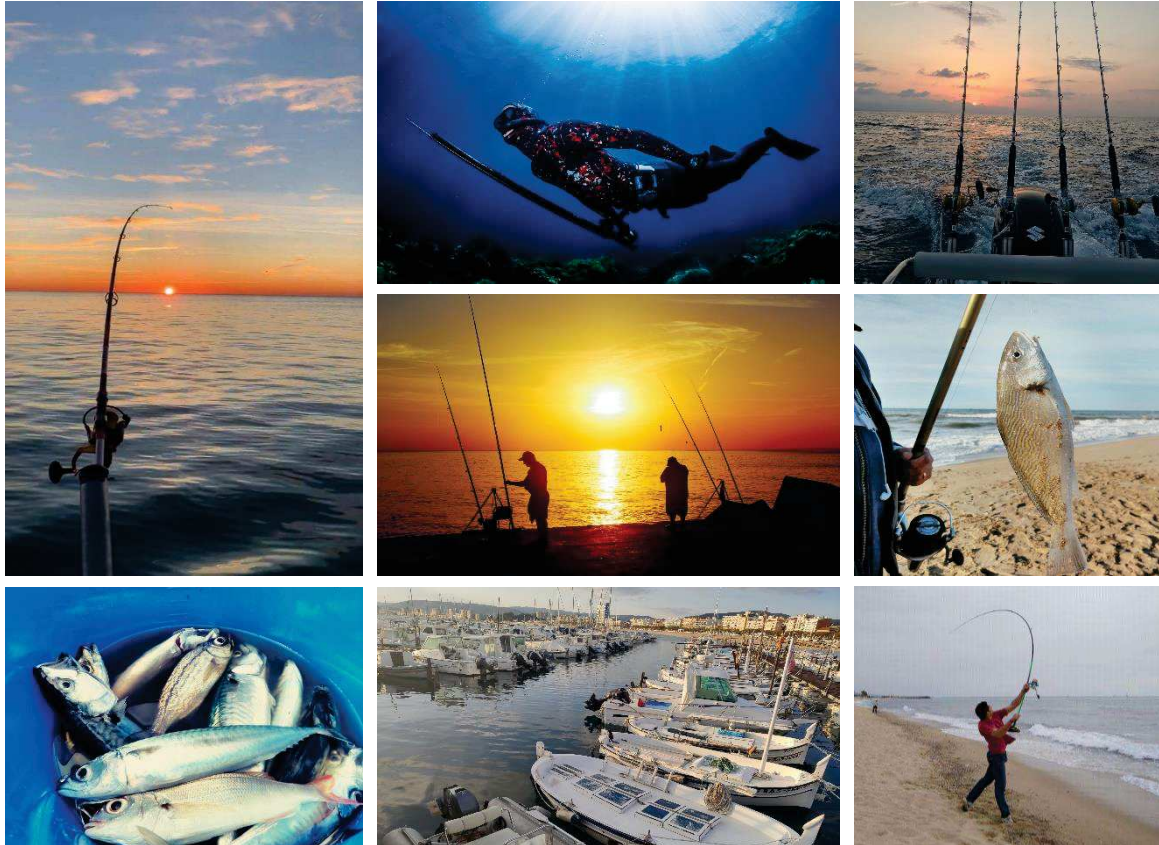


Institut Català de Recerca per a la Governança del Mar (ICATMAR)

Diagnosis of Marine Recreational Fishing in Catalonia 2019 (ICATMAR, 20-04)



Edited by: Arnau L. Dedeu



Institut Català de Recerca
per a la Governança del Mar



Generalitat de Catalunya
Departament d'Agricultura,
Ramaderia, Pesca i Alimentació



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Institut
de Ciències
del Mar

This document presents the main results of a pilot study on marine recreational fishing in Catalonia during 2019. It was produced by the Catalan Institute for Ocean Governance Research (ICATMAR), which is a cooperation organism between the Directorate-General of Fisheries and Maritime Affairs (DGPAM) of the Ministry of Agriculture, Livestock, Fisheries and Food (DARP) of the Government of Catalonia and the Institute of Marine Sciences (ICM) of the Spanish National Research Council (CSIC).

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1. CONTEXT

Marine recreational fishing is a non-professional activity practiced for recreation or sport with no commercial interests. In Catalonia, it has deep historical roots in coastal towns and, still today, holds great social and cultural relevance. The activity includes three modalities: shore fishing, boat fishing and spearfishing. All three have sustained important growth during the past decades. This in part has been associated with the increase in popularity of outdoor activities; also, the increase in tourism may contribute to activity growth. Similar growth trends have been observed in other countries in the south of Europe (FAO, 2016).

Recreational fishing coexists with the commercial fishing sector, both activities often affecting the same fishing resources. Nonetheless, the degree of overlap of both activities is generally unknown. This, combined with the increasing activity trend, has sparked interest by both fisheries managers and the scientific community in recent years (Hyder et al., 2017). Currently there is general consensus that new fisheries management models and assessments must incorporate recreational catches (Cooke & Cowx, 2006).

In this context, the Directorate-General of Fisheries and Marine Affairs of the Government of Catalonia (DGPAM), has initiated a data collection programme, which has been designed and implemented by the Catalan Institute for Ocean Governance Research (ICATMAR). Taking into consideration the recommendations made by the International Council for the Exploration of the Sea (ICES), in 2019, a pilot test was launched consisting in voluntary online and onsite surveys. The online surveys were sent to available emails from the licence registry and were made open access so they could be shared with other users, including those not holding a fishing licence. Onsite surveys were also undertaken to obtain contrasted information as well as biological data from catches.

The results obtained are published in the 2019 ICATMAR annual report (available in the Ministry of Agriculture, Livestock, Fisheries and Food website <http://agricultura.gencat.cat/>). This document is an executive summary of the main results.

2. METHODS

The online and onsite surveys were designed in coordination, sharing sets of questions related to fishing modality, socioeconomic profile, fishing activity, goal catches and expenses. Additionally, the online survey focussed specifically on obtaining year-round averages of fishing indicators, expenses and locations visited to fish. The onsite survey additionally observed daily catches, taking measures and weights when possible.

Onsite surveys were undertaken by personnel with first-hand experience as recreational fishers. Between September and May 2019, a total 30 surveying days were deployed. These were distributed between different ports, beaches and littoral reefs to obtain information from participants during or just after the activity took place. Surveys were done both during weekdays and weekends, and in the morning, afternoon or at dusk depending on the target modality. Boat fishing surveys were exclusively done in ports and surveys were conducted at the return from fishing outings. Shore fishing and spearfishing surveys were conducted following the coastline either by foot or by motorboat depending on the accessibility of beaches, rocky shores and reefs. In order to optimize survey effort, the pilot study included 11 zones of the central and northern parts of Catalonia representing a range of different environmental characteristics.

The online data collection was done using a software that allows designing and distributing online surveys to large e-mail lists. The survey could be responded using PCs, cell phones and tablets. Language options were available in Catalan, Spanish, English and French. The survey could be completed in under 10 minutes. It was disseminated to a total 41,644 available e-mails from the licence registry that had been voluntarily provided by users who requested a licence between the January 1st 2014 and December 31st 2018 (the field in the registry was non-mandatory). The survey was also communicated in an official press note and via the Catalan Government's Ministry of Agriculture, Livestock, Fisheries and Food (DARP for its initials in Catalan) social media accounts. In parallel, the survey was disseminated to relevant representatives of the recreational fishing sector, such as the Catalan Federation of Subaquatic Activities or the Catalan Federation of Sport Fishing and Casting, as well as other local entities. The survey application was open from June 14th until August 25th 2019.

The geographical framework of the study was the whole of the Catalan coast. It was divided into 3 great regions (north, centre and south) sectioned into a total 21 zones with similar environmental conditions (Figure 1). Zones were determined by similarities in substrate and nutrient availability, and were delimited by clear structures such as ports, lighthouses, rivers or streams. The 8 zones comprised between Porbou and Port Blanes were grouped into the northern region of the country, the 5 zones within the limits of Blanes and Port Vilanova i la Geltrú were considered the central region, and the area that goes from Vilanova i la Geltrú until the river Sènia was the southern region.

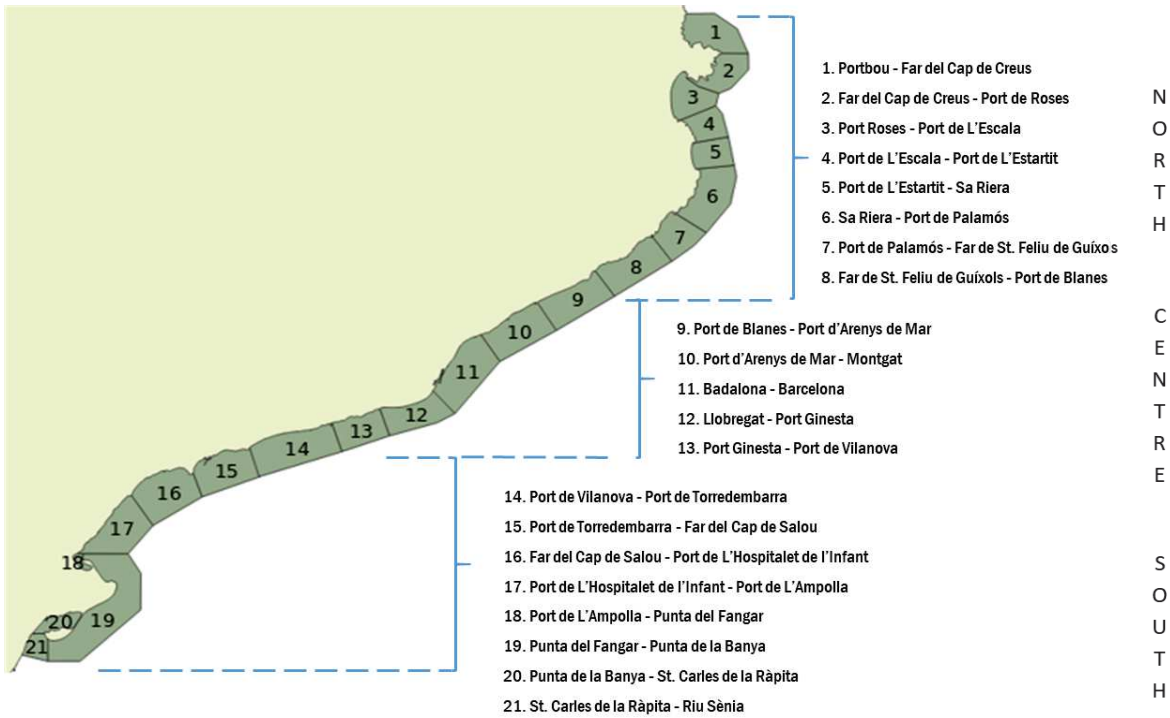


Figure 1. Division of the Catalan littoral into 21 zones. Zones 1-8 correspond to the north region, zones 9-13 to the central region and zones 14-21 to the south region.

3. RESULTS AND DISCUSSION

The section presents the relevant information obtained by each method (online and onsite surveys) and details the data sources used in each case.

3.1 Survey response

The onsite survey campaign obtained a total 423 personal survey responses out of a total 485 engaged fishers (86% response rate). Of these, 188 (44%) were shore fishers, 188 (44%) were boat fishers, and 47 (11%) were spearfishers. Foreign fishers accounted for 10% of the total volume. The most common foreign nationalities were France, Belgium, Germany and Romania. Most fishers (83%) declared only practicing one fishing modality.

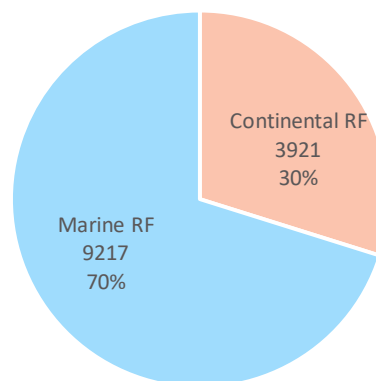


Figure 2. Number of online survey responses and percentage of total respondents practicing mainly continental (orange) and marine (blue) recreational fishing (RF).

The online survey was directed to recreational fishers fishing in both marine and continental waters, as the licence system does not discriminate between the two environments. A total 13,138 responses were obtained, out of which 9,217 were from fishers mainly fishing in marine waters and 3,921 of which mainly fished in continental waters (Figure 2). Most responses from marine fishers were answered from within Catalonia, although many responses were also obtained from other Spanish regions, France, Switzerland, Belgium, the Netherlands, the United Kingdom and Morocco.

3.2 Activity volume by modality

According to the DARP recreational fishing licence registry, the total number of valid active licences for surface fishing during 2018 was 60,588. Using the proportions obtained from the online survey, 42,506 licences would account for fishers mainly practicing marine fishing and 18,082 would be used by fishers fishing mostly in continental waters. Additionally, in 2018 there were 2,942 active subaquatic fishing licences.

Of the total marine fishers, 65% of respondents practiced shore fishing, 22% fished from a boat and 13% were subaquatic fishers; also, 22% of respondents practiced more than one fishing modality, and 3% practices all three modalities. Both the online and the onsite surveys found that subaquatic fishers were the most prone to practice more than one modality.

Both surveys collected data on unlicensed fishers. Around 20% of shore fishers and spearfishers practiced the activity without a valid licence, for boat fishers, the unlicensed activity neared 10%. These results allow estimating a total activity of 53,830 marine recreational fishers accounting for illegal fishers (Figure 3).

Marine recreational fishing would thus involve loosely below 1% of the total Catalan population, which would represent a relatively small participation in contrast with other autonomous communities in Spain of the Mediterranean littoral. In the Valencian Community, for instance, participation is around 2%, in the Region of Murcia 3.6%, in Andalusia 3.4% and in the Balearic Islands 4.7%. (Gordoa et al., 2019).

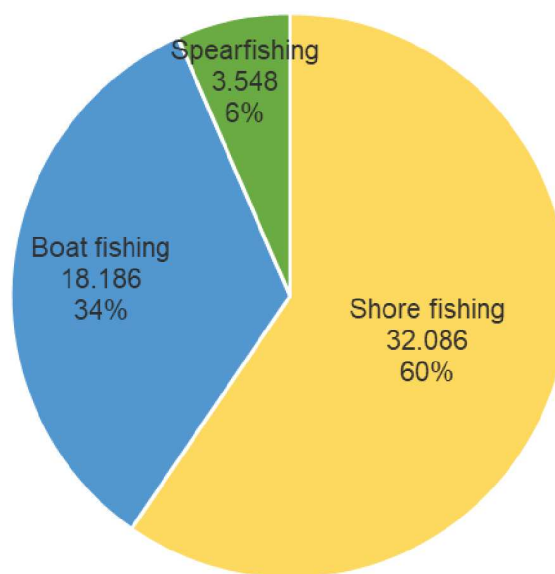


Figure 3. Estimation of total activity by modality. Participation values for shore and boat fishing were obtained as the number of estimated active licences by modality (for spearfishing, the known number of licences were used) plus the estimated number of unlicensed participants.

3.3 Social profile

Marine recreational fishing is a primarily male activity. Results from the onsite survey found a 96% of male participation; the online survey obtained a similar result (94%; Figure 4). As for the language of preference chosen to respond the online surveys, most participants chose Spanish (59%), followed by Catalan (34%), French (5%) and english (2%; Figure 5).

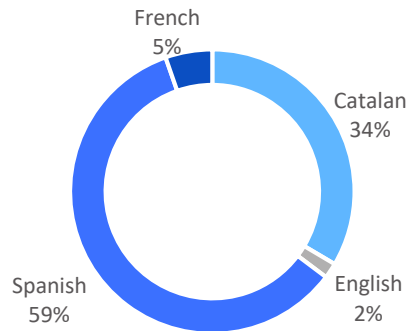
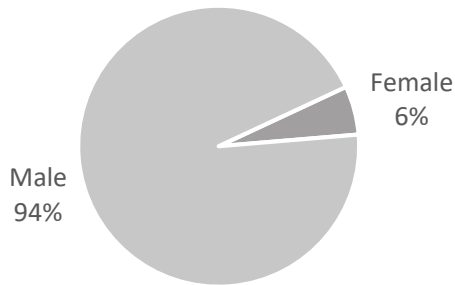


Figure 4. Percentage of responses by genre. 0.2 % of respondents selected the non-binary option "other".

Figure 6. Language chosen to respond the survey.

Average participant age using the onsite survey method was 47, and the average experience practicing recreational fishing was 15 years. This result was similar to the onsite survey results, which obtained an average age of 46. Differences were found between modalities, with boat fishers averaging 51 years, shore fishers 44 years, and spearfishers 43 years. The age distribution of the online responses was representative of that Catalan population age distribution (Catalan Institute of Statistics; Figure 6).

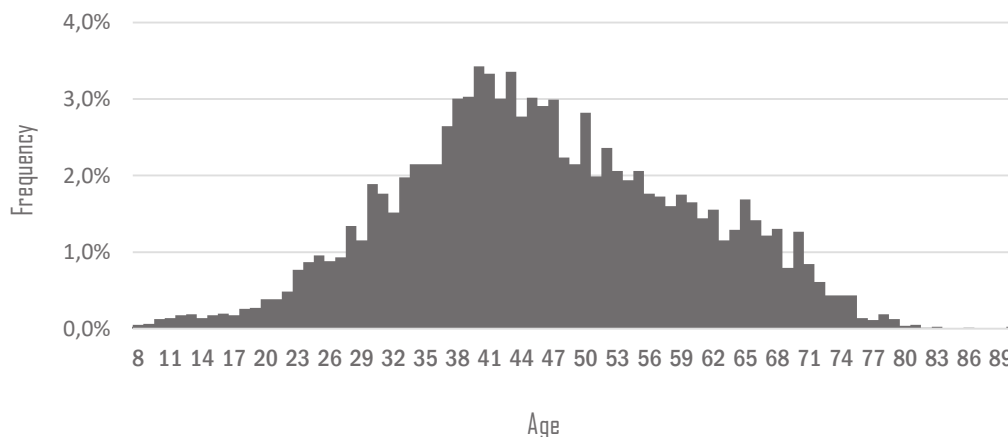


Figure 6. Age frequency obtained by the online survey.

As for participant education levels, an important proportion of participants had attained higher studies (32%), most had continued their formation after mandatory secondary school (68%), while 12% had not completed this stage (Figure 7). Occupation-wise, 78% of participants were actively working and the remaining 22% were either students, retirees, unemployed or people with permanent working impediments (Figure 8).

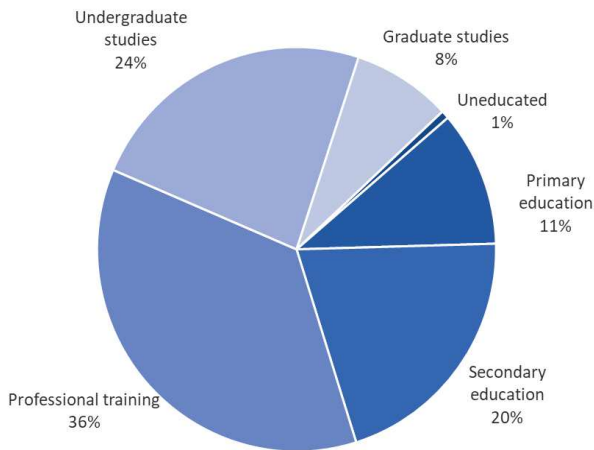


Figure 7. Attained studies of online survey respondents.

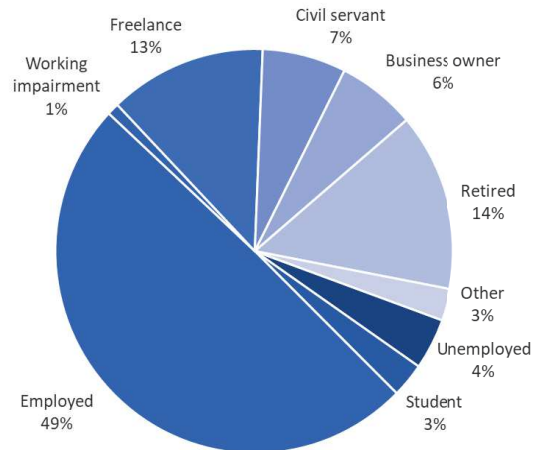


Figure 8. Working status of online survey respondents.

Close to 90% of onsite respondents declared practicing the activity mostly in company. This evidences the highly social nature of recreational fishing in Catalonia. Additionally, a considerable proportion of fishers (40%) participate in fishing social networks.

Nevertheless, altogether participation in organized groups, associations or federations is low. Onsite surveys and online surveys found that organizations respectively represented 25 and 18% of participants. The low level of association is especially notable for shore fishing, for which both surveying methodologies found an association rate of 9%; for boat fishing the rate was higher, 27% in the onsite and 22% in the online surveys, while spearfishers showed a very high level of association, with 63 and 46% found for both methods respectively. As for participation in fishing competitions, 11% of total participants declared actively engaging at least occasionally.

3.4 Fishing effort

Onsite surveys obtained fishing effort values representing the total hours invested in the activity during fishing outings. The online method obtained information of both daily fishing hours and average annual fishing days. The results obtained represented a wide spectrum of fishing avidity. However, the discrepancies observed between methods evidence the considerable extent of the different biases affecting both methods (see conclusions).

Considering annual effort, boat fishing would be the modality with a greatest fishing effort, followed by shore fishing. Spearfishing would be the least effort-intensive activity (Table 1). For all three modalities, most fishers are below average in effort intensity, whereas a small proportion of fishers invests up to 5 times the annual average effort (ANNEX I).

Table 1. Results obtained by the onsite* and online** surveys on the average duration of fishing trips and average fishing trips per year for each fishing modality.

| | Hours per trip* | Hours per trip** | Trips per year** |
|---------------|-----------------|------------------|------------------|
| Shore fishing | 5.5 | 4.8 | 24.9 |
| Boat fishing | 4.1 | 4.3 | 32.3 |
| Spearfishing | 4.3 | 3.5 | 27.1 |

Shore fishing effort is distributed heterogeneously throughout the Catalan coast (ANNEX II). Densely populated areas accumulate higher total effort, as do accessible areas that are well connected to the metropolis. Sandy beach areas also received higher fishing efforts compared to zones dominated by rocky shores.

Boat fishing was distributed heterogeneously and was highly port-dependant. No evident geographic distribution could be observed that could relate effort to population density or to port size. Ports with higher activity were Port St. Carles de la Ràpita, Port Torredembarra, Port Ginesta, Port Badalona, Port Mataró, Port L'Estartit and Port L'Escala. In a few ports (Port Aiguablava, Port Llafranc, Marina Port Vell Barcelona, Reial Club Nàutic de Barcelona, Reial Club Marítim de Barcelona, Port Vallcarca and Port Alcanar), detected activity was residual. Boat fishing was mostly practiced from boats that were owned by the respondents, secondarily, from boats owned by friends or family. Rental and charter boats had a smaller, but not insignificant importance.

For underwater spearfishing, effort was concentrated mainly in rocky coasts and areas with accessible rocky reefs. The northern and central regions are much more important than the southern parts of Catalonia (dominated by sandy beaches), with the exception of the rocky zone of L'Hospitalet de l'Infant until Port L'Ampolla, where the activity was more relevant.

3.5 Activity seasonality

Recreational fishing is a considerably seasonal activity. This has been observed for all three fishing modalities. All of them present activity peaks during the summer season and a strong decrease during winter (Figure 9). Shore fishing is comparatively more seasonal than the other two modalities, with a declared participation during the summer months almost triplicating that of winter. Conversely, spearfishing is least dissimilar during the warmer and cooler seasons; the activity also decreases considerably, but in this case it is only halved.

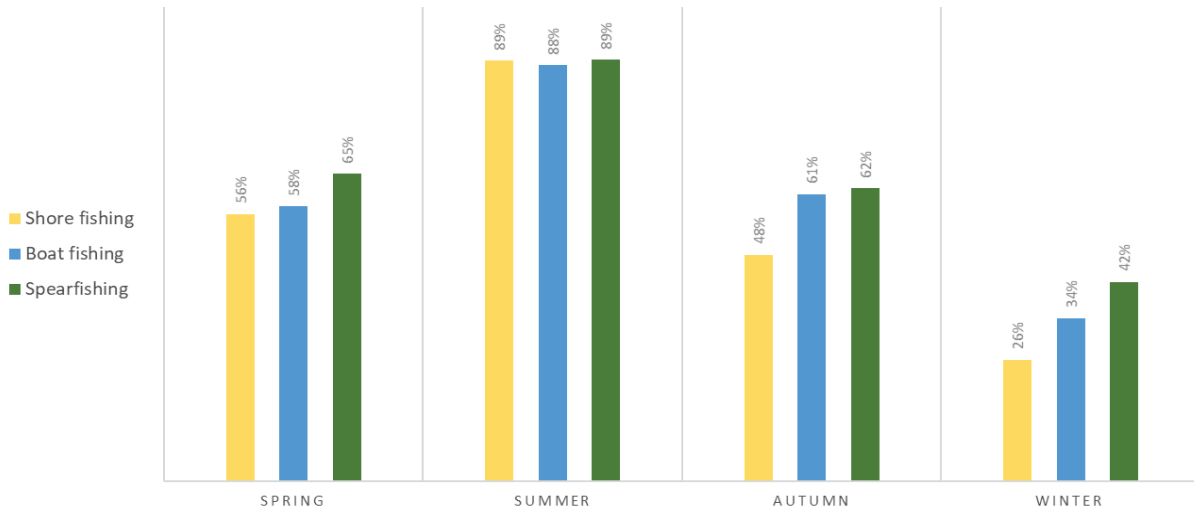


Figure 9. Percentage of participants practicing each modality by season.

Results from the online surveys showed that all three modalities are practiced primarily during weekends (65 – 68 % participation depending on the modality). Approximately half (48 – 58%) participants fished during holidays, and less than one third (24 – 29%) fished during weekdays. Nevertheless, the onsite surveys also observed an important number of fishers (34%) fishing during weekdays or weekends indifferently. Most of these were retirees and many of them declared having been initiated after their retirement and were mostly motivated by spending time outdoors rather than obtaining great catches. Shore fishing was practiced mostly during the afternoon, at dusk and at night, but also still significantly during the first hours of morning. Boat fishing was mainly practiced from dawn until midday, with a second activity peak during the evening until dusk. Spearfishing was mainly practiced from dawn until midday, and secondarily during the evening until dusk.

3.6 Fishing productivity

Catch per unit effort (CPUE) is a measure of fishing productivity. The results obtained by both survey methods showed important discrepancies (Table 2). Both methods are affected by important sources of bias: the onsite surveys tend to over-represent avid fishers (especially relevant for spearfishing), while the online surveys are affected primarily by memory and

Table 2. Average catch per unit effort (CPUE) by modality obtained by the onsite* and online** surveys.

| | CPUE* | CPUE** |
|---------------|---------|---------|
| | kg/trip | kg/trip |
| Shore fishing | 0.26 | 0.53 |
| Boat fishing | 1.50 | 1.03 |
| Spearfishing | 3.07 | 0.87 |

perception biases. CPUE results from the online surveys were used to estimate total catch, as they represented the ensemble of fishing avidity classes, geographic distribution and seasonality better than the more partial onsite surveys. There were significant differences between modalities using both methods, with shore fishing consistently showing low productivity.

3.7 Total annual catch

Total annual catch was estimated using the fishing indicator results from the online surveys. Total catch values were calculated individually for each respondent using their CPUE and effort values. The most harvest intensive activity was boat fishing (760 annual tonnes), followed by shore fishing (508 t) and spearfishing (98 t; Table 3). Altogether they added up to 1,366 annual tonnes, which represents a 5.3% of the total commercial catch in Catalonia in 2019. Results may be overestimated due to the method's inherent bias towards avid fishers,

Table 3. Average total annual catch by recreational fisher (RF) for each modality and total annual catch by modality. Estimates obtained from the online results.

| | Average annual catch per RF (kg/year) | Average annual catch (t/year) |
|---------------|--|----------------------------------|
| Shore fishing | 15.8 | 508 |
| Boat fishing | 41.8 | 760 |
| Spearfishing | 27.7 | 98 |
| Total | | 1,366 |

and may also be affected by memory and perception biases.

The total catch results that would be obtained using the onsite fishing indicator results would be a total 602.3 t. This quantity would represent a 2.36% of total commercial catches in 2019. Most of the catch would also be capitalized by boat fishing (515 t), but spearfishing (69 t) would overtake shore fishing (8.7 t). It must be considered that these data were obtained in the centre and north of Catalonia during 5 warm months, and that they have been extrapolated to the rest of the Catalan territory for the whole year.

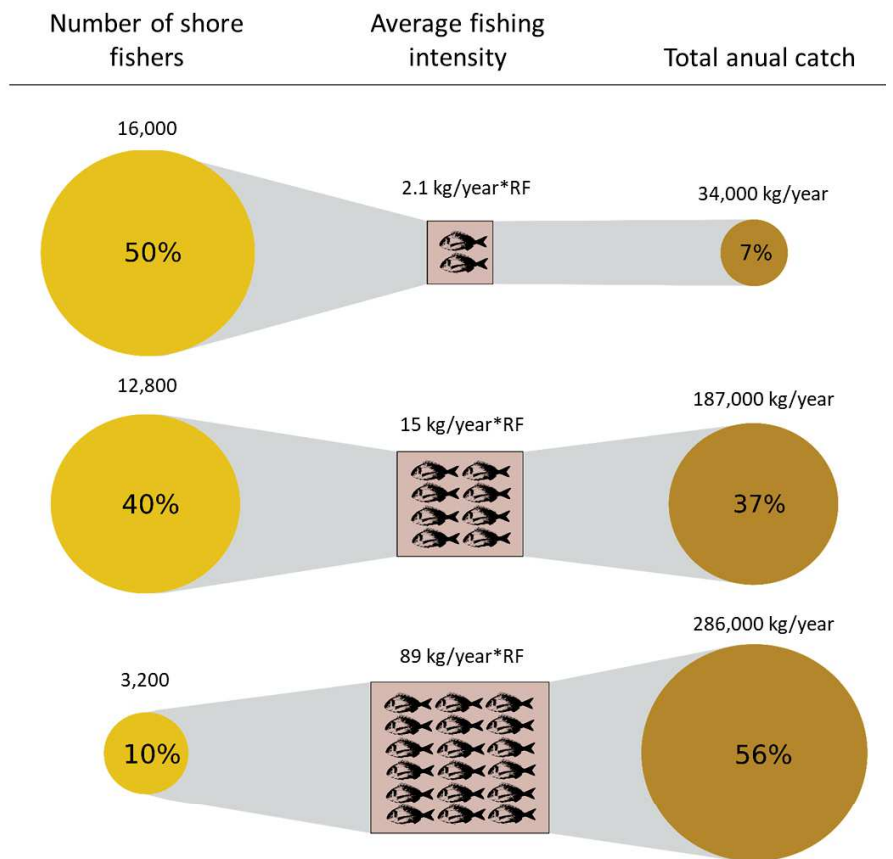
3.8 Inequality in the distribution of the total catch

Recreational fishers are notoriously heterogeneous in their fishing avidity and productivity. This causes that total individual catch per fisher values have very wide ranges. While a relatively small proportion of participants have very high annual catches, the majority of fishers' annual harvest is one order of magnitude smaller (Figures 10 – 12).

Shore fishing

For shore fishing, the 50% less intensive fishers were those that harvested under 5 kg/year (average 2,1 kg/year). They were responsible for 7% of total shore fishing harvest. The fraction of mid-intensity fishers (represented by the intermediate 40%) caught 5 to 40 kg/year (average 15 kg/year). The most intensive 10% caught between 40 and 420 kg/year (average 89 kg/year; Figure 10). Their catches added up to 56% of the modality's total catch.

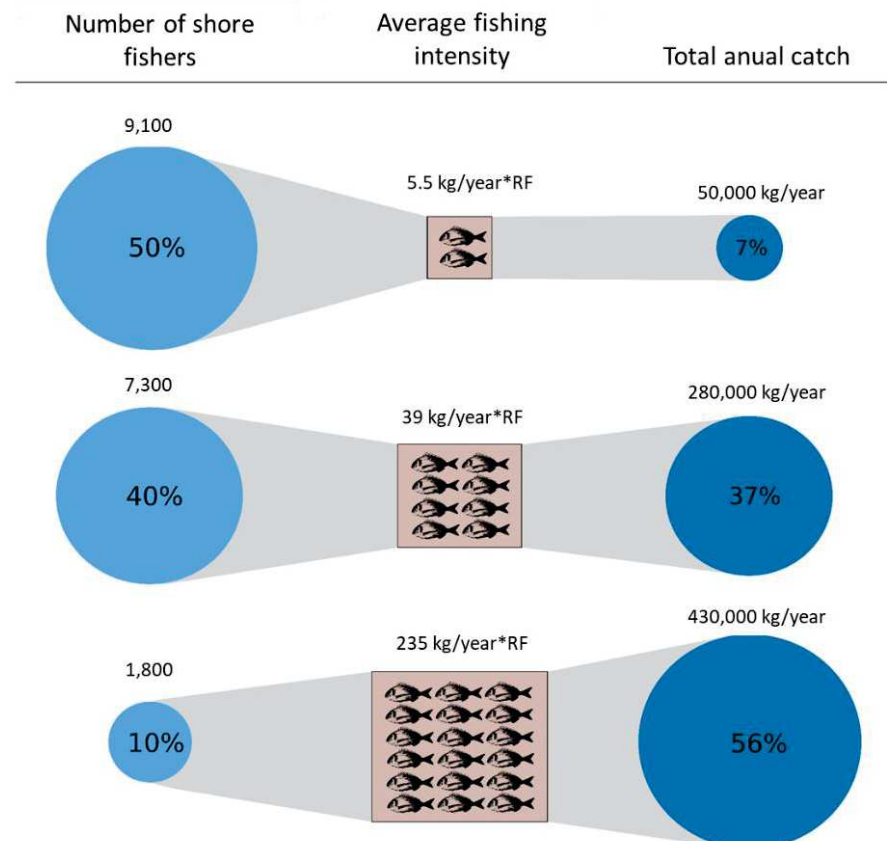
Figure 10. Left: shore fishers by fishing intensity class based on individual total annual catches (50% least intensive fishers, 40% intermediate intensity and 10% highest intensity fishers). Centre: Average total annual catch per fishing intensity class. Right: total annual catch corresponding to each fishing intensity class and percentage that that represents towards the total shore fishing annual catch. RF = Recreational fisher.



Boat fishing

For boat fishing, the least intensive 50% were those fishing under 14 kg/year. Altogether they represented less than 7% of the total modality catch. The intermediate intensity group were those catching between 14 and 100 kg/year, and were responsible for 280 t/year. The most intensive 10% caught 56% of the total boat fishing catch, 430 annual tonnes (Figure 11).

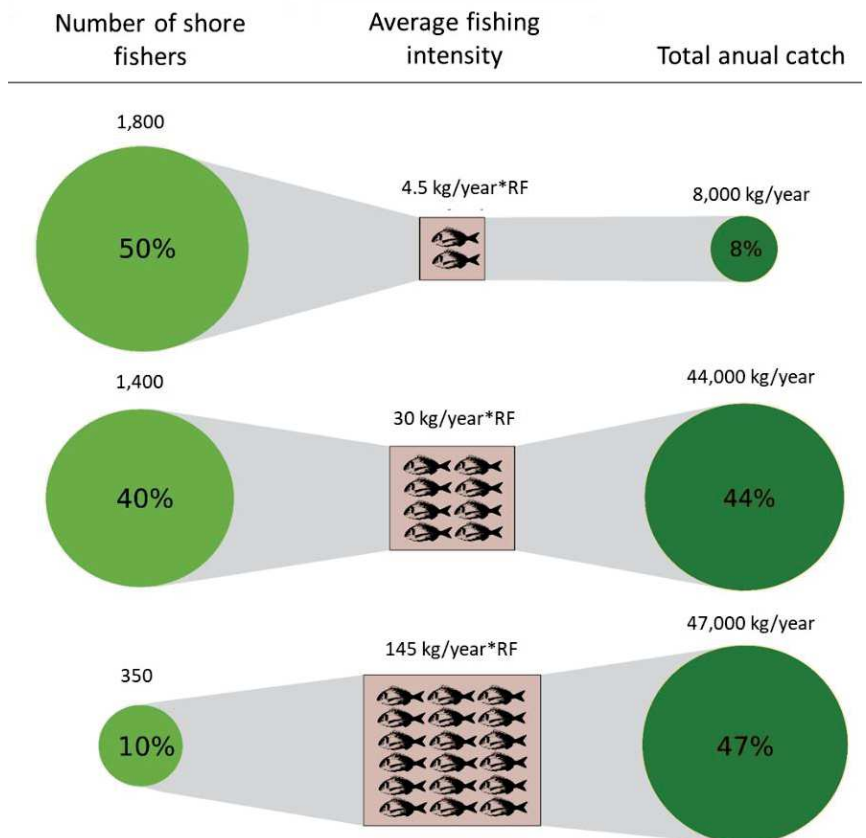
Figure 11. Left: boat fishers by fishing intensity class based on individual total annual catches (50% least intensive fishers, 40% intermediate intensity and 10% highest intensity fishers). Centre: Average total annual catch per fishing intensity class. Right: total annual catch corresponding to each fishing intensity class and percentage that that represents towards the total shore fishing annual catch. RF = Recreational fisher.



Spearfishing

The least intensive spearfishers caught under 10 kg/year, their harvest supposed 8% of the total annual modality harvest. Intermediate intensity spearfishers caught between 10 and 70 kg/year, averaging 30 kg/year and adding up to a 44% of the total catch. The most intensive spearfishers caught between 70 and 405 kg/year; their joint total catch added up to 47 t, just below 47% of the total modality harvest (Figure 12).

Figure 12. Left: spearfishers by fishing intensity class based on individual total annual catches (50% least intensive fishers, 40% intermediate intensity and 10% highest intensity fishers). Centre: Average total annual catch per fishing intensity class. Right: total annual catch corresponding to each fishing intensity class and percentage that that represents towards the total shore fishing annual catch. RF = Recreational fisher.



The unequal distribution between the different fishing intensity groups of the three modalities was remarkably similar, practically identical for shore and boat fishing. This common trend reflects the fact that most recreational fishers fish either occasionally or are not particularly focussed at maximizing productivity. What they obtain from fishing is probably less related to harvest satisfaction than to other hedonic values, such as enjoying the outdoors, sharing good company or taking pleasure from recreation or sport. Conversely, a smaller fraction of highly intensive fishers seems to be much more focussed on harvest, searching high yields. This, in turn, tends to require higher knowledge of the environment, greater fishing experience, dedication and adequate gear. Altogether, the more intensive 10% fishers had a greater fishing impact than the 90% intermediate and low intensity fishers combined.

3.9 Target species

The onsite survey allowed identifying a total 1,425 catches belonging to 62 different species, of which 1,413 individuals were measured and weighted. It must be considered that out of all the fishers surveyed, only 51% had at least one catch at the time of the interview. Surveyed shore fishers declared targeting mainly gilthead seabream (*Sparus aurata*) and other seabreams of the genus *Diplodus* (*Diplodus* spp.); boat fishers targeted mostly mackerel and horse mackerel (*Scomber* spp. and *Trachurus* spp.), atlantic bonito (*Sarda sarda*), pearly razorfish (*Xyrichtis novacula*), dentex (*Dentex* spp.) and common dolphinfish (*Coryphaena*

hippurus); spearfishes targetted dusky grouper (*Epinephelus marginatus*), seabreams (gilthead seabream and other seabreams), dentex, European seabass (*Dicentrarchus labrax*) and mullets (*Mugilidae*). A total 36 species were declared to be actively targetted by fishing activity in the online surveys. The main species in order of importance were the gilthead seabream, other *Diplodus* seabreams, mackerels (*Scomber* spp.), dentex and Atlantic bonito.

Shore fishing is mainly cantered in catching sparids. Seabreams are the predominant target catch, and including *Diplodus sargus*, *Diplodus vulgaris*, *Diplodus annularis* *Diplodus puntazzo*. Other sparids such as *Sparus aurata*, *Lithognatus mormyrus* and *Oblada melanura* are also of great importance. These are all common predators in Mediterranean coasts, particularly in the Catalan littoral and they generate a high interest by the recreational fishing community. The European seabass, which is common in the turbid waters of river mouths and has a great commercial and culinary interest, also shares an important position in recreational shore fisher catches. Mugilids such as the thicklip grey mullet (*Chelon labrosus*), the golden grey mullet (*Chelon aurata*) or the boxlip mullet were of a relatively low importance (around 7% declared targeting them), which contrasts with previous studies (Gordoa 2009; Dedeu et al., 2019), could be a result of the effect of seasonal bias (Figure 13).

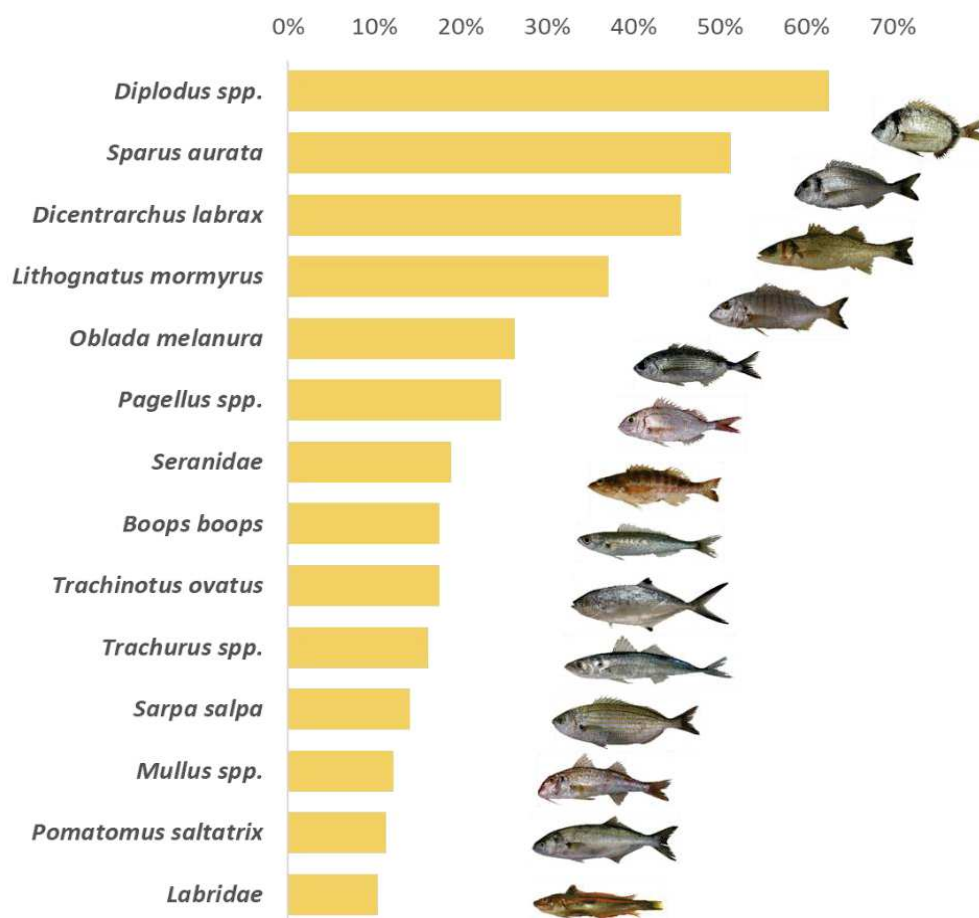


Figure 13. Species (or taxa) ranked by the percentage of shore fishers declaring to have them among their target species.

Boat fishing can be practiced using a great variety of techniques, which contributes to it being

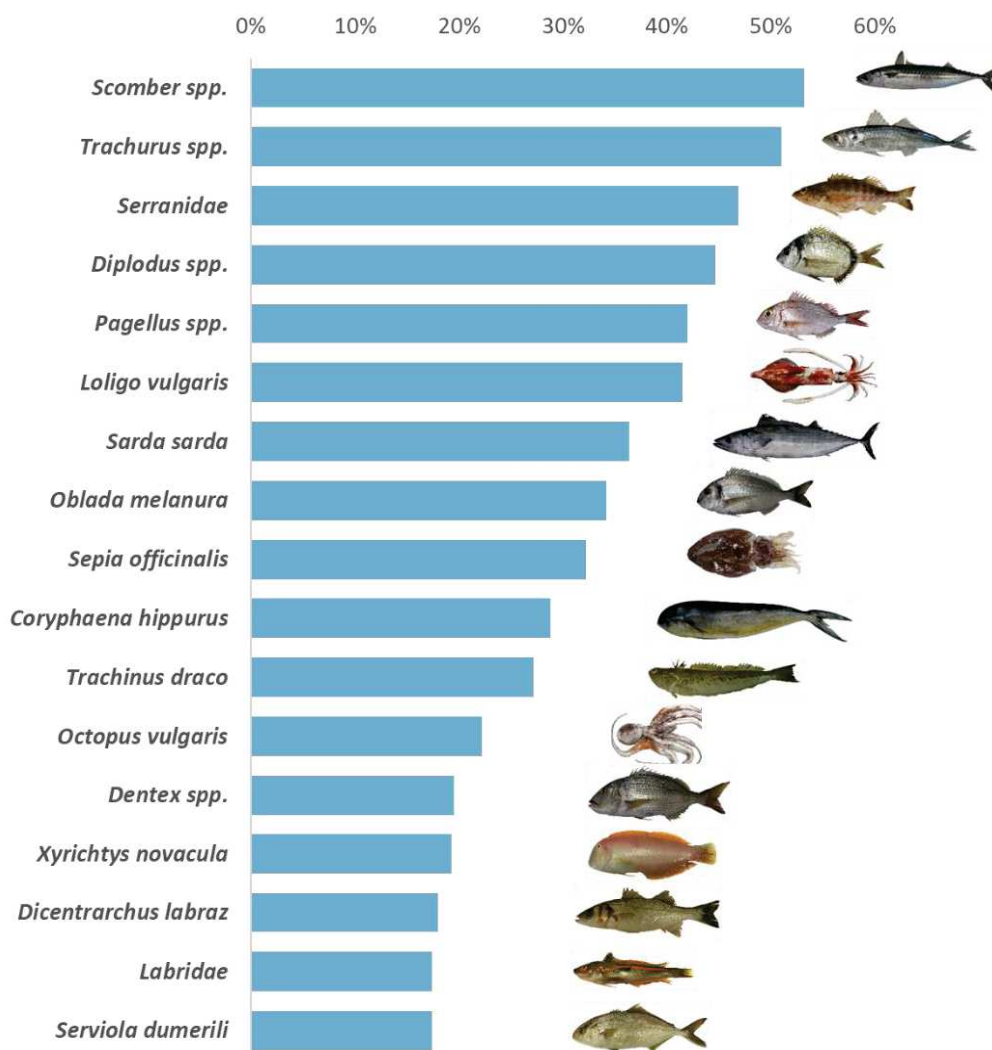


Figure 14. Species (or taxa) ranked by the percentage of boat fishers declaring to have them among their target species.

the most diverse activity in terms of catch. The two most popular catches were mackerel and horse mackerel (*Scombrus spp.* and *Trachurus spp.*), which are most often caught using surface trawling (Figure 14). They are closely followed by combers such as the brown comber (*Serranus hepatus*), which is found in deep waters, the common comber (*Serranus cabrilla*) and the painted comber (*Serranus scriba*), which is found in shallow rocky shores and meadows. Despite the diversity of techniques, coastal sparids maintain a high relevance in boat fishing. Still, a series of technique-specific species appear, such as the common squid (*Loligo vulgaris*) or the common cuttlefish (*Sepia officinalis*), mostly caught using jigs, or the pearly razorfish, which is caught in very specific areas. It is worth noting that a relatively high number of boat fishers declared targeting species that are under a special protection regime (those included in the Reial Decret 347/2011 Annex II). Longfin tuna (*Thunnus alalunga*) and Atlantic bluefin tuna (*Thunnus thynnus*) were targeted by 15 and 6% of fishers respectively; also, 14% declared they aspired to catching sharks, and 2% searched for other elasmobranchs such as ray fish.

Underwater spearfishing is an especially selective fishing modality for which catches are more specific compared to boat and shore angling. Still, there are many spearfishing

techniques (e.g. surface diving, ambushing or bottom diving) that allow diversifying the ecology of fishing grounds, spanning out to different target species. The results showed that sparids are generally the most coveted catch for spearfishing (more than 80% of spearfishers targeted *Diplodus* spp. and over 60% targeted gilthead seabream). These were followed in importance by the common octopus (*Octopus vulgaris*), European bass, red mullet and red striped mullet (*Mullus surmuletus* and *Mullus barbatus*, aggregated in *Mullus* spp.; Figure 15). There is also an interest in sedentary species like scorpionfishes (*Scorpaena porcus*; *Scorpaena scrofa*), groupers and conger (*Conger conger*). The fact that the common octopus, which is mostly caught during the warmer months, had such a relevant position is a new indicator of the potential seasonal bias that the survey may have suffered.

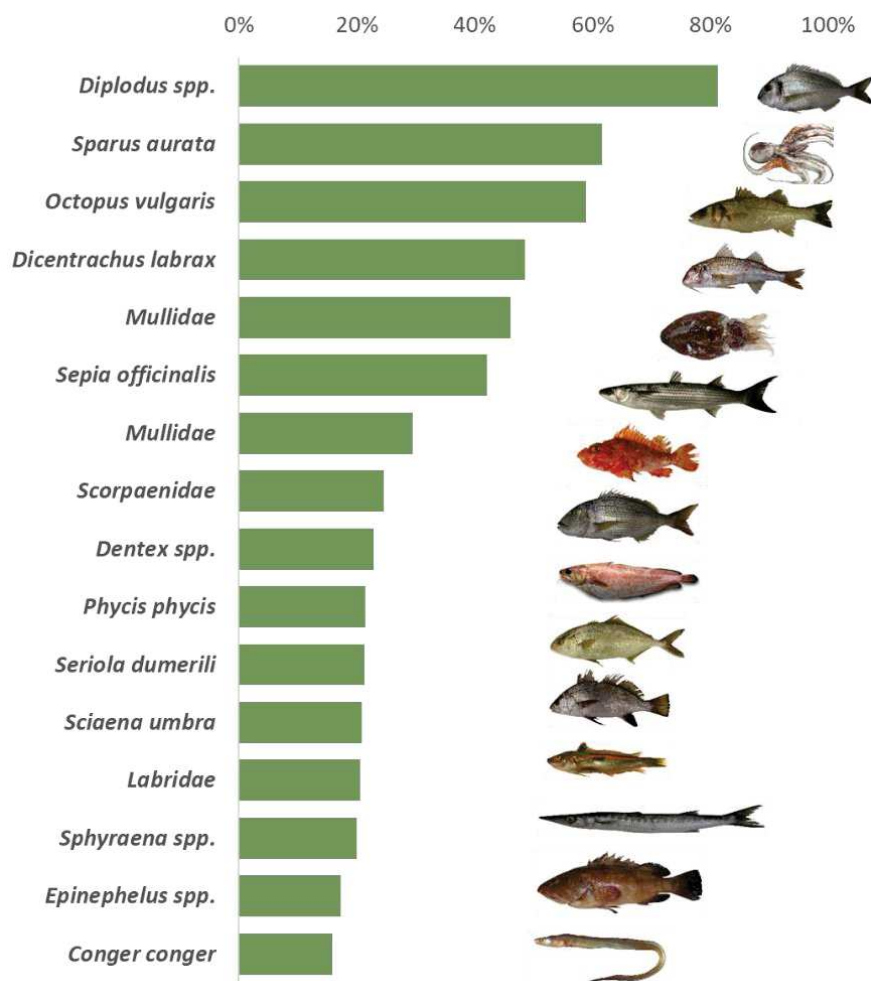


Figure 15. Species (or taxa) ranked by the percentage of spearfishers declaring to have them among their target species.

3.10 Catch compositions

The onsite survey obtained data of real catches. These contrasted with the target species declared online with some important differences found between both methods. Catch observations generally showed a tendency towards small individuals of abundant species. Fishers generally did not practice catch and release and those who released catches mostly did it because the minimum landing size was not met.

For shore fishing, the onsite surveys covered 11 zones (zones 1 – 12). A total 167 individuals of 28 different species were measured and weighted. Catches were dominated by serranids, represented primarily by the painted comber, followed by labrids, represented mainly by the rainbow wrasse (*Coris julis*), but also including the East Atlantic peacock wrasse (*Stiphodon tinca*) and the brown wrasse (*Labrus merula*). In third position came the sparids of the group *Diplodus* sp., which were mainly represented by the white seabream, the common two-banded seabream and the annular seabream. Other seabreams such as the gilthead seabream and the axillary seabream were also relevant. Surprisingly, European seabass catches accounted for less than 1% of the total catch for this modality (Figure 16).

Boat fishing onsite surveys were undertaken in zones 1, 3, 7, 8, 9 and 11. A total 1.206 individuals were measured and weighted, corresponding to 49 different species. Catches were dominated by *Scomber* sp. mackerels, which included the Atlantic mackerel (*Scomber scombrus*) and Pacific chub mackerel (*Scomber japonicus*), followed by serranids (mainly the painted comber and the blackbelly rosefish (*Helicolenus dactylopterus*) and *Trachurus* sp. (Atlantic horse mackerel and Mediterranean horse mackerel). Other important catches included the pearly razorfish (*Xyrichtys novacula*), other labrids (mainly the rainbow wrasse and the brown wrasse) and

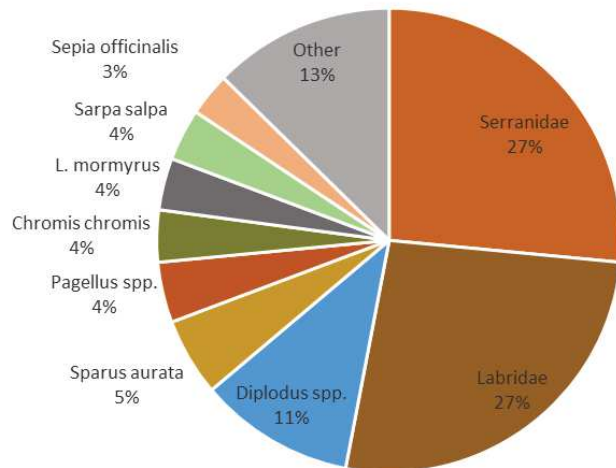


Figure 16. Shore fishing species (or taxa) catch composition observed in the onsite surveys.

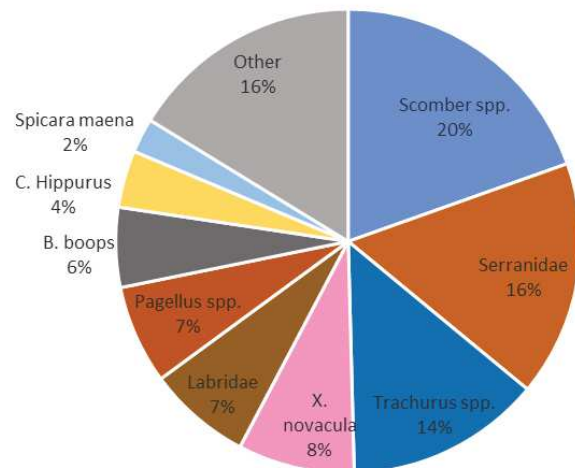


Figure 17. Boat fishing species (or taxa) catch composition observed in the onsite surveys.

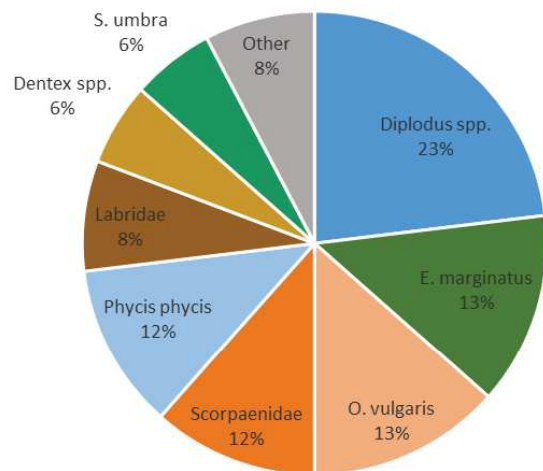


Figure 18. Shore fishing species (or taxa) catch composition observed in the onsite surveys.

several species from the *Pagellus* sp. group (including the common pandora (*Pagellus erythrinus*), the axillary seabream and the blackspot seabream). Amongst other relevant catches, it is worth noting the importance of the swallowtail seaperch (*Anthias anthias*), the round sardinella (*Sardinella aurita*) and the wide-eyed flounder (*Bothus podas*; Figure 17).

For spearfishing, zones 1, 2, 4 and 10 were surveyed. A total 52 individuals of 15 different species were weighted and measured. Aside from the preeminent *Diplodus* sp. group, most of the rest of the catch was represented by characteristically sedentary species, such as the dusky grouper, the common octopus, scorpionfish (black scorpionfish and red scorpionfish) and the forkhead (*Phycis phycis*). Labrids were represented only by the brown wrasse. Amongst the species grouped under “other”, the main catch was the surmullet (*Mullus surmuletus*; Figure 18).

The catches observed in the onsite surveys often corresponded to those declared as target species in the online surveys, but this correspondence was not proportional for many species. Fishers’ will to catch certain species does not necessarily match their fishing outcome. Some species, such as those within the serranid and labrid groups, are relatively un-coveted and are caught much more often than what would be expected by the target species results. Still, it must be considered that the results obtained are partial due to the surveys’ seasonality and zonification. These results must hence not be understood as representative of the whole of Catalonia, rather, as a seasonal and geographic sample set in the framework of a pilot study.

3.11 Economic impact of recreational fishing

The direct and indirect economic impacts of recreational fishing in Catalonia were estimated using both outing expenses and occasional expenses data. Both methods obtained information on daily expenses, which included transportation, meals, baits, boat fuel and port services. For shore fishing, average daily expense was 27.4 and 25.9 € (on site and online surveys respectively); For boat fishing the results were 24.5 and 47 € per trip respectively, and for spearfishing, 40,5 and 27 € respectively per trip. The online survey additionally collected data on occasional expenses. These included expenses that are directly related to fishing activity, such as fishing gear, subscriptions to fishing Apps or magazines, insurances and club or federation quotas. Other indirect expenses were also collected included fishing holidays and boat expenses.

The most relevant expenses for shore fishers were fishing gear and logistic expenses such as transportation and meals (Table 4). Average annual expense per shore fisher was 943 €, which supposes a total economic annual impact of 30M €, of which 16M € represent direct economic impacts (Table 5). For boat fishing, the most significant expense was boat fuel, followed by port services and fishing gear (Table 4). The total annual expense in fishing materials was 12M €, and the total impact including indirectly related expenses was over 53M € (Table 5). The most important expenses for spearfishers who initiate the activity from land were transport expenses, parking and meals. These were followed by holiday trips motivated by fishing. The total annual activity expense of land-based spearfishers was 2.5M € (Table 4). For spearfishers who use a boat to practice, the main expense is boat fuel, followed by trip logistics (Table 4); in total, boat-based spearfishing activity amounted 2.9M €. Both types of spearfishers combined expended a total 5.4M €, of which close to 1M € are expenses were related to fishing gear.

Table 4. Estimate of average daily and annual expenses by recreational fisher (RF) by modality. For spearfishing, the activity initiated from a boat is differentiated from that initiated from land. Expenses considered include fishing gear (bait, sinkers and floats, etc.), boat fuel and other expenses related to the activity (transportations, parking and meals), permanent gear (rods, reels, spear guns, clothes, etc.), port services, boat maintenance, travels motivated by fishing, and other expenses motivated by fishing (such as insurances, Medical certificates, licenses, maps, subscriptions to magazines and apps), boat rentals and charter services. Expenses related to boats were pondered by average boat use for fishing (62.5% for boat fishing and 74.3% for spearfishing initiated from a boat). Boat cost was not included.

| | Shore fishing | | Boat fishing | | Spearfishing | | | |
|----------------------|-----------------------|----------------------------|-----------------------|----------------------------|-----------------------|----------------------------|------------------------|----------------------------|
| | Annual RF expenditure | Total activity expenditure | Annual RF expenditure | Total activity expenditure | Initiating from land | | Initiating from a boat | |
| | | | | | Annual RF expenditure | Total activity expenditure | Annual RF expenditure | Total activity expenditure |
| Consumable gear | 342.96 € | 11,004,244 € | 447.96 € | 8,146,776 € | 105.65 € | 260,678 € | 98.19 € | 106,120 € |
| Boat fuel | | | 812.62 € | 14,778,625 € | | | 831.94 € | 899,131 € |
| Other daily expenses | 302.27 € | 9,698,661 € | 372.75 € | 6,778,977 € | 377.57 € | 931,608 € | 592.00 € | 639,812 € |
| Permanent gear | 161.26 € | 5,174,202 € | 211.04 € | 3,838,056 € | 170.92 € | 421,724 € | 189.94 € | 205,280 € |
| Port services | | | 487.57 € | 8,867,116 € | | | 398.06 € | 430,211 € |
| Boat maintenance | | | 419.75 € | 7,633,738 € | | | 347.11 € | 375,141 € |
| Holidays | 117.86 € | 3,781,666 € | 111.40 € | 2,025,964 € | 305.31 € | 753,315 € | 176.07 € | 190,290 € |
| Other | 18.63 € | 597,764 € | 31.80 € | 578,327 € | 60.51 € | 149,301 € | 42.65 € | 46,095 € |
| Boat rentals | | | 27.15 € | 493,811 € | | | 12.54 € | 13,550 € |
| Charters | | | 15.46 € | 281,210 € | | | | |
| Total | 942.98 € | 30,256,536 € | 2,937.50 € | 53,422,600 € | 1,019.96 € | 2,516,626 € | 2,688.50 € | 2,905,630 € |

Altogether, the total annual expenditure on recreational fishing gear was 29M €. The total direct and indirect expenditure amounted 89M € (Table 5). These data respectively represent 28.4 and 86.8% of the total commercial fishing sector turnover for 2019, which evidences the great relevance of recreational fishing in Catalonia's blue economy. The economic data obtained by this pilot study are liable to overestimation, and should be interpreted with caution because both survey methods tend to over-represent avid fishers. This may cause an overestimation effort, and potentially also an overrepresentation of fishers with high fishing expenses. Therefore, extrapolations made in this exercise may feasibly magnify economic impact to an unknown degree.

Table 5. Total annual expenditure in fishing gear and total annual expenditure including expenses indirectly related to fishing activity.

| | Fishing gear | Total activity |
|---------------|---------------------|-----------------------|
| Shore fishing | 16,178,446 € | 30,256,536 € |
| Boat fishing | 11,984,832 € | 53,422,600 € |
| Spearfishing | 993,803 € | 5,422,256 € |
| Total | 29,157,080 € | 89,101,392 € |

4. CONCLUSIONS

The online surveys sent during 2019 reached approximately 16% of the total marine recreational fishing participants, and allowed measuring the activity's social, fishing and economic impact.

Regarding the activity's **social impact**, there are close to 54,000 marine recreational fishers in Catalonia, of which 60% mostly fish from shore, 34% practice mainly boat fishing, and 6% are spearfishers. In general, it is a prominently male activity (95% male participants), with an average age between 40 and 50 years depending on the fishing modality. Fishing is practiced mostly as a social activity; nevertheless, data show that most shore and boat fishers do not partake in recreational fishing associations, clubs or federations. The opposite is true for spearfishers, who have high rates of association to fishing entities.

It is a markedly seasonal activity as it is practiced more widely during the warmer months of the year, particularly during holidays. Both boat fishing and spearfishing are practiced preferentially in the morning, beginning at first light, while shore fishing is mostly practiced around dusk.

As for the **fishing impact**, results show a wide range of impacts on different fishing resources depending on the fishing modality. Fishing volumes, fishing grounds, target species and actual catches vary enough to consider shore fishing, boat fishing and spearfishing as three entirely different fisheries within the recreational fishing sector. Shore fishing is mostly concentrated in accessible beaches near densely populated areas, with shore fishers averaging 25 fishing days per year and spending an average 5 hours per fishing trip. Boat fishing shows no clear pattern of geographical distribution; boat fishers take on average 32 fishing trips per year and spend an average 4 hours per fishing trip. Spearfishing is mostly concentrated in rocky parts of the coastline in the centre and north of Catalonia; spearfishers take around 27 fishing trips per year and dedicate an average 4 hours per trip. The total fishing impact of the recreational sector in Catalonia is estimated in 1,366 annual tonnes; 508 t correspond to shore fishing, 760 t to boat fishing and 98 t to spearfishing. These total catches correspond to nearly 5% of the total commercial catch in Catalonia during 2019. Comparing volumes between different sectors is ill-advised because different sectors (commercial and recreational) and different modalities within each sector impact different fishing resources in different degrees. Specific impacts on particular species should be used when comparing sectors (work in progress).

A detailed analysis of the online survey responses underlines the great unevenness in user fishing intensity and their very unequal impact on littoral and oceanic ecosystems. For all three modalities, results indicate that the 10% most avid of fishers are responsible for nearly 50% of the total catch, while the lowest 50% avidity groups do not reach 10% of the total catch. This supports the idea that there is a main body of recreational fishers who are interested in aspects that may be unrelated to fishing productivity, such as enjoying nature or the social and recreational aspects of fishing. For all three modalities it has been observed that target species and actual catches are mostly oriented to species with a culinary interest, for which they are mostly commercially relevant species.

The **economic impact** of marine recreational fishing on Catalonia's blue economy has been estimated in approximately 90 million euros, out of which roughly one third corresponds to direct impacts on fishing gear shops and distributors.

The information presented in this document must be taken with caution, given that many of the data used are subject to important sources of bias (avidity, seasonality, perception and memory biases); but particularly due to the fact that voluntary respondents tend to engage the activity more actively and hence tend to be in the upper side of the avidity spectrum. Additionally, both surveys were undertaken during the warmer months, for which cold season activity is underrepresented.

This pilot test has been a successful experience that has provided a first image of marine recreational fishing in Catalonia for each of the three fishing modalities: shore fishing, boat fishing and spearfishing. It has served to set forth a thorough data collection system that must help improve the management of the activity and of the littoral resources it affects. Strengths and weaknesses have been identified from this experience and have allowed further developing the combined methodology data collection system. This is to be implemented by the Generalitat de Catalunya and ICATMAR within the context of a permanent strategy for the assessment of the activity, in view of improving future management.

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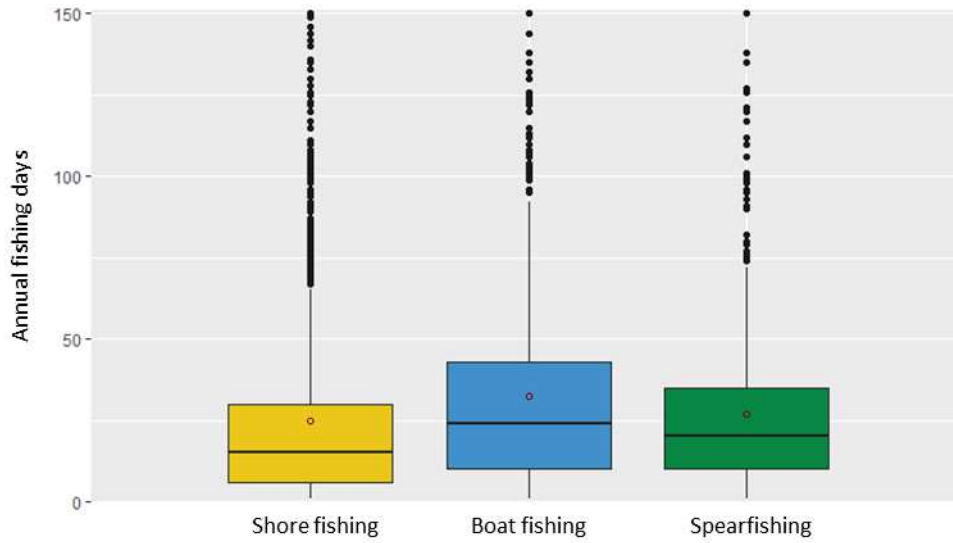
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6. ANNEXES

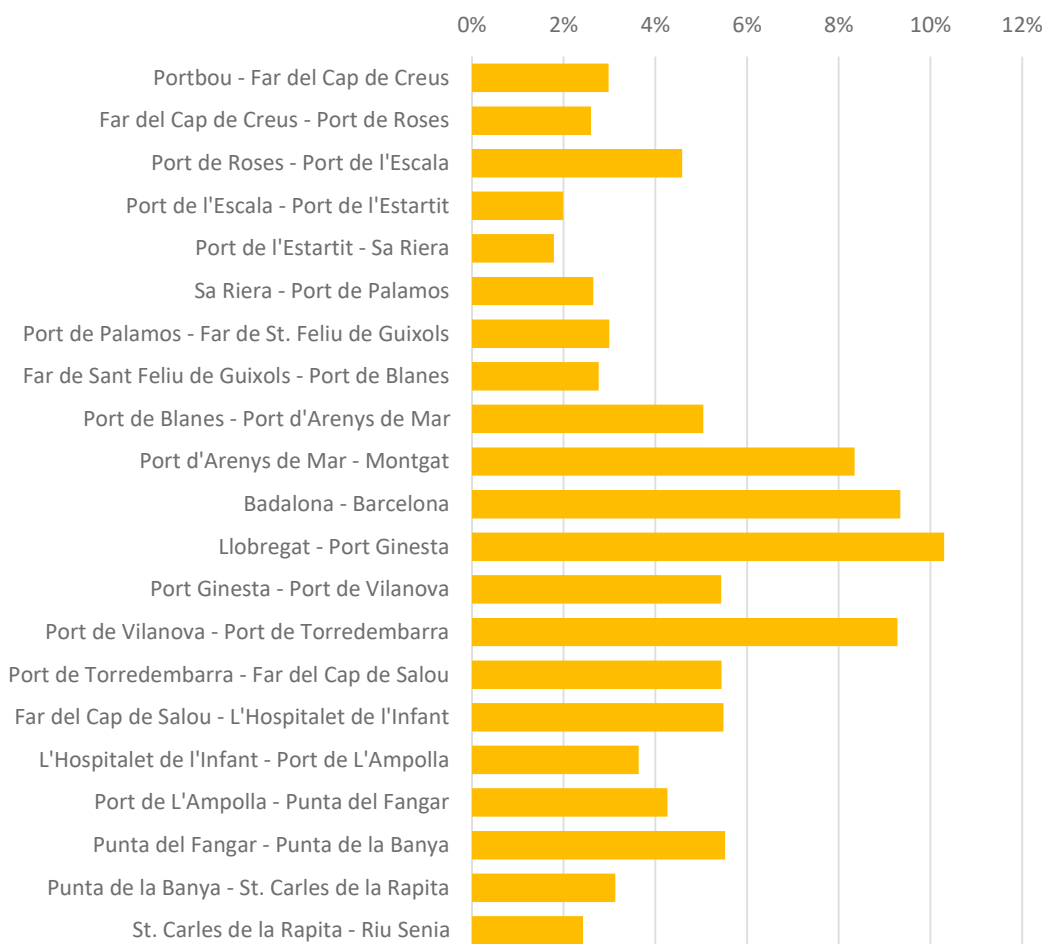
ANNEX I: Effort by modality

Boxplot of effort by modality (in annual trips) obtained by the online survey. The red dot and the horizontal black line indicate the average and median respectively. Box limits represent interquartilic ranges, and vertical lines represent the 95% confidence interval (CI). Black dots represent extreme values outside the 95% CI. The upper limit set by the survey question was 150 days.

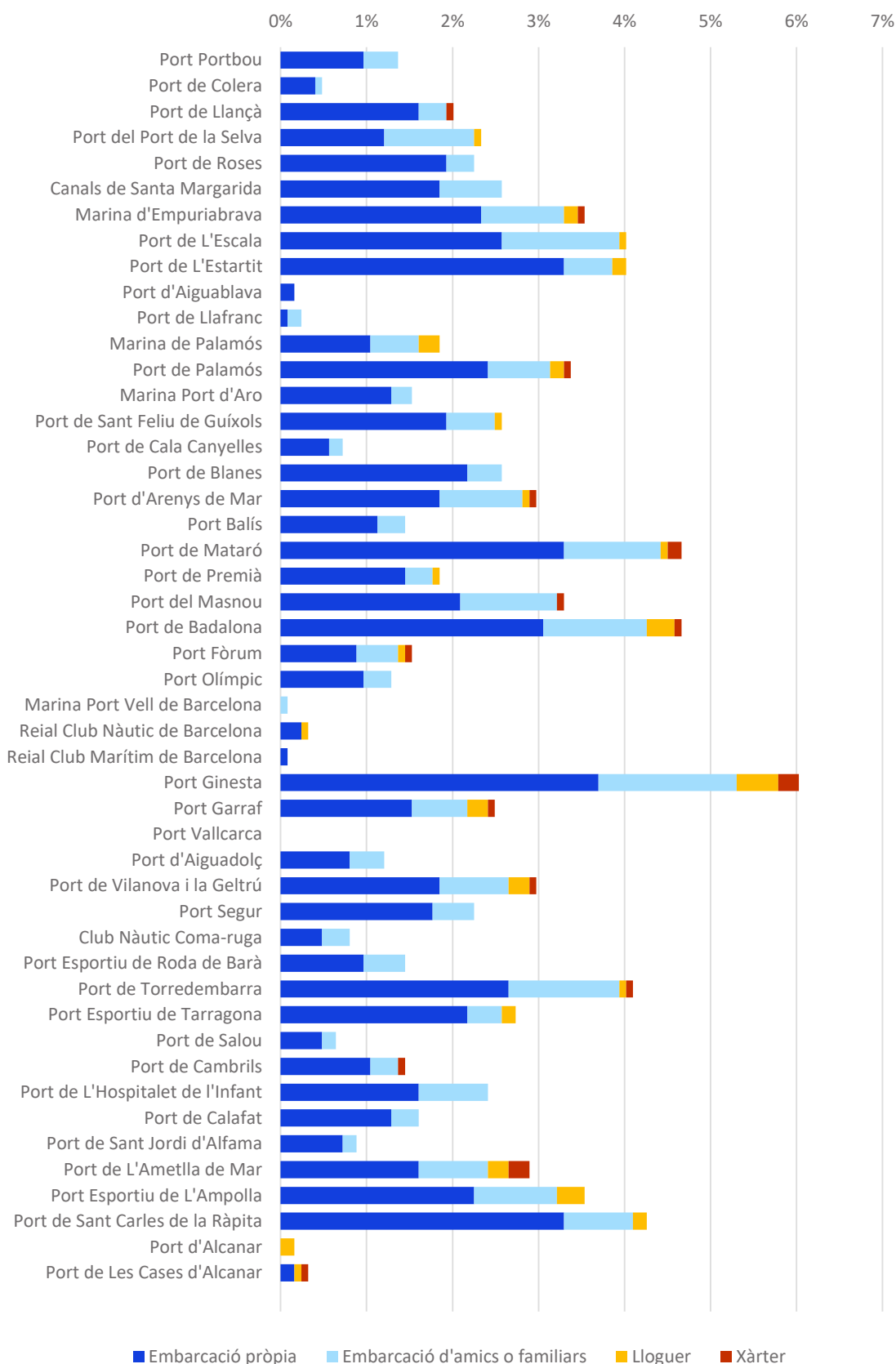


ANNEX II: Effort distribution

Annex II.a. Results obtained by the online survey on the proportion of total shore fishing effort distributed by each of the 21 studied zones.



Annex II.b. Results obtained by the online survey on the proportion of total effort distributed by each port in Catalonia. Results show the proportion of effort attributed to owned vessels, boats owned by friends and family, rental boats and charters.



Annex II.c. Results obtained by the online survey on the proportion of total spearfishing effort distributed by each of the 21 studied zones.

