became the only region in the country to issue an updated regulation for MRF. In 2024, in Catalonia, the Catalan government approved a resolution for the province of Girona establishing a list of species with minimum size limits, bag limits, and seasonal closures, developed collaboratively with the recreational fishing sector and the administration (RESOLUCIÓ ARP/3253, 2024). Similarly, in 2025, the Catalan government approved two more resolutions, one for Barcelona and one for Tarragona provinces, with similar measures (RESOLUCIÓ ARP/3310, 2025 and RESOLUCIÓ ARP/3311, 2025). Furthermore, the establishment of the co-management roundtable has enabled the discussion of multiple topics, including ongoing uncertainties, the development of future resolutions for central and southern Catalonia, and the review of the 1995 decree, fostering collaborative work between stakeholders and authorities towards updated regulation.

This report consolidates five years of long-term MRF data collection, enabling 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.

2

Method

2.1. Study area

The present report examines data collected from the period January 2020 to December 2023 and throughout 2024. Specifically, it analyses the data from 2024 in comparison to the average from 2020-2023 for onsite and online data. The study area included the entire Catalan coast divided into 11 zones, as noted in previous reports (Figure 1).

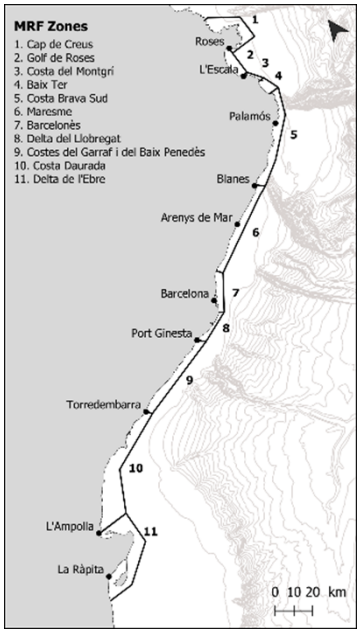


Figure 1. Division of the Catalan coastline and model of zone aggregation.

2.2. Data collection

As described in previous reports, the onsite and online surveys were designed to address the same queAs 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 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, 2023). 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 2024 a total of 92 sampling days per year were ensured. In addition, 25 additional sampling days were conducted within the monitoring programme of the natural parks of Cap de Creus, Medes Islands, and Montgrí coast. These surveys were carried out following the same protocol and survey format as the annual MRF monitoring programme. The sampling days were randomly assigned, with 30-40% on weekdays and 60-70% 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. During each different sampling day, given the high effort involved, all available fishers were interviewed whenever possible. 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, although by 2024 only one charter continued to provide data. Efforts are currently underway to look at the description of the data collected and to explore the extent of the sector.

2.3. 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. Firstly, 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, 2022). 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 7).

Since the unification of recreational fishing licences in 2000 (DECRET 100/2000), different validity periods have been established within the "surface angling" category. These include temporary licences of 1, 2, or 15 days, as well as annual and multi-annual licences. In addition, there are specific surface licences without harvest, and reduced-fee licences for minors, retirees, and persons with disabilities, all with varying validity periods. In contrast, spearfishing licences are issued with a single validity of one year for all groups. In the preparation of the 2024 report, several inconsistencies were detected in the licence registries, and therefore the number of marine recreational fishers should be considered an estimate.

The geographical distribution of fishing effort by season was estimated using the online effort results of the aggregate number of trips per zone, and all distribution maps were generated using natural breaks. 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 (kg/day). The calculations were carried out taking into account the type of 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 calculated 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). An average value of total catch per fisher for each avidity class within each season was estimated as the product of the CPUE and effort values of these crossed categories. Then, the number 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 survey

3.1. Response to the onsite survey

During the first four years of the monitoring program (2020 to 2023) there were 421 survey days with a total of 5 777 onsite surveys. This represents an annual average of 105 survey days and 1 444 onsite surveys. In 2024, the 117 surveys days, yielded a total of 1 726 survey responses (Figure 2).

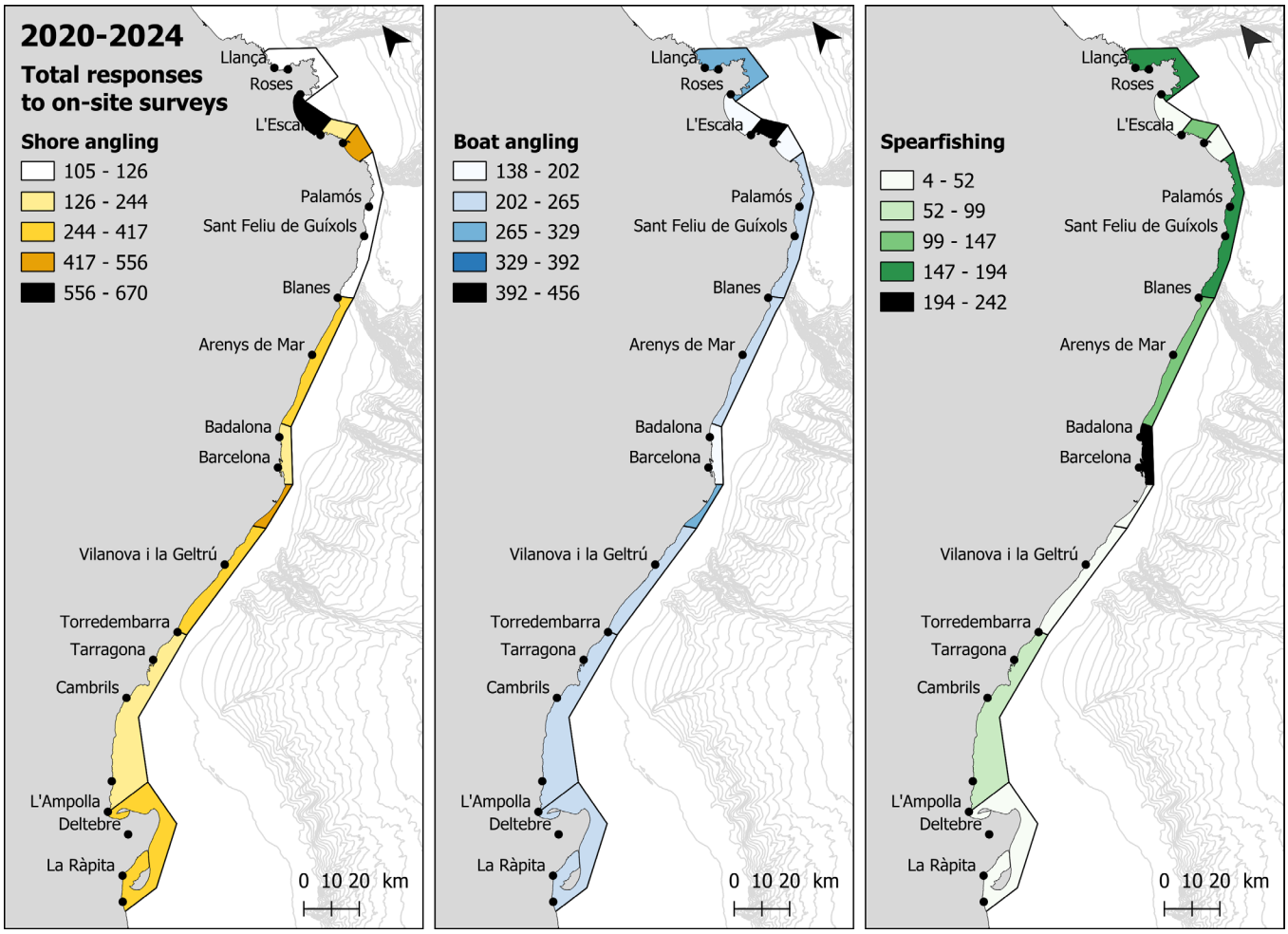


Figure 2. Number of responses for each fishing modality in the onsite surveys conducted in each of the 11 zones during the period 2020-2024 (right)): 1. Cap de Creus, 2. Golf de Roses, 3. Costa del Montgrí, 4. Baix Ter, 5. Costa Brava Sud, 6. Maresme, 7. Barcelonès, 8. Delta del Llobregat, 9. Costes del Garraf, 10. Costa Daurada and 11. Delta de l'Ebre.

As for the onsite survey responses in 2024 there were 697 responses from shore anglers, 725 from boat anglers and 304 from spearfishers. From the period 2020 to 2023, there were a total of 3 065 responses from shore anglers, 1 947 from boat anglers, and 765 from spearfishers (Figure 3).

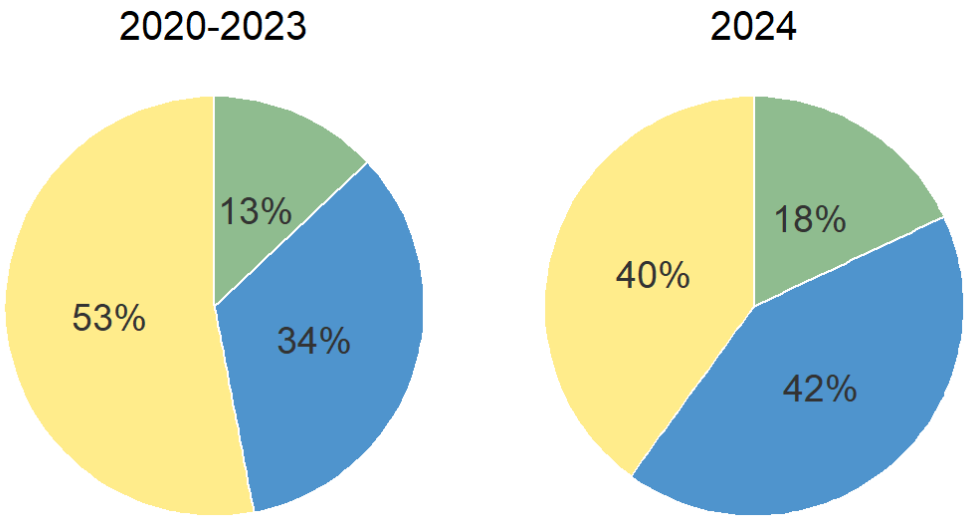


Figure 3. Percentage of the three fishing modalities (shore angling; yellow, boat angling; blue and spearfishing; green) of the fishers surveyed in the onsite sampling.

Regarding the nationalities of the onsite survey respondents, in 2024 78.7% of the respondents were from Spain, 16.6% from the rest of Europe (mainly from France, Italy, and East Countries), 3% from African countries (i.e., Morocco), 0.4% from South American countries (i.e., Colombia and Argentina) and 0.4% from Asian countries. In the period 2020-2023, 87.6% of the fishers were from Spain, 8.3% from the rest of Europe (mainly from France), 2.4% from African countries (i.e., Morocco and Algeria), 0.9% from South American countries (i.e., Colombia and Venezuela), and 0.1% from Asian countries (i.e., Russia and China; Figure 4).

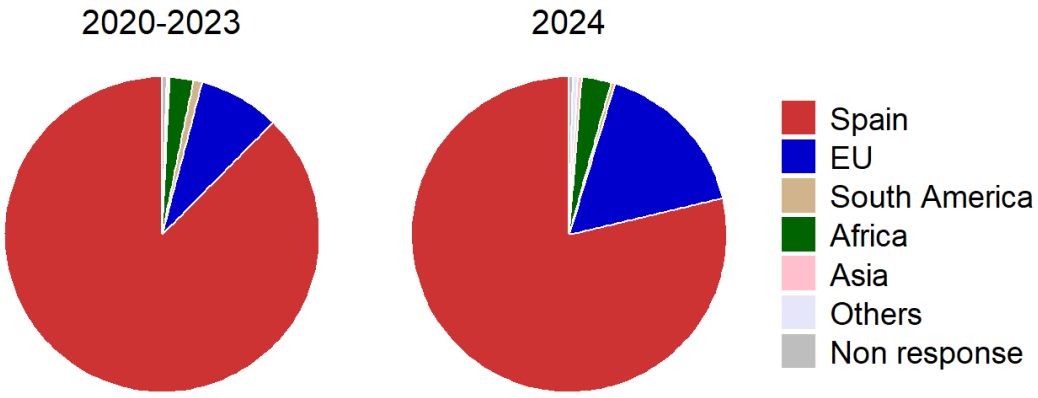


Figure 4. Percentage of the nationalities of the fishers surveyed in the onsite sampling.

3.2. Response to the online survey

Regarding online surveys, in 2024 a total of 8 385 online surveys were answered: 6 037 of the respondents declared practising mostly MRF (72%), while 2 348 declared practising mainly continental recreational fishing (28%). Among them, 45% of those who reported fishing primarily in continental waters also practised marine fishing, while 23% of those who declared fishing mainly in marine waters occasionally practised continental fishing. Only 32% of respondents reported engaging exclusively in one main activity. On the other hand, a total of 36061 online surveys were collected in 2020 to 2023, averaging 9 015 annually. The results are practically the same for the years compared. In detail, we obtained: 25 599 of the respondents declared practising primarily

MRF (71%) and 10 465 practised mostly freshwater recreational fishing (29%; Figure 5). However, 49% of those who reported fishing primarily in continental waters also practised marine fishing, while 24% of those who declared fishing mainly in marine waters occasionally practised continental fishing. Only 27% of respondents reported engaging exclusively in one main activity.

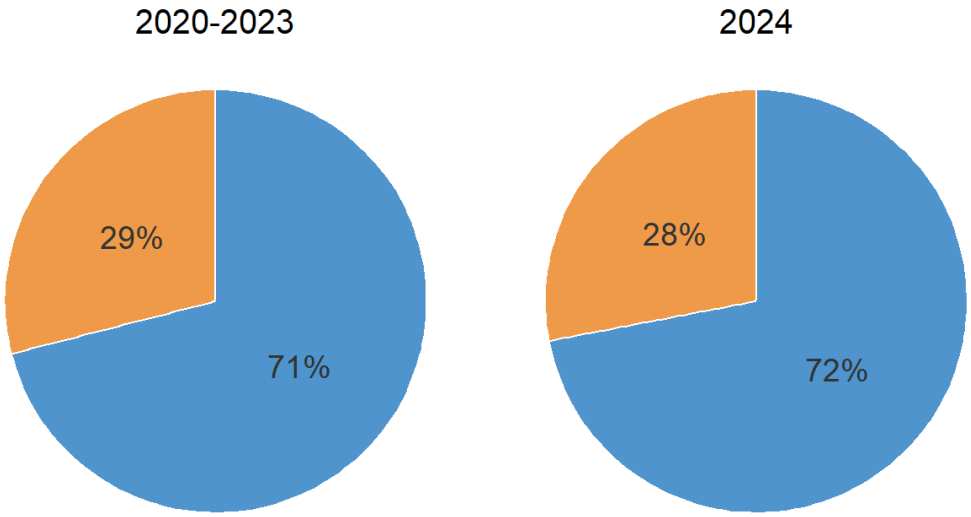


Figure 5. Percentage of answers to online surveys by continental recreational fishing (orange), and marine recreational fishing (blue).

In 2020, 2021, 2022 and 2023, MRF respondents mainly answered the survey from devices that were physically located in Catalonia, but others responded from other locations; i.e., the most populated regions of Spain, and the south of France (Figure 6; for more information on the international response location see Annex I). The spatial distribution of responses in 2024 was similar to that observed between 2020 and 2023.

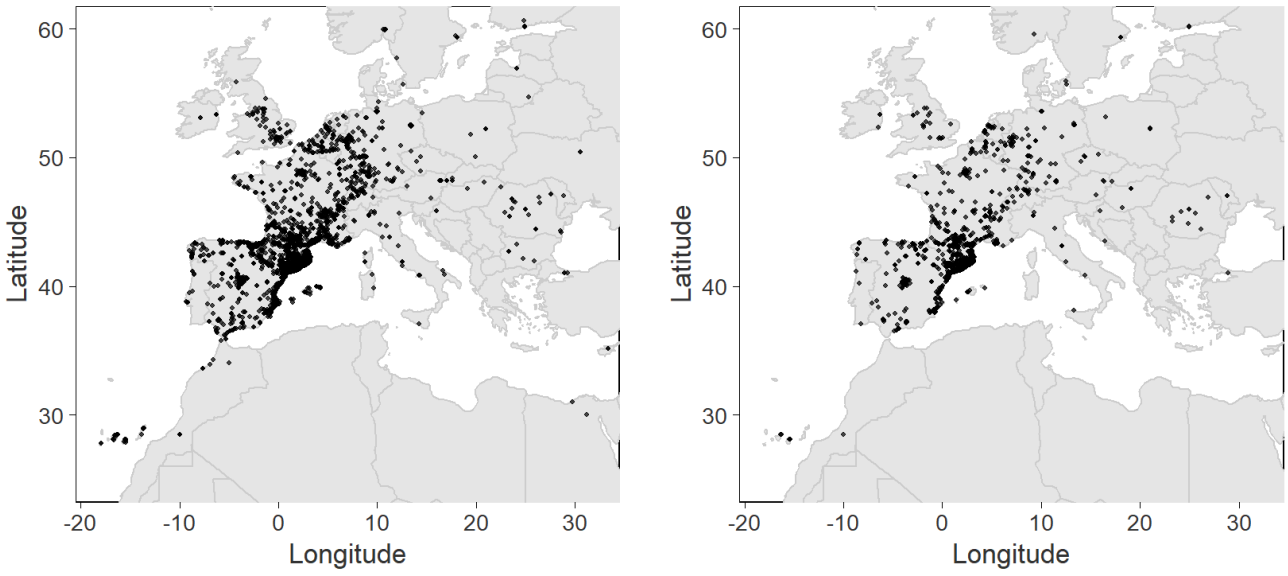


Figure 6. Location of devices used to respond to MRF online surveys: (A) in 2020-2023 and (B) 2024.

Between 2020 and 2024 a total of online surveys was collected annually, with values ranging from 4 894 in 2020 to a peak of 11 992 in 2021. In subsequent years, the number of responses progressively declined, with 9 767 surveys in 2022, 9 408 in 2023, and 8 385 in 2024. This decreasing trend over time indicates a gradual decline in participation, despite the still considerable number of respondents each year.

In 2024 a total 3 125 respondents declared practising shore angling, of which 889 also practised boat fishing, and 146 also spearfished. A total 876 responses were obtained from boat fishers, of which 106 respondents practised both boat fishing and spearfishing (Figure 7). The total amount of responses from spearfishers was 432. In addition, 201 respondents reported practising all three modalities. In contrast, in 2020-2023, a total of 11 712 respondents declared practising shore angling, of which 3 466 also practised boat fishing, and 550 also spearfished. A total 2 971 responses were obtained from boat fishers, of which 372 respondents practised both boat fishing and spearfishing. The total amount of responses from spearfishers was 1 277. In addition, 761 respondents reported practising all three modalities.

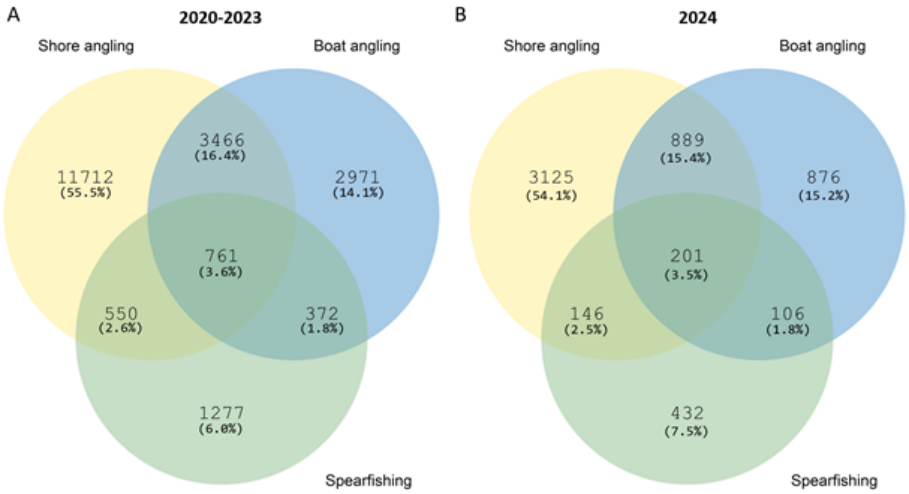


Figure 7. Number of marine recreational fishers by modality from the online surveys in (A) 2020-2023 and (B) 2024.

About the main fishing modality declared by the respondents, in 2024, 3 833 respondents declared shore angling as their main modality (63.5%), 1 382 declared it was boat angling (22.9%) and 635 spearfishing (10.5%). In addition, 187 of the participants did not answer the survey. On the other hand, in total 2020-2023, 16 341 answers were from shore anglers (63.8%), 5 796 from boat anglers (22.6%) and 2 627 from spearfishers (10.3%; Figure 8). In addition, a total of 835 participants did not answer this question and the rest of the survey, but only opened it.

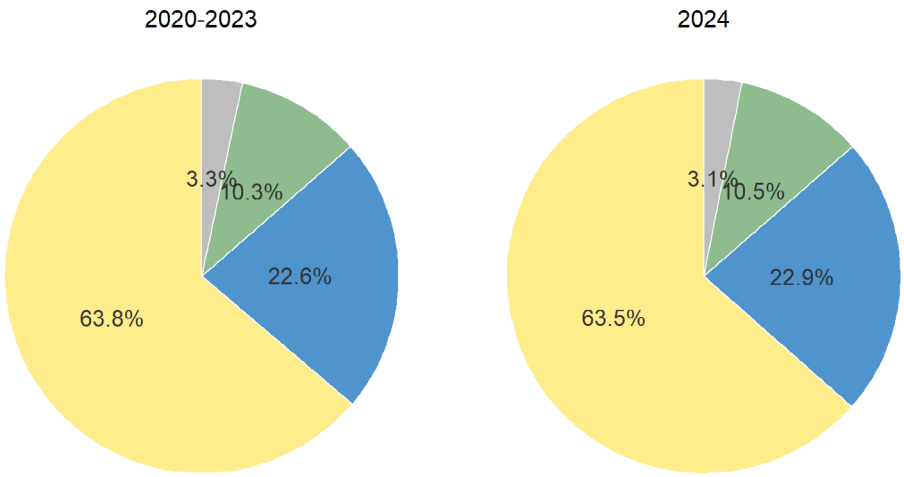


Figure 8. Percentage if practitioners based on the main fishing modality of each respondent in (A) 2020 – 2023, and (B) 2024.

4

Activity volume

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

There was an increase in the number of licences issued in 2024 for each modality compared to 2020-2022. This can be in part due to the dual licences being considered from 2023. The total number of active surface angling, both marine and freshwater, and spearfishing licences issued during 2024 were 67 687and 3 480, respectively. Using the proportion of freshwater to marine responses from the online survey, a total 48 735 surface angling licences were estimated to be used primarily for MRF while 18 952 corresponded to freshwater fishers. Of the MRF licences, the proportion of licences attributed to shore and boat angling were 74% and 26%, respectively. In summary, a total of 52 215 MRF licences were issued: 36 064 corresponded to shore anglers, 12 671 to boat anglers and 3 840 to spearfishers.

On the other hand, the average number of active surface angling, both marine and freshwater, and spearfish¬ing licences during 2020-2023 was 64 157 and 3 385, respectively. Using the proportion of freshwater to marine responses from the online survey, a total 45 558 surface angling licences were estimated to be used primarily for MRF while 18 599 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 summary, in 2020-2023 an average of 48 943 MRF licences were issued: 33 713 corresponded to shore anglers, 11 845 to boat anglers and 3 385 to spearfishers (see Table 1).

Table 1. Classification (type of license) of the total Surface licenses aimed at marine recreational fishers.

	Shore angling		Boat angling		Spearfishing	
	2020-2023	2024	2020-2023	2024	2020-2023	2024
One day	2 808	3 807	986	1 338		
Two days	996	1 498	350	526		
Fifteen days	3 374	4 669	1 185	1 640		
Annual	21 373	21 843	7 509	7 675	3 385	3 480
Pluriannual (2, 3 or 4 years)	5 136	4 247	1 814	1 492		

The estimate of active marine recreational fishers considered fishers with 2, 3, and 4 years licences issued prior to the years studied. 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).

4.2. Analysis of fishing days 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?”. According to the results of the online surveys, in 2020, the average (±standard error) days declared for fishing were 22.1 (± 0.58) for shore angling, 29.1 (±1.05) for boat angling, and 25.5 (± 1.12) for spearfishing. In 2021, the average (±standard error) days declared for going fishing were 18.3 (± 0.33) for shore angling, 25.1 (± 1.12) for boat angling, and 22.4 (± 0.79) for spearfishing. There was a general increase in all three modalities in 2022, 20.8 (± 0.43), 28.2 (± 0.74), and 25.3 (± 0.96), respectively. However, in 2023, there was a slight decrease in 19.9 (± 0.41), 27.0 (± 0.67), and 23.0 (± 0.90). In 2024, there was a slight decrease in 18.9 (± 0.42), 25.8 (± 0.76), and 21.1 (± 0.87; Figure 9A).

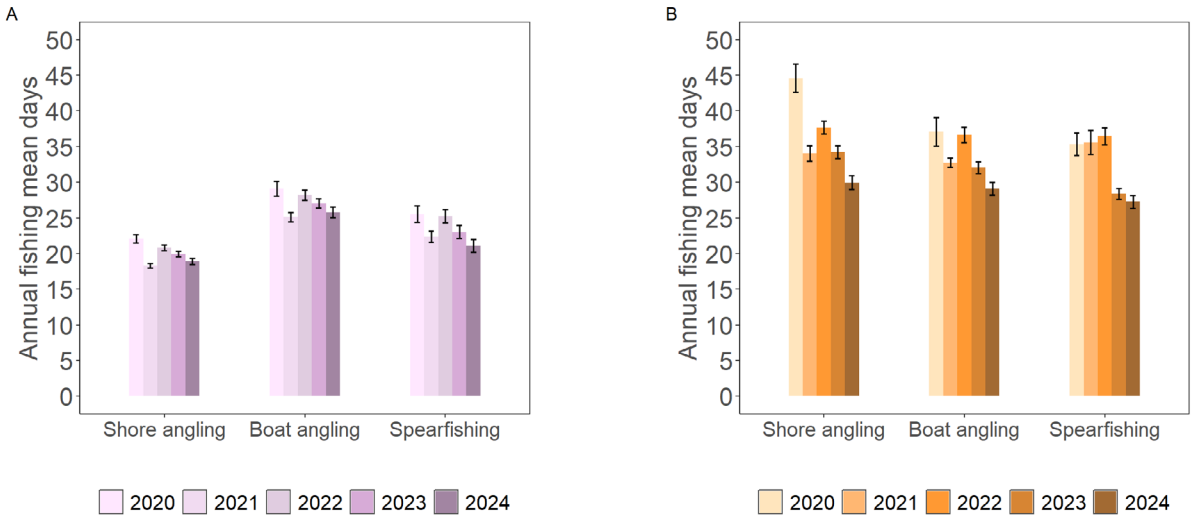


Figure 9. (A) Average annual fishing days from online surveys by fishing modalities for each year: 2020, 2021, 2022, 2023, and 2024. (B) Average annual fishing days from onsite surveys by fishing modalities for each year: 2020, 2021, 2022, 2023, and 2024.

Figure 9B represents the average number of declared annual fishing days from onsite surveys. We obtained more responses from fishers who fish more frequently since it is easier to encounter them during the onsite sampling. In 2020, 44.6 (±1.96) days of shore angling, 37.1 (±2.0) days of boat fishing, and 35.3 (±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 and 2024, the averages were remarkably lower 34.2 (±0.91) for shore angling, 32.1 (±0.84) for boat angling, and 28.4 (±0.77) for spearfishing, and 30.0 (±0.96), 29.1 (±0.90), and 27.3 (±0.90), respectively for each year.

Figure 10A displays how often marine recreational fishers reported going fishing within the last year, based on surveys conducted online in 2024. 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 did not 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 10B represents data from onsite surveys conducted in 2024, 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.

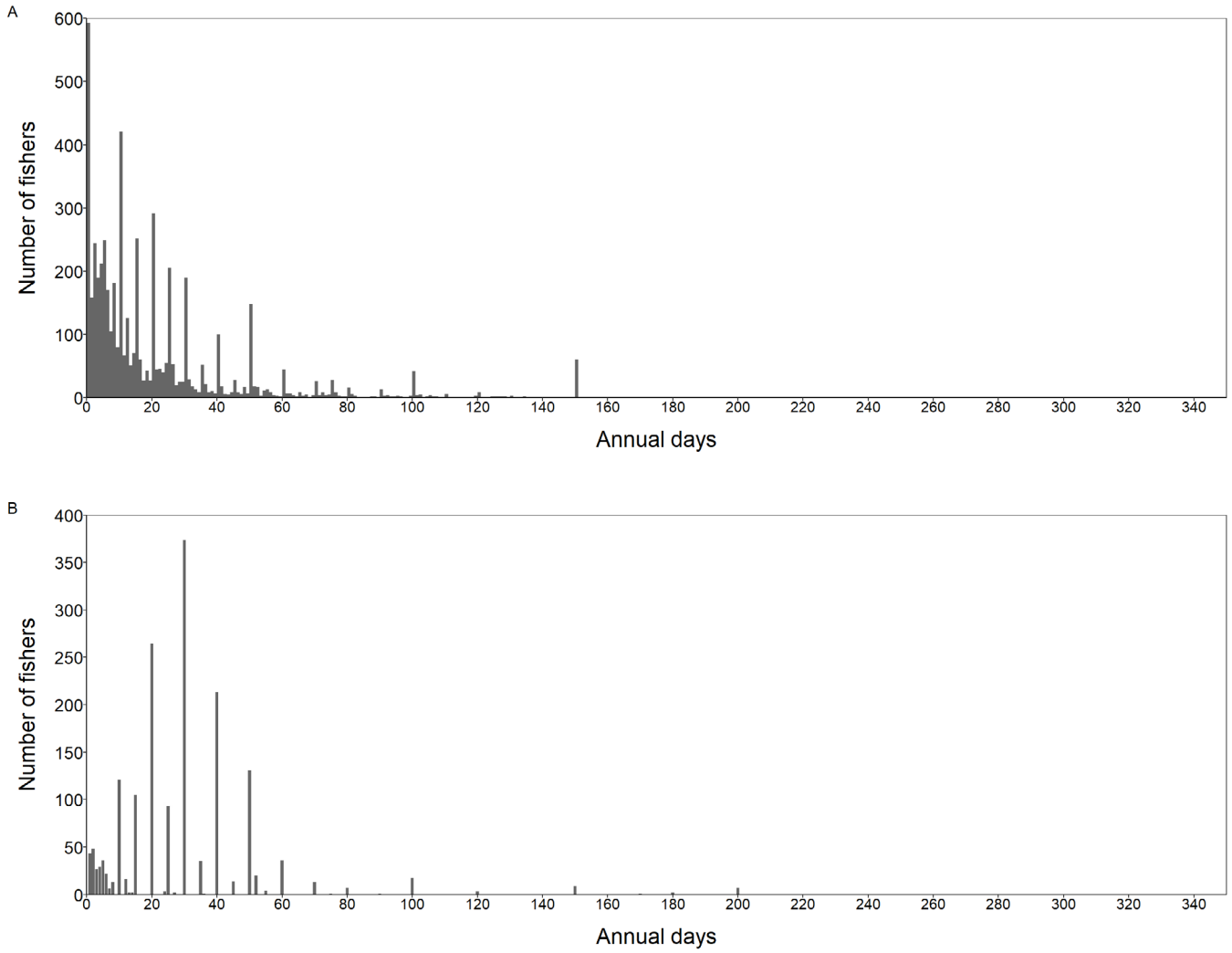


Figure 10. The fishing days on marine recreational fishers collected during online(A) and onsite(B) surveys in 2024. Bars, number of marine recreational fishers.

5

Modality analysis

Shore angling

5.1. 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 issued in Catalonia.

The results showed a considerable proportion of individuals holding a recreational fishing licence who did not make any use of it during the period 2020 – 2024 (10%). For the two periods, the majority of anglers showed low avidity effort patterns (45%). The medium avidity class was 18% for 2020-2023 and 16% for 2024, whereas the response rate for high avidity shore anglers was 9% and 8% for 2020-2023 and 2024, respectively (Table 2).

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

	2020-2023	2024
Zero	10%	10%
Sporadic (1 -2 days)	17%	21%
Low (3 -19 days)	45%	45%
Medium (20 -49 days)	18%	16%
High (+50 days)	9%	8%

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 6,5% (Table 3).

Table 3.Estimate total number of shore anglers during 2020-2023 (average) and 2024.

	2020-2023	2024	Variation	% Variation
Zero	3 504	3 546	42	1.2
Sporadic (1 -2 days)	5 806	7 671	1 865	24.3
Low (3 -19 days)	15 178	16 328	1 150	7.0
Medium (20 -49 days)	6 213	5 687	-526	-9.3
High (+50 days)	3 012	2 832	-180	-6.4
Total	**33 713**	**36 064**	2 351	6.5

Reported annual fishing effort for shore anglers who went fishing at least once in 2024 showed an average of 19 fishing days per year, also with a similar periodicity throughout the different seasons ranging from 3 days per year in winter to 6 days per year in summer. Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2020-2023 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?”. The average by avidity class per season is presented for the average 2020-2023 and in 2024 (Table 4 and Table 5; see Annex II).

Table 4. Seasonal average frequency of fishing days for shore angling from online surveys for the period 2020-2023.

Year 2020 - 2023	Zero	Sporadic	Low	Medium	High
Winter	0	0.16 (±0.14)	0.82 (±0.15)	3.88 (±0.46)	15.33 (±1.59)
Spring	0	0.56 (±0.26)	2.44 (±0.23)	7.94 (±0.59)	21.55 (±1.56)
Summer	0	0.71 (±0.21)	4.07 (±0.25)	11.50 (±0.62)	24.83 (±1.66)
Autumn	0	0.22 (±0.14)	1.68 (±0.17)	6.36 (±0.42)	19.17 (±1.31)

Table 5. Seasonal average frequency of fishing days for shore angling from online surveys for the period 2024.

Year 2024	Zero	Sporadic	Low	Medium	High
Winter	0	0.14 (±0.26)	1.34 (±0.44)	4.56 (±0.82)	16.92 (±2.52)
Spring	0	0.63 (±0.52)	2.68 (±0.60)	7.34 (±1.14)	21.94 (±3.10)
Summer	0	0.55 (±0.38)	3.40 (±0.58)	9.98 (±1.36)	21.63 (±3.01)
Autumn	0	0.27 (±0.35)	1.36 (±0.47)	6.13 (±1.04)	19.89 (±4.05)

5.1.1. 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 2024, 30% of shore anglers spent their fishing days in northern Catalonia during winter, while this value was 24% in spring, 26% in summer, and 29% 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, 70% of shore anglers spent their fishing days in these zones, whereas this value was 76% in spring, 74% in summer, and 71% in autumn. The areas accumulating the most fishing days were Costa Daurada, Delta de l'Ebre, and Maresme, with 120 112, 96 911, and 68 888 fishing days during 2024, respectively (Figure 11). In most zones, summer continued to be the most popular season for shore angling, with 177 753 fishing days per year. Overall, shore angling accumulated an estimated 542 496 fishing trips per year.

Following the same analytical pattern, during 2020-2023, in winter, 25% of shore anglers spent their fishing days in northern Catalonia during winter, while this value was 24% in spring, 26% in summer, and 25% in autumn. 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 zones with the highest number of fishing days were Costa Daurada, Delta de l'Ebre, and Maresme, with 125 653, 90 657, and 75 486 fishing days during the period 2020-2023, respectively. In most zones, summer was the most popular season for shore angling, with up to 212 236 fishing days per year. During the bathing season (runs to 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 11). Overall, shore angling effort accumulated an estimated 574 370 fishing trips per year.

In 2024, the average daily shore angling trips per kilometer continued to show the uneven distribution of this fishing activity across temporal and geographical scales. The most intensely fished zone corresponds, again, to the densely populated beaches from the city of Barcelona and its metropolitan area, with a yearly average of 7.1 fishing trips per kilometer (Figure 12). The spatial distribution of shore fishers remains fairly consistent throughout the year.

The average daily shore angling trips per kilometer for the average 2020-2023 illustrate the uneven distribution of this fishing activity both temporally and geographically. The most intensely fished zone coincides with the most densely populated beaches in the city of Barcelona and its metropolitan area, exhibiting a yearly average of 7.0 fishing trips per kilometer. Despite variations in seasonal activity, the spatial distribution of shore fishers remains relatively consistent across different seasons (Figure 12).

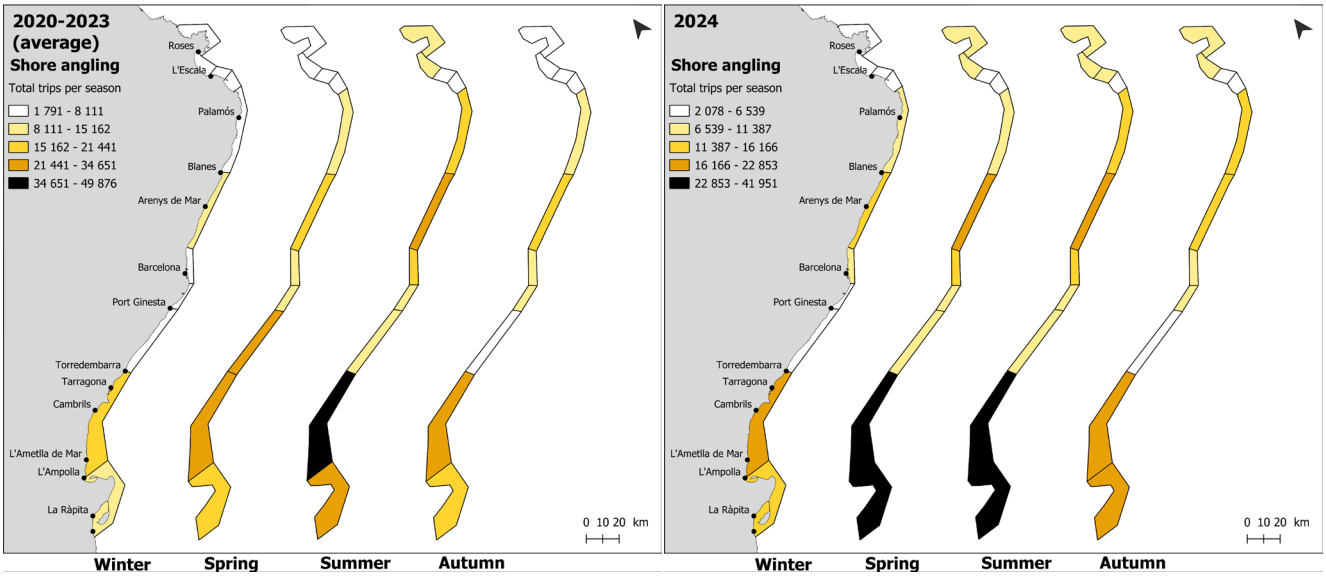


Figure 11. Total shore fishing trips during 2020-2023 (left) and in 2024 (right) per zone during each season. In this analysis we do not consider the areas where fishing is not allowed. All distribution maps were classified using natural breaks.

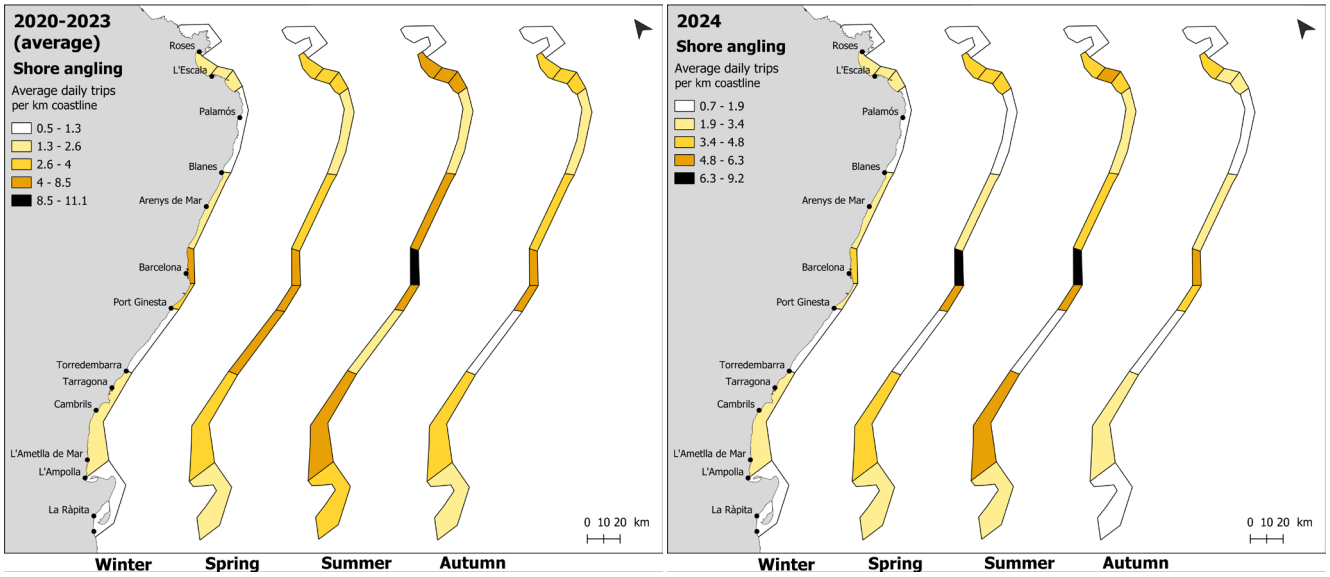


Figure 12. Average number of daily fishing trips during 2020-2023 (left) and in 2024 (right) per kilometer coastline within each season.

5.2. Fishing yield

Fishing yield was analyzed using catch per unit effort (CPUE) measured in kilograms caught per day fished. Overall, the proportion of respondents reporting catches varied across years: from a balanced distribution in 2020 (52.1% reporting catches and 47.9% without), to a predominance of surveys without reported catches in 2021 (60.0%), while in 2022 the proportions were nearly balanced (47.6% with catches and 52.4% without). In

2023, however, the percentage of surveys reporting catches (52.8%) already exceeded those without captures (47.2%). In 2024, however, 56.1% of surveys reported catches, indicating a slight recovery compared to previous years.

The fishing yield values for shore anglers showed the lowest fishing productivity for both years (0.43 ± 0.02 kg/day and 0.62 ± 0.06 kg/day in average 2020-2023 and 2024, respectively; Figure 13), followed by boat anglers and spearfishers, as detailed in Annex III. The fishing yield values from shore angling significantly differed from the other two fishing modalities (p-value < 0.002).

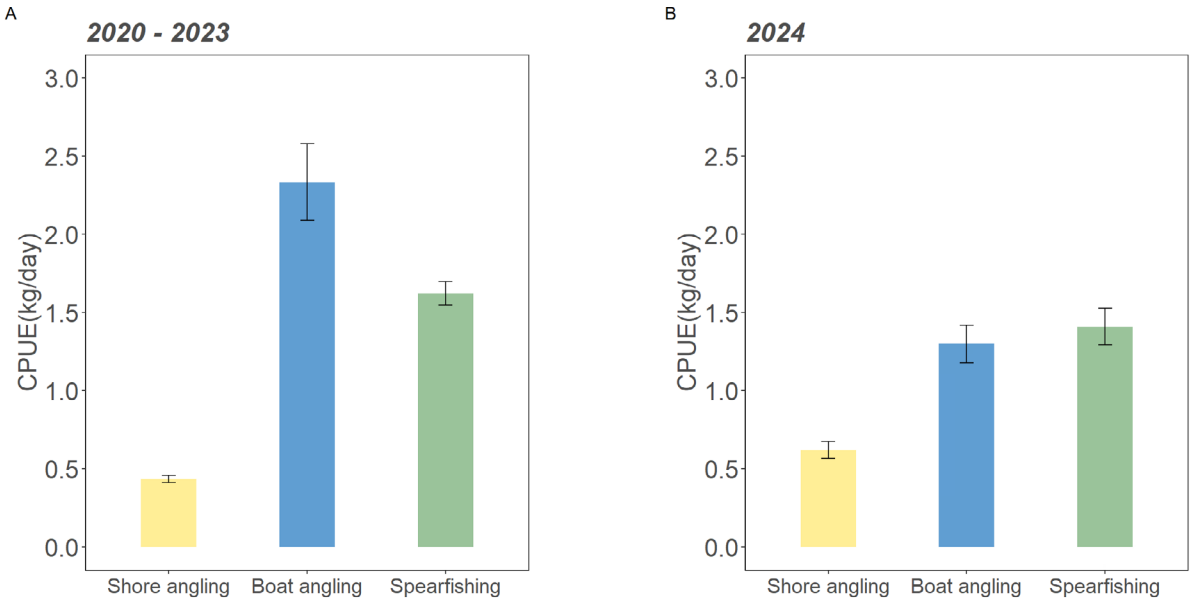


Figure 13. The CPUE by 2020 to 2023 and 2024 by three fishing modalities. The colour bars indicate the mean and the black line indicates the standard error. Shore angling (yellow), boat angling (blue), spearfishing (green).

Comparing the periods studied, there was a significant difference between the years 2020 to 2023, 2021 to 2024, and 2022 to 2024 (p-value < 0.05). Therefore, there was a difference in CPUE for shore angling fishing between the two periods studied. In detail, the average CPUE in 2020-2023 was lower (0.43 ± 0.02 kg/day) than that from 2024 (0.62 ± 0.06 kg/day). However, there were significant differences in CPUE for shore angling fishing among seasons in the period 2020-2023 (p-value < 0.001). Pairwise Wilcoxon tests indicated that CPUE differed significantly between winter and the other seasons (spring, summer, and autumn), as well as between spring and summer. In detail, the average CPUE was 0.25 ± 0.05 kg/day, 0.50 ± 0.07 kg/day, 0.42 ± 0.03 kg/day, and 0.49 ± 0.04 kg/day for winter, spring, summer and autumn, respectively (Figure 14).

In 2024, there were significant differences (p-value = 0.004) in CPUE for shore angling fishing among seasons. Significant differences were found between spring and summer, and between spring and autumn (p-value = 0.0003 and p-value = 0.021, respectively). In detail, the average CPUE was 0.42 ± 0.07 kg/day, 0.53 ± 0.09 kg/day, 0.84 ± 0.11 kg/day and 0.72 ± 0.17 kg/day for winter, spring, summer and autumn, respectively (Figure 14).

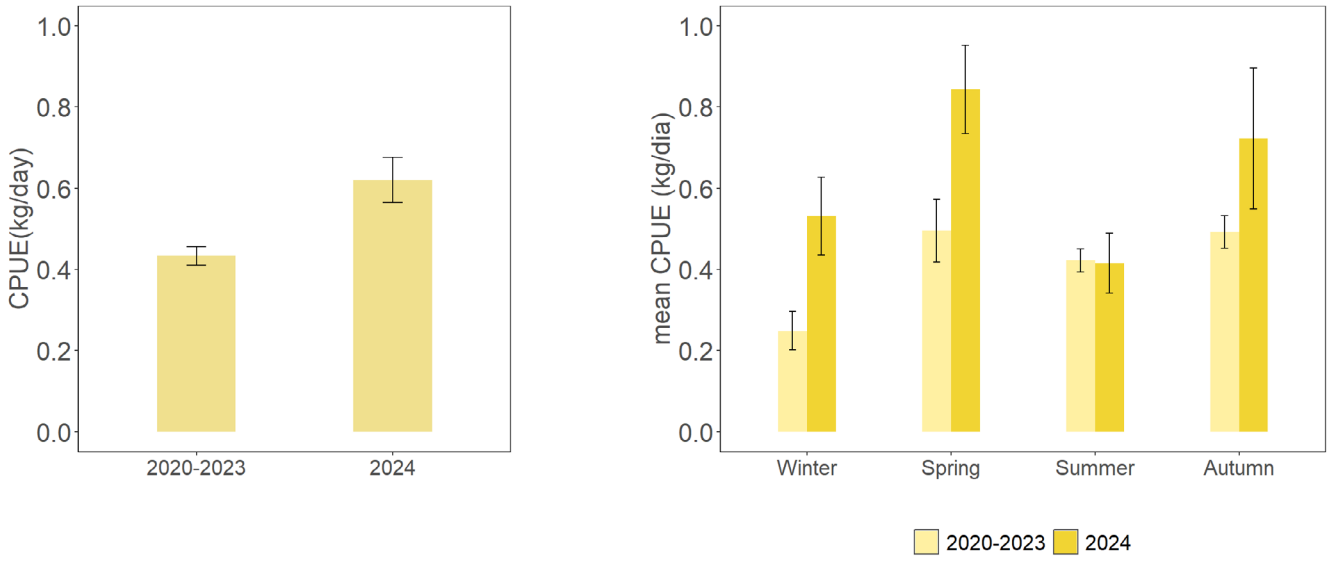


Figure 14. The CPUE by 2020 to 2023 and 2024 for shore angling. The yellow bars indicate the mean and the black line indicates the standard error (left). The CPUE by season in average 2020 to 2023 (light yellow) and 2024 (dark yellow). The bars indicate the mean and the black line indicates the standard error (right).

5.3. Seasonal catch composition

In In the onsite sampling, a total 3 330 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 for all three fishing modalities, there is a difference between species' desirability of catch 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 composition for shore angling represented a total of 58 different species throughout the period 2020-2023. 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. In 2024, shore angling represented a total of 40 different species. This lower diversity of species caught was due to challenges in sampling. Spring was the season with the highest diversity, with 31 different species, followed by summer with 24, autumn with 23, and winter with 21 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.

Catch composition results show the actual catches obtained from the onsite surveys. In winter 2020-2023, the catches of Spicara maena accounted for 51.2% of the total. However, in winter 2024, no catches of S. maena were recorded. Instead, Serranus cabrilla made up 18.5% of the catch, followed by Diplodus sargus at 17.7%, and Sparus aurata at 9.7%. 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 D. sargus, and, in lower representation, S. cabrilla for the period 2020 - 2023. Autumn shows less differences between the two years depending on the percentage of representation. For example, S. aurata, D. sargus and S. cabrilla are 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 15).

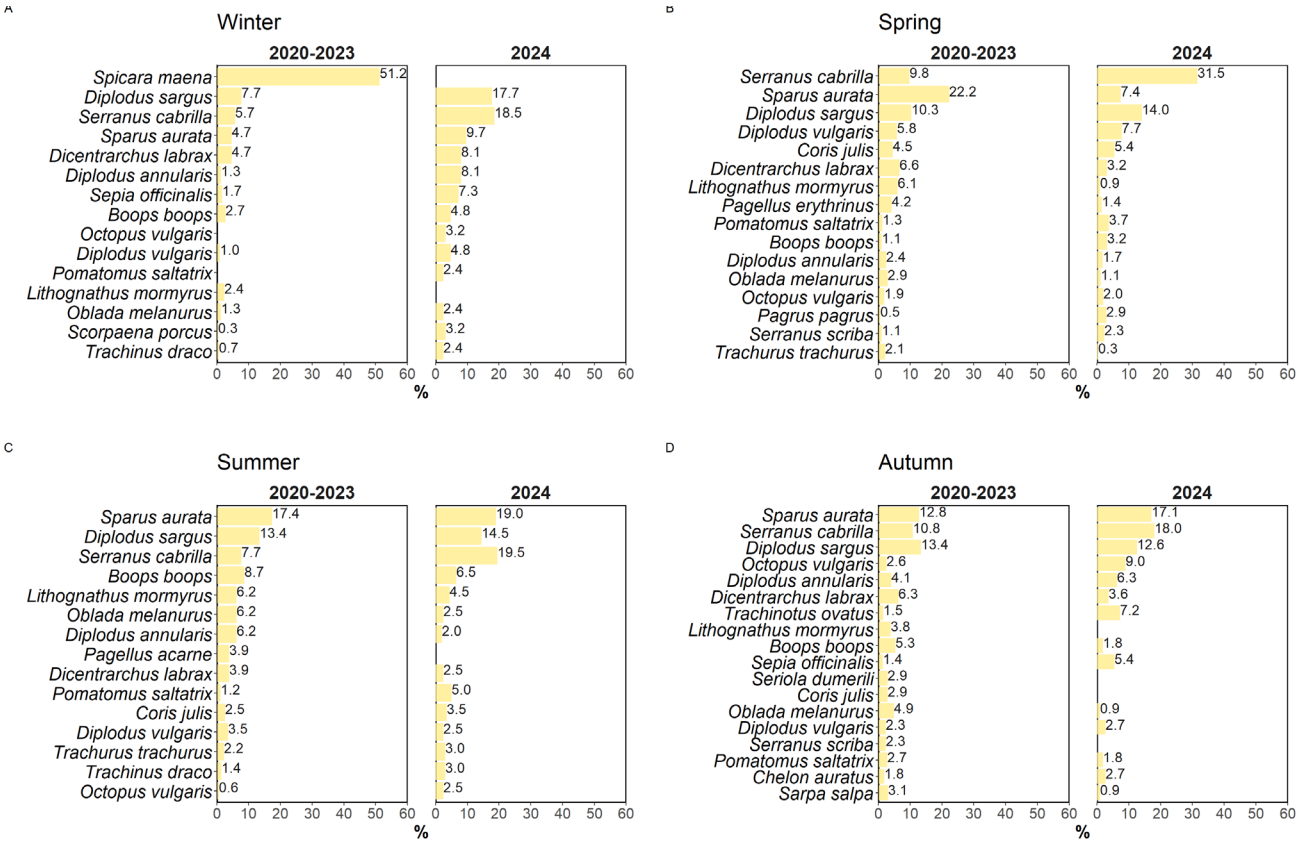


Figure 15. Seasonal catch composition (in percentage of individuals number) for onsite shore angling sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2023 (left) and in 2024 (right). Only species representing over 2% of the total catch are shown.

5.4. Total annual catch

Estimates of total annual catches used catch data from the onsite surveys and effort values from the online surveys; they 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 2024, the total annual catch from shore angling was dominated by S. aurata, with 81 315 kg, followed by Octopus vulgaris (75 483 kg) and D. sargus (58 377 kg). Other relevant species included Pomatomus saltatrix (36 143 kg) and Dicentrarchus labrax (32 571 kg). Most of the remaining species presented considerably lower catches, generally below 10 000 kg per year. The comparison between the 2020–2023 average and 2024 shows that, while S. aurata and D. sargus consistently ranked among the main species, O. vulgaris displayed an increase in 2024 compared to previous years becoming one of the dominant spe-

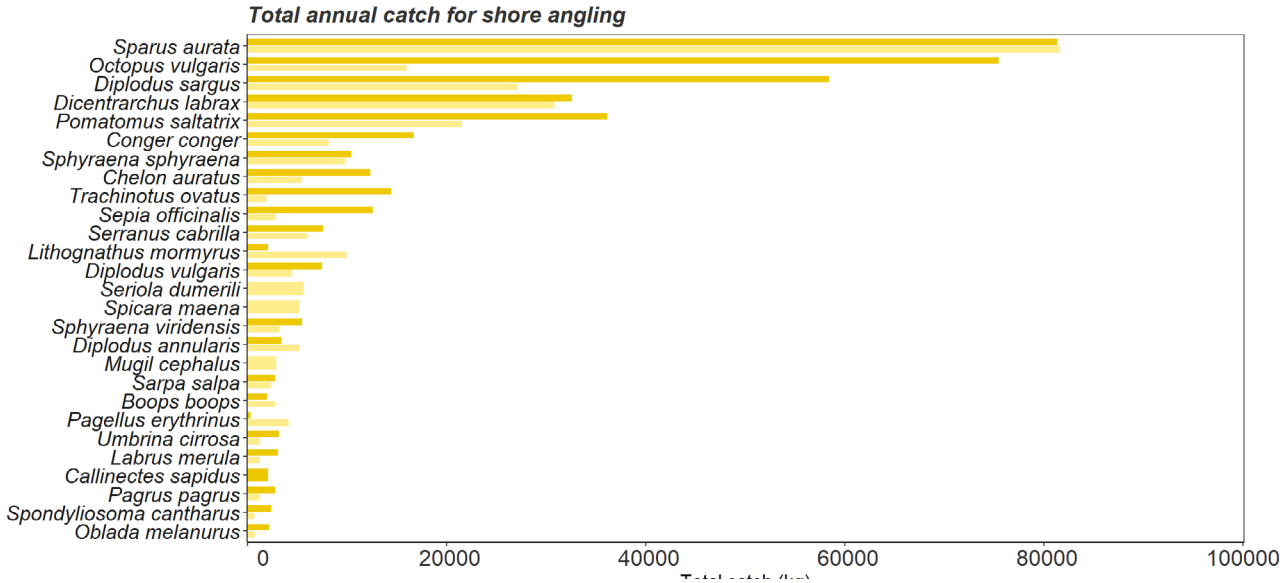


Figure 16. Total annual catch per species for shore angling in average 2020-2023 (light yellow) and in 2024 (dark yellow).

cies in the catches (Figure 16). The role of O. vulgaris in shore angling catches had been previously documented (ICATMAR, 2022). Caution is recommended in the use of total catch results as its potential overrepresentation in the onsite surveys could cause the extrapolation of the total catches to grossly overestimate total catch values.

5.5. Spatial distribution of the total annual catch

The zones with more catches were very similar between both studied years, with generally higher values in 2024 than in the period 2020-2023 (Figure 17). In general, the most populated zones, such as Costa Daurada (87 830 and 60 304, respective), Delta de l'Ebre (71 879 and 43 772, respective), and Maresme (51 747 and 36 407, respectively), yield the highest number of catches per kilometre. Population density and fishing extraction are particularly related to catches in the case of shore angling.

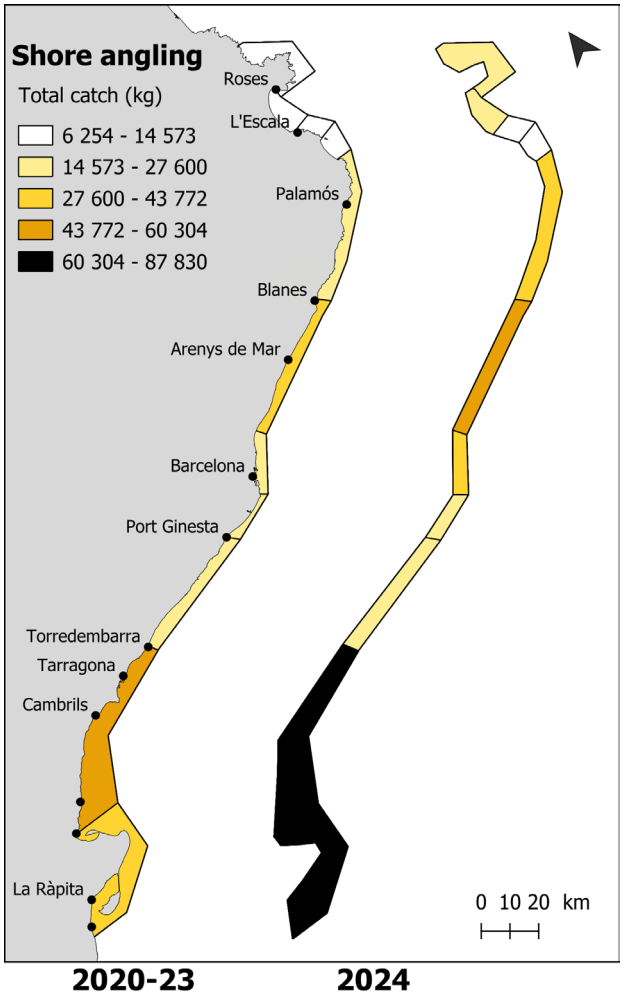


Figure 17. Distribution of total annual catch for shore angling in 2020-2023 (left) and 2024 (right).

5.6. Inequality in the distribution of the total annual catches

Shore 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 is the table corresponding to shore angling modality in 2020-2023(A) and 2024(B), 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 leading to 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.

For shore angling, over 72% of the anglers took less than 20 fishing trips during the 2020-2023 period, jointly contributing 17.6% of the total modality catch. The remaining 27% who fished more than 20 days per year, of which 9% took over 50 trips, caught 55.7% of the total shore fishing catch. While sporadic avidity anglers caught on average 0.26kg, the low avidity recreational anglers extracted approximately 3 kg of catch per angler. Conversely, medium avid class anglers extracted almost 12 kg per year per angler, while the most avid anglers extracted an average of 51.5 kg per year per angler (Table 6A).

In 2024, over 76% of the shore anglers took less than 20 fishing trips, jointly contributing 14.6% of the total modality catch. The remaining 24% who fished more than 20 days per year, of which 8% took over 50 trips, caught 63.4% 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 (Table 6B).

Table 6. Number and proportion of shore anglers average individual fishing intensity, and total accumulated catch per avidity group in average by 2020-2023 (A) and for 2024 (B).

A. Year 2020-2023					
Avidity class	Anglers		Average total catch (kg/year/angler)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	3 504	10	0	0	0
Sporadic	5 806	17	0.3	1 516	0.5
Low	15 178	45	3.1	47 568	17.1
Medium	6 213	18	11.9	74 106	26.6
High	3 012	9	51.5	155 066	55.7
B. Year 2024					
Avidity class	Anglers		Average total catch (kg/year/angler)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	3 546	10	0	0	0
Sporadic	7 671	21	0.7	5 697	1.4
Low	16 328	45	3.3	53 504	13.2
Medium	5 687	16	15.7	89 006	22.0
High	2 832	8	90.8	257 029	63.4

Boat angling

5.1. Fishing effort

The results for 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 7). Since the online survey only represents licence, the effort distributions from the online surveys were extrapolated only to licenced fishers. The results showed a slightly lower proportion of individuals holding a recreational fishing licence not used during the period 2020-2023 and 2024, (6% and 9%, respectively). For the sporadic avidity class, the percentages increased (14% and 18%, respectively). For the low avidity class, the percentages also increased (40% and 42%, respectively). Boat anglers with medium and high avidity classes declined to 27% and 24% in 2020-2023 and 2024, respectively for the medium avidity class, and 14% and 11%, respectively for the high avidity class (Table 7).

Table 7. Online avidity class distribution of licensed fishers for boat recreational anglers.

	2020-2023	2024
Zero	6%	5%
Sporadic (1 -2 days)	14%	18%
Low (3 -19 days)	40%	42%
Medium (20 -49 days)	27%	24%
High (+50 days)	14%	11%

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 6.5% (Table 8).

Table 8. Estimate total number of boat anglers during 2020-2023 (average) and 2024.

	2020-2023	2024	Variation	% Variation
Zero	687	592	-95	-16.1
Sporadic (1 -2 days)	1 642	2 275	633	27.8
Low (3 -19 days)	4 714	5 379	665	12.4
Medium (20 -49 days)	3 168	2 981	-187	-6.3
High (+50 days)	1 633	1 444	-189	-13.1
Total	**11 845**	**12 671**	826	6.5

Reported annual fishing effort for boat anglers who went fishing at least once during 2024 showed an average of 21 fishing days per year, with a similar periodicity through the different seasons: 8 days per year in summer, 5 days per year in spring, followed by autumn and winter with 4 days per year. Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2020-2023 showed an average of 22 fishing days per year, with a similar periodicity through the different seasons, ranging from 8 days per year in summer to 3 days per year in winter, each season. However, in order to accurately estimate the frequency of fishing days, it was analysed using the monthly average by avidity class per season in 2020-2023 (Table 9) and in 2024 (Table 10).

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 9. Seasonal average frequency of fishing days for boat angling from online surveys for the period 2020-2023.

Year 2020 - 2023	Zero	Sporadic	Low	Medium	High
Winter	0	0.14 (±0.20)	1.11 (±0.29)	3.70 (±0.50)	14.53 (±2.09)
Spring	0	0.45 (±0.50)	2.36 (±0.38)	6.39 (±0.71)	19.48 (±2.05)
Summer	0	0.85 (±0.47)	4.58 (±0.49)	11.91 (±0.91)	23.47 (±1.79)
Autumn	0	0.25 (±0.28)	1.76 (±0.26)	7.04 (±0.58)	18.71 (±1.72)

Table 10.Seasonal average frequency of fishing days for boat angling from online surveys for the period 2024.

Year 2024	Zero	Sporadic	Low	Medium	High
Winter	0	0.08 (±0.22)	1.20 (±0.44)	4.63 (±1.11)	15.29 (±3.34)
Spring	0	0.59 (±1.15)	2.54 (±1.03)	7.93 (±1.53)	18.47 (±3.32)
Summer	0	0.50 (±0.72)	4.37 (±0.88)	10.47 (±1.59)	26.35 (±4.05)
Autumn	0	0.51 (±1.01)	1.68 (±0.72)	5.63 (±1.20)	18.53 (±3.29)

5.1.1. Effort distribution

The zones with more fishing days in 2024 were Delta de l'Ebre, Costa Daurada, the south of Costa Brava, and Cap de Creus, portraying a very similar spatial distribution as that found for shore angling. In most zones, the season with more fishers was summer, with abound 93 924 fishing days. Most boat angling trips occurred in the central and southern zones of the Catalan coastline (36% in the north of Catalonia and 64% the rest). Overall, the boat angling effort accumulated an estimate of 255 531 fishing trips per year.

Following the same analytical pattern, in 2020-2023 were Delta de l'Ebre, the south of Costa Brava and Cap de Creus, portraying a very similar spatial distribution as that found in 2024. In most zones, the season when most people went fishing was in summer, with 99 021 fishing days. Most boat angling trips were taken in the central and southern zones of the Catalan coastline (59%). Approximately 41% of the boat fishing activity was in the northern zones of the Catalan coast. In detail, the northern zone of Cap de Creus and Costa Brava were the most intensively fished per kilometre (Figure 18). In summer, this activity increased as the population rises with the presence of tourists. Overall, the boat angling effort is estimated in 265 407 fishing trips per year.

The average daily boat angling trips per kilometre in 2024 show how the fishing activity is unevenly distributed at a temporal and geographical level. Boat fishing intensity in Barcelonès zone was the highest throughout the seasons, with a yearly average of 2.8 fishing trips per kilometre, followed by the Golf de Roses zone with a yearly average of 2 fishing trips per kilometre, and followed by Costa del Montgrí with a yearly average of 1.9 fishing trips per kilometer (see below Figure 19). There was seasonal variability in Costa del Montgrí, Delta de l'Ebre, Baix Ter and Delta del Llobregat, which have a very reduced activity during colder seasons. Conversely, boat fishing intensity was stable in the zones of Golf de Roses and Barcelonès.

The average daily boat angling trips per kilometre during the period 2020-2023 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales. Boat fishing intensity in the Barcelonès, Costa del Montgrí and Golf de Roses area was the highest throughout the seasons, with a yearly average of 2.8, 2.5 and 2.4 fishing trips per kilometre, respectively (Figure 19). There was seasonal variability in Delta de l'Ebre, Gold de Roses, Cap de Creus and Costa Brava zones, which activity was reduced during colder seasons.

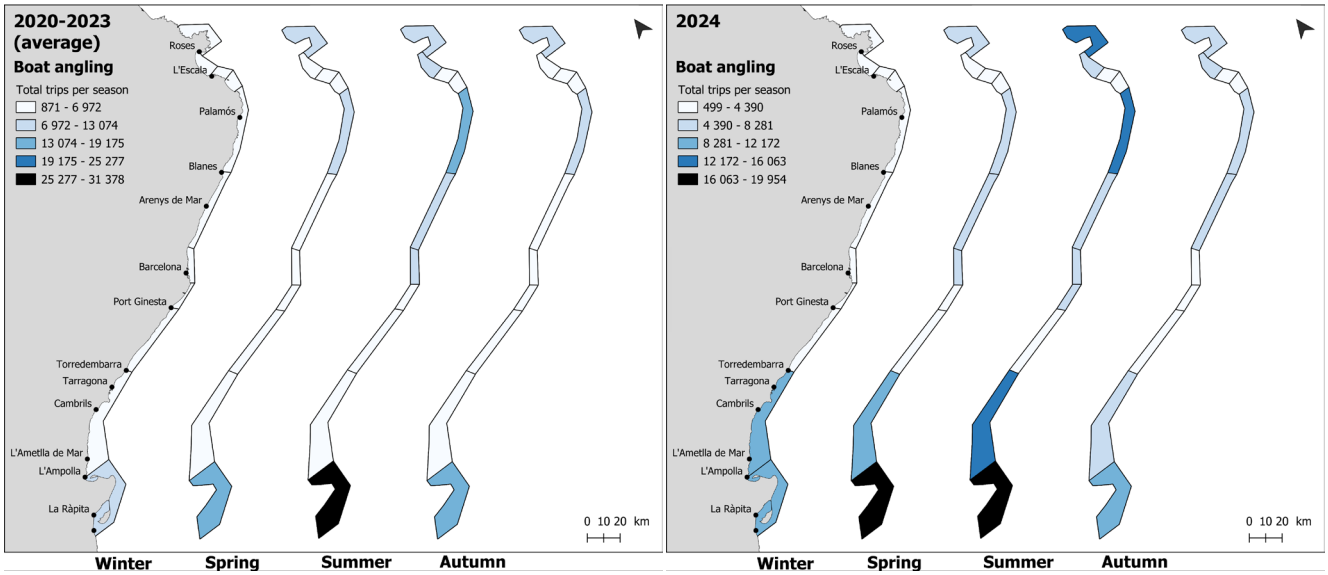


Figure 18. Total boat fishing trips during 2020-2023 (left) and in 2024 (right) per zone during each season. In this analysis we do not consider the areas where fishing is not allowed.

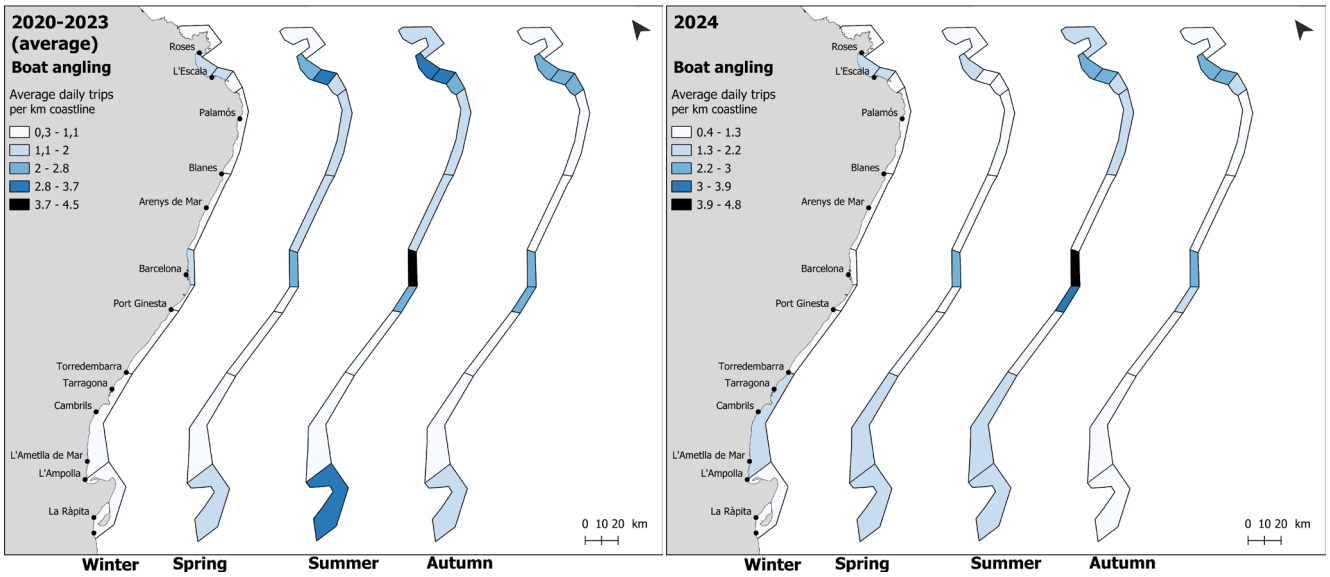


Figure 19. Average number of daily fishing trips during 2020-2023 (left) and in 2024 (right) per kilometer coastline within each season.

5.2. Fishing yield

The fishing yield was analysed using catch per unit effort (CPUE) measured in kilograms caught per day fished. Both periods studied had significant differences (p-value < 0.05; Wilcoxon rank with continuity correction test). The average CPUE for boat anglers was significantly higher in 2020 – 2023 (2.33 ± 0.25 kg/day) compared to 2024 (1.30 ± 0.12 kg/day), as detailed in Figure 20.

The seasonal variation in catch per unit effort (CPUE) for boat angling differed significantly across the studied years, as confirmed by the Kruskal–Wallis test (p-value < 0.05). During 2020–2023, the highest mean CPUE were recorded in spring (2.82 ± 0.45 kg/day) and summer (2.80 ± 0.52 kg/day), with no significant differences between these two seasons (p-value = 0.3625), while the lowest value corresponded to winter (0.58 ± 0.07 kg/day), which differed significantly from the other seasons (p-value < 0.01). In contrast, in 2024 the seasonal pattern changed: winter had the highest mean CPUE (1.58 ± 0.45 kg/day), which was significantly higher than the CPUE in summer (0.98 ± 0.20 kg/day) and spring (1.25 ± 0.18 kg/day). Autumn and winter both displayed higher values with non-significant differences between them (p-value = 0.11, p-value = 0.62, respectively). Autumn yielded similar catches in both periods (1.96 ± 0.25 kg/day in 2020–2023 and 1.53 ± 0.16 kg/day in 2024). These results indicate a temporal variability in fishing yield, with both interannual and seasonal differences (Figure 20).

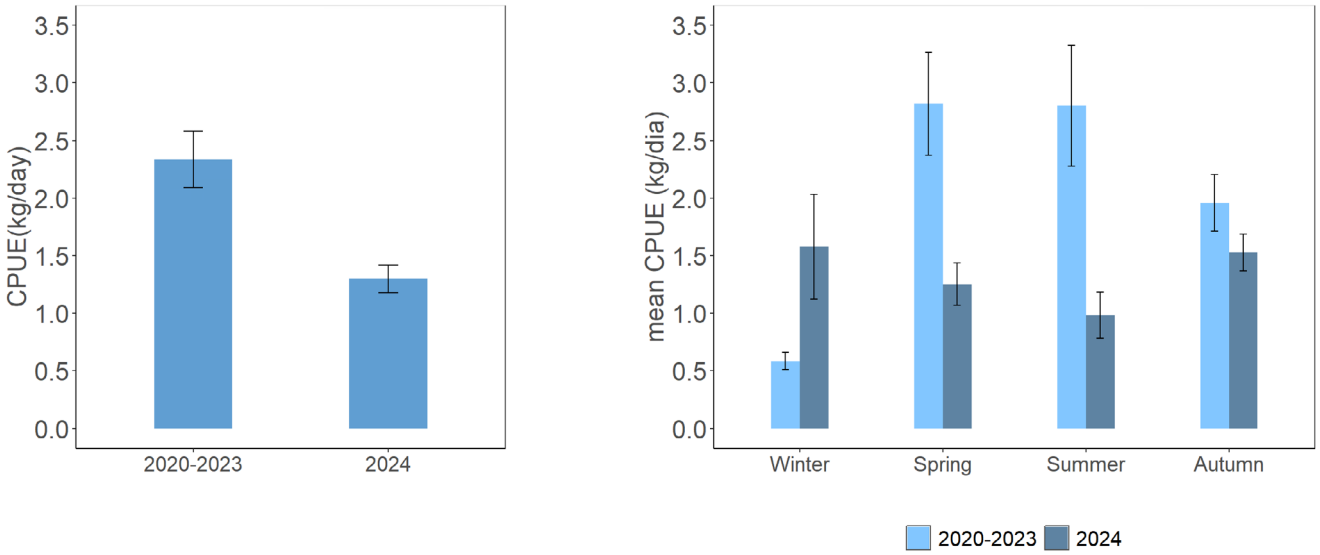


Figure 20. The CPUE by 2020 to 2023 and 2024 for boat angling. The blue bars indicate the mean and the black line indicates the standard error (left). The CPUE by season in average 2020 to 2023 (light blue) and 2024 (dark blue). The bars indicate the mean and the black line indicates the standard error (right).

5.3. Seasonal catch composition

In In the onsite sampling for all years, a total of 9 376 individual catches from boat fishing were identified recording a total 69 different species. 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 present, or more or less desired during different times of the year. The diversity patterns of boat fishing catches are much higher than those for spearfishing and shore angling (with a smaller difference). In 2020 – 2023 period, the total number on individuals recorded was 6 809. The highest diversity values were found in the summer (64 different species observed), followed by spring with 55, autumn with 48 and the, lowest values, in winter. It should be noted that the total number of species in this modality is much higher than in the others (9 376 vs. 2 546 number of individuals by shore angling and 1 332 by spearfishing). The results in 2024 were very similar, summer was the season with the highest diversity, with 43 different species recorded followed by spring with 35, autumn with 29 and finally, the lowest values from winter with 21 different species (Figure 21).

In winter, the two most captured species differ between the studied years. For the period 2020-2023 they were S. cabrilla (39.9%) and Loligo vulgaris (20.3%) while in 2024 they were Sepia officinalis (28.9%), S. cabrilla (22.9%), and L. vulgaris (17.1%). Other species represented were O. vulgaris and Pagellus erythrynus, accounting for 5.1% and 4.4% of the catches in 2024, respectively. However, both species were caught in lower amounts during 2020-2023. In spring, there was a great difference between the top caught species according to year being S. cabrilla (48.9%) and Pargus pargus (8.5%) the main catches in 2024 but S. cabrilla decreased to 19.2% in the period of 2020-2023. Summer also showed great differences depending on the year. In 2024, the catch was dominated by S. cabrilla (35%) followed by Pagellus bogaraveo (9%), whereas in 2020 – 2023 the dominant species were S. cabrilla (15.3%), Scomber scombrus (10.4%) and P. erythrinus (10%). In autumn, nearly one-third of the catches were attributed to L. vulgaris (28.2%,) in 2024 and during the 2020-2022 period (22.3%; Figure 21).

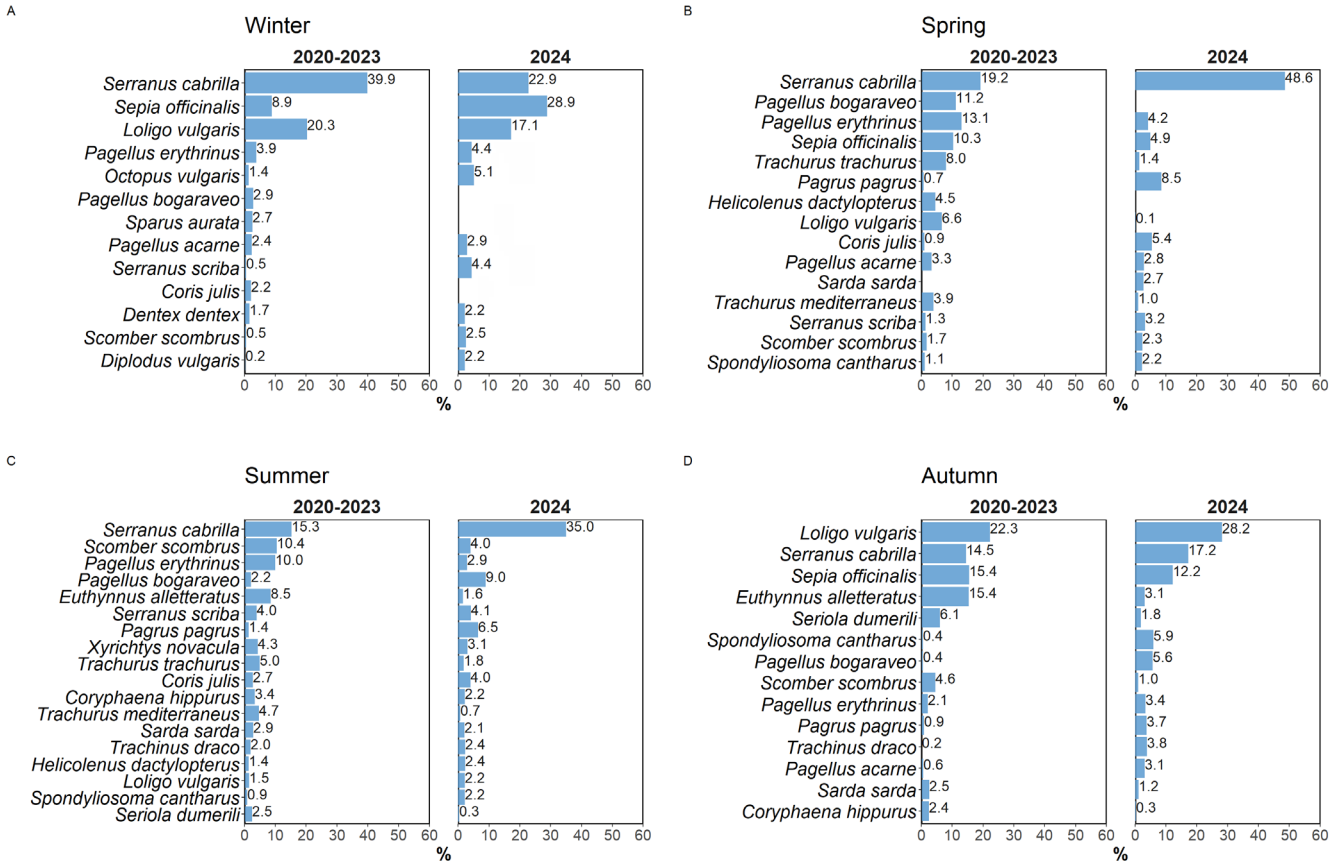


Figure 21: Seasonal catch composition (in percentage of individuals number) for onsite boat angling sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2023 (left) and in 2024 (right). Only species representing over 2% of the total catch are shown.

5.4. Total annual catch

The previous section showed how seasonal patterns are highly influencing species' catches, but it is also worth noting the great variety of different fishing techniques that this modality may use. The results here presented are the product of a survey design that has made its best effort to include 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 the surveyors and this could potentially have effects of an unknown magnitude on the total catch volumes per species here presented.

In 2024, the main species caught by boat varied, with four of the top five species differing from previous years. Sarda sarda was the most caught species (45 303 kg). Other abundantly caught species were, in order of total annual catches, S. officinalis with 31 548 kg followed by L. vulgaris with 31 352 kg, Dentex dentex with 31 281 kg and O. vulgaris with 28 995 kg. In the period of 2020-2023, the most abundant annually caught species were Thunnus thynnus with 115 528 kg, followed by Euthynnus alletteratus with 77 966 kg, Seriola dumerili with 39 543 kg and S. officinalis with 38 165 kg (Figure 22).

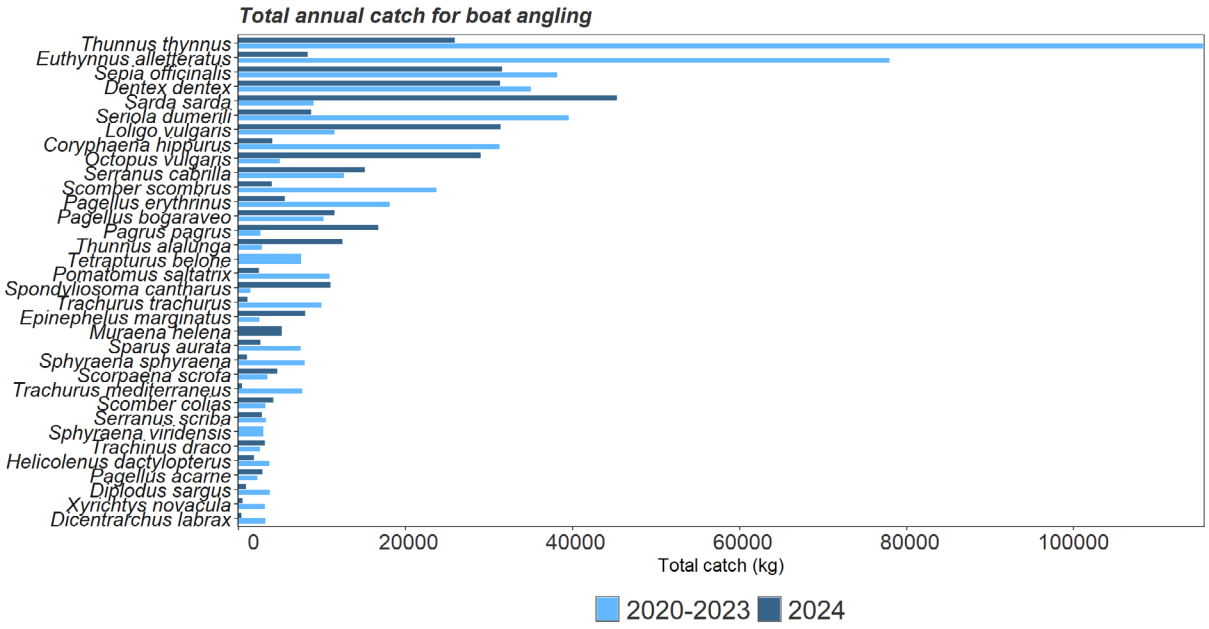


Figure 22. Total annual catch per species for boat angling in average 2020-2023 (light blue) and in 2024 (dark blue).

5.5. Spatial distribution of the total annual catch

The spatial distribution of boat angling catches between 2020–2023 and 2024 shows an overall similar pattern, although the intensity and location of catches vary between periods. The highest catches in both periods were concentrated in Delta de l'Ebre (159 216 kg in 2020–2023 and 83 643 kg in 2024), followed by south of Costa Brava (72 865 kg in 2020–2023) and Cap de Creus (68 145 kg). However, in 2024, the Costa Daurada recorded the second-highest number of catches (56 180 kg), followed by south of Costa Brava (40 527 kg; Figure 23). The lowest values were observed in Montgrí coast and Baix Ter, ranging between 13 538 – 25 719 kg in 2020–2023 and falling below 15 000kg in 2024. Overall, while the ranking of the most productive zones remained stable, the total catch volume decreased across most areas in 2024 compared to the 2020–2023 average.

5.6. 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 is a table corresponding to boat angling modality in 2020-2023 and 2024, 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 leading to 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 boat angling, over 60% of the anglers took less than 20 fishing trips during the 2020-2023 period, jointly contributing 7.1% to the total modality catch. The remaining 40% who fished more than 20 days per year, of which 13% took over 50 trips, caught 44.5% of the total boat fishing catch. These inequalities in the relative contributions to the total catch can be explained by the positive synergy between avidity and catch rates. These results marked difference observed in annual catch extractions between avidity classes. Throughout 2020-2023, sporadic avidity anglers caught, on average, 0.98 kg per angler, the low avidity recreational anglers extracted approximately 8 kg biomass per year per angler. Conversely, medium avid class anglers extracted almost 82 kg per year per angler, and the most avid anglers extracted an average of 146 kg per angler (Table 11A). In 2024, over 65% of the boat anglers did less than 20 fishing trips, jointly contributing 11.3% of the total modality catch.

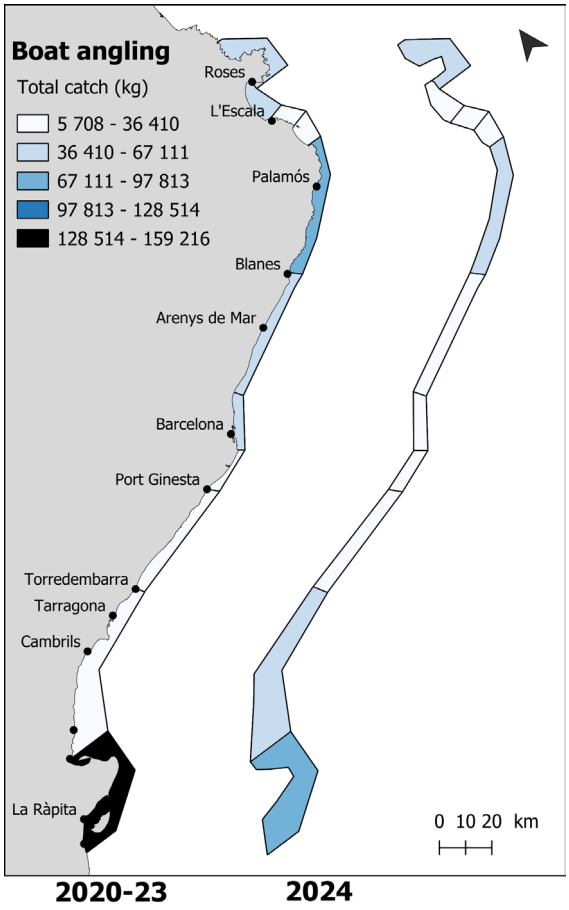


Figure 23: Distribution of total anual catch for boat angling in 2020-2023 (left) and 2024 (right).

The remaining 35% who fished more than 20 days per year, of which 11% took over 50 trips, caught 54.7% of the total boat fishing catch. As a result, while sporadic avidity anglers caught, on average, 0.92 kg per angler, the low avidity recreational anglers extracted approximately 7 kg biomass per angler. Conversely, medium avid class anglers extracted almost 39 kg per angler, and the most avid anglers extracted an average of 130 kg per year per angler (Table 11B).

Table 11. Number and proportion of boat anglers average individual fishing intensity, and total accumulated catch per avidity group in average by 2020-2023 (A) and for 2024 (B).

A. Year 2020-2023					
Avidity class	Anglers		Average total catch (kg/year/angler)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	687	6	0	0	0
Sporadic	1 642	14	1.0	1 606	0.3
Low	4 714	40	7.8	36 644	6.8
Medium	3 168	27	81.7	258 852	48.4
High	1 633	13	145.9	238 157	44.5
B. Year 2024					
Avidity class	Anglers		Average total catch (kg/year/angler)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	592	5	0	0	0
Sporadic	2 275	18	0.9	2 090	0.6
Low	5 379	42	6.9	36 963	10.7
Medium	2 981	24	39.4	117 369	34.0
High	1 444	11	130.7	188 620	54.7

Spearfishing

5.1. Fishing effort

The results for 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 12). The online survey only represents licence-holders. Therefore, the effort distributions from the online surveys were extrapolated only to licenced fishers.

Table 12. Online avidity class distribution of licensed fishers for spearfishers.

	2020-2023	2024
Zero	6%	7%
Sporadic (1 -2 days)	3%	5%
Low (3 -19 days)	42%	45%
Medium (20 -49 days)	36%	33%
High (+50 days)	13%	10%

The results showed a low proportion of individuals holding a recreational fishing licence who did not make any use of it during both period 2020-2023 and 2024 (6% and 7%, respectively; Table 12). In the case of the sporadic avidity class, the percentage was the lowest and very similar for both periods (3% in 2020-2023 and 5% 2024). The majority of spearfishers showed low avidity effort patterns (42% and 41% in 2020-2023 and 2024, respectively), followed by medium avidity class (36% and 33% in 2020-2022 and 2024, respectively). Highly avid spearfishers accounted for 13% and 10% in both studied periods, respectively.

Table 13. Estimate total number of spearfishing during 2020-2023 (average) and 2024

	2020-2023	2024	Variation	% Variation
Zero	189	232	43	18.6
Sporadic (1 -2 days)	116	178	62	34.8
Low (3 -19 days)	1 414	1 550	136	8.8
Medium (20 -49 days)	1 227	1 164	-63	-5.4
High (+50 days)	439	356	-83	-23.4
Total	**3 385**	**3 480**	95	2.7

The percentage responses obtained from the surveys were extrapolated to the number of active fishers to estimate the number of fishers by avidity category. For the present report, we recalculated the number of active fishers taking into account the percentage of dual licences. The year-to-year variation was about 3% (Table 13).

Reported annual fishing effort for spearfishers who went fishing at least once during 2020-2023 showed an average of 24 fishing days per year. The periodicity throughout the different seasons was 10 days per year in summer, 6 days per year in spring, 4 days per year in autumn, and 3 days per year in winter.

Similarly, reported annual fishing effort for shore anglers who went fishing at least once during 2024 showed an average of 23 fishing days per year. This had a similar periodicity through the different seasons ranging from 10 days per year in summer to 3 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 2020-2023 and 2024 (Table 14 and Table 15).

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 14. Seasonal average frequency of fishing days for spearfishing from online surveys for the period 2020-2023.

Year 2020 - 2023	Zero	Sporadic	Low	Medium	High
Winter	0	0.22 (±0.34)	1.03 (±0.48)	3.43 (±0.68)	13.06 (±2.80)
Spring	0	0.65 (±0.85)	2.59 (±0.58)	6.56 (±1.15)	16.05 (±2.82)
Summer	0	0.63 (±0.66)	5.09 (±0.77)	13.24 (±1.45)	27.04 (±2.80)
Autumn	0	0.09 (±0.18)	1.22 (±0.31)	5.21 (±0.73)	15.78 (±2.01)

Table 15. Seasonal average frequency of fishing days for spearfishing from online surveys for the period 2024.

Year 2024	Zero	Sporadic	Low	Medium	High
Winter	0	0,38 (±0.90)	1.06 (±0.72)	3.47 (±1.28)	15.5 (±5.64)
Spring	0	0.22 (±0.27)	2.30 (±1.29)	6.39 (±1.56)	14.8 (±3.41)
Summer	0	0.72 (±0.74)	4.83 (±1.45)	14.15 (±2.70)	27.5 (±4.49)
Autumn	0	0.33 (±0.00)	1.23 (±0.87)	4.31 (±1.42)	14.1 (±3.35)

5.1.1. Effort distribution

The highest total spearfishing effort was recorded in the southern Costa Brava, Cap de Creus, and Costa Daurada during both study periods (Figure 24). Effort was seasonal, peaking in summer with an estimated 35 390 annual fishing days in 2020–2023 and 33 905 in 2024. Spatially, the spearfishing activity was concentrated in zones characterized by rocky coastlines and underwater reefs, particularly in the south of Costa Brava, Cap de Creus, Costa del Montgrí, and Costa Daurada. The average annual spearfishing effort for 2020–2023 was estimated at 80 709 trips, decreasing to 73 458 trips in 2024. Overall, 69% of all spearfishing trips were concentrated in the northern and central sections of the Catalan coastline.

The average daily spearfishing trips per kilometre in 2024 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales. The Montgrí Coast and Golf de Roses hold the highest yearly average, with 1.1 and 0.7 fishing trips per kilometre, respectively (Figure 25). This might be because this zone has a small but very popular area 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 2020-2023 show the degree to which fishing activity is unevenly distributed at a temporal and geographical scales. 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 1.0 fishing trip per kilometre, and Barcelonès, with a yearly average of 0.8 fishing trips per kilometre (see below Figure 25).

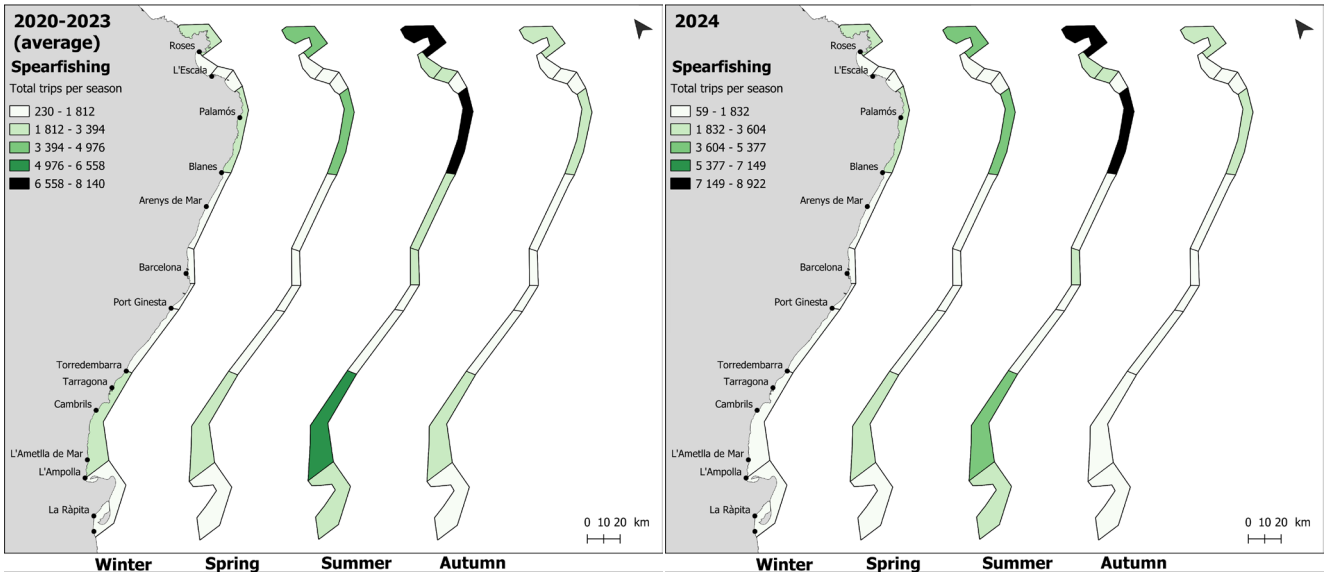


Figure 24. Total spearfishing trips during 2020-2023 (left) and in 2024 (right) per zone during each season. In this analysis we do not consider the areas where fishing is not allowed.

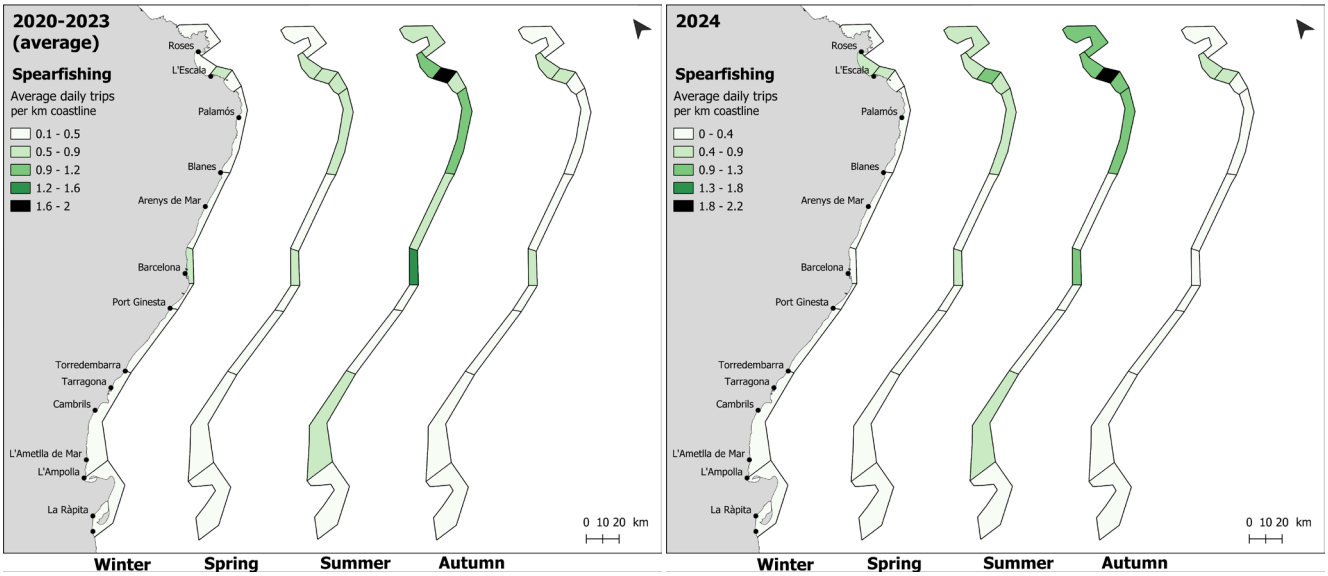


Figure 25. Average number of daily fishing trips during 2020-2023 (left) and in 2024 (right) per kilometer coastline within each season.

5.2. 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 significant differences using a Wilcoxon rank with continuity correction test (p-value = 0.019). Post-hoc comparisons indicated that CPUE in 2022 differed significantly from 2021 (p-value = 0.01) and 2024 (p-value = 0.003). In detail, the average of CPUE in 2020 – 2023 was higher (1.62 ± 0.08) than that from 2024 (1.41 ± 0.12; Figure 26).

There were significant differences (p-value = 0.002) in CPUE for spearfishing among seasons in 2020-2023. In detail, the differences were between winter and summer (p-value = 0.03), winter and spring (p-value < 0.001) and winter and autumn (p-value < 0.001). The average CPUE was, in order of magnitude, 1.83 ± 0.19 kg/day, 1.79 ± 0.14 kg/day, 1.51 ± 0.16 kg/day, and 1.24 ± 0.20 for spring, autumn, summer and winter, respectively (Figure 26). However, there were non-significant differences (p-value = 0.28) in CPUE for spearfishing among seasons in 2024. The average of CPUE was, in order of magnitude, 1.90 ± 0.36 kg/day, 1.42 ± 0.28 kg/day, 1.31 ± 0.17 kg/day and 1.17±0.20 kg/day for winter, autumn, spring and summer, respectively (Figure 26).

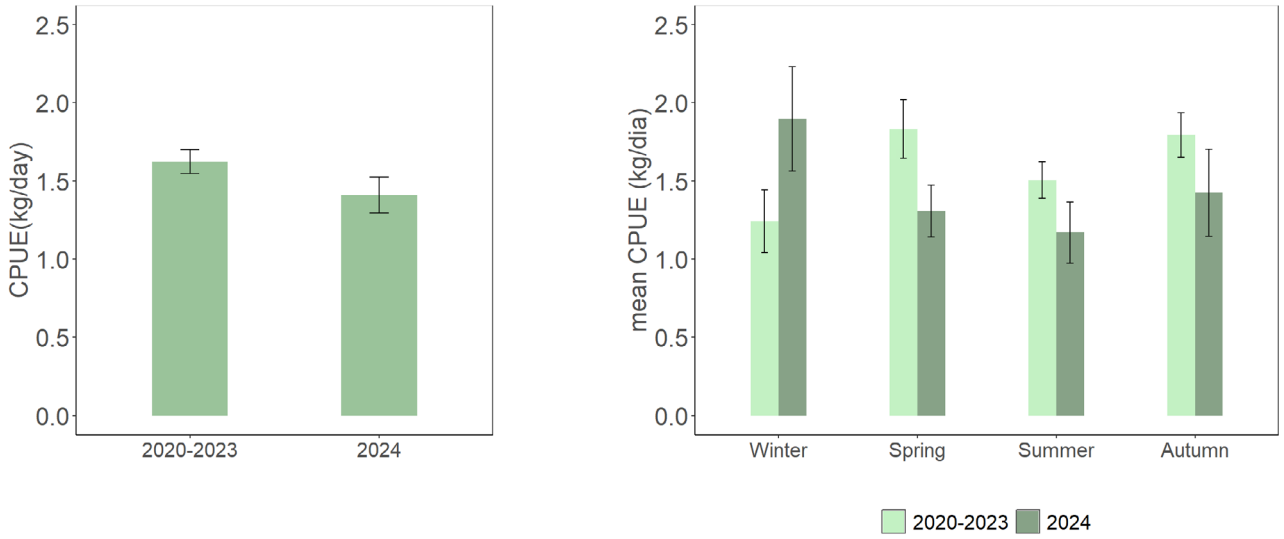


Figure 26. The CPUE by 2020 to 2023 and 2024 for spearfishing. The green bars indicate the mean and the black line indicates the standard error (left). The CPUE by season in average 2020 to 2023 (light green) and 2024 (dark green). The bars indicate the mean and the black line indicates the standard error (right).

5.3. Seasonal catch composition

In In the onsite sampling, a total of 2 343 individuals caught by spearfishers were identified from a total 37 different species considering all 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 present, or more or less desired, during different times of the year.

During 2020-2023 the seasonal species catch composition differences can also be observed for spearfishing. Summer was the season with the highest diversity, with 28 different species' observations, followed by autumn with 27, spring with 25, and winter with 21 different species out of the 34 species identified. In 2024, summer and spring were the seasons with the highest diversity, with 25 different species observations, followed by winter with 19 and autumn with 17 different species out of the 33 species observed. Lower catch diversity is expected for spearfishing because it is a more selective activity. It must be noted that the spearfishing catches diversity results are calculated from a lower number of surveys compared to the other two fishing modalities (shore and boat angling). Nonetheless, the number of spearfishing surveys was 1 069 surveys, all years together.

Catch composition results show the actual estimates obtained from the onsite surveys. In winter, Paracentrotus lividus represented more than a third (33.6%) of the total catch during the period of 2020-2023 and almost the total number of catches in 2024 (89%). In spring, D. sargus was the dominant species in both 2020 – 2023 (18.3%) and 2024 (24.4%). S. officinalis was the second species in 2020 – 2023 (24.4%) and the number of catches decreased in 2024 (4.1%). In summer, the two main species were D. sargus (25.3% and 14.5% for 2020-2023 and 2023, respectively), and Mullus surmuletus (16.5% and 26.6% for 2020-2023 and 2023, respectively). During autumn, P. lividus was present in both periods 2020-2023 and 2024 represented 15.7% and 35.1 of the total catch, respectively (Figure 27).

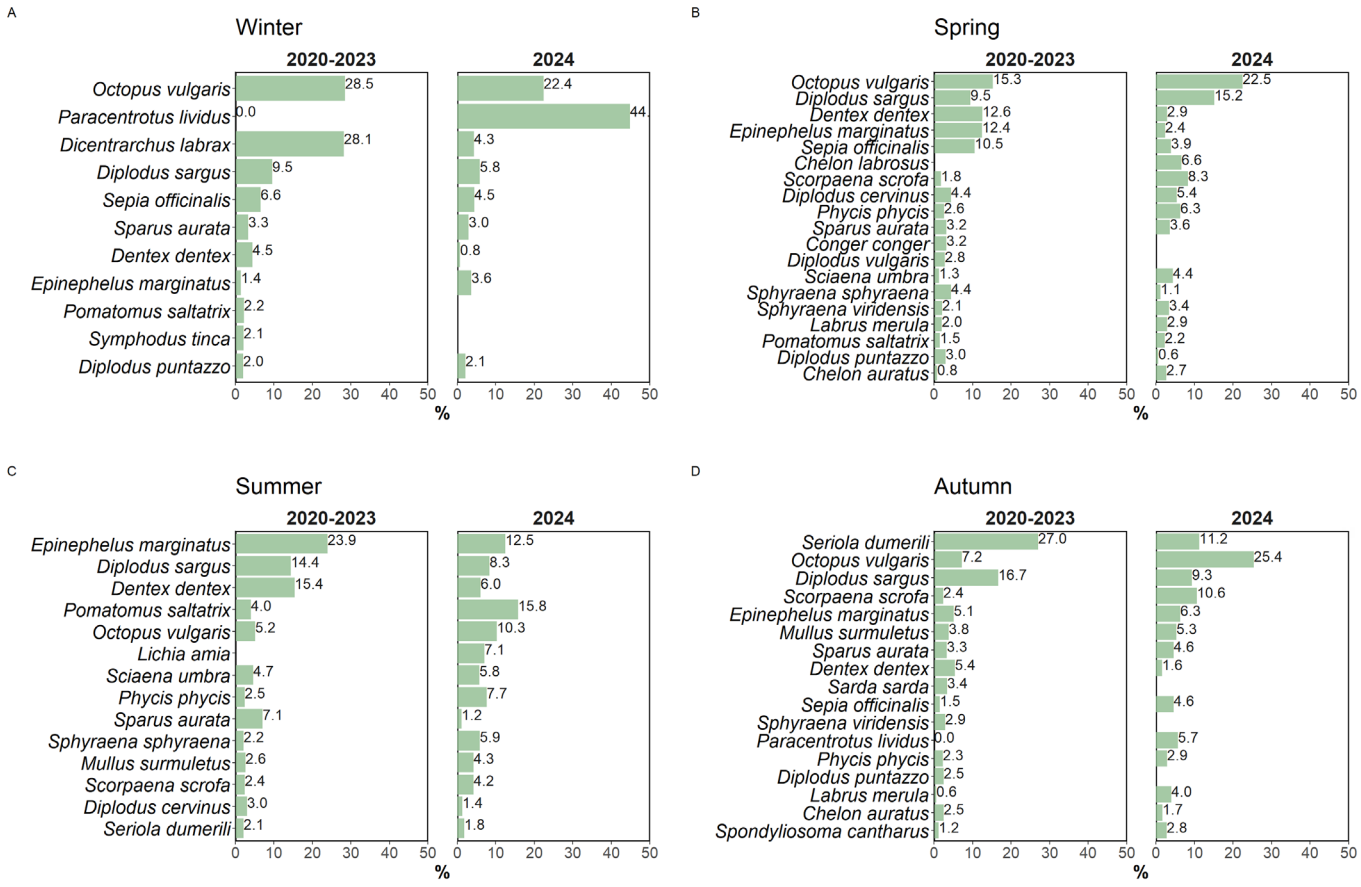


Figure 27. Seasonal catch composition (in percentage of individuals number) for onsite spearfishing sampling in winter (A), spring (B), summer (C), and autumn (D) from 2020-2022 (left) and in 2023 (right). Only species representing over 2% of the total catch are shown.

5.4. Total annual catch

Estimates Estimates of total annual catches were obtained from catch data collected during onsite surveys but effort values were obtained from online surveys. The main total catches in the spearfishing modality in 2024 was O. vulgaris with total annual catches of 18 349 kg, followed by D. sargus with 9 268 kg, and Epinephelus marginatus with total annual catches of 7 330 kg. In addition, 2024 was the first year in which sea urchin (P. lividus) catches were systematically recorded in weight rather than only in units, allowing their inclusion in biomass calculations, which were estimated in 12 336 kg. Regarding the main total catches during the period of 2020-2023, E. marginatus accounted for 18 241 kg. The second most notable species was D. sargus with total annual catches of 16 395 kg. The third most caught species were Dentex dentex and O. vulgaris with very similar total annual catches (14 329 kg and 14 130 kg, respectively; Figure 28).

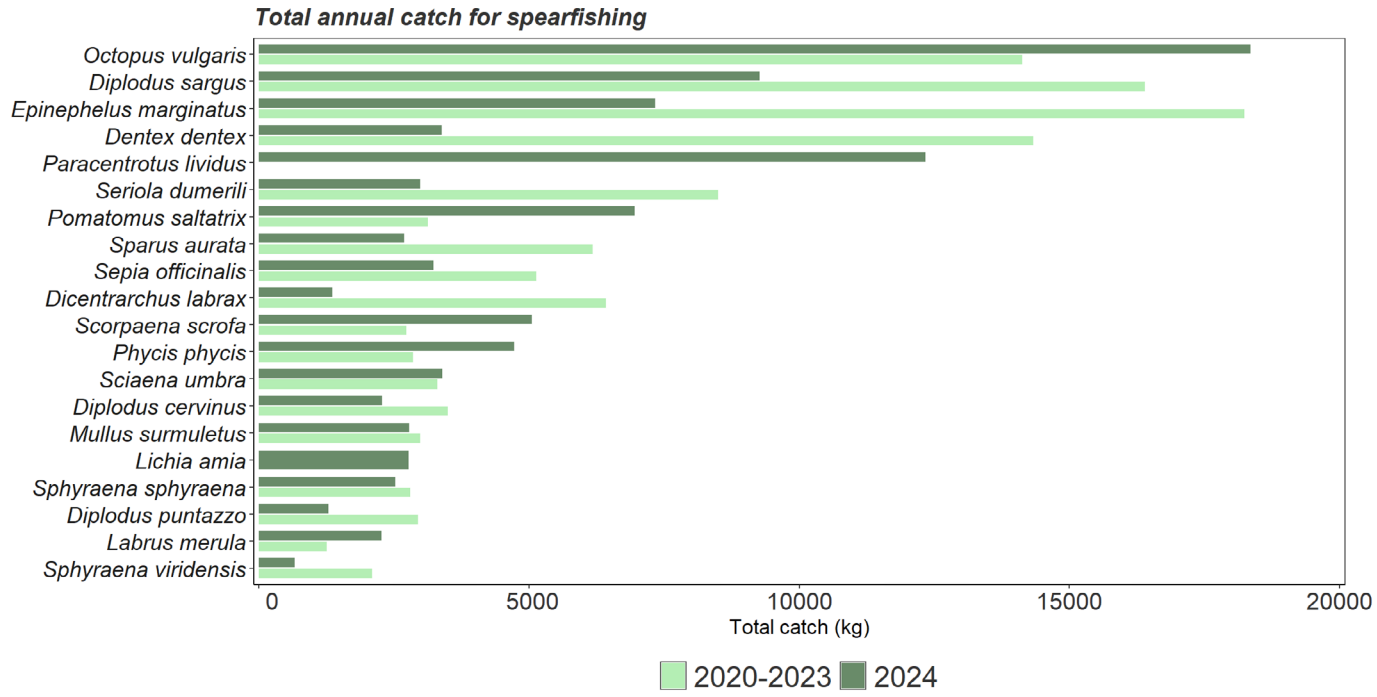


Figure 28.Total annual catch per species for spearfishing in average 2020-2023 (light green) and in 2024 (dark green).

5.5. Spatial distribution of the total annual catch

The spatial distribution of spearfishing total annual catch was very similar between both studied periods. However, in 2020 – 2023, there were more annual catches, in general, compared to 2024. The differences were mainly observed in the following zones: Costa Daurada (20 155 and 12 432, respectively), Delta de l'Ebre (7 927 and 5 255, respectively), Maresme (10 890 and 5 847, respectively) and Barcelonès (7 918 and 5 401, respectively). The spatial distribution of the annual catches evidences the ranging fishing impacts (Figure 29). In general, the most populated zones, such as Barcelona and its adjacent area, yielded the highest number of catches per kilometre.

5.6. Inequality in the distribution of the total annual catches

Spearfishing is one of the most selective and efficient forms of recreational fishing. From the online surveys, in the division of the typology of fishers according to their avidity class, we found a small percentage who got their licence but did not go fishing or went only a few days in both studied periods. The different avidity groups designed in this study are responsible for very different proportions of the total catches. Below is a table (Table 16) corresponding to spearfishing modality in 2020-2023 and 2024, 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 in relation to their avidity patterns. These amount to 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 51% of the fishers had less than 20 fishing trips during the 2020-2023 period, jointly contributing 12% of the total catch. Out of the remaining 49%, those who fished more than 20 days per year, 13% had over 50 trips and caught 43% of the total spearfishing catch. As a result, while sporadic avidity fishers caught on average 3 kg per year per fisher, the low avidity recreational anglers extracted approximately 11 kg of catch during the year per fisher. Conversely, medium avid class fishers extracted almost 47 kg per year, and the most avid fishers extracted a median of 124 kg per year per fisher (Table 16A). In 2024, spearfishing also showed a similar catch trend among the different avidity classes, with the 57% of the spearfishers who fished less than 20 days per year contributing a 11.2% of the total modality catch, while the more avid (43%) took 20 fishing trips throughout the year accumulating the remaining 89%. Notoriously, the estimated 1 164 (33%) medium avidity class recreational spearfishers individually caught an average of 45 kg throughout the natural year, accounting

for over half (51.7%) of the total annual catches for the whole modality and contributing significantly to the total catch for the overall MRF activity (Table 16B).

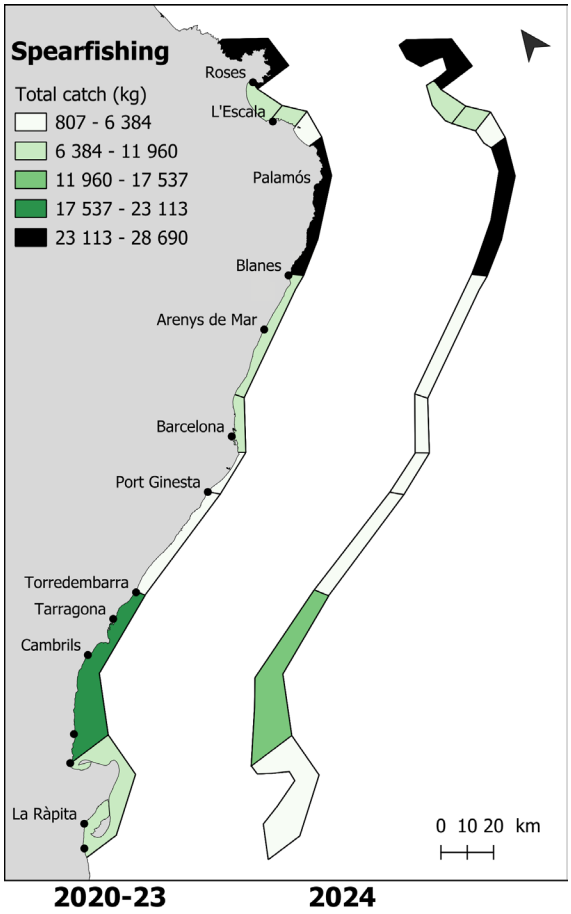


Figure 29. Distribution of total annual catch for spearfishing in 2020-2023 (left) and 2024 (right).

Table 16. Number and proportion of spearfishing activities, average individual fishing intensity, and total accumulated catch per avidity group in average by 2020-2023 (A) and for 2024 (B).

A. Year 2020-2023					
Avidity class	Fishers		Average total catch (kg/year/fisher)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	189	6	0	0	0
Sporadic	116	3	3.04	353	0.3
Low	1 414	42	10.49	14 836	11.7
Medium	1 227	36	46.57	57 125	45.2
High	439	13	123.79	54 370	43.0
B. Year 2024					
Avidity class	Fishers		Average total catch (kg/year/fisher)	Total catch (kg)	
	Number	Percentage (%)		Number	Percentage (%)
Zero	232	7	0	0	0
Sporadic	178	5	1.09	193	0.2
Low	1 550	45	7.12	11 037	11.0
Medium	1 164	33	44.71	52 043	51.7
High	356	10	105.23	37 496	37.3

6

Total annual catch distribution

Estimates of total annual catches used catch data from the onsite surveys and effort values from the online surveys; they 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 CPUE estimates also took into account the avidity of the fishers, adjusting the results to better reflect fishing effort across respondents. The total annual catch for shore angling in 2020 – 2023 was 278 256 kg per year, and in 2024 increased to 405 236 kg per year. Boat angling accumulated 535 258 kg per year in 2020-2023, and in 2024 declined to 345 042 kg per year. Finally, for spearfishing in the average period was 126 331 kg per year, and in 2024 decreased to 100 576 kg per year.

The spatial distribution of the annual catches evidences the ranging fishing impacts of the different fishing modalities along the Catalan coast (Figure 30). Overall, catches by boat and spearfishing decreased in 2024 compared to 2020-2023 on virtually the entire coastline. In the case of boat angling, although the total catches declined, their spatial distribution across the territory remained broadly similar between the two study periods. As for shore angling, a slight increase in catches was recorded in the zones Cap de Creus, Costa Brava Sud, Maresme, Barcelonès, Costa Daurada, and Delta de l'Ebre. In both periods, spearfishing catches were considerably lower in all zones dominated by sandy bottoms (Delta de l'Ebre, Golf de Roses, Baix Ter, and Delta del Llobregat).

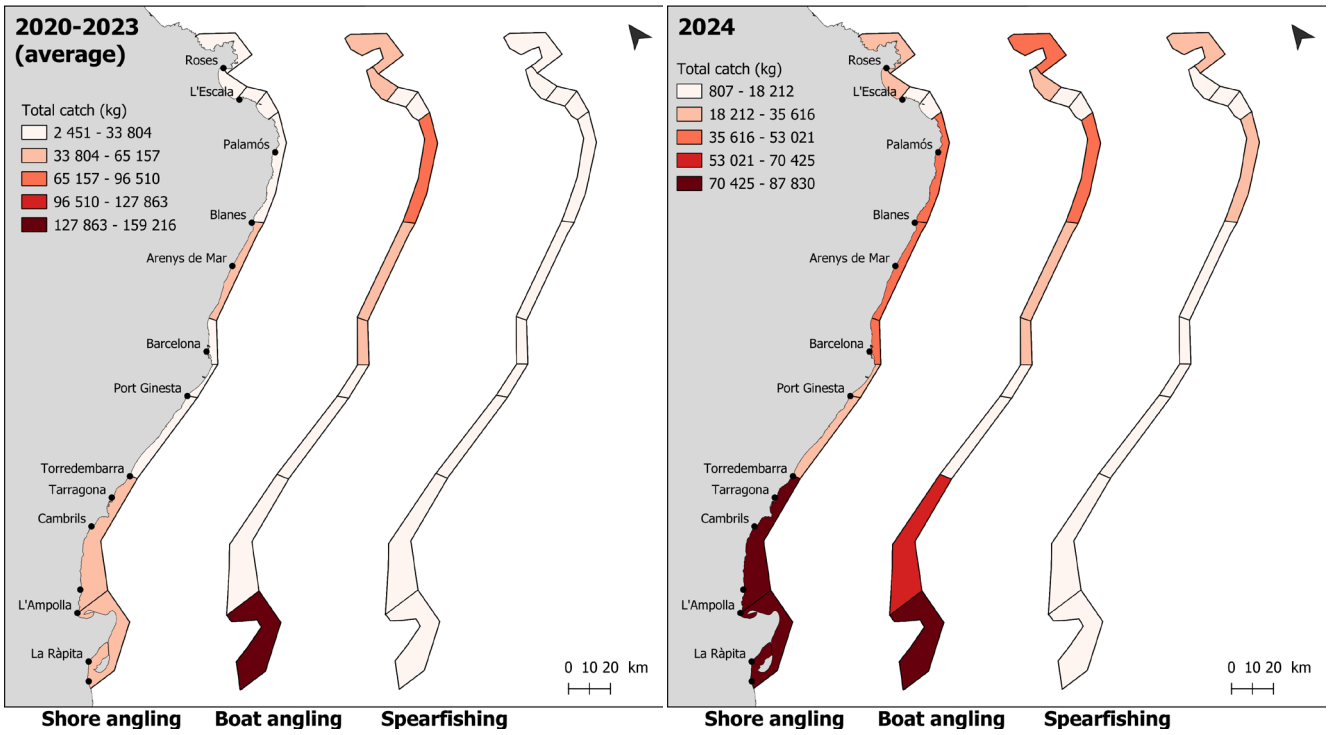


Figure 30. Distribution of total annual catch by modalities during the period 2020-2023 (left) and 2024 (right).

The catches reported by recreational fishers were largely dominated by harvest in both periods. During 2020–2023, 88.2% of the reported catches were kept, while 9.4% were discarded, 1.0% released through catch and release (C&R), and 1.3% remained unknown. In 2024, the proportion of harvest remained stable (87.6%), while discards increased slightly to 11.4%. Conversely, C&R and unknown responses decreased to 0.2% and 0.8%, respectively. These results highlight the predominance of harvest across years, with minor shifts in the relative contribution of discards and C&R practices (Figure 31).

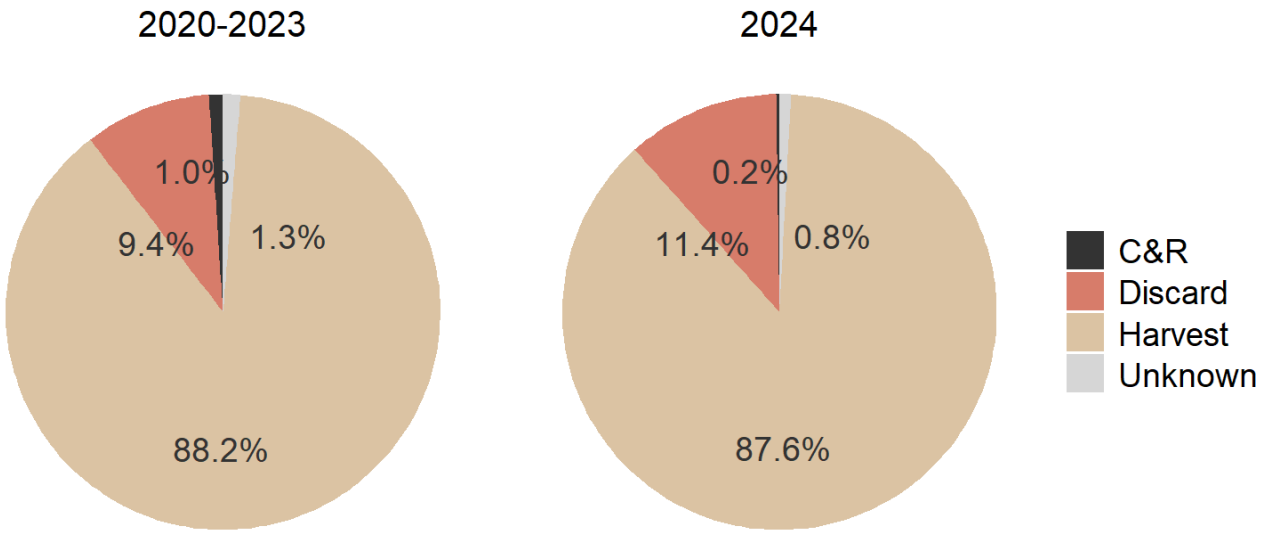
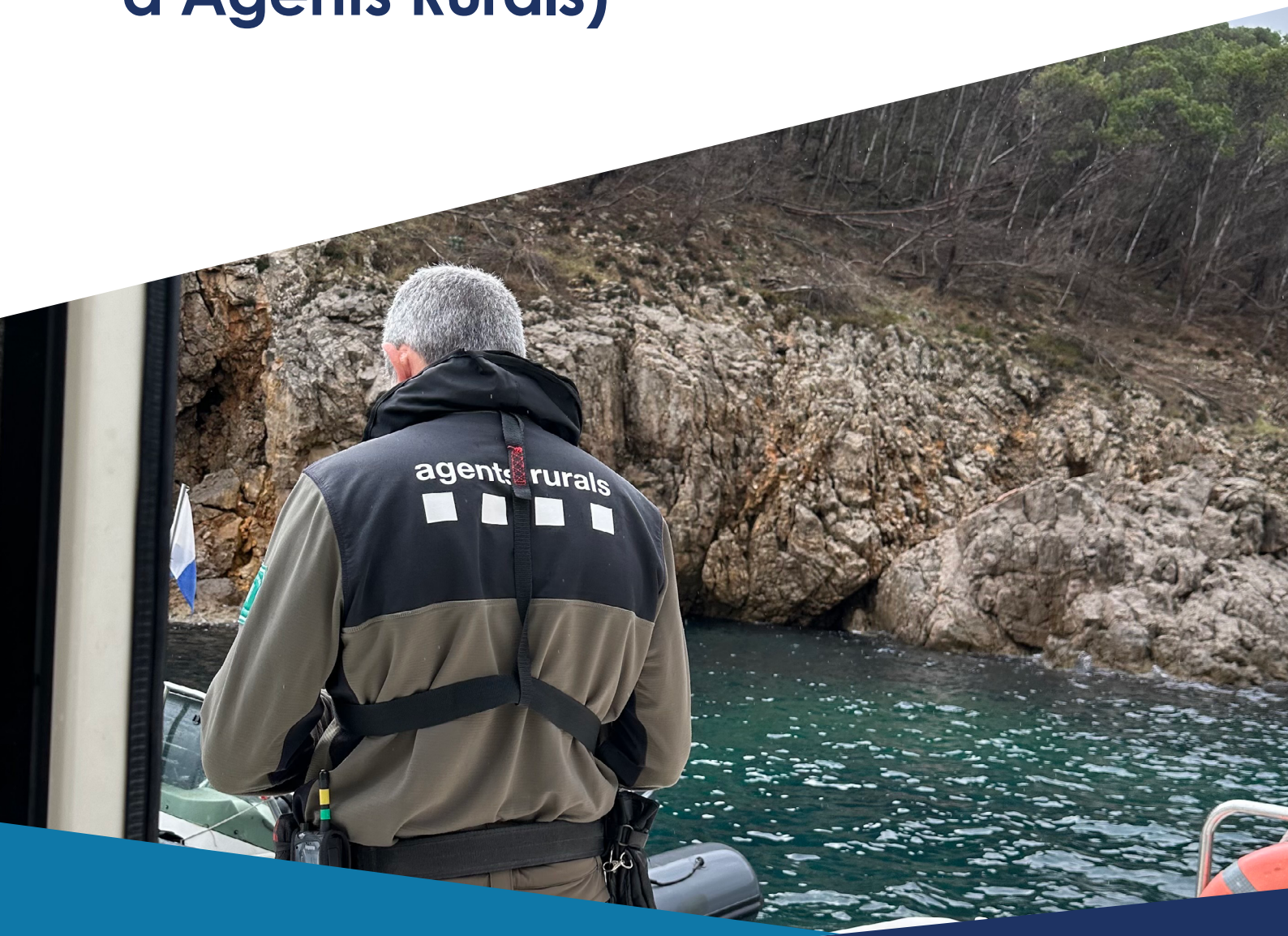


Figure 31. Percentages of catch distribution in harvested, released (C&R), discarded, and unknown for all three modalities combined during the period 2020-2023 and 2024.

7

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



Between 2022 and early 2024, three coordinated inspection campaigns on marine recreational fisheries were conducted by the Catalan Directorate-General of Maritime Policy and Sustainable Fisheries (DGPMPS), the regional police (CME), and the Rural Agents Corps (CAR). In total, more than 1 600 fishers were inspected across the Catalan coast, the majority of whom held valid licenses issued mainly in Catalonia. Shore anglers consistently represented the largest group of inspected fishers, followed by boat anglers and spearfishers. The proportion of unlicensed activity was generally low (ranging from 3% to 11% depending on the campaign and modality), although higher levels were observed among spearfishers in 2023. Compared with the 2019 pilot test, which estimated higher proportions of unlicensed fishers, these campaigns suggest a reduction likely linked to a more targeted enforcement approach.

In 2024, the scheduled joint inspection campaign by the Catalan Directorate-General of Maritime Policy and Sustainable Fisheries (DGPMPS), the Catalan regional police (CME), and the Rural Agents Corps (CAR) could not be carried out. However, a new coordinated campaign has recently been implemented in 2025, running from August 25th to September 15th, with the same objective of monitoring and controlling recreational marine fisheries along the Catalan coast. Data will be analysed upon availability. Readers are referred to the last annual report (ICATMAR, 2024) for detailed baseline information on the outcomes of previous coordinated enforcement actions.

8

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 2024, the results of the onsite surveys show: 1 610 fishers identified as men, there was 111 as women, and 5 people identified as non-binary. During the period 2020-2023, in the total onsite surveys, 5 534 fishers identified as men, 229 as women and 14 people identified as non-binary (Figure 32). Results from the onsite surveys in both periods showed that most fishers practice the activity with other people (82% and 81%, respectively). This underlines the predominantly social nature of MRF in Catalonia.

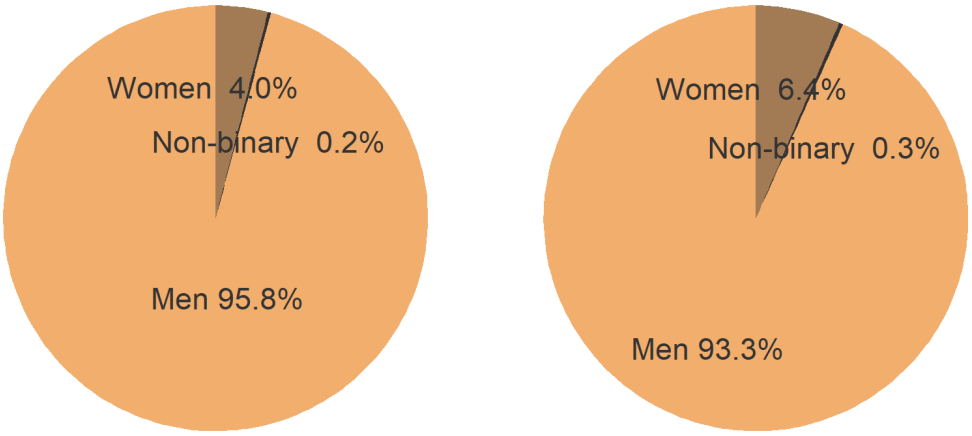


Figure 32: Percentage of responses by gender from onsite surveys in the period 2020-2023 and 2024.

As for the online surveys, in 2024, 4 238 fishers identified as men, 243 as women, 1 536 did not respond, and 20 identified as non-binary. During the period 2020-2023, a total of 17 150 fishers identified as men, 981 as women, 7 386 did not respond, and 82 identified as non-binary (Figure 33). These results are highly consistent with those of the latest report (ICATMAR, 2022) and the pilot study (ICATMAR, 2020a).

Results from the online surveys in both periods showed that most fishers practice the activity with other people (66.5% and 68%, respectively), and this proportion consistently remained above 50%, in line with the trends observed in the onsite surveys. However, there were important differences in the sociability response between both types of survey for which we could not provide an explanation.

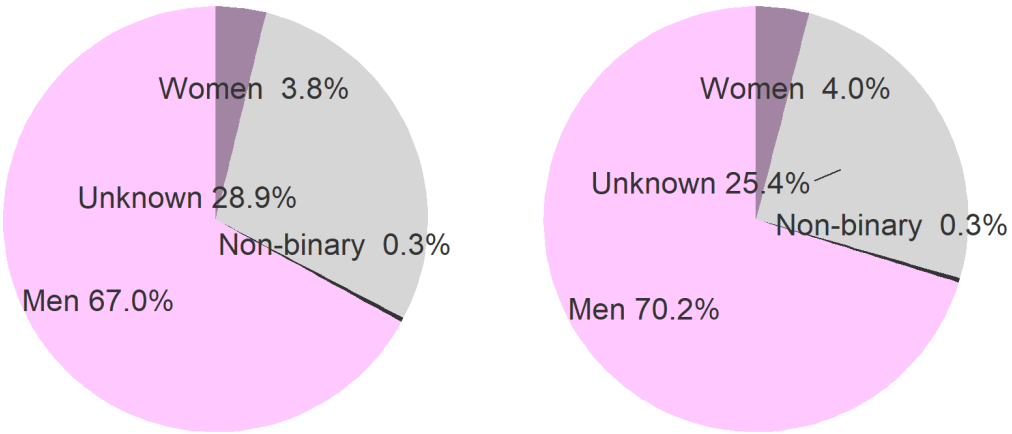


Figure 33: Percentage of responses by gender from online surveys in the period 2020-2023 and 2024.

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 2020-2023 and 2024 respectively, and in the online surveys it was 49 and 50, 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 2024 onsite surveys the average age for shore anglers was 46 (± 0.6), for boat anglers it was 52 (± 0.6) and for spearfishers it was 39 (± 0.62). In the 2024 online surveys, the average ages were 47 (± 0.26), 55 (± 0.38), and 47 (± 0.55) for shore angling, boat angling, and spearfishing respectively (Figure 34B).

In the 2020-2023 onsite surveys the average age for shore anglers was 46 (± 0.27), for boat anglers it was 52 (± 0.34) and for spearfishers it was 38 (± 0.39). In the 2021-2023 online surveys, the average ages were 47 (± 0.12), 53 (± 0.18), and 46 (± 0.25) for shore angling, boat angling, and spearfishing respectively (Figure 34A). 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).

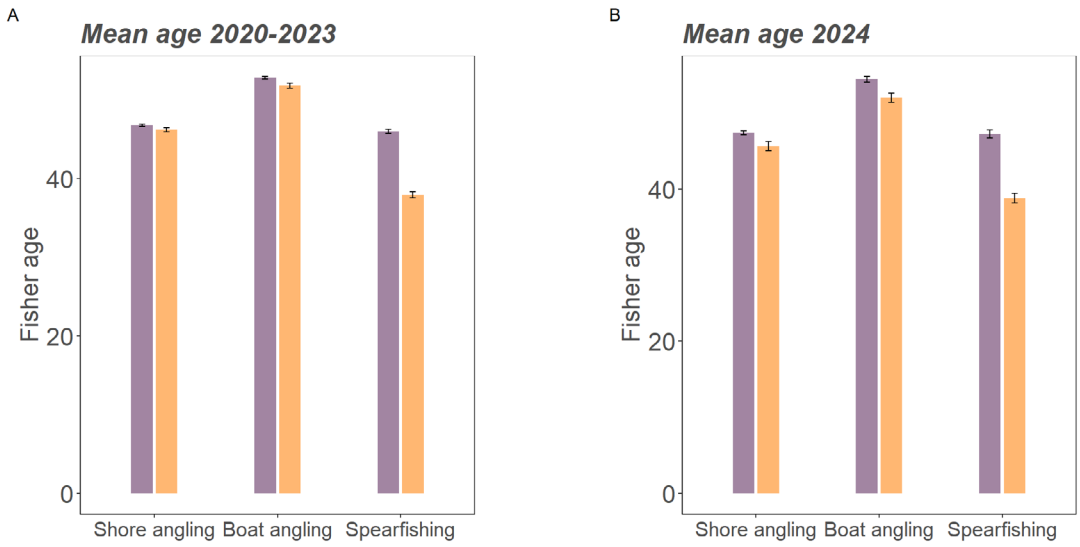


Figure 34. Recreational fishers age in 2020-2023(A) and in 2024(B) obtained from the onsite surveys (in orange) and the online surveys (in purple). Bars represent the average and vertical black lines represent standard error values.

Onsite and online surveys also asked about the years of experience practicing the activity. As expected, boat anglers were the most experienced fishers in onsite and online surveys for both periods, with 25 (± 0.36) and 28 (± 0.24) years of experience from 2020 – 2023, and 26 (± 0.61) and 29 (± 0.5) years in 2024, respectively (Figure 35A). In 2024, shore fishers presented 21 (± 0.58) and 23 (± 0.29) years of experience in 2020-2023 and 2024. On the other hand, spearfishing responses showed the largest experience gap between the onsite and online responses, with 17 (± 0.43) and 24 (± 0.31) years of experience in 2020-2023 and 2024 respectively. For 2024, the gap between the two surveys responses was similar, with an average of 18 (± 0.67) years of experience in the onsite

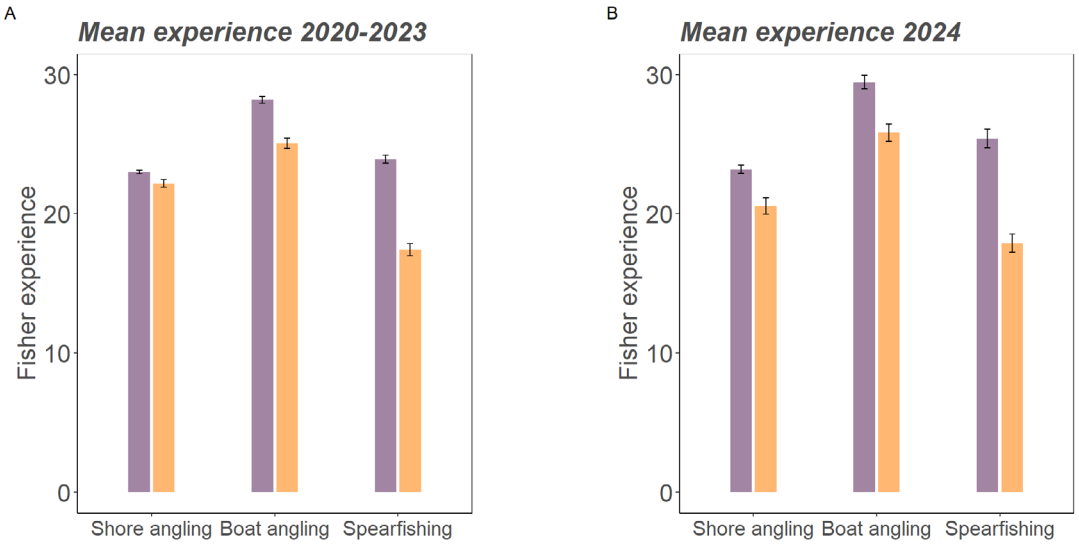


Figure 35. Recreational fishers experience in years in 2020-2023(A) and in 2024(B) obtained from the onsite surveys (in orange) and the online surveys (in purple). Bars represent the average and vertical black lines represent standard error values.

9

Economic impact of marine recreational fishing

and 25 (± 0.68) in the online surveys (Figure 35B).

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 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 licenses, 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 boat. In the Table 17 and Table 19, we described the daily expenses including 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 licenses, 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 2024, the results of the estimate daily expenses per fisher showed an average expenditure of 28.40€ per fishing trip for shore anglers, 56.52€ for boat anglers, 26.83€ for spearfishers initiating the activity from land, and 65.83€ for spearfishers who initiate the activity from a boat. Daily expenses were annualized using fisher effort data, and were added to the expenses that were measured on an annual basis. Average annual expenditures amounted to 707.14€ for shore fishing, 3 072.62€ for boat fishing, 1 041.94€ for spearfishing mainly initiating the activity from land, and 3 745.47€ for spearfishers initiating the activity mainly from a boat (Table 19).

In the period 2020-2023, the results of the estimated daily expenditures per fisher showed an average expenditure of 26.69€ per fishing trip for shore anglers, 50.45€ for boat anglers, 20.19€ for shore-initiated spearfishers, and 44.65€ for boat-initiated spearfishers. Daily expenditures were annualized using fisher effort data, and added to the expenses that were measured on an annual basis. Average annual expenditures amounted to 821.96€ for shore angling, 3 192.72€ for boat angling, 915.91€ for spearfishers mainly starting the activity from land, and 2 870.28€ for spearfishers mainly starting the activity from a boat (Table 17).

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 2024, the total of 36 064 shore anglers was estimated to have generated an economic impact of 25.5M€ (Table 20). The main expenditure in shore angling was on fishing gear (3.9M€ on consumables and 8.5M€ on permanent gear), followed by fishing holidays (3.2M€) and other daily expenses such as transportation and meals (8.8M€). An increase was recorded in the period of 2020-2023, when it was estimated that 33 713 shore anglers have generated a total expenditure of 27.7M€ (Table 18). The main expenditure in shore angling was on fishing gear (4M€ on consumables and 7.7M€ on permanent gear), followed by fishing holidays (7.5M€) and other daily expenses such as transportation and meals (7.5M€).

In 2024, the total of 12 671 boat anglers was estimated to have generated an economic impact of 32.6M€ (Table 20). The main expenditures of boat angling were on maintenance and port services, totalling 13M€ (7.6M€ on port services and 5.3M€ on boat maintenance). The other expenditures of this modality were very diversified: 1.6M€ were spent on fishing holidays, 5.8M€ on boat fuel and 5.8M€ on fishing gear (2.3M€ on consumables and 3.4M€ on permanent gear). In regards to 2020-2023, it was estimated that 11 845 boat anglers generated an economic impact of 36M€ (Table 18). The main expenditure for boat angling was on maintenance and port services,

totalling 13.8M€ (8.2M€ on port services and 5.6M€ on boat maintenance). The other expenses of this modality were very diversified: 1.3M€ were spent on fishing holidays, 6.2M€ on boat fuel and 9.2M€ on fishing gear (5.7M€ on consumables and 3.1M€ 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 3 480 recreational spearfishers during 2024, of which 2 749 started primarily from shore and 731 primarily from a boat (see Table 19). It was estimated that shore-initiated spearfishers generated a total expenditure of 2.8M€ (Table 20). Their main expenditure was on other daily expenses (1.3M€), followed by fishing holidays (0.5M€), and fishing gear 0.7M€ (0.3M€ on consumables and 0.4M€ on permanent gear; see Table 19). Boat-initiated spearfishers were estimated to generate a total expenditure of 2.7M€. In this case, there were additional costs associated with fuel (0.4M€), boat maintenance and port services (0.9M€ altogether). In the period 2020 – 2023, there were an average of 3 385 recreational spearfishers, of which 2 573 started primarily from shore and 812 primarily from a boat. Shore-initiated spearfishers were estimated to generate an economic impact of 2.3M€ (Table 18). Their main expenditure was on other daily expenses (1M€), followed by fishing gear 0.6M€ (0.2M€ on consumables and 0.4M€ on permanent gear) and fishing holidays (0.5M€; see Table 17). Similar expenditure, boat-initiated spearfishers were estimated to generate a total economic impact of 2.3M€ (Table 18). In this case, there were additional costs associated with fuel (0.4M€) boat maintenance and port services (0.8M€ 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 2020-2023, the total expenditure of shore angling was estimated to be 11€ million for direct impacts, and 27.7€ million including all costs associated with the activity. Direct expenditure on boat-based fishing gear and materials was estimated at 9.2M€, while the total direct plus indirect costs of the activity amounted to 36M€. Shore and boat-initiated spearfishing had direct economic impacts on fishing gear of 0.64M€ and 0.28M€ respectively. The total direct and indirect impacts of the activity were estimated at 2.35M€ and 2.3M€ respectively, totalling 4.6M€ for spearfishing activity as a whole.

In 2024, total expenditures of shore angling were estimated at 12.4M€ for direct impacts, and 25.5M€ including all costs associated with the activity (Table 20). Direct expenditure on boat-based fishing gear and materials were estimated at 5.8M€, while the total direct plus indirect expenses of the activity amounted to 32.6M€. Shore and boat-initiated spearfishing had direct economic impacts on fishing gear of 0.7M€ and 0.4M€ respectively. The total direct and indirect impacts were estimated at 2.8M€ and 2.7M€ respectively, amounting to a total 5.5M€ for the spearfishing activity as a whole.

The areas with the highest economic impact in the period 2020-2023 for all three modalities of MRF were Costa Brava Sud and Costa Daurada (Figure 36). Shore angling and boat angling were also highly impactful on the Delta de l'Ebre, Maresme and Cap de Creus zones. In 2024, where there was a lower total expenditure compared with 2020-2023, the zones with the highest economic impact for all three modalities of MRF were Costa Brava Sud, Cap de Creus, and Costa Daurada (Figure 36). Shore angling was also highly impactful on Maresme and Delta de l'Ebre, while boat angling produced most of it is expenditure, also in the Delta de l'Ebre Maresme and Golf de Roses zones.

Table 17. Estimates of average expenses per recreational fisher (RF) and total activity expenses (in euros) in Catalonia for each modality during the period 2020-2023.

	Shore angling		Boat angling		Spearfishing			
					Initiating from land		Initiating from boat	
	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure
Consumable gear	121.48 €	4 095 455 €	483.33 €	5 725 044 €	93.36 €	240 178 €	123.36 €	100 218 €
Boat fuel			548.46 €	6 236 648 €			547.92 €	445 130 €
Other daily expenses	223.89 €	7 548 004 €	265.32 €	3 142 715 €	391.2 €	1 006 401 €	400.32 €	325 220 €
Permanent gear	229.84 €	7 748 596 €	296.12 €	3 507 541 €	156.82 €	403 435 €	227.16 €	184 545 €
Port services			722.08 €	8 210 862 €			629.10 €	511 080 €
Boat maintenance			495.31 €	5 632 346 €			453.99 €	357 391 €
Holidays	223.23 €	7 525 753 €	111.23 €	1 317 519 €	199.15 €	512 333 €	282.31 €	229 349 €
License	16.84 €	567 727 €	18.74 €	221 975 €	30.46 €	78 361 €	32.68 €	26 549 €
Insurances	2.24 €	75 517 €	141.31 €	1 606 864 €	16.5 €	42 448 €	103.12 €	83 775 €
Clubs memberships	1.54 €	51 918 €	23.88 €	282 859 €	18.97 €	48 802 €	36.28 €	29 474 €
Other anual expenses	2.90€	97 768 €	12.08 €	143 088 €	9.45 €	24 311 €	18.98 €	15 419 €
Boat rentals			52.70 €	24 969 €			12.45 €	314 €
Fishing charters			22.16 €	10 499 €			2.61 €	66 €
Total annual	**821.96 €**	**27 710 738 €**	**3 192.72 €**	**36 062 931 €**	**916 €**	**2 356 270 €**	**2 870.28 €**	**2 308 528 €**

Table 18. Estimates of total direct annual expenditure on fishing materials and gear, and total annual expenditure (in euros) related to the fishing activity including indirect expenses for each MRF modality during the period 2020-2023.

2020-2023	Fishing gear	Total activity
Shore angling	11 844 051 €	27 710 737 €
Boat angling	9 232 585 €	36 062 931 €
Spearfishing from land	643 613 €	2 356 270 €
Spearfishing from boat	284 762 €	2 308 528 €
Total	**22 005 012 €**	**68 438 466 €**

Table 19. Estimates of average expenses per recreational fisher (RF) and total activity expenses (in euros) in Catalonia for each modality during 2024.

	Shore angling		Boat angling		Spearfishing			
					Initiating from land		Initiating from boat	
	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure	Annual expenditure per RF	Total activity expenditure
Consumable gear	109.3 €	3 941 795 €	186.66 €	2.365.169 €	117.07 €	321 849 €	306.59 €	224 056 €
Boat fuel			603.96 €	5.892.638 €			556.14 €	406 427 €
Other daily expenses	246.16 €	8 877 514 €	307.02 €	3.890.250 €	500.02 €	1 374 655 €	651.36 €	476 014 €
Permanent gear	236.64 €	8 534 185 €	275.94 €	3.496.436 €	147.96 €	406 772 €	302.63 €	221 162 €
Port services			784.16 €	7.650.765 €			694.32 €	507 409 €
Boat maintenance			553.19 €	5.397.311 €			577.84 €	422 284 €
Holidays	90.14 €	3 250 809 €	132.99 €	1.685.116 €	195.58 €	537 689 €	413.68 €	302 317 €
License	17.88 €	644 824 €	20.13 €	255.067 €	30.26 €	83 191 €	35.41 €	25 878 €
Insurances	2.79 €	100 619 €	151.47 €	1.477.843 €	18.41 €	50 613 €	132.47 €	96 809 €
Clubs memberships	1.53 €	55 178 €	25.06 €	317.535 €	21.33 €	58 640 €	41.71 €	30 482 €
Other anual expenses	2.70 €	97 373 €	9.55 €	121.008 €	11.31 €	31 094 €	25.35 €	18 526 €
Boat rentals			18.09 €	52.720 €			4.46 €	743 €
Fishing charters			4.40 €	12.823 €			3.51 €	585 €
Total annual	**707.14 €**	**25 502 297 €**	**3 072.62 €**	**32 614 682 €**	**1 041.94 €**	**2 864 501 €**	**3 745.47 €**	**2 732 691 €**

Table 20. Estimates of total direct annual expenditure on fishing materials and gear, and total annual expenditure (in euros) related to the fishing activity including indirect expenses for each MRF modality during 2024.

2024	Fishing gear	Total activity
Shore angling	12 475 980 €	25 502 297 €
Boat angling	5 861 605 €	32 614 682 €
Spearfishing from land	728 620 €	2 864 501 €
Spearfishing from boat	445 218 €	2 732 691 €
Total	**19 511 423 €**	**63 714 172 €**

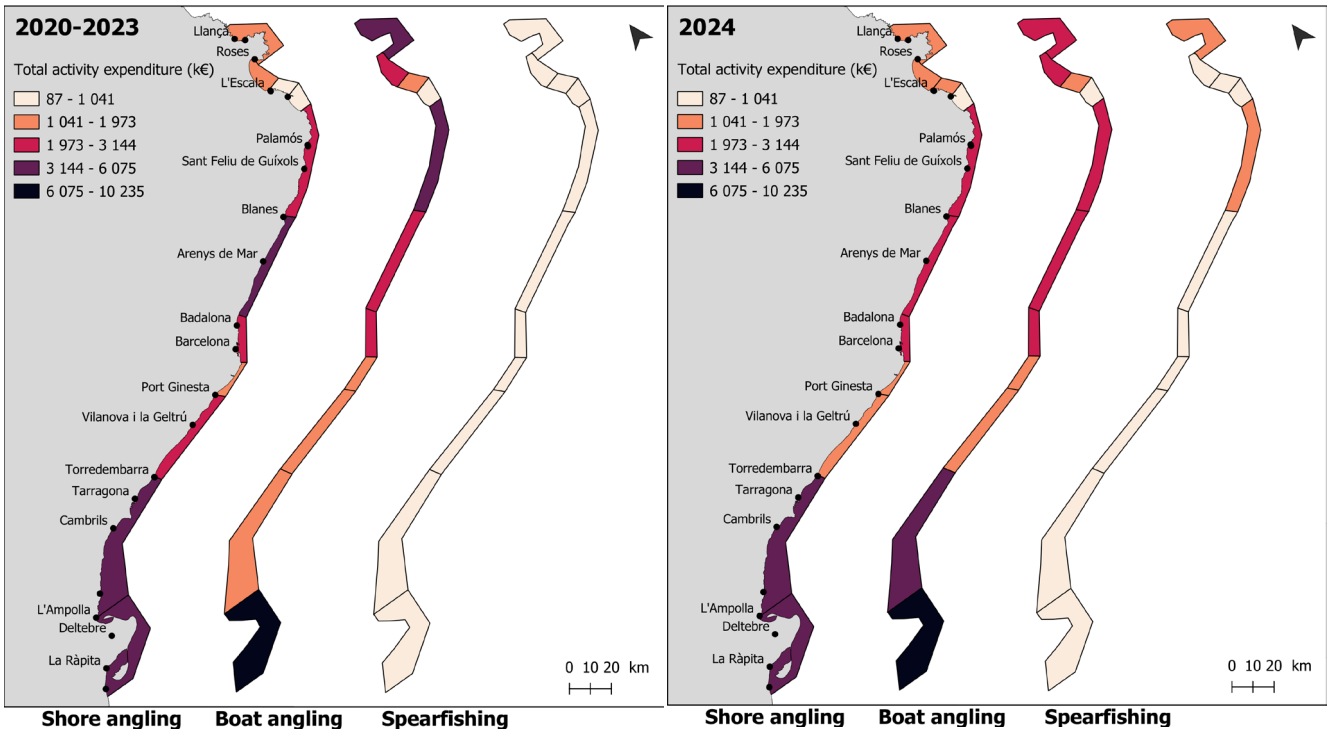


Figure 36. Estimate of total annual expenditure (in euros) related to fishing activity for each MRF modality per zone in the period 2020-2023 (left) and in 2024 (right).

10

Conclusions

In Catalonia, marine recreational fishing was practised by an estimated 48 943 fishers in 2020-2023, and by 52 215 fishers in 2024. It should be noted, however, that these figures are approximate due to uncertainties in the exact number of licences and their different validity periods. In addition, 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.

MRF is predominantly practiced 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 2024, the percentage of female marine recreational fishers has increased. In both studied periods, the most practiced 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. However, in 2024, increased fishing activity was observed during the winter months, particularly for boat angling and spearfishing.

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 genus Diplodus, and European bass (Dicentrarchus labrax). Boat angling mostly extracts biomass of Serranus cabrilla, pelagic species such as Euthynnus alletteratus, Seriola dumerili and Scomber scombrus, common cuttlefish (Sepia officinalis) and European squid (Loligo vulgaris). Spearfishing catches mainly include along with a variety of sparids, such as Diplodus sargus, the dusky grouper Epinephelus marginatus and the common octopus (Octopus vulgaris). The total annual biomass extracted of marine resources in 2020-2023 was estimated in 940 T for MRF as a whole, while in 2024, the total annual extraction decreased to 851 T.

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.

References

Arostegui, M. C., Anderson, C. M., Benedict, R. F., Dailey, C., Fiorenza, E. A., & Jahn, A. R. (2021). Approaches to regulating recreational fisheries: balancing biology with angler satisfaction. *Reviews in Fish Biology and Fisheries*. https://doi.org/10.1007/s11160-021-09662-y

Brownscombe et al., (2019). Fisheries Research, *211*, 247–255. https://doi.org/10.1016/j.fishres.2018.10.019

Cooke, S. J., & Cowx, I. G. (2005). Contrasting recreational and commercial fishing: Searching for common issues to promote unified conservation of fisheries resources and aquatic environments, *8*. https://doi.org/10.1016/j.biocon.2005.09.019

Dedeu, A. L., Boada, J., & Gordoa, A. (2019). The first estimates of species compositions of Spanish marine recreational fishing reveal the activity' s inner and geographical variability. *Fisheries Research*, *216*(December 2018), 65–73. https://doi.org/10.1016/j.fishres.2019.03.025

Font, T. Lloret, J. (2011). Biological implications of recreational shore angling and harvest in a marine reserve: the case of Cape Creus, *217*(January), 210–217. https://doi.org/10.1002/aqc.1167

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

Herfaut, J., Levrel, H., Thébaud, O., & Véron, G. (2013). Ocean & Coastal Management The nationwide assessment of marine recreational fishing: A French example. *Ocean and Coastal Management*, *78*, 121–131. https://doi.org/10.1016/j.ocecoaman.2013.02.026

Hyder, K., Weltersbach, M. S., Armstrong, M., Ferter, K., Townhill, B., Ahvonen, A., Strehlow, H. V. (2018). Recreational sea fishing in Europe in a global context—Participation rates, fishing effort, expenditure, and implications for monitoring and assessment. *Fish and Fisheries*, *19*(2), 225–243. https://doi.org/10.1111/faf.12251

Institut Català de Recerca per a la Governança del Mar (ICATMAR). Diagnosi de la pesca marítima recreativa a Catalunya (2020) 24 pp. Treball tècnic (21). Direcció General de Pesca i Afers Marítims, Generalitat de Catalunya.

Institut Català de Recerca per a la Governança del Mar (ICATMAR). Evolució de les Captures i els Preus de Venda del Sector Pesquer a Catalunya: Comparativa 2018-2019 (ICATMAR, 20-06) 92pp, Barcelona.

Institut Català de Recerca per a la Governança del Mar (ICATMAR). Report on the continuous monitoring of marine recreational fishing in Catalonia (ICATMAT, 21-04), Barcelona.

McPhee, D. P., Leadbitter, D., & Skilleter, G. A. (2002). Swallowing the bait: Is recreational fishing in Australia ecologically sustainable? *Pacific Conservation Biology*, *8*(1), 40–51. https://doi.org/10.1071/pc020040

Michailidis, N., Katsanevakis, S., & Chartosia, N. (2020). Recreational fi sheries can be of the same magnitude as commercial fi sheries : The case of Cyprus. *Fisheries Research*, *231*(July), 105711. https://doi.org/10.1016/j.fishres.2020.105711

Rocklin, D. et all (2014). Combining Telephone Surveys and Fishing Catches Self- Report: The French Sea Bass Recreational Fishery Assessment, *9*(1). https://doi.org/10.1371/journal.pone.0087271

Ruiz, J.Z.L., Urtizberea, A., Andonegi, E., Mugerza, E., Artetxe, I., 2014. In: Gondra, J.R. (Ed.), Establecimiento de un sistema de recogida sistemática de datos sobre PESCA RECREATIVA. AZTI-Tecnalia, Sukarrieta.

Strehlow, H. V, Schultz, N., Zimmermann, C., & Hammer, C. (2012). and management, *69*, 1769–1780.

Vitale, G., Dedeu, A. L., Pujol, M., & Sbragaglia, V. (2021). Characterizing the Profile of Recreational Fishers Who Share Their Catches on Social Media, *8*(November), 1–12. https://doi.org/10.3389/fmars.2021.768047

Annexes

ANNEX I

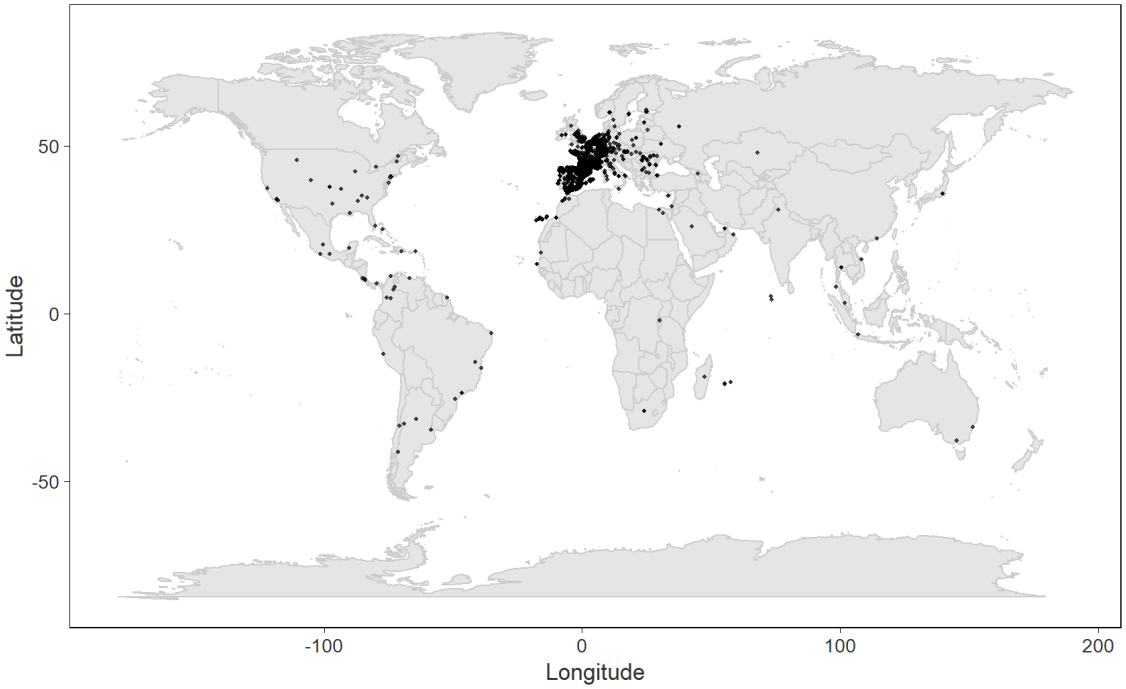


Figure 37. Locations of all responses to online surveys conducted by marine recreational fishers during 2020-2023.

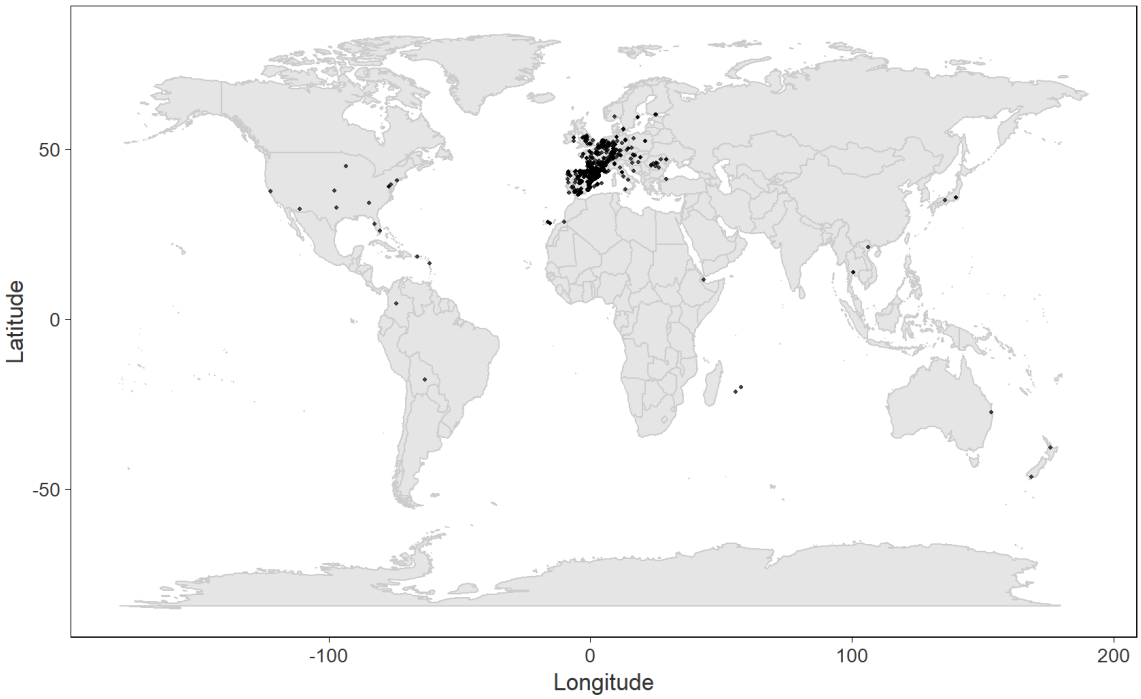


Figure 38. Locations of all responses to online surveys conducted by marine recreational fishers during 2024.

ANNEX II

Table 21. Monthly average shore angling fishing effort (in days) calculated from online surveys data in the period 2020-2023 and 2024 by answering the question: "How many times have you gone fishing in the last 4 weeks?" Standard error is indicated in parentheses.

Shore angling								
Year 2020-2023	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
January	0.21	0.06	0.31	0.05	1.33	0.15	5.76	0.63
February	0.13	0.06	0.32	0.06	1.52	0.17	4.41	0.52
March	0.05	0.02	0.37	0.05	1.28	0.14	4.81	0.44
April	0.31	0.08	0.79	0.07	1.95	0.16	6.99	0.54
May	0.47	0.08	0.94	0.08	2.86	0.21	6.64	0.51
June	0.58	0.10	1.25	0.09	3.13	0.22	7.43	0.50
July	0.50	0.07	1.55	0.08	3.36	0.20	7.62	0.52
August	0.80	0.07	2.14	0.09	4.79	0.24	8.96	0.55
September	0.45	0.07	1.28	0.07	3.34	0.19	7.69	0.59
October	0.27	0.06	1.01	0.07	2.70	0.15	6.82	0.46
November	0.09	0.03	0.63	0.05	1.99	0.13	6.31	0.46
December	0.16	0.05	0.41	0.04	1.67	0.14	5.61	0.38
Year 2024	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
January	0.25	0.11	0.64	0.10	2.10	0.29	6.15	0.76
February	0.05	0.05	0.82	0.17	1.66	0.30	5.79	1.04
March	0.15	0.11	0.85	0.17	1.58	0.23	4.92	0.71
April	0.71	0.16	1.34	0.17	2.69	0.42	7.24	1.09
May	0.90	0.19	1.31	0.22	2.15	0.31	6.60	1.06
June	0.42	0.17	1.97	0.21	3.76	0.41	8.03	0.95
July	0.68	0.12	1.97	0.16	3.82	0.38	8.07	1.08
August	0.76	0.15	2.31	0.22	5.03	0.55	8.33	1.12
September	0.34	0.11	1.59	0.20	2.85	0.44	5.16	0.80
October	0.29	0.10	1.01	0.18	2.81	0.37	5.76	0.92
November	0.26	0.15	0.63	0.13	1.76	0.35	8.10	1.83
December	0.33	0.11	0.71	0.17	2.61	0.31	5.96	1.30

Table 22. Monthly average boat angling effort (in days) calculated from online surveys data in the period 2020-2023 and 2024 by answering the question: "How many times have you gone fishing in the last 4 weeks?" Standard error is indicated in parentheses.

Boat angling								
Year 2020-2023	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
anuary	0.23	0.11	0.43	0.09	1.16	0.15	4.45	0.53
ebruary	0.00	0.00	0.54	0.12	1.47	0.19	6.75	0.94
March	0.10	0.09	0.38	0.08	1.41	0.16	4.43	0.62
April	0.55	0.24	0.67	0.10	2.08	0.23	7.02	0.94
May	0.25	0.13	0.95	0.12	2.35	0.28	5.90	0.51
une	0.22	0.14	1.24	0.16	2.55	0.20	8.03	0.61
uly	0.50	0.13	1.82	0.15	3.77	0.29	8.01	0.58
August	0.74	0.18	2.21	0.18	4.91	0.28	9.55	0.59
eptember	0.71	0.17	1.52	0.16	4.31	0.34	7.67	0.62
October	0.39	0.15	1.20	0.12	3.20	0.21	7.40	0.57
November	0.00	0.00	0.58	0.08	2.44	0.20	6.70	0.62
December	0.18	0.12	0.35	0.06	2.04	0.17	6.02	0.52
Year 2024	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
anuary	0.00	0.00	0.60	0.12	2.10	0.30	7.00	1.09
ebruary	0.00	0.00	0.34	0.15	1.51	0.42	4.00	1.49
March	0.25	0.22	0.63	0.17	1.43	0.39	4.54	0.76
April	0.60	0.36	0.61	0.23	1.62	0.33	5.60	1.05
May	0.40	0.36	1.70	0.60	3.65	0.68	5.94	0.96
une	0.80	0.44	1.03	0.20	3.38	0.51	7.23	1.31
uly	0.29	0.17	1.76	0.28	3.19	0.55	10.55	2.01
August	0.25	0.15	2.85	0.37	5.02	0.61	8.67	0.93
eptember	1.00	0.40	1.12	0.23	3.21	0.42	7.56	1.11
October	0.25	0.22	1.06	0.37	2.30	0.46	4.85	1.09
November	0.50	0.35	0.69	0.17	2.10	0.43	7.67	1.29
December	0.80	0.44	0.45	0.20	1.74	0.31	6.32	0.91

Table 23. Monthly average spearfishing effort (in days) calculated from online surveys data in the period 2020-2023 and 2024 by answering the question: "How many times have you gone fishing in the last 4 weeks?" Standard error is indicated in parentheses.

Spearfishing								
Year 2020-2023	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
January	0.18	0.17	0.52	0.14	1.19	0.22	3.33	1.17
February	0.33	0.16	0.36	0.10	1.22	0.26	4.27	0.65
March	0.00	0.00	0.51	0.24	1.25	0.20	4.55	0.98
April	0.14	0.13	0.49	0.13	1.71	0.26	6.00	0.85
May	0.38	0.25	0.93	0.22	1.84	0.41	2.82	0.93
June	1.00	0.47	2.05	0.23	3.45	0.48	6.11	1.05
July	0.73	0.21	2.48	0.30	4.28	0.59	8.38	1.30
August	0.50	0.23	2.98	0.26	5.68	0.41	9.25	0.82
September	0.25	0.22	1.38	0.21	4.18	0.45	7.53	0.68
October	0.00	0.00	0.81	0.15	2.51	0.31	6.45	0.77
November	0.20	0.18	0.52	0.09	1.35	0.15	4.31	0.66
December	0.00	0.00	0.31	0.07	1.70	0.27	3.91	0.59
Year 2024	Sporadic		Low		Medium		High	
	mean	se	mean	se	mean	se	mean	se
January	0.67	0.54	0.52	0.18	0.94	0.26	5.50	2.31
February	0.50	0.35	0.50	0.27	1.29	0.57	5.33	2.37
March	0.00	0.00	0.71	0.28	1.57	0.45	3.25	0.96
April	0.67	0.27	1.17	0.45	2.55	0.47	4.50	1.40
May	0.00	0.00	1.14	0.51	2.46	0.68	6.73	1.11
June	0.00	0.00	1.43	0.32	2.00	0.42	2.25	0.89
July	0.80	0.44	2.94	0.46	4.36	1.03	9.20	2.03
August	1.40	0.30	3.50	0.54	8.11	1.03	9.40	1.40
September	0.00	0.00	1.44	0.45	3.05	0.64	6.50	1.06
October	1.00	0.00	1.20	0.44	1.33	0.37	7.40	0.67
November	0.00	0.00	0.45	0.22	1.59	0.35	3.75	2.41
December	0.00	0.00	0.35	0.20	1.80	0.70	1.67	0.27

ANNEX III: Catch per Unit Effort (kg/day)

Table 24. Means and standard deviations of catch per unit effort values (in kg/day) per fishing modality and per year.

	Shore angling		Boat angling		Spearfishing	
	2020-2023	2024	2020-2023	2024	2020-2023	2024
mean	0.43	0.62	2.33	1.30	1.62	1.41
sd	±1.07	±1.30	±10.8	±3.17	±2.08	±1.98
se	±0.02	±0.06	±0.25	±0.12	±0.08	±0.12
ic	0.05	0.11	0.48	0.24	0.15	0.23

ANNEX IV: Intended target species

RecreationalRecreational fishers mostly have a specific catch or set of catches in which they are interested. The intended target species must be considered merely as 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 Dicentrachus labrax. Other target species include cephalopods, such as Sepia officinalis, and Octopus vulgaris. The intended target species answers from all the average 2020-2023 and 2024 are shown in Figure 39.

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 both periods, boat anglers from the Catalan coast aimed to catch the most popular cephalopods, S. officinalis and Loligo vulgaris 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 species such as Sarda sarda and Coryphaena hippurus. It is worth mentioning that due to specific fishery regulations for Thunnus thynnus, this 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 S. aurata, followed by Dicentrarchus labrax, and D. dentex. Also, the main cephalopod caught is the common octopus O. vulgaris. There is also interest to catch Epinephelus marginatus. The intended target species are very similar between both studied periods, aiming to catch S. aurata, followed by D dentex, and D. labrax (Figure 39).

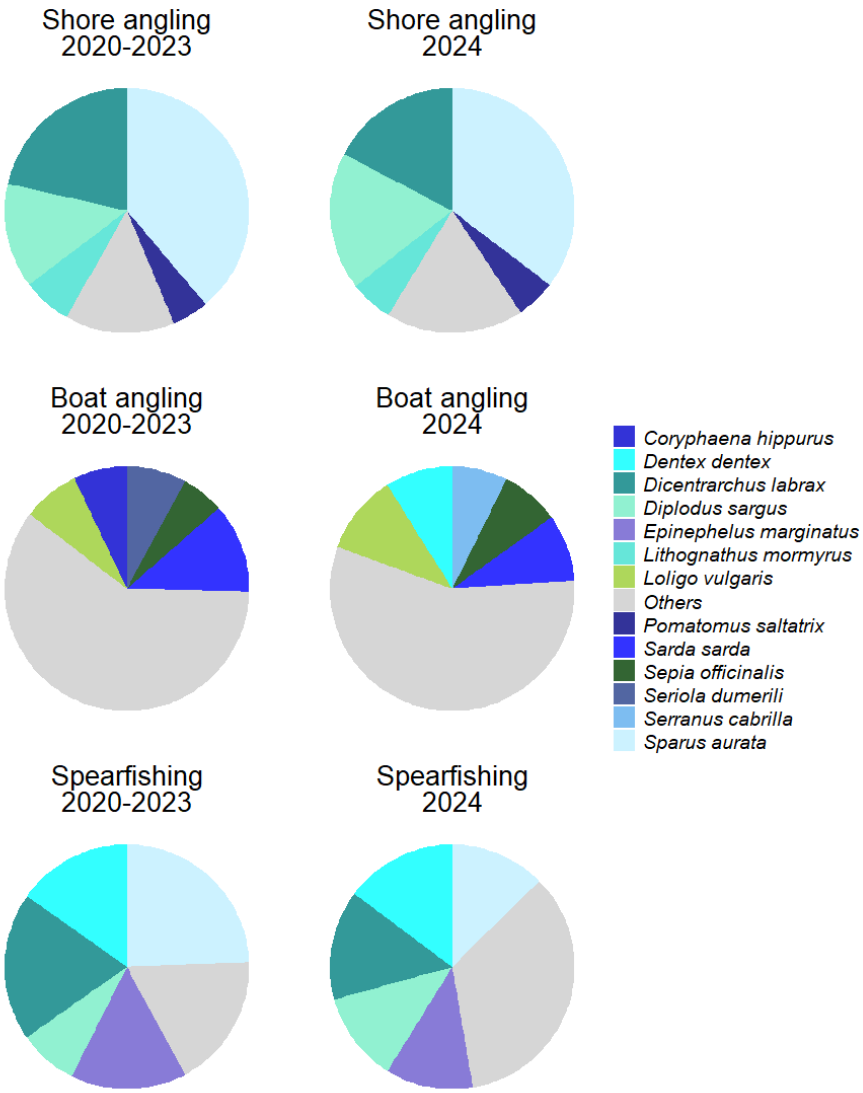


Figure 39. Proportion of species declared as target in onsite surveys in the period 2020-2023 and in 2024 by fishing modalities.

ANNEX V: Distribution of the total activity expenditure

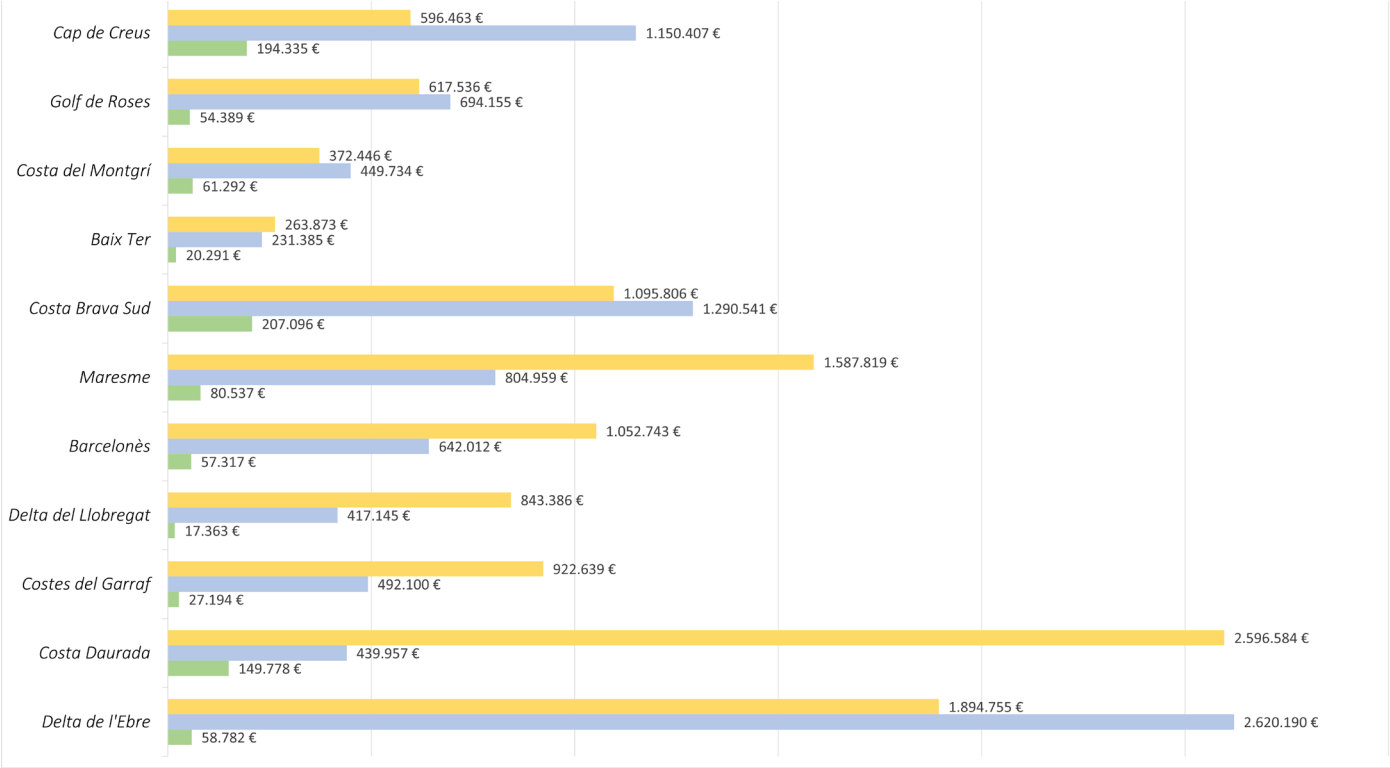


Figure 40. Estimate of total annual fishing gear expenditure (in euros) related to fishing activity for each modality by zone during the period 2020-2023.

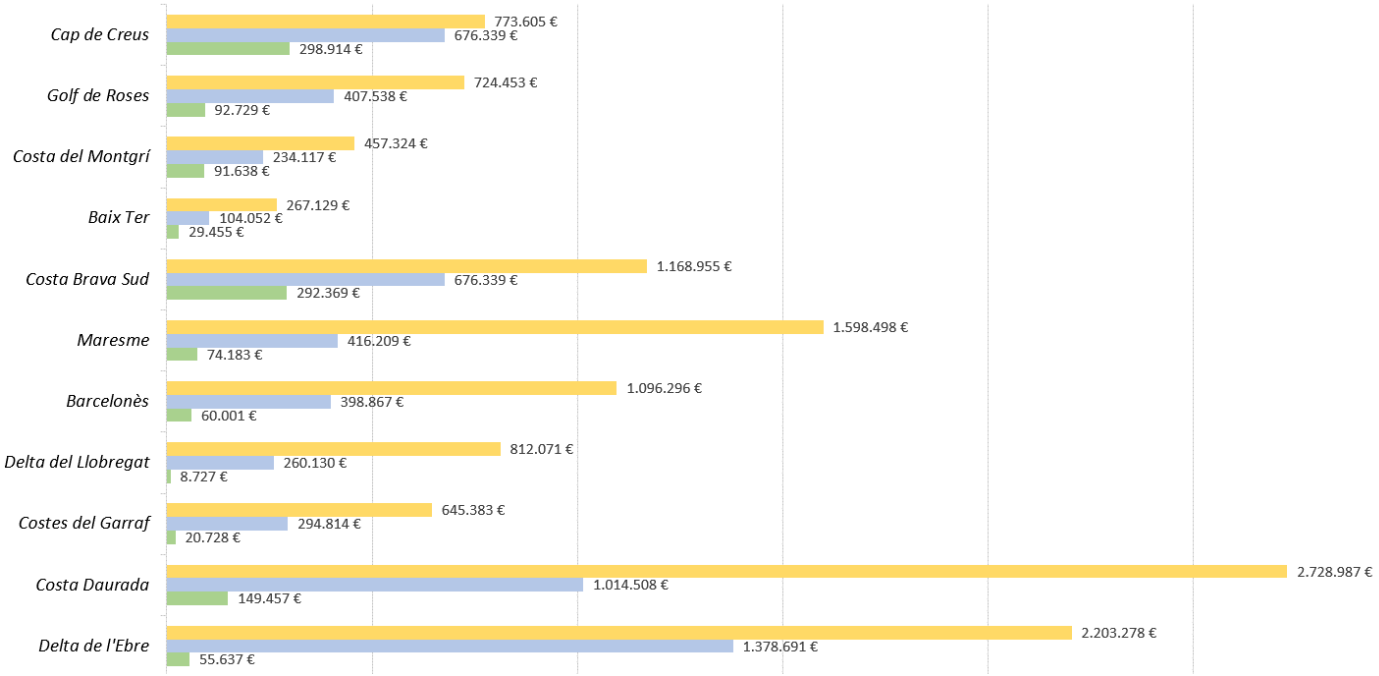


Figure 41. Estimate of total annual fishing gear expenditure (in euros) related to fishing activity for each modality by zone during 2024.

ANNEX VI: List of species

Table 25. Alphabetic list of all species observed with scientific and common names.

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

Table 25 (cont.). Alphabetic list of all species observed with scientific and common names.

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

icat mar

Institut Català de Recerca per a la Governança del Mar

www.icatmar.cat

Co-funded by the European Union

Generalitat de Catalunya

CSIC

Consejo Superior de Investigaciones Científicas

Institut de Ciències del Mar