Marine Recreational Fishing Catches in Ireland - 2022

Irish Marine Recreational Angling Survey (IMREC)

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1. Introduction

The legal framework for the collection of recreational fisheries data by EU Member States (MS) was given by the EU Data Collection Framework (Council Regulation EU 1004/2017 and Commission Decision EU 1251/2016). Like other MS, Ireland is required to report annual volumes (numbers and weights or lengths) of catches and releases of sea bass, cod, pollack, elasmobranchs and highly migratory ICCAT species in marine recreational fisheries within its waters. As Inland Fisheries Ireland (IFI) is the state agency responsible for the protection, management and conservation of the Republic of Ireland's recreational sea angling resources, it is tasked with collecting these data. To that end IFI initiated the Irish Marine Recreational Angling Survey (IMREC) programme in October 2019.

This report describes application of the knowledge gained through the pilot study of marine recreational fishing (MRF) catches in Ireland (Ryan et al., 2022). Sampling plans to estimate MRF catch across the three major sea angling elements in Ireland (shore, small boat and charter) were refined and implemented during the 2022 sampling programme.

On-site random sampling methods continue to be central to the programme, albeit with considerable modifications to account for the constraints associated with a limited budget. Random sampling techniques remain the most reliable for estimating catch rates in diverse and complex fisheries as they reduce fisher selection biases (Lewin et al., 2021; Arlinghaus and Cooke, 2009; Pollock et al., 1994) and often allow direct measurement of retained fish (Jones and Pollock, 2012). Data from these surveys and estimates of total catches are presented in this report.

As on-site sampling methods are expensive to maintain in the long term in terms of staff time and resources, a citizen science based voluntary catch data collection method, the IMREC Angler Diary, was developed primarily to increase data returns and coastline coverage, and engage the angling community. This online angling diary was developed and tested during the pilot study. It is well documented that self-selecting survey data collection methods are susceptible to biases (Skov et al., 2021; Venturelli et al., 2017). However, these tools are likely to play a central role in fisheries data collection (Lennox et al., 2021; Gundeland et al., 2020) due to advances in technology and because they are relatively inexpensive to operate. Anglers, as stakeholders, also benefit by being meaningful contributors to a citizen science-based process. This tool allowed anglers to record fishing trips with information regarding location, methods used, time spent fishing, species caught, fish length (cm) and if catches were released. This report presents over a year of diary-based angling data which has been collected and analysed.

2. Methods

Ireland is in the Eastern North Atlantic. Its coastline encompasses ICES divisions (VIIa, VIIg, VIIj, VIIb and Via) (Fig. 1). The IMREC survey is designed account for all MRF along the Irish coastline and within its inshore waters. Ryan et al., 2021 & 2022 characterised the different MRF sectors in Ireland considerable detail.

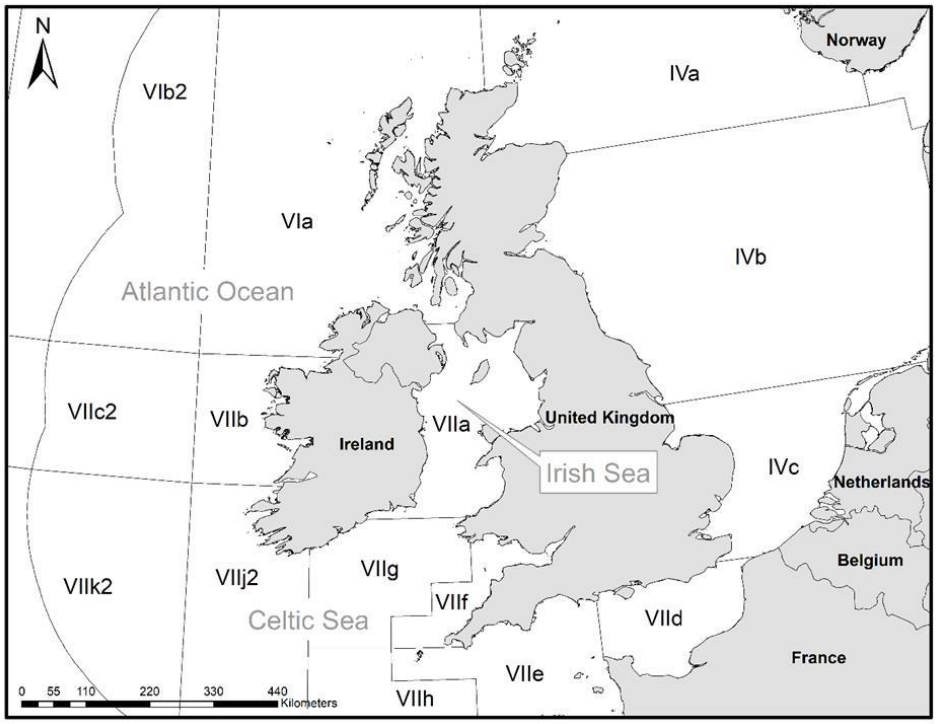

Fig. 1: Ireland's location in a European and ICES region context. The pilot study will assess all marine recreational fishing along the Irish coast and within its inshore waters.

2.1 On-site angling surveys

2.1.1 Roving creel survey of shore anglers

Sampling strata

The IMREC survey of shore anglers utilises a spatio-temporal sampling method to collect catch per unit effort (CPUE) data of sea anglers around the Irish coast. The roving-creel survey approach was applied due to the disparate nature of shore angling around Ireland and the multiple potential access points to the sea (Armstrong et al., 2013; Lockwood, 2000; Pollock et al., 1997). The survey also incorporates spatial and temporal stratification into its final design to maximise sampling efficiency (Jones and Pollock, 2012; Pollock et al., 1997).

Increased sampling effort is allocated to the places and times with greater angling effort (unequal probability sampling) thus increasing the precision of the effort estimates (Hayne, 1991), as well as increasing sampling efficiency (Best and Boles, 1956).

Information collected by surveyors during the pilot sampling programme 2019 - 2021 (Ryan et al., 2022) enabled analysis of the variables which cause temporal and spatial variation in fishing effort around Ireland. Therefore, a refined spatio-temporal sampling frame has been designed for this current shore survey programme. The aim was to increase the number of angler interviews per stratum without increasing overall sampling effort. Originally, the coastline was divided into five spatial strata according to ICES divisions (Fig. 1). Upon completion of the pilot study, which sampled around the entire coast, shore angling effort in ICES regions VIIa and VIIg was found to be considerably higher than the rest of the country. Likewise, catch type and angling effort along the entire western seaboard (VIIj2, VIIb and Via) is relatively similar. Therefore, it was appropriate to combine certain spatial strata. For 2022 and for the foreseeable future the revised sampling frame has two spatial strata: East (VIIa and VIIg) and West (VIIj2, VIIb and Via). This means that the same sampling effort will increase the number of datapoints per stratum and greatly reduce or remove the need for imputation. In addition, sampling will be conducted in each stratum in alternate years to improve precision and also reflecting the limited staff resource available for this element of the project.

The temporal strata have also been reduced from four quarterly strata to two biannual strata (Winter, November to March; Summer, April to October). According to the pilot study (Ryan et al., 2021) and a B&A study (Ryan et al., 2021), angling effort is low during Q4 and Q1; this potential lack of data per temporal strata could limit precision. The revised design allows for increases in sampling effort per stratum. Angling activity strata (high and low) will be retained in the sampling frame although this component has also been improved by updating secondary sampling unit (SSU, known angling marks) activity scores based on field activity observed at each site visited. This refinement will increase the likelihood of surveyors encountering anglers during their workday as primary sampling unit (PSU) activity scores continue to be derived from combined SSU scores (Ryan et al., 2021). PSU activity levels are derived for both temporal strata.

Several PSU boundaries were redrawn due to experiences of surveyors during the roving-creel survey component of the pilot study. The main reason was that some PSUs could be surveyed in a shorter time than originally anticipated. The sampling frame now has 121 PSUs (reduced by 46) and as a result, a greater proportion of the coast can be sampled (Fig. 2).

Sampling protocol

All sampling took place within the Eastern spatial stratum in 2022 (Fig. 3). The Western stratum is scheduled to be sampled in 2023.

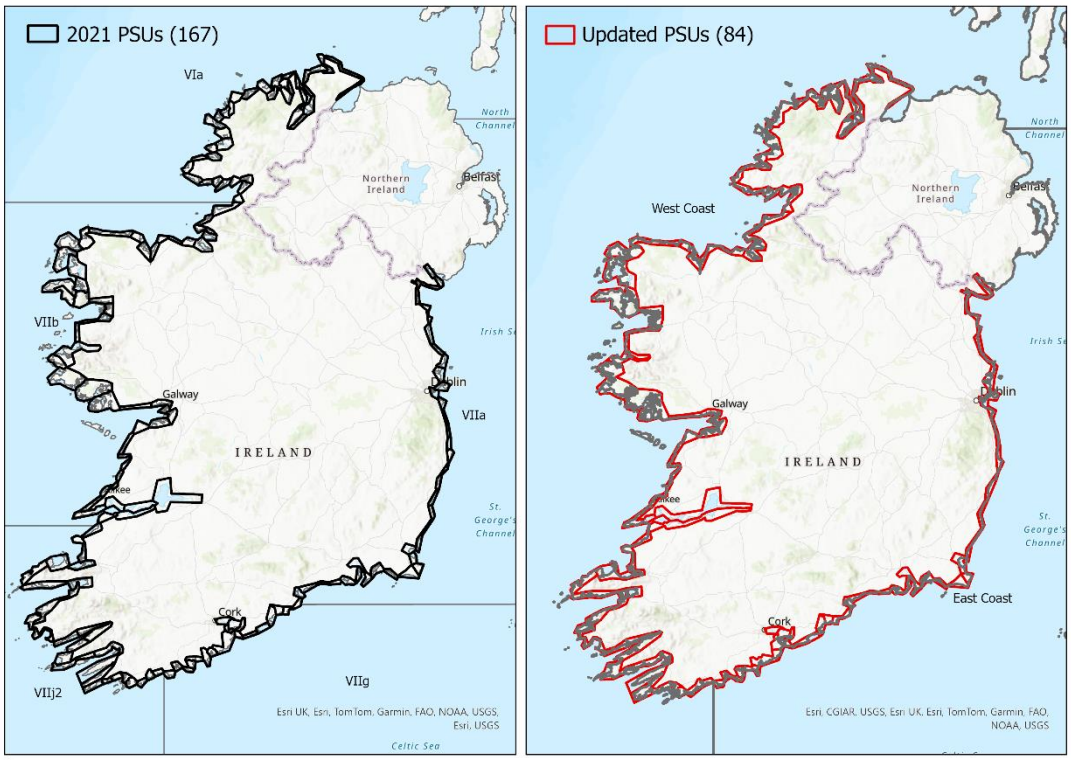

Fig. 2: Maps of Ireland comparing the original PSUs and spatial strata defined for the pilot study sampling frame for the roving creel survey of shore anglers (left) and the refined sampling frame for future surveys (right). Eastern spatial stratum extends from Carlingford to Clonakilty. West spatial stratum extends from Clonakilty to Lough Foyle.

Sampling was selected sequentially for each sampling week. Prior to each sampling season, a sampling programme for each consecutive week was created, taking account of each stratum and cluster in the sampling design. Visits to PSUs were heavily weighted towards those designated as high activity (probability = 0.75).

The schedule was created using a randomly selected starting location. If either end of the PSU was reached before the sampling day was complete, staff retraced their steps rechecking sites until the shift time was completed. Surveyors did not resample anglers that had been interviewed already. Upon conclusion of angler catch rate interviews, the surveyor asks if he can contact the angler after their fishing session to collect complete trip data (Vølstad et al., 2020) to reduce bias associated with incomplete angling data (Hoenig et al., 1997; Pollock et al., 1994).

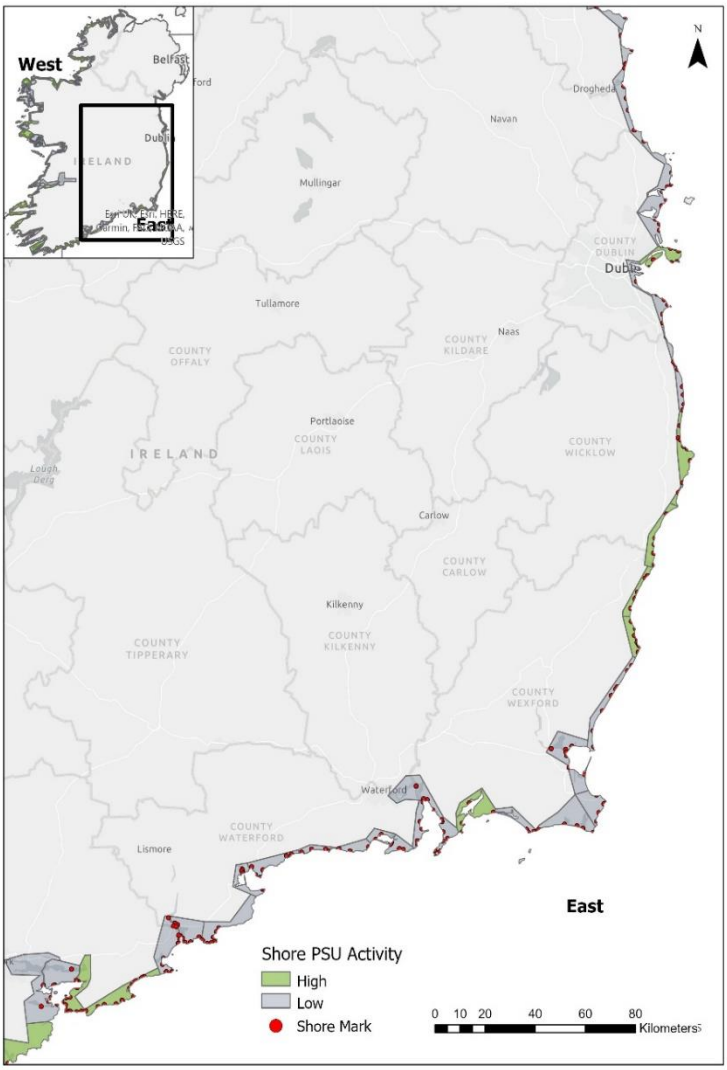

Fig. **3**: Map of Ireland identifying PSUs and SSUs within an extensive section of the Eastern region stratum, for the roving creel survey of shore anglers.

On arrival at each SSU within each PSU, an instantaneous count of people actively shore fishing was completed. If the surveyor encountered large fishing parties and it was not possible to interview all anglers due to time constraints, one or more individuals were randomly selected to answer questions relating to the current fishing trip on behalf of the entire group.

Data collection and analysis

To collect the catch survey data *in situ* a robust questionnaire has been designed in Survey123 https://survey123.arcgis.com (ESRI 2020). This tablet-based resource allows for instant data capture and safe storage to a centralised IFI geodatabase. Fish length data are collected as it is unusual for catches to be weighed *in situ* by Irish anglers. These lengths can be converted at analysis using well characterised length, weight-relationships (Silva et al., 2013) and validated with fisher-independent data collected during this survey programme. Protocols have also been put in place to collect on-site weight data when possible.

Each angler surveyed is asked how long (min) they have been fishing for this trip and to name all species which they have retained and/or released. If retained fish are available for inspection, each will be measured on site by the surveyor. Otherwise, the angler is asked if they have measured released species. If so, this can be recorded; if not, the angler will be asked to estimate the lengths of their catch. At this point the angler is shown a measuring board to aid them in estimating the length of their catch.

The mean catch-per-unit-effort (CPUE) of all MRF species caught during each shore session is estimated where a session is defined as one daily angler trip for shore angling. Roving creel surveyors interview shore anglers during their angling session so the data collected does not necessarily account for their complete session catch. All shore anglers interviewed were asked how long they have fished that day and how long they intended to continue to fish that day. Therefore, if a shore angler refused to accept a follow up call to collect complete session catch rates, constant average catch rates were assumed throughout the angling session. Refusals for follow up interviews were low (7%).

An individual daily survey is defined as the PSU. All known angling marks within a PSU as the SSUs and all anglers encountered within each PSU as tertiary sampling units (TSU). The method for calculating means and variances for species specific CPUE estimates follows the procedures for random stratified surveys described in (Vølstad et al., 2006). Precision of the final CPUE estimates was based on the variation between daily PSU visits within strata.

A ratio of the means estimator (Armstrong et al., 2013; Pollock et al., 1994; Vølstad et al., 2006) was used to calculate average species specific CPUE across all strata for shore and small boat angling, whereby a stratum was defined for each season and high/low activity combination. Retained or released fish of a particular species were considered as a separate catch. Weighting factors for each stratum were calculated by expanding the total number of observed anglers summed over all the PSUs in a stratum by the ratio of total number of PSUs in the stratum (sites x days) to the number of site-days sampled. As per Armstrong et al. (2013), a factor to correct for length of stay bias was calculated using unweighted CPUE (unit of effort is equal to the nearest hour) data with all catches combined for all shore anglers who accepted interviews. This value was applied to the final species specific CPUE estimates calculated through the full analysis.

Finally, the overall CPUE estimates of a selection of species were combined with effort estimates derived from CSO and IPSOS-MRBI surveys described in Ryan et al. (2022), to calculate total catch of all released and retained species through shore angling (Table 1). Where applicable, CPUE estimates for some species were converted to CPUE biomass estimates using length/weight conversion equations derived during the pilot study (Ryan et al. 2022). As this survey focused on the East coast, effort estimates were apportioned according to data obtained during the IFI Behaviour and Attitudes survey (Ryan et al. 2021) (Fig. 4).

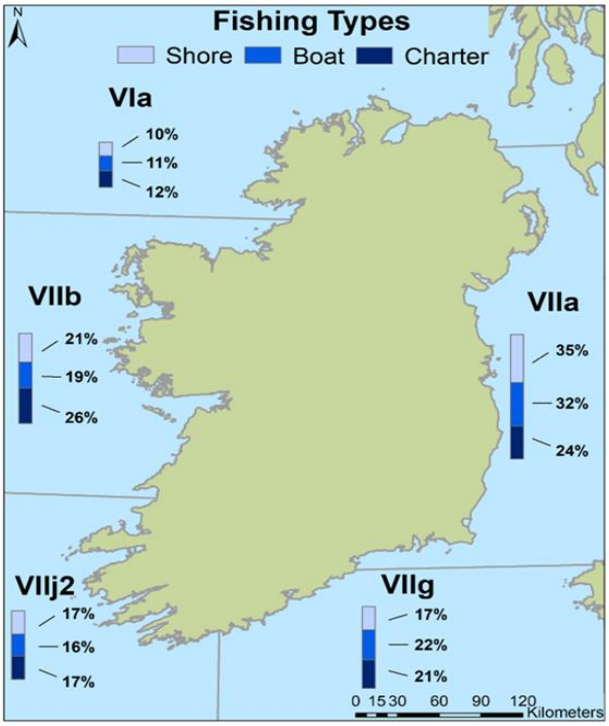

Fig. 4: Proportion of angling effort around Ireland according to the Inland Fisheries Ireland behaviour and attitudes survey of Irish sea anglers (n=1211) (Ryan et al. 2021).

2.1.2 Bus route access point survey of small boat anglers

The IMREC survey of private small boat anglers also uses a spatio-temporal sampling method to collect catch per unit effort data around the Irish coast. The most appropriate method of collection of catch data for this survey is through a random-access point survey. Unlike the roving-creel type approach, this method captures complete angling trip data as the interview occurs when the angler has completed their fishing trip. Due to the disparate nature of small boat angling around Ireland and the large number of potential access points, a bus route type survey programme was planned. This method combines elements of both roving and access point surveys by allowing a surveyor to travel around a circuit, incorporating access points according to a predetermined schedule (McGlennon and Kinloch, 1997). Like the roving-creel survey of Irish shore anglers, this survey incorporated stratification into its final design to maximise sampling efficiency.

Table 1: Total annual sea angling trip estimates per annum along the eastern half of Ireland. For details refer to Ryan et al. (2022).

Angling type	Angling trips per year	RSE
Shore	851,000	0.31
Small boat	549,000	0.43

As a result of information gathered during the pilot study (Ryan et al. 2022), the bus route access point survey of small boat anglers was redesigned to increase sampling effort per stratum and to capture small boat anglers at levels of experience and ability which is a true representation of the total population. Like the shore angling survey, the number of spatial strata in the sampling frame was reduced from five to two and the number of temporal strata from four to two. To achieve the assumptions of probability-based sampling all potential launching sites were retained in the sampling frame but site selection criteria was heavily weighted so that high activity sites had a 95% chance of being chosen for survey.

Based on surveyor feedback and further desktop research 108 inactive SSUs were removed from the sampling frame. Subsequently the number of PSUs was reduced from 78 to 70. This refinement will allow surveyors to cover a greater proportion of the coastline.

Sampling protocol

All sampling took place within the Eastern spatial stratum in 2022 (Fig. 5). The Western stratum is scheduled to be sampled in 2023.

Site selection procedures generally followed the steps described in the roving creel survey of shore anglers above. However, in the small boat bus route procedure, each access point/SSU is sub-sampled across the sampling day. The amount of time spent at each SSU depended on the number of SSU within a PSU. Time spent at each SSU was apportioned evenly across the sampling day.

Data collection and analysis

This generally followed the steps described in the roving creel survey of shore anglers above with some exceptions. Small boat data were not corrected for length of stay bias, as the access point design means that trip length will not affect the likelihood of a surveyor encountering a small boat angler. The small boat CPUE unit of effort is defined as a small boat angling trip. However, the total small boat annual effort estimates collected for this study define the unit of effort as one angler trip. Therefore, the CPUE estimates had to be

corrected prior to raising up to total catch. An average of 2.1 anglers per small boat were recorded across all small boat interviews.

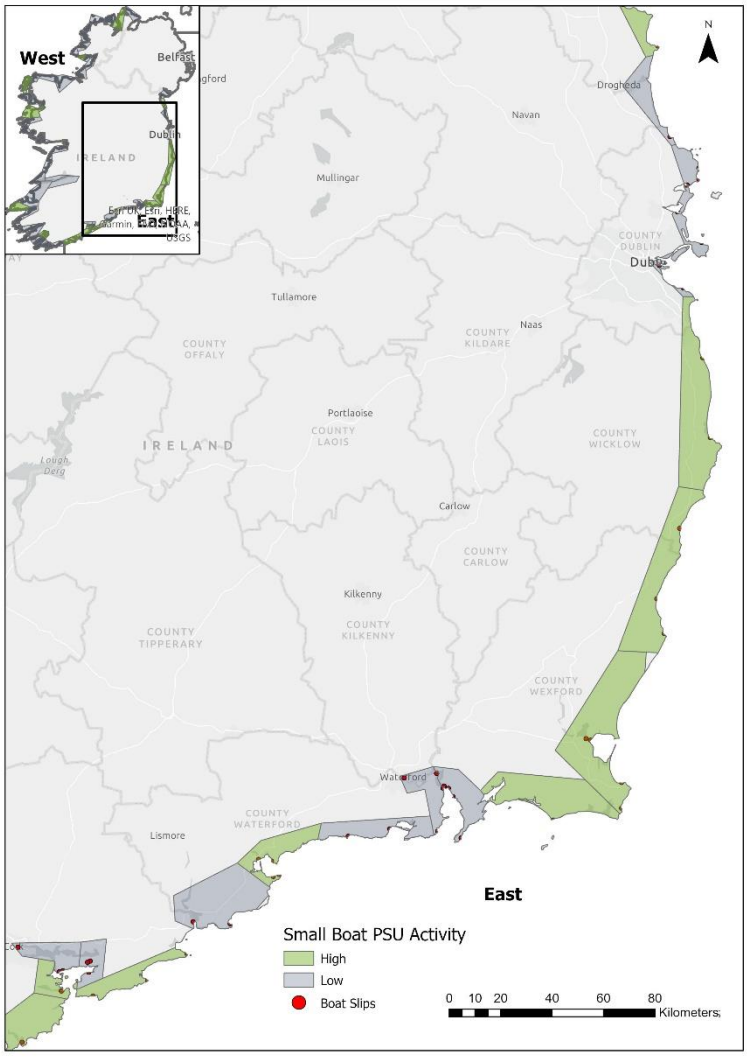

Fig. **5**: Map of Ireland identifying PSUs and SSUs within a substantial portion of the Eastern region stratum, for the bus route access point survey of small boat anglers.

2.1.3 Onboard charter catch survey

The charter vessel sampling programme developed by IFI and undertaken in summer 2021 by IFI staff and Marine Institute (MI) contractors was re-run in 2022. This programme sampled randomly designated chartered angling trips to record species numbers, and measure lengths and weights of all captured and released fish (Ryan et al. 2022).

A sampling frame was developed from a subset of charter skippers (Fig. 6) who agreed to participate in the programme (n=22). As per the surveys, the sampling frame was stratified

spatially (east and west coasts) and temporally (summer and winter). Surveys were selected through a well-defined random sampling frame and, unlike the shore and small boat surveys in 2022, the sampling frame included the entire coast of Ireland in 2022 due to the relatively low number of vessels and the availability of sampling resources. When possible, samplers were assigned to a vessel trip to survey to accurately measure and weigh captured fish. Unfortunately, sampling was limited by sampler availability in 2022. In total, 13 trips were sampled between June and December 2022. It was appropriate to combine the 2021 and 2022 datasets for analysis as the programme continued without modification over both sampling years. Therefore 46 sampling trips (including 33 from 2021) were used in the analysis. Differences in catch between years was not compared as sample size was low.

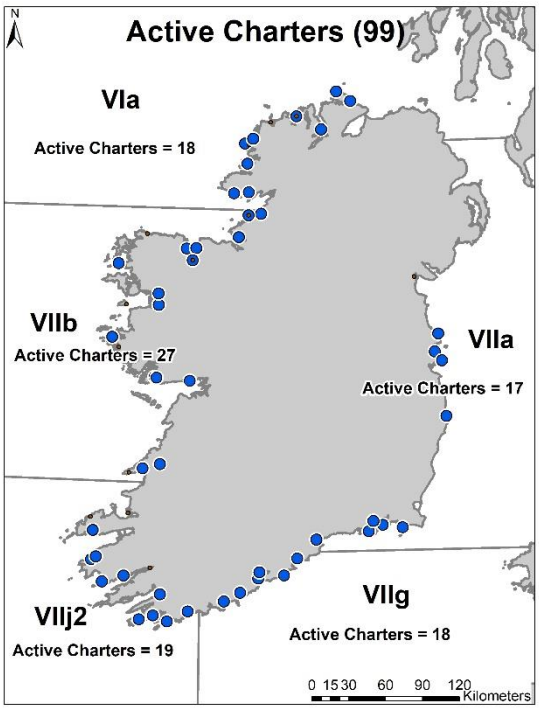

Fig. **6**: Map of Ireland identifying the general location of active charter sea angling vessels by ICES division.

Data collection and analysis

An onboard sampler boards a randomly chosen charter vessel prior to the trip, as agreed with the charter skipper. They record relevant trip information and biometric catch data that allows for the estimation of angler Catch Per Unit Effort (CPUE), total retained biomass, and where possible length-weight relationships for individual species. Priority was given to seabass, cod, pollack, elasmobranchs and highly migratory ICCAT species (Council Regulation (EU) 2017/1004). For further detail refer to Ryan et al. (2021).

Individual species (retained or released fish of a particular species are considered as a separate catch) catch per unit effort (CPUE) for charter angling was calculated using a ratio of the means estimator (Pollock et al., 1994; Vølstad et al., 2006) for each sampling region (East and West coast). Variance (V) was estimated by determining the variance between each trip CPUE record. CPUE was also estimated as a mean weight (retained or released) per charter angler day (CPUE biomass).

To estimate countrywide CPUE, weighting factors were assigned to each sampling region based on the probability that an angling trip will be selected in a sample using the following equation:

$$W_s = \left(\sum_i A_{i,s}\right) \times \frac{N_s}{n_s}$$

Where:

W_s = the weighting factor assigned to regional stratum *s.*

$A_{i,s}$ = total number of anglers observed in regional stratum *s.*

N_s = total number of possible charter angling trips in regional stratum *s.*

n_s = total number of trips sampled in regional stratum *s*.

The weighted mean CPUE (R) for both regional strata combined was calculated by:

$$R = \frac{\sum_s W_s R_s}{\sum_s W_s}$$

The variance of the weighted mean CPUE (R), was calculated as:

$$V(R) = \frac{\sum_s (V(R_s) \times W_s^2)}{(\sum_s W_s)^2}$$

To estimate to annual charter angling effort across the charter angling sector, detailed effort data (1992-2008) from a charter skipper voluntary diary scheme, managed by IFI, was reviewed, and collated (Ryan et al, 2023). Although there were more vessels in the fleet in the 1992-2008 period it was assumed that charter angling characteristics (specifically average number of days angling, species targeted etc), were like those observed over the course of this current study. These effort data were used to estimate total catch. Total retained catch was estimated for each species (where released and retained fish are

considered a separate catch) as the product of the mean retained weight of a particular species per angler charter day and the estimated total number of charter angler days undertaken (charter angling effort) across the sector. Collection of data for the estimation of contemporary charter effort is ongoing and will continue to be refined.

2.2 Off-site angling surveys

2.2.1 Online angling diary

To recruit diarists for the IMREC Angler Diary, several approaches were used. A call to action for all sea anglers subscribed to a weekly IFI issued 'Irish Angling Update' was released along with recruitment during Face-to-Face angler surveys. A coordinated media launch of the IMREC Diary, in conjunction with ESRI Ireland (providers of IMREC Diary platform), occurred during 2022 leading to a further increase in diarist recruitment.

Each diarist receives an email with their own login details, user manual and a fish ID guide, giving them the information needed to start recording their fishing trips through the online diary. The requested information for each session included the general fishing location, time spent fishing, type of fishing, methods used and any catch data (species, total caught, retained/released, length (cm)). Each angler can access their own catch data through an online dashboard which provides an overview of all sessions the angler has recorded. All data submitted is uploaded to an ArcGIS Online Feature Layer. This is stored on Inland Fisheries Ireland's ArcGIS Enterprise cloud storage. Data can be downloaded for analysis as required.

All personal data was removed from the database before data analysis. All data are aggregated and are presented in the results came from sessions between August 2021 and December 2022. For comparison, results are also presented for the different strata used in the roving creel approach.

Data collection and analysis

The diary allows for one of 4 types of fishing to be selected per session, Shore, Small boat, Kayak and Charter. The fishing type for each session is recorded and allows for catch percentages to be calculated based on catch and effort levels. As with the onsite surveys, data are collated into two regional strata (East and West) and two temporal strata (summer and winter).

Catch Per Unit effort was based on total fish caught and total trips by sector (shore, small boat etc) recorded. All CPUE figures are calculated at species level with further separations to identify seasonal and spatial differences. Due to the broad variety and number of

different species recorded in the diary, only the overall top 10 species were included in CPUE calculations. Region/Season strata are based on the total sessions per Region/Season and number of fish caught per species in each. An example of this would be whiting CPUE in the East coast during Summer = 0.438. This is based on 109 whiting caught in 249 sessions along the East coast during the summer months. Total diary CPUE figures for whiting is 0.489 based on 314 whiting caught across 642 sessions across all regions/seasons.

$$CPUEn = \frac{\sum FISHn}{\sum TRIPSn}$$

Where: $CPUEn$ is the number of captured fish (retained or released) for a particular species ($FISHn$) divided by the total number of sessions recorded (TRIPSn).

Analysis at species level was confined to the top 10 species based on overall total catch (shore and small boat catches combined) and total catch per fishing type.

3. Results

3.1 On-site angling surveys

3.1.1 Roving creel survey of shore anglers

During 2022, IFI surveyors conducted 81 shore surveys (PSU visits) which consisted of 574 SSU visits. During the surveys, 130 shore angler interviews were completed and 138 catches of 36 different species were recorded (Table 2). Of the four shore survey strata scheduled for 2022, (east coast, season; summer/winter, activity; high/low), the winter/low activity stratum had the lowest number of PSU visits (Table 2).

Table 2: Primary sampling unit (PSU) survey details during IMREC roving creel shore surveys along the East Region stratum in 2022.

Seasonal stratum	Angling activity stratum	number PSU visits	number SSU visits	number PSU visits (anglers present)	number angler Interviews	Average catch count (±s.d)	Average angling time mins (±s.d)
Winter	High	15	108	7	15	0.9 (2.3)	164 (86)
Winter	Low	8	47	4	7	3.6 (4.8)	206 (62)
Summer	High	35	307	25	77	0.89(1.7)	192 (111)
Summer	Low	23	112	14	31	0.88 (1.7)	169 (88)

Catch per unit effort (CPUE) estimates

CPUE estimates for all shore caught species recorded during the survey have been weighted using the survey design approach and calculated across all survey strata. Mackerel were the most retained species (CPUE 0.17, *0.03 RSE*), followed by pollack (CPUE 0.06, *0.2 RSE*). Only three other retained species were recorded during the survey in 2022 (Flounder, European seabass and gilthead bream) (Table 3). In total 20 species were recorded as caught and released during the onsite shore surveys (Table 3). The most common caught and released species were mackerel (CPUE 0.37, *0.12 RSE*), and whiting (CPUE 0.31, *0.03 RSE*), followed by European seabass and lesser spotted dogfish (Fig. 6).

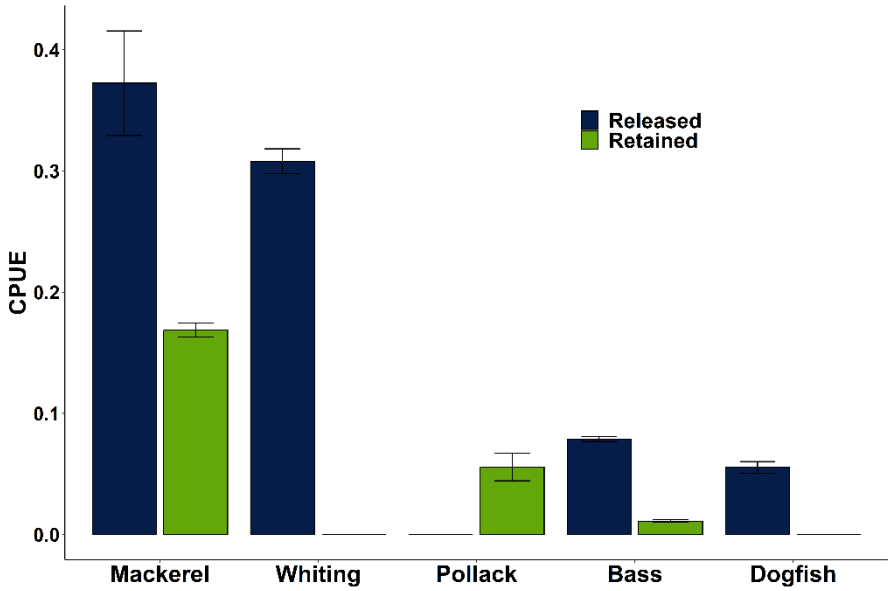

Fig 6. Mean weighted CPUE (catch per angler day) estimates of the five most commonly shore caught species recorded during on-site surveys along the Eastern Region stratum of Ireland (Jan-Dec 2022).

Fish lengths

Released mackerel were on average smaller (24cm) than retained catches (28cm). Released catches of European sea bass were on average 38cms, which is below the legal-size retention limit of 42cm (Table 3).

Annual shore catch estimates – Eastern Region stratum

No catches of cod were recorded during the on-site shore sampling surveys. Mackerel made up the largest proportion of retained fish by shore anglers (Table 4) with an estimated 25(*0.31 RSE*)

tonnes retained along the eastern half of Ireland. Surprisingly, it was estimated that more mackerel were released than retained according to the survey design based CPUE value. Besides mackerel, pollack were the most retained species by number and weight (Table 4). European sea bass were retained, albeit in small numbers. Total retention was estimated to be around 9,000 (0.41 RSE) individuals, whereas around 67,000 (0.33 RSE) individuals were caught and released, according to estimates.

Table 3: Weighted CPUE (catch per angler day) estimates and average lengths/weights of all fish captures recorded during IMREC on-site shore surveys along the Eastern Region stratum of Ireland (Jan – Dec 2022).

Species	Number of catch records	CPUE(RSE)	CPUE biomass (RSE)	Length (±se) cm	Ave weight (±se) g
Released Catches					
Mackerel	16	0.37(0.12)	32.15(0.01)	24.3(0.2)	128.4(3.3)
Whiting	15	0.31(0.03)	5.81(0.01)	11.3(0.3)	20.8(1.9)
European seabass	16	0.08(0.02)	42.92(0)	37.6(0.7)	684.1(51.3)
Lesser spotted dogfish	12	0.06(0.09)	NA	43.5(0.1)	NA
Smoothhound	5	0.05(0.05)	NA	64.6(0.9)	NA
Black Goby	4	0.01(0.04)	NA	10(0)	NA
Ballan wrasse	3	0.01(0.1)	NA	21(1.4)	NA
Bull huss	3	0.01(0.09)	NA	35(0)	NA
Dab	3	0.08(0.04)	NA	13(0.2)	NA
Flounder	3	0.01(0.07)	NA	22.3(0.6)	NA
Rock Goby	3	0.01(0.06)	NA	20(0)	NA
Bib (Pouting)	2	0.07(0.05)	NA	17.5(0.3)	NA
Coalfish	2	0.07(0.05)	NA	19.5(0.9)	NA
Scad	2	0.01(0)	NA	10(0)	NA
Common Blenny	2	0.01(0.08)	NA	11(NA)	NA
Common dragonet	1	0.03(0.02)	NA	10(NA)	NA
Common Goby	1	0.009(0.04)	NA	10(NA)	NA
Corkwing wrasse	1	0.01(0.19)	NA	16(NA)	NA
European eel	1	0.01(0.11)	NA	20(NA)	NA
Plaice	1	0.01(0.19)	NA	18(NA)	NA
Retained catches					
Mackerel	32	0.17(0.03)	29.73(0)	27.9(0.3)	180.1(6.2)
Pollack	5	0.06(0.2)	15.35(0.01)	29(0.8)	275.7(26.7)
Flounder	3	0.02(0.08)	NA	30(NA)	NA
European seabass	1	0.01(0.11)	3.15(0.01)	30(NA)	282.6(NA)
Gilthead bream	1	0(0.09)	NA	38(NA)	NA

Table 4: Shore angling estimates of total catch and weight for selected species along the Eastern Region stratum of Ireland (Jan - Dec 2022).

Species	Total Annual catch (000's) (RSE)	Total Catch Biomass (t) (RSE)
Released		
Mackerel	317 (0.42)	27 (0.32)
Whiting	262 (0.34)	5 (0.31)
European seabass	67 (0.33)	37 (0.31)
Lesser spotted dogfish	47 (0.39)	NA
Smoothhound	40 (0.35)	NA
Retained		
Mackerel	144 (0.34)	25 (0.31)
Pollack	47 (0.51)	13 (0.32)
European seabass	9 (0.41)	3 (0.31)

3.1.2 Bus route access point survey of small boat anglers

During 2022, IFI surveyors conducted 26 shore surveys (PSU visits) which consisted of 53 SSU visits. During the surveys, 36 small boat interviews were completed and 878 catches of 27 different species were recorded (Table 5).

Table 5: Primary sampling unit (PSU) survey details during IMREC roving creel shore surveys along the Eastern Region stratum of Ireland (Jan-Dec 2022).

Seasonal stratum	**Angling activity stratum**	**number PSU visits**	**number SSU visits**	**number PSU visits (anglers present)**	**number angler Interviews**	**Average Catch count (±s.d)**	**Average angling time mins (±s.d)**
Winter	High	4	9	1	1	0	141
Winter	Low	0	0	0	0	NA	NA
Summer	High	21	43	13	34	25.4 (33)	274 (114)
Summer	Low	1	1	1	1	4	150

Catch per unit effort (CPUE) estimates

CPUE estimates for all small boat caught species recorded during the survey have been weighted using the survey design approach and calculated across all survey strata. Mackerel strongly dominated the most retained species (CPUE 2.7, *0.01 RSE*) category, followed by pollack (CPUE 0.29, *0.02 RSE*) and cod (CPUE 0.06, *0.01 RSE*). Four other retained species were recorded during the survey in 2022 (Table 6). In total 27 species were recorded as caught and released during the onsite small boat surveys (Table 6). The most common caught and released species was mackerel (CPUE 0.57, *0.28 RSE*). Other commonly caught and released species included pollack, lesser spotted dogfish, grey gurnard and ballan wrasse (Fig. 7; Table 6).

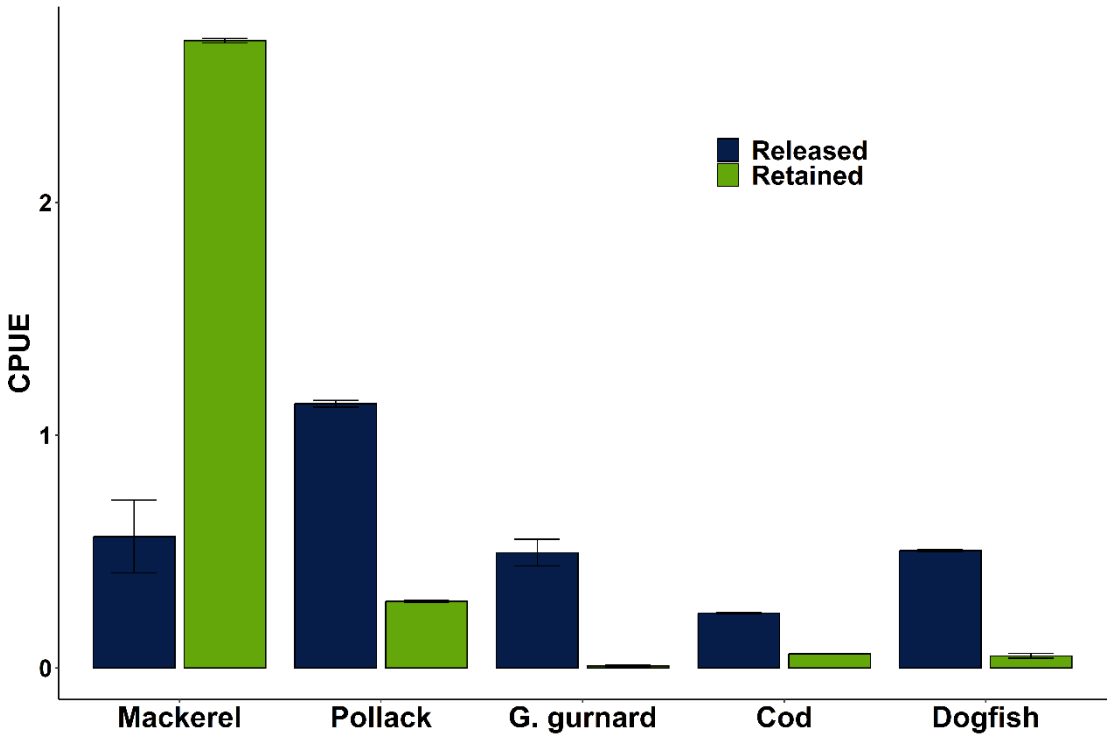

Fig 7. Mean weighted CPUE (catch per angler day) estimates of the five most commonly small boat caught species recorded during on-site surveys along the Eastern Region stratum of Ireland (Jan-Dec 2022).

Table 6: Weighted CPUE (catch per angler day) estimates and average lengths/weights of all fish captures recorded during IMREC on-site small boat surveys along the Eastern Region stratum of Ireland (Jan – Dec 2022).

Species	Number of catch records	CPUE(RSE)	CPUE biomass (g)(RSE)	Length cm (±se)	Ave weight g (±se)
Released					
Mackerel	65	0.57(0.28)	105.76(0.02)	27.8(0.9)	187.2(10.6)
Lesser spotted dogfish	58	0.5(0.01)	NA	49(0.8)	NA
Pollack	58	1.14(0.01)	744.78(0)	35.8(0.9)	450.7(42.6)
Grey gurnard	57	0.5(0.11)	NA	20.6(0.9)	NA
Ballan wrasse	50	0.43(0.16)	NA	24(0.8)	NA
Tub gurnard	43	0.37(0.06)	NA	26.9(0.9)	NA
Greater Sandeel	37	0.32(0.05)	NA	40.7(1.5)	NA
Corkwing wrasse	36	0.31(0.18)	NA	15.9(0.3)	NA
Cod	27	0.23(0.01)	186.56(0)	42(1.4)	794.9(68.6)
Cuckoo wrasse	27	0.23(0.19)	NA	22.7(0.4)	NA
Red gurnard	17	0.15(0.16)	NA	24.8(1)	NA
Bib (Pouting)	15	0.13(0.11)	NA	23.4(0.7)	NA
Tompot Blenny	12	0.1(0.2)	NA	10(0)	NA
Dab	11	0.1(0.15)	NA	16.4(1.2)	NA
Whiting	8	0.07(0.02)	12.12(0)	27.5(0.4)	174.3(7.5)
Tope	4	0.03(0.2)	NA	110(12.5)	NA
Poor cod	3	0.03(0.2)	NA	11.7(0.5)	NA
Thornback ray	3	0.03(0.42)	NA	41.7(3.8)	NA
Black seabream	2	0.02(0.03)	NA	25(0)	NA
Smooth-hound	2	0.02(0.42)	NA	82.5(0.6)	NA
Bull huss	1	0.01(0.2)	NA	65(NA)	NA
Common dragonet	1	0.01(0.2)	NA	14(NA)	NA
Conger eel	1	0.01(0.2)	NA	45(NA)	NA
European seabass	1	0.01(0.09)	0.53(0.01)	18(NA)	60.9(NA)
Goldsinny Wrasse	1	0.01(0.2)	NA	10(NA)	NA
Herring	1	0.01(0.2)	NA	25(NA)	NA
Plaice	1	0.01(0.2)	NA	32(NA)	NA
Retained					
Mackerel	286	2.7(0)	575.15(0)	28(1.1)	201.3(18.4)
Pollack	33	0.29(0.02)	206.77(0)	42.5(0.9)	720.8(52.7)
Cod	7	0.06(0.01)	97.21(0)	50.6(2.4)	1597.6(231.7)
Lesser spotted dogfish	6	0.05(0.2)	NA	45(0)	NA
European seabass	2	0.02(0.08)	32.54(0)	56(0.9)	1871.7(93.4)
Grey gurnard	1	0.01(0.42)	NA	40(NA)	NA
Tompot Blenny	1	0.01(0.2)	NA	10(NA)	NA

Fish lengths

Pollack, the most caught small boat caught fish, after mackerel, were on average 43cm when retained and 36 cm when released. Likewise, released cod were on average smaller (42cm) than retained fish (51cm). Although released mackerel were on average smaller than retained catches, this difference was small (Table 6).

Annual small boat catch estimates – Eastern Region stratum

The data collected during the pilot study estimated that small boat anglers retain 113 (0.44 RSE) tonnes of pollack and 53 (0.43 RSE) tonnes of cod over the course of a year along the Eastern Region stratum (Table 7). Small boat anglers along the Eastern Region stratum retained 18 (0.44 RSE) tonnes of European sea bass according to the analysis. (Table 7). Overall small boat catch records were low due to the considerable difficulties in encountering these anglers at sampling points, so estimates are imprecise.

Table 7: Small boat angling estimates of total catch and weight for selected species along the Eastern Region stratum of Ireland (Jan - Dec 2022).

Species	Total Annual catch (000's) (RSE)	Total Catch Biomass (t) (RSE)
Released		
Mackerel	310 (0.71)	58 (0.46)
Lesser spotted dogfish	277 (0.45)	NA
Pollack	623 (0.45)	409 (0.44)
Cod	129 (0.45)	102 (0.44)
Whiting	38 (0.46)	7 (0.44)
Tope	19 (0.64)	NA
Thornback ray	14 (0.85)	NA
Smoothhound	10 (0.85)	NA
Bull huss	5 (0.64)	NA
European seabass	5 (0.52)	<0 (0.45)
Retained		
Mackerel	1480 (0.44)	316 (0.44)
Pollack	157 (0.45)	113 (0.44)
Cod	33 (0.44)	53 (0.43)
Lesser spotted dogfish	29 (0.64)	NA
European seabass	10 (0.51)	18 (0.44)

3.1.3 Onboard charter catch survey

The onboard charter catch survey (n= 46 sampling trips) around the coast collected data on 33 species (4585 fish) over both sampling years. A greater number of sampling trips were in the Western Regional stratum (n=35) (Fig. 8).

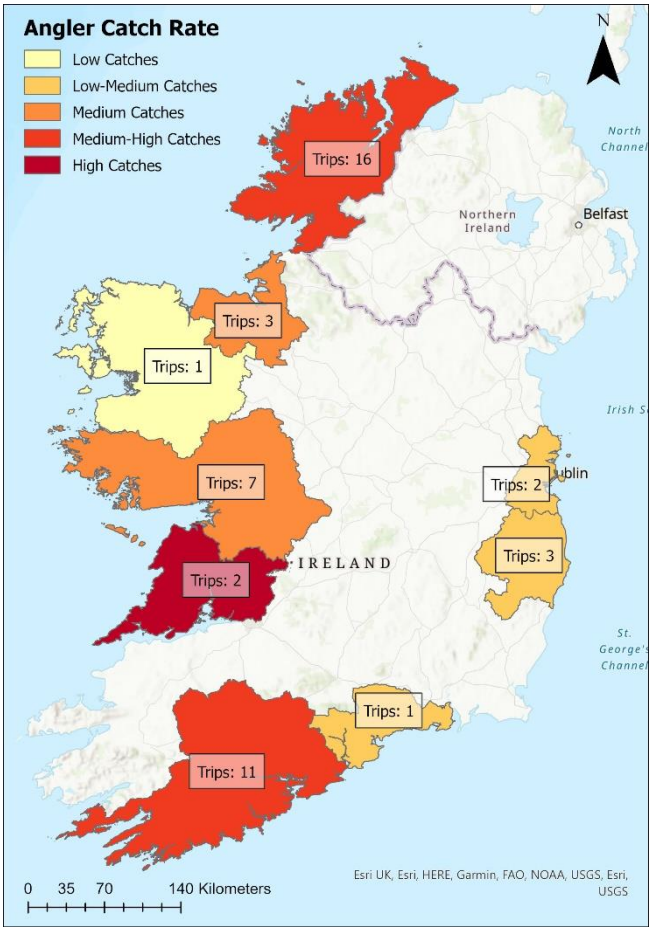

Fig 8. Sampling trip locations during the IMREC onboard charter angling survey (Jan 2021-Dec 2022).

Catch per unit effort (CPUE) estimates

Mackerel were the highest retained species by number (Fig. 9) and pollack were the highest retained by biomass (Table 8). Species length had a minor influence on rate of retention. Retained fish were on average longer than released ones for the most commonly caught species (Fig. 10).

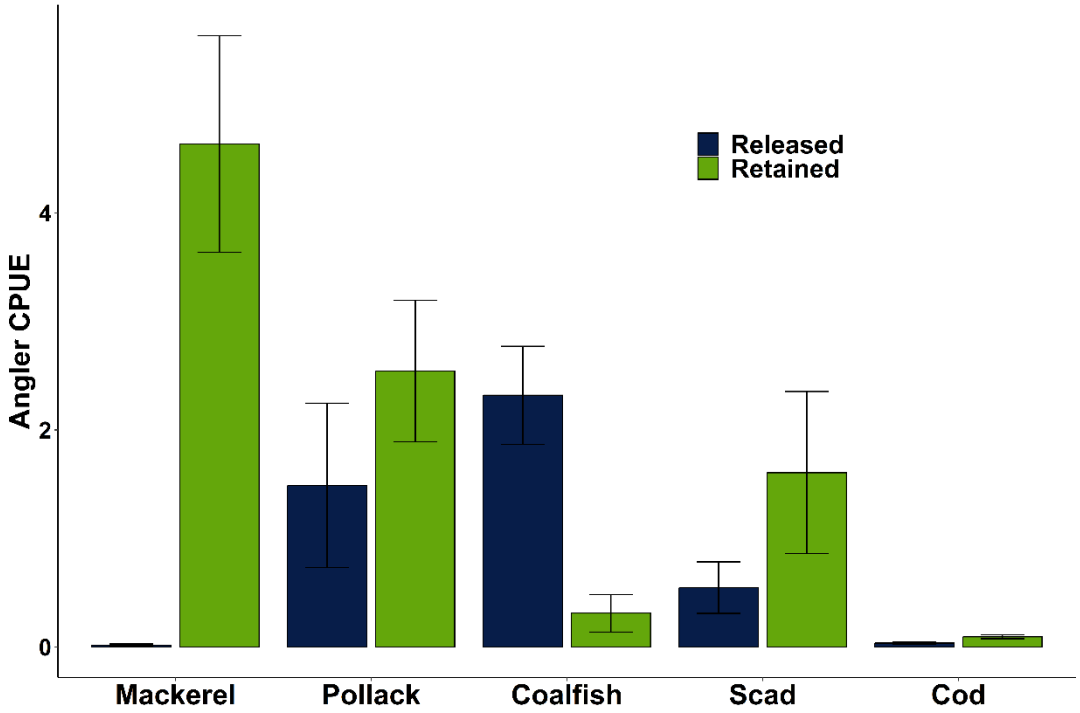

Fig 9. Mean weighted CPUE (catch per angler day) estimates of the five most commonly charter caught species recorded during the national IMREC onboard charter survey (Jan 2021-Dec 2022).

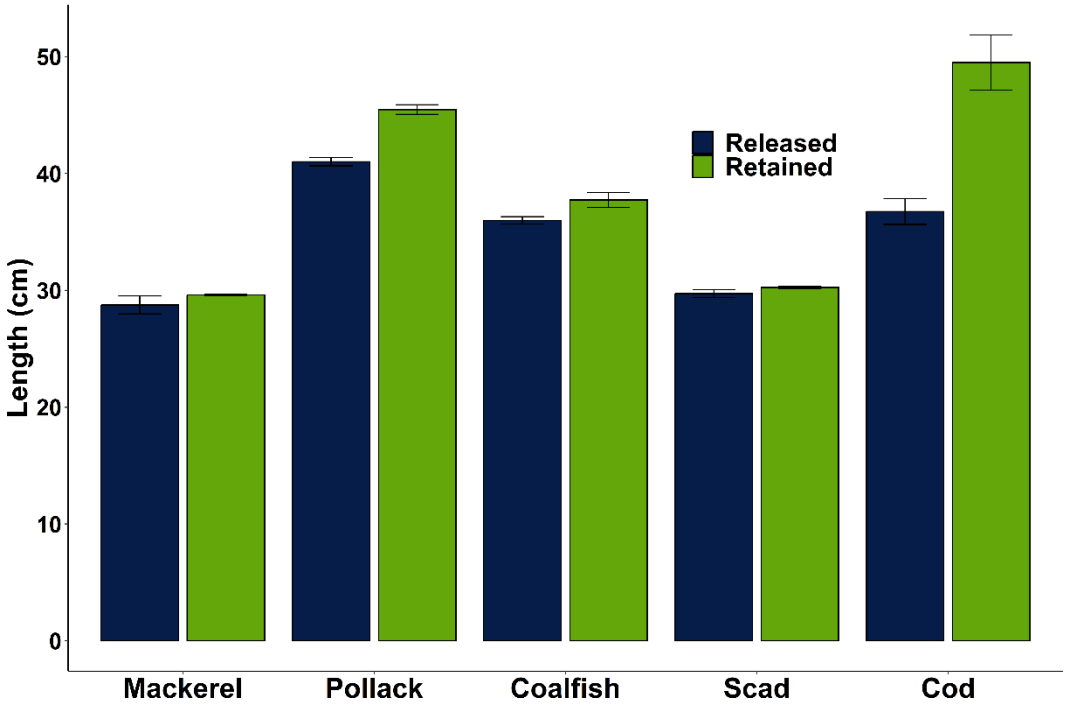

Fig 10. Mean lengths (cm ±s.e) of the five most commonly charter caught species recorded during the national IMREC onboard charter survey (Jan 2021-Dec 2022).

Table 8: Weighted CPUE (catch per angler day) **ranked** estimates and average lengths/weights of all fish captures recorded during national IMREC on-board charter surveys throughout Ireland (Jan 2021 – Dec 2022).

Species	Total Caught	CPUE (±s.e)	CPUE Biomass (kg) (±s.e)	Average length (cm) (±s.e)	Average weight (Kg) (±s.e)
Released					
Coalfish	531	2.32 (0.45)	1.18 (0.23)	36 (0.3)	0.51 (0.01)
Pollack	467	1.49 (0.76)	1.04 (0.35)	41 (0.4)	0.72 (0.02)
Lesser Spotted Dogfish	143	0.63 (0.14)	0.45 (0.04)	55.6 (0.4)	0.65 (0.02)
Scad	125	0.55 (0.24)	0.14 (0.03)	29.7 (0.4)	0.25 (0.01)
Cuckoo Wrasse	118	0.37 (0.14)	0.08 (0.03)	25.7 (0.3)	0.22 (0.01)
Ballan Wrasse	41	0.13 (0.05)	0.05 (0.02)	30.2 (0.6)	0.43 (0.03)
Dab	41	0.18 (0.08)	0.03 (0.01)	21.8 (0.4)	0.16 (0.01)
Blue Shark	38	0.15 (0.05)	NA	260 (57.6)	NA
Pouting	37	0.12 (0.03)	0.04 (0.01)	28.1 (0.9)	0.32 (0.03)
Poor Cod	34	0.11 (0.04)	0.01 (0)	19.5 (0.5)	0.12 (0.01)
Whiting	33	0.1 (0.09)	0.01 (0)	26.8 (0.6)	0.14 (0.01)
Bull Huss	32	0.15 (0.05)	0.14 (0.1)	67.2 (3.3)	1.18 (0.24)
Ling	16	0.07 (0.03)	0.06 (0.02)	52.6 (3.2)	0.91 (0.18)
Grey Gurnard	15	0.06 (0.01)	0.01 (0)	21.9 (0.9)	0.15 (0.02)
Thornback Ray	11	0.05 (0.04)	0.05 (0.04)	52.5 (1.2)	1.04 (0.08)
Tope	10	0.16 (0.04)	NA	124.6 (12)	NA
Cod	8	0.03 (0.01)	0.02 (0.01)	36.8 (1.1)	0.51 (0.05)
Smoothound	7	0.11 (0.03)	NA	75 (4.9)	NA
Spurdog	7	0.03 (0.08)	NA	82 (0)	NA
Red Gurnard	6	0.03 (0.01)	0.01 (0)	30.3 (2.1)	0.33 (0.07)
Tub Gurnard	6	0.03 (0.01)	0.01 (0)	27.5 (2.1)	0.22 (0.06)
Mackerel	5	0.02 (0.01)	0 (0)	28.8 (0.8)	0.22 (0)
Porbeagle	5	0.02 (0.01)	NA	NA	NA
Sandeel	5	0.02 (0.01)	0 (0)	27.8 (1.9)	0.09 (0.03)
Homelyn Ray	4	0.01 (0.01)	0.01 (0)	50.5 (4.2)	0.49 (0.17)
Conger	2	0.03 (0.01)	NA	95.5 (3.5)	NA
Haddock	2	0.01 (0.01)	NA	30 (2)	NA
Retained					
Mackerel	1386	4.64 (1)	1.07 (0.11)	29.6 (0.1)	0.23 (0)
Pollack	804	2.54 (0.65)	2.6 (0.51)	45.5 (0.4)	1.04 (0.02)
Scad	368	1.61 (0.75)	0.4 (0.18)	30.3 (0.1)	0.25 (0)
Coalfish	101	0.31 (0.17)	0.19 (0.08)	37.7 (0.6)	0.61 (0.04)
Launce	57	0.25 (0.08)	NA	28.9 (0.2)	NA
Cod	28	0.09 (0.02)	0.12 (0.03)	49.5 (2.4)	1.39 (0.21)
Ling	20	0.09 (0.02)	0.13 (0.04)	62.5 (2.5)	1.47 (0.18)
Pouting	18	0.09 (0.02)	0.02 (0.01)	29.3 (1.3)	0.29 (0.04)
Whiting	17	0.05 (0.05)	0.02 (0.01)	31.6 (1.3)	0.4 (0.02)
Dab	15	0.07 (0.04)	0.02 (0.01)	28.9 (0.4)	0.3 (0.01)
Herring	6	0.03 (0.01)	<0.01 (0)	21.3 (0.2)	0.06 (0)
Cuckoo Wrasse	3	0.05 (0.01)	0.01 (0)	26.7 (0.3)	0.17 (0)
Red Gurnard	2	0.03 (0)	<0.01 (0)	26 (1)	0.14 (0.02)

All 257 elasmobranch catches recorded over the course of the survey were released. Lesser spotted dogfish were the most frequently caught elasmobranch species, followed by blue shark and bull huss respectively (Table 8). Catch rates of lesser spotted were higher along the eastern half of the country, whereas blue shark catch rates were highest along the western half. In fact, most elasmobranch species catches were highly stratified by region (Figs. 11&12).

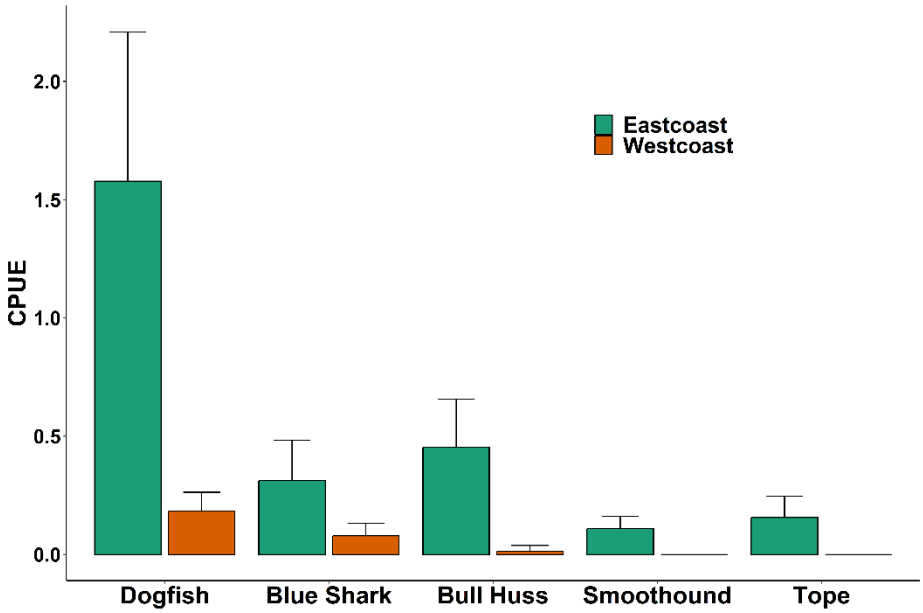

Fig 11. Regional CPUE (catch per angler day) of released charter caught elasmobranch species recorded during the IMREC onboard charter survey (Jan 2021-Dec 2022).

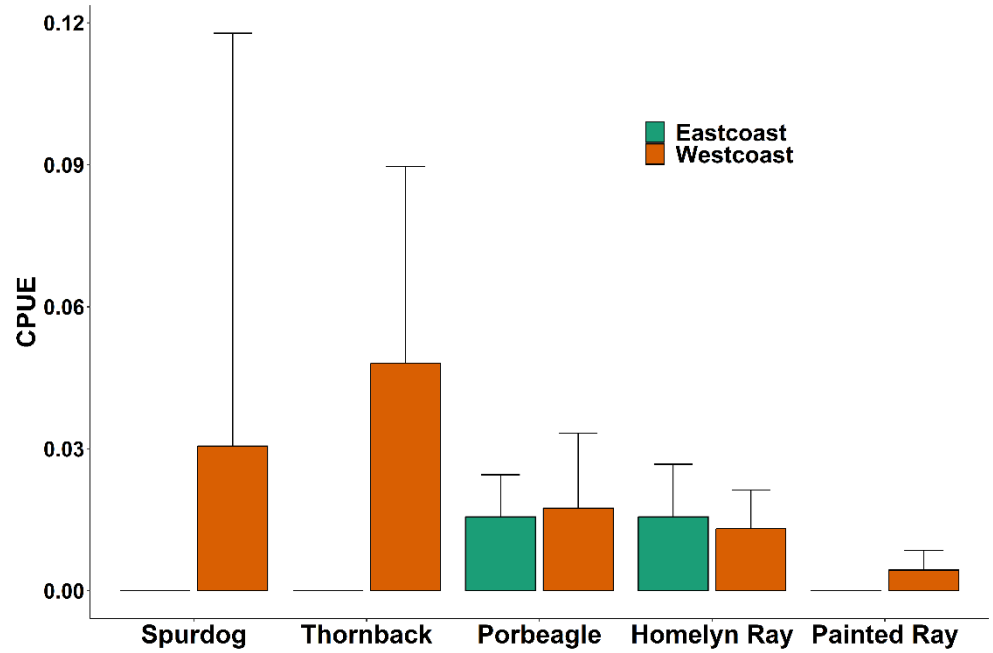

Fig 12. Regional CPUE (catch per angler day) of released charter caught elasmobranch species recorded during the IMREC onboard charter survey (Jan 2021-Dec 2022).

Annual charter catch estimates

The collated IFI historical charter effort data determined that, on average, charter vessels undertook 62 (±0.9 s.e) angling trips per year (Ryan et al., 2023). The current survey found that 6.4 anglers were aboard the average charter trip. According to most recent data, the highest possible size of the active charter fleet in Ireland is 99. This equals 39,039 (±781 se) charter angler days in Ireland, per year.

It is estimated that 102 tonnes of pollack and 42 tonnes of mackerel are retained by charter anglers in Ireland annually (Table 9). Otherwise, harvest is very low and most catches are returned alive.

Table 9: Charter angling estimates of total annual catch and weight for selected species throughout the coast of Ireland.

Species	Total Annual catch (000's) (RSE)	Total Catch Biomass (t) (RSE)
Released		
Coalfish	91(0.19)	46(0.19)
Pollack	58(0.51)	41(0.34)
Lesser Spotted Dogfish	24(0.23)	18(0.1)
Scad	21(0.44)	5(0.25)
Cuckoo Wrasse	14(0.39)	3(0.39)
Dab	7(0.47)	1(0.44)
Ballan Wrasse	5(0.36)	2(0.34)
Pouting	5(0.25)	1(0.29)
Poor Cod	4(0.34)	1(0.26)
Retained		
Mackerel	181(0.22)	42(0.11)
Pollack	99(0.26)	102(0.2)
Scad	63(0.46)	16(0.45)
Coalfish	12(0.56)	7(0.44)
Launce	10(0.34)	NA
Cod	4(0.19)	5(0.23)
Ling	3(0.25)	5(0.29)
Pouting	3(0.22)	1(0.36)
Whiting	2(0.92)	1(0.71)

3.2 Off-site angling surveys

3.2.1 Online angling diary

Increases in angler recruitment figures were observed during co-ordinated media publicity drives (Fig. 13). An initial recruitment of 79 anglers was observed during 2021. A soft launch using IFI media streams in April 2022 saw diarist figures rise from 83 to 134 in August, a 61% increase. A further media drive through IFI and ESRI platforms saw another 25 diarists recruited an 18.6% increase.

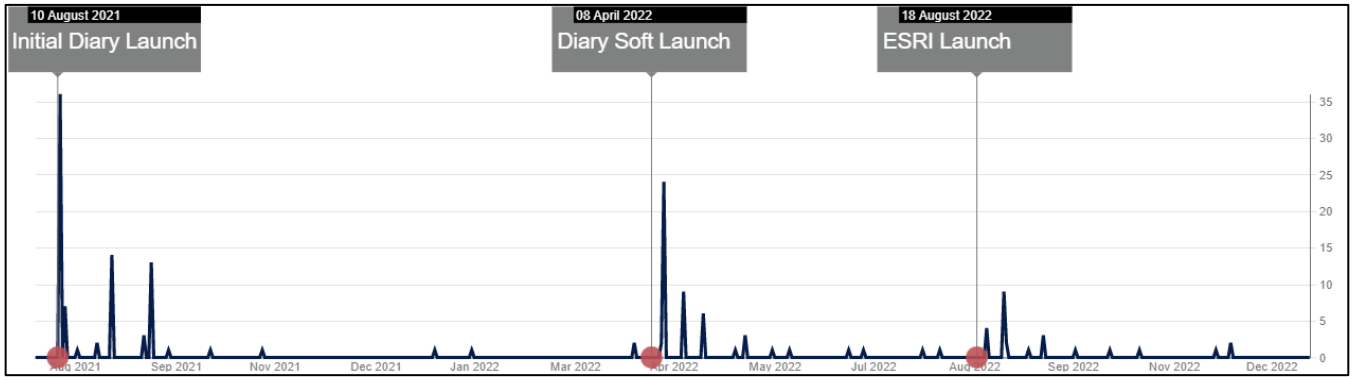

Fig. 13: Diarist recruitment and media drives throughout 2021 & 2022.

A summary of the diarists fishing activity recorded during 2021 and 2022 is provided in Table 10. 2022 saw a 101% increase in diarist sign ups compared to 2021 leading to a total recruitment figure of 159 as of end December 2022. This led to a 157% increase in active diarists in 2022 and twice the number of recorded sessions. Of 79 anglers recruited in 2021, 35% were active (recorded at least 1 session). In 2022, 80 anglers were recruited resulting in a total of 159 diarists by September 2022, with 36% of these considered active diarists. A breakdown of sessions per diarist for 2021 and 2022 were 2.7 and 6.4 respectively with an overall average of 4.5 sessions per angler. In comparison, the average number of sessions for active diarists for 2021 & 2022 were 7.6 and 11.6 respectively with 12.7 sessions being the overall average. Average session length was 3.3 hours for active diarists. In total, 2386 hours of angling were recorded. This results in an average of 15.0 hours per diarist. A substantial increase in this average was seen when limiting the fishing hours to active diarists (41.9 hours per angler) (Table 10).

Table 10: IMREC Diary summary 2021-2022			
	2021	**2022**	**Total**
Number of diarists recruited	79	80	159
Number of diarists reporting	28	44	57
Number of sessions recorded	213	509	722
Average number of sessions per diarist	2.7	6.4	4.5
Average number of sessions per diarists who reported at least one session	7.6	11.6	12.7
Average session length (hours)	3.3	3.3	3.3
Total fishing hours recorded	696	1690	2386
Average number of hours per diarist in the study	8.8	21.1	15.0
Average number of hours per diarists who reported at least one session	24.8	38.4	41.9

Angling type

Shore angling represented 86% of all recorded sessions, accounting for 42.7% of all fish caught. Small boat angling saw 37.4% of all catches while only representing 10.7% of total reports. Small boat angling displayed a much higher catch rate when compared to shore angling. Kayak and charter angling represented a smaller portion of recorded sessions with 10.9% and 9% respectively and each representing less than 2% of all catches (Fig. 14). The number of hours spent fishing based on the type of angling mirrors the number of sessions recorded.

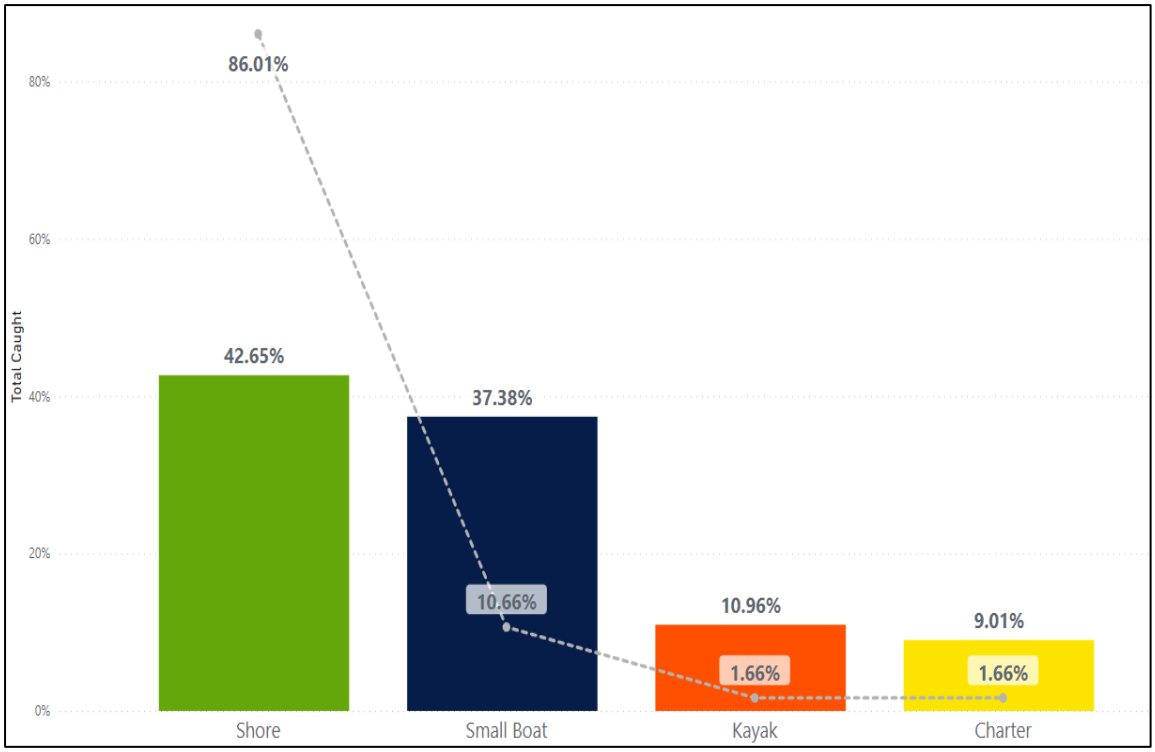

Fig. 14: All angling records (dotted line) and catch rates per fishing type (Bars), recorded on the IMREC angling diary 2021-2022.

Number of angling trips by strata

Contributing anglers recorded 317 trips on the East Region stratum and 405 on the West Region stratum (Fig. 15). A greater proportion trips were recorded during the summer period in both strata with the East seeing 18% of all sessions in the winter. The West saw a higher rate of winter fishing with 34% of sessions taking place during this period.

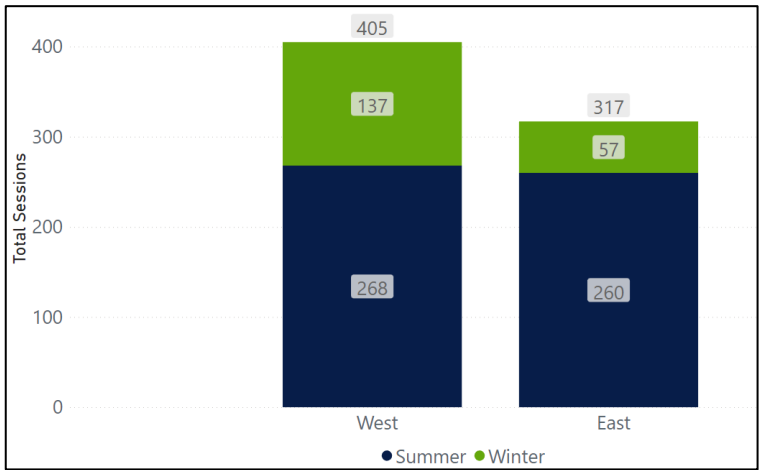

Fig. 15: All angling trips recorded by sampling strata on the IMREC angling diary 2021-2022.

Number of angling trips by angling type

A total of 621 shore angling sessions were recorded (Fig. 16). Of these, 70% logged at least one fish capture (Table 11). Of the 77 small boat sessions, 92% of all sessions resulted in fish being caught. Both the charter and kayak angling had noticeably fewer sessions (12) logged but all were successful.

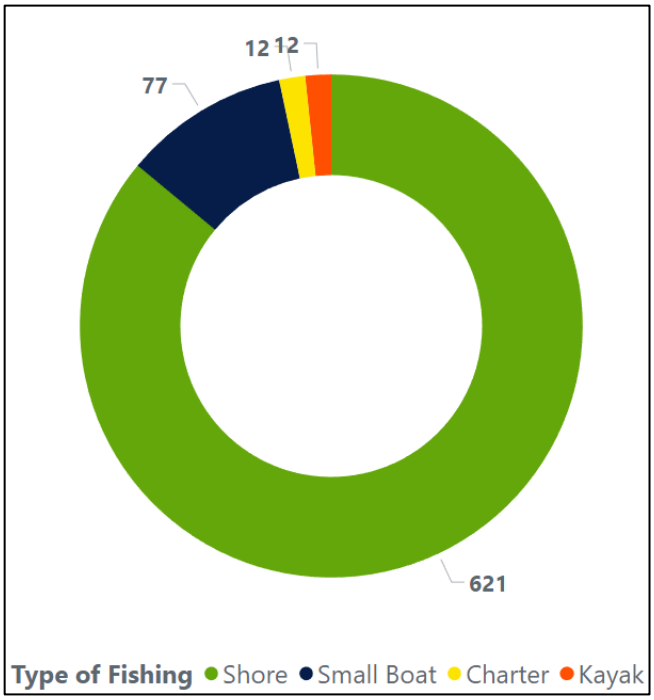

Fig. 16: All angling trips recorded by angling type on the IMREC angling diary 2021-2022.

Table 11: Percentage of successful angling trips by angling type.

	Total	Fish Caught	No Fish Caught
Shore	621	70%	30%
Small Boat	77	92%	8%
Charter	12	100%	-
Kayak	12	100%	-

Number of angling trips by angling type – across strata

Seasonal variations were observed for each fishing type per spatial strata with 18% of total sessions logged in the East during winter (1st Oct-31st Mar) and 34% in the West (Fig. 17). The winter stratum was dominated by shore angling in both the East and West strata. Only 3 small boat sessions were recorded in the East. Only one kayak session was recorded.

A much higher proportion of small boat angling was recorded in the summer sampling stratum (1st April-31st Sept). Around 14% of all summer sessions recorded were from small boats, regardless of regional stratum. Charter and kayak angling records were rare in both regional strata, representing 2% or less of all angling trips recorded. Only 9 charter sessions were recorded in the East coast and 3 in the West over the sampling period. Regarding kayak angling, five sessions were recorded in the East coast and seven in the West.

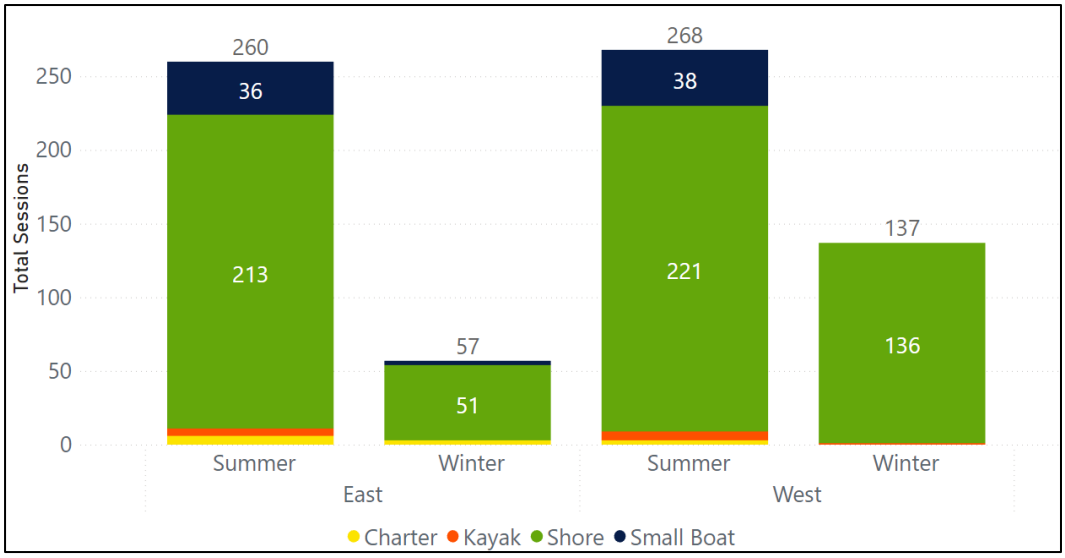

Fig. 17: All angling trips recorded by angling type across regional and temporal strata on the IMREC angling diary 2021-2022.

Species catch records

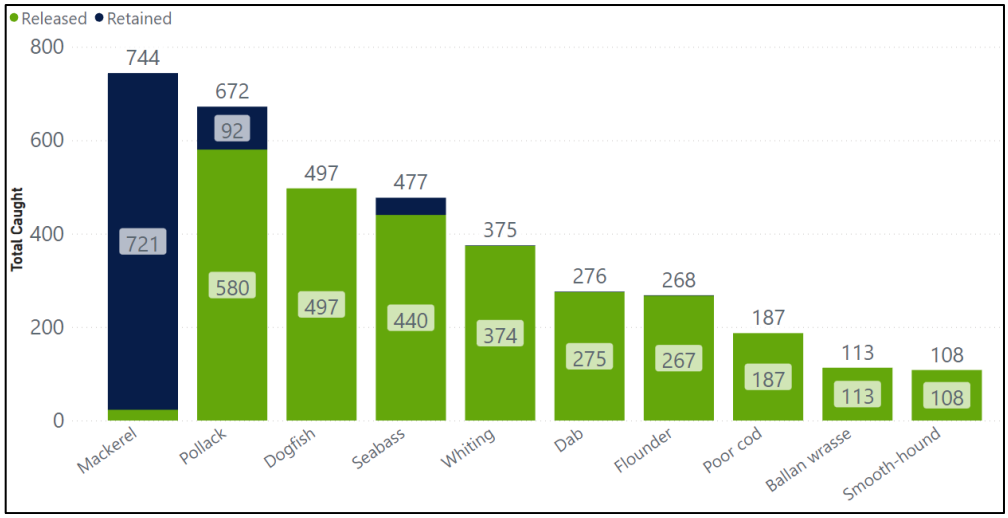

Fig. 18: Top ten species catches (retained/released) recorded on the IMREC angling diary 2021-2022.

A total of 4,617 fish were caught across 57 species between August 2021 and December 2022 with mackerel and pollack accounting for 30.6% of all catches (Fig. 18). A high release rate (80%) was observed across all captures. Mackerel release rates reduce the overall release rate as only 3% of mackerel catches were released. When mackerel catches are omitted, a release rate of 95% is evident across all catches. Mackerel represented 16% of all catches in the diary. Pollack represented 14.5% of all catches with a release rate of 86%. Lesser spotted dogfish represented 10.7% of all catches with 100% release rate closely followed by European Seabass representing 10.3% of total with a 92% release rate. Whiting

was the 5th most caught species comprising 8% of all catches with 99% release rate. Dab represented 6% of all catches with 99% release rate. Flounder (5.8%), Poor Cod (4%), ballan wrasse (2.4%) and smooth hound (2.3%) all recorded 99% release rate or higher.

Other notable catches outside the top 10 species were coalfish (107 caught, 94% release rate), cod = (39 caught, 64% release rate), Thornback ray (66 caught, 100% release rate) and 1 released stingray catch record.

Top 10 species by fishing type

Over 66% of all mackerel catches were from small boats. Similarly, most pollack catch records came from small boats (64%). European seabass and flounder catch records were dominated by shore captures (>95%). The majority of poor cod catches were recorded by kayak anglers (67%). Charter anglers accounted for 47.8% of all dab catch records while also representing 15% of all mackerel recorded (Fig. 19).

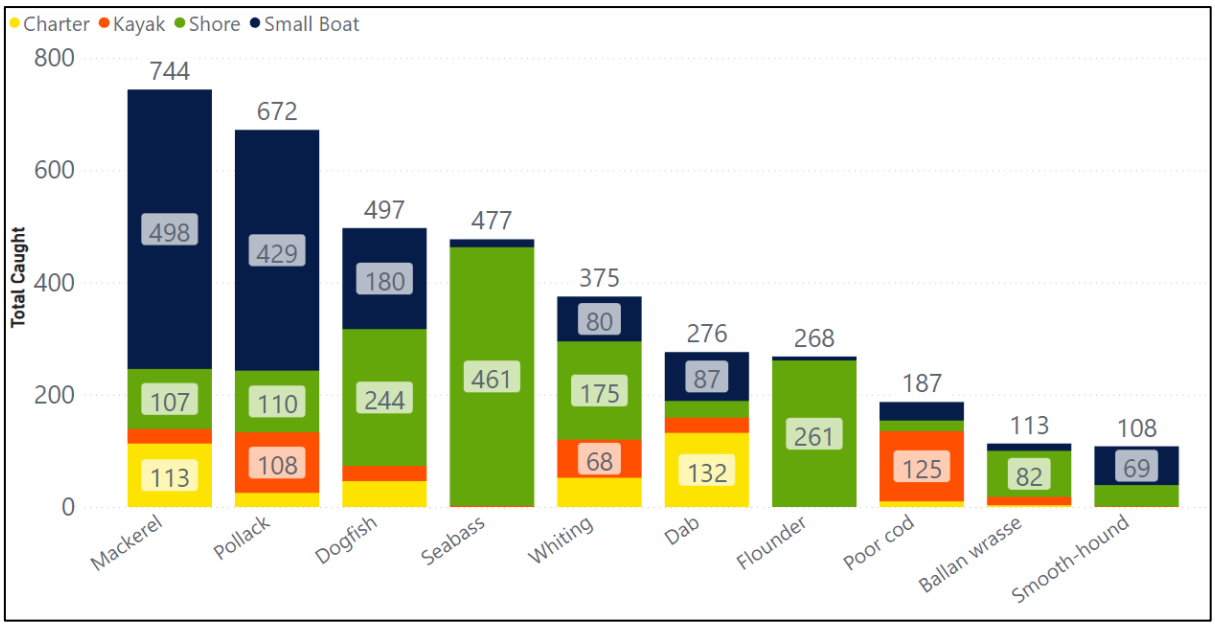

Fig. 19: Top ten species catches by fishing type recorded on the IMREC angling diary 2021-2022.

Release and retained rates vary depending on the fishing type with kayak angling showing the highest release rate (93%). Shore angling showed a 91% release rate. The small boat and charter sectors saw lower release rates with 59% and 70%, respectively.

Species catch by strata

In total, 2,011 catch records were logged by anglers fishing on the East and 2,606 were logged by those fishing on the West between Aug 21-Dec 22. Catch records related to the Top 10 species saw 1,693 catches along the East and 2,024 catches along the West (Table 12). West Region anglers recorded 591 (79%) mackerel catches compared to 153 on the East

Region. Pollack capture records were more common along the West with 508 (76%) captures recorded while anglers fishing in the East recorded 164 pollack catches. The East saw higher catches of lesser spotted dogfish (362, 73%) and whiting (263, 70%) compared to the West with 135 (27%) and 112 (30%) respectively. Over 80% of Ballan wrasse (92) and 76% of poor cod (142) catches were recorded by anglers fishing in the West Region (Fig. 20).

As the majority angling sessions were recorded in summer (East, 82%; West, 66%), most fish captures were recorded during the summer months across both East and West coasts. Dab and whiting were the only species which diarists recorded more catches in winter. More dab catches were recorded along the East in the winter (163) compared to summer (65). Whiting saw 149 catches in Winter along the East compared to 114 during the summer (Fig. 18). Each of the top 10 species were caught at least once in both east and west coasts during the summer months (Table 12).

Table. 12: Top ten species catches by regional and temporal strata recorded on the IMREC angling diary 2021-2022.

	East		West		Total
	Summer	Winter	Summer	Winter	
Ballan wrasse	20	1	86	6	113
Dab	65	163	36	12	276
European seabass	287	75	93	42	497
Flounder	75	34	85	74	268
Lesser spotted dogfish	153	-	546	45	744
Mackerel	158	6	448	60	672
Pollack	24	21	131	11	187
Poor cod	197	44	157	79	477
Smooth hound	103	4	1	-	108
Whiting	114	149	75	37	375
Total	1196	497	1658	366	3717

The summer stratum diary records from the west coast consisted mainly of mackerel (546) and pollack (448) catches, making up 11.8% and 9.7% of all catch records, respectively. European seabass was the third most common catch during this timeframe and region. The winter stratum saw a lower number of fish catches recorded. However, a more even spread of catches across species was reported with seabass (79), flounder (74), pollack, (60), Mackerel (45), turbot (42), dogfish (42), whiting (37) and Coalfish (35) consisting of most of the catch records submitted.

The East saw a large number of lesser spotted dogfish (287) catches recorded during the summer stratum (Fig. 18). European seabass (197), pollack (158) and mackerel (153) were the next most common species reported during this period. The winter stratum records on

the East were comprised of Dab (165) and whiting (149) catches. Other notable catches in this period were dogfish (32), seabass (44) and flounder (24).

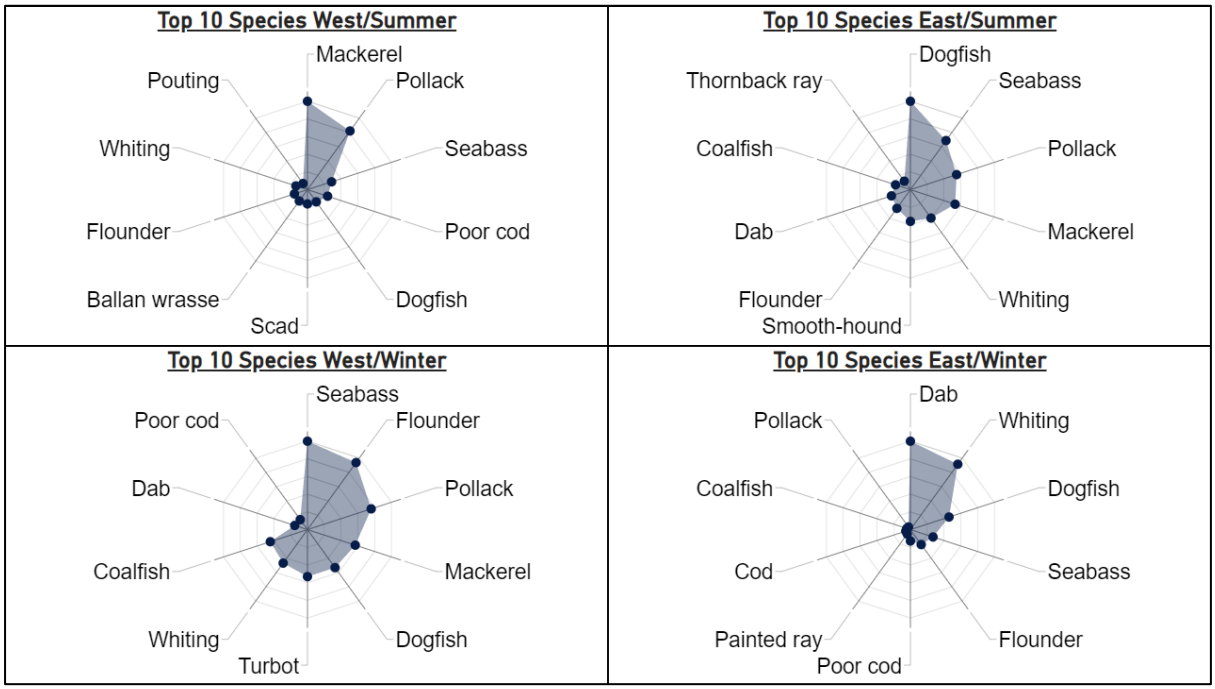

Fig. 20: Top 10 species across regional and temporal strata. Each point represents the total catch per species recorded on the IMREC angling diary 2021-2022. A point located near the outer edge indicates a high catch rate.

Catch per unit effort across strata – shore angling

According to the IMREC diary, overall CPUE for shore caught European sea bass was 0.74 (Table. 5). European seabass shore CPUE was relatively high in both regional strata (East, 0.85; West, 0.66) (Table 5). Overall CPUE for shore caught Flounder was 0.42. Catch rates were similar in both regions (Table 5). Overall CPUE for shore caught Dogfish was 0.39. Dogfish shore catch rates were more common along the east coast with CPUE figures of 0.64. West CPUE figures were 0.39. Overall CPUE for shore caught Whiting was 0.28. Most catches were along the East during winter (CPUE 1.31). Otherwise, whiting catch rates were low (Table 13). Overall CPUE for shore caught Pollack was 0.18. Catch rates were far higher along the West (CPUE 0.27) than the East (CPUE 0.05).

No mackerel shore catches were recorded during the winter along the east coast and catch rates were low during the summer (Table 13). Although catch rates were higher along the east coast, overall shore caught mackerel CPUE was 0.17. Coalfish CPUE was slightly higher along the East (0.20) compared to the West (0.13). Overall CPUE for shore caught Ballan Wrasse was 0.13. Ballan Wrasse catches were less common along the East (Table 13). CPUE values for other shore caught species of interest are provided in Table 13.

Table 13: IMREC angling diary 2021-2022: CPUE by regional and temporal strata of the 10 most commonly caught shore angling species.

Species	Overall CPUE	Diary - East Region CPUE			Diary - West Region CPUE		
		Summer	Winter	Seasons combined	Summer	Winter	Seasons combined
European seabass	0.74	0.85	0.86	0.85	1.15	0.36	0.66
Flounder	0.42	0.32	0.67	0.39	0.63	0.33	0.45
Lesser spotted dogfish	0.39	0.64	0.65	0.64	0.24	0.19	0.21
Whiting	0.28	0.33	1.31	0.52	0.01	0.17	0.11
Pollack	0.18	0.04	0.08	0.05	0.28	0.27	0.27
Mackerel	0.17	0.05	0	0.04	0.38	0.2	0.27
Coalfish	0.16	0.22	0.14	0.2	0.08	0.16	0.13
Ballan wrasse	0.13	0.04	0.02	0.03	0.49	0.03	0.2
Turbot	0.1	0	0	0	0.15	0.19	0.18
Smooth-hound	0.06	0.17	0.04	0.14	0	0	0

Catch per unit effort release rates – shore angling

With the exception of shore caught mackerel, where retained CPUE made up the majority of the catch (0.15 retained, 0.02 released), retained CPUE was very low (Fig.21).

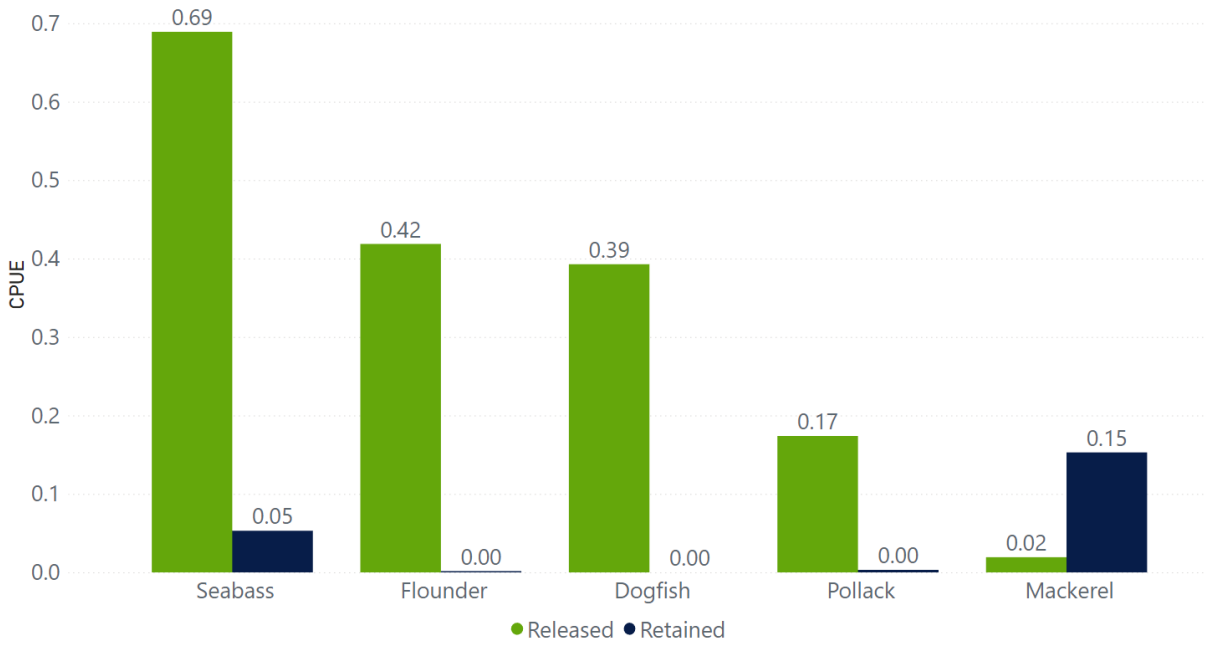

Fig. 21: Catch per unit effort (CPUE) values of the top 5 shore caught species recorded on the IMREC angling diary 2021-2022. Captures across strata combined.

Catch per unit effort across strata – small boat angling

Small boat CPUE focused on the top 10 species based on total caught during small boat fishing including catches recorded from kayaks (Table 14). No captures were recorded in the winter months along the west coast.

CPUE for small boat caught pollack was 6.03 (Table 14). East Region CPUE figures of 3.46 and 0.67 were recorded for Summer and Winter respectively with a combined East Region CPUE of 3.27. Catch rates along the West Region were more than twice as high as the East coast (Table 14). Mackerel catches rates were also far higher along the West Region(CPUE 8.49) compared to the East Region (CPUE 3.46). High catch rates along the East Region resulted CPUE of 3.34. Overall CPUE for small boat caught Dogfish was 2.33 (Table 14). Poor cod CPUE along the West Region was 2.89. This was higher than the East Region. Overall CPUE for small boat caught Poor Cod was 1.78 (Table 14). Overall CPUE for whiting and dab were also greater than 1. Regarding whiting, CPUE was similar along both coasts (Table 14). However, dab catch rates were over twice as high along the East Region (Table 14). The two most commonly caught elasmobranchs, smoothhound and thornback ray had CPUEs of 0.79 and 0.61 respectively. Catch rates were higher along the East Region for both species (Table 14).

Table 14: IMREC angling diary 2021-2022: CPUE by regional and temporal strata of the 10 most caught small boat angling species.

Species	Overall CPUE	Diary - East Region CPUE			Diary - West Region CPUE		
		Summer	Winter	Seasons combined	Summer	Winter	Seasons combined
Pollack	6.03	3.46	0.67	3.27	8.93	0	8.73
Mackerel	5.89	3.46	0	3.23	8.68	0	8.49
Lesser spotted dogfish	2.33	3.17	5.67	3.34	1.36	0	1.33
Poor cod	1.78	0.44	3.33	0.64	2.95	0	2.89
Whiting	1.66	0.85	13	1.68	1.68	0	1.64
Dab	1.28	1.37	9.33	1.91	0.68	0	0.67
Scad	0.89	0	0	0	1.8	0	1.76
Pouting	0.81	0.17	0.00	0.16	1.48	0.00	1.44
Smoothhound	0.79	1.63	0.67	1.57	0.02	0	0.02
Thornback ray	0.61	0.8	0	0.75	0.48	0	0.47

Catch per unit effort release rates – small boat angling

Like shore catch records, retained CPUE was generally low except for mackerel, where retained CPUE was 5.8 compared to a CPUE of 0.1 for released mackerel. Although pollack retention rates around the Irish coastline were far lower than release rates, a retained CPUE of 1 makes pollack the second most retained species. For all other caught species, CPUE retention rates were low (Fig. 22).

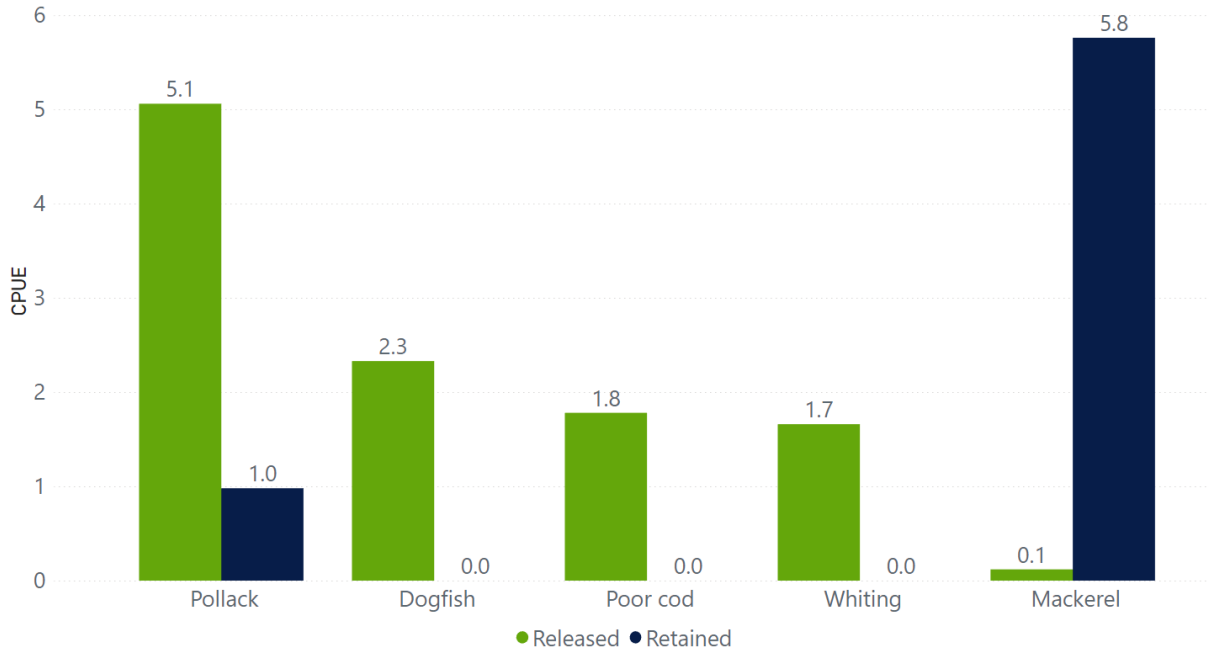

Fig. 22: Catch per unit effort (CPUE) values of the top 5 small boat caught species recorded on the IMREC angling diary 2021-2022. Captures across strata combined.

4. Discussion

This report has used the knowledge gained in the pilot study report of MRF catches in Ireland (2019-2021) (Ryan et. al 2022) to refine the sampling programmes developed during the pilot study so that the best possible catch estimates can be calculated, with the resources available. If more resources become available, sampling designs are such that sampling effort can be increased easily to further improve precision of catch estimates.

Table 15: Irish angling catch estimates of retained catch and weight for selected species around the coast of Ireland (Jan - Dec 2022).

	Shore – Eastern regional stratum only		**Small Boat** – Eastern Regional stratum only		**Charter Boat** – Countrywide	
Species	**Total Annual catch (000's) (RSE)**	**Total Catch Biomass (t) (RSE)**	**Total Annual catch (000's) (RSE)**	**Total Catch Biomass (t) (RSE)**	**Total Annual catch (000's) (RSE)**	**Total Catch Biomass (t) (RSE)**
Mackerel	144 (0.3)	25 (0.3)	1480 (0.4)	316 (0.4)	181(0.2)	42(0.1)
Pollack	47 (0.5)	13 (0.3)	157 (0.5)	113 (0.4)	99(0.3)	102(0.2)
Cod	NA	NA	33 (0.4)	53 (0.4)	4(0.2)	5(0.2)
Lesser spotted dogfish	NA	NA	29 (0.6)	NA	<1	<1
European seabass	9 (0.4)	3 (0.3)	10 (0.5)	18 (0.4)	<1	<1

On-site surveys 2022 overview

All on-site creel surveys took place along the newly defined Eastern Region of the coast. Across the sector surveyors conducted 130 interviews with anglers during their sea angling trips. Interview refusals were low, indicating that anglers are willing to engage with survey programmes. The majority of shore anglers interviewed, did not catch anything during their trip, indicating that shore catches are low overall. Of those who caught fish, as recorded during the pilot study (Ryan et al., 2022), mackerel and pollack were the most caught species. Whiting was also recorded as a common catch by shore anglers on the East coast. European sea bass were a relatively common catch on the East coast of Ireland, according to the shore angling surveys. Over 85% of catches were released. This release rate is like estimates reported by O'Reilly and Roche (2012). These comparisons with previous surveys offer confidence that the programme is providing an accurate assessment of the fishery. Ongoing sampling should refine this further as the quantity of data increases over an extended period.

Small boat interview records (36 interviews) remain too low to make confident catch estimates. This issue is highlighted by unrealistic precision estimates. For example, precision of mackerel retention rate estimates was calculated to be less than ±0.1RSE. This is in part due to the low number of interviews carried out during the sampling year which highlights the difficulties in encountering these anglers on their return to port. However, it should be noted that small boat angling is seasonal and weather dependent, so overall small boat angling effort in Ireland is low.

The rate of onboard charter sampling effort was low for some strata (East Region and winter). Although most charter angling takes place in the West Region stratum Ireland

during the summer months (Ryan et al. 2022), which reflects the rate of sampling effort carried out during this programme, some biases can be expected. For example, tope CPUE is high. This is likely related to the limited number of angling trips sampled in the East Region. Many trips were aboard a vessel which targeted tope (e.g. in the Irish Sea) and a relatively low number of trips were aboard vessels which undertake general ground fishing trips. This sampling bias was likely inflated by the weighting calculations used to estimate country-wide tope catch rates. Sampling on additional boats in the East Region, where it should be noted, charter angling effort is relatively low, should account for this bias in the future.

Pollack are by far the most common harvest, by weight in the Irish charter fishery. This report estimated that 101 ±0.2RSE tonnes of pollack were retained in 2022. In comparison, the commercial pollack landings of all Irish and foreign vessels in all Irish ports between 2013-2022 around Ireland (landings in foreign ports not included) was estimated at around 940 tonnes per annum (CSO, 2023).

As sampling coverage continues to increase, improved weighting values will be derived and included in further analyses. Total charter catch estimates assumed that the charter fleet consists of 99 active vessels. Expert opinion from the sector suggests that this is likely to be an over estimation. However, until more data is collected it is appropriate to include the maximum likely effort (i.e. all likely vessel effort) to estimate the recreational catches. Ongoing consultation with stakeholders in this sector by IFI is positive and should lead to an even more accurate sampling frame.

Angler diary 2021 & 2022 review

The IMREC diary collected angler catch data for the Irish coastline. CPUE figures were calculated for fishing type within seasons and strata, highlighting the temporal and spatial variation of Irish MRF catches. Notable findings showed that mackerel and pollack contributed to a large proportion of catches (30.6%) across all fishing types and locations. Generally, release rates were high for all species (80% average release rate) except mackerel where release rates were 3%. Small boat angling (including kayak angling) provided more than half of all catch records to the diary despite only accounting for 12% of submitted sessions. Analysis of these data also revealed more sessions were logged from the west stratum (405) compared to the east (317), highlighting the effectiveness of offsite data collection in remote areas.

Generally, from diary results or all results, release rates were high across all fishing types and most species. However, release rates were lower for small boat (66%) and charter (53%) compared to shore angling. The total catch recorded from the small boat sector was greater than the shore sector even though small boat angling records accounted for only 12% of trips, whereas shore records accounted for 86% of trips. This highlights the relatively high impact small boat anglers may have on stocks compared to the shore sector. A possible

explanation for lower release rates for small boat and charter angling compared to shore angling is the larger size of fish caught compared to the shore anglers. The average size of small boat caught pollack were nearly twice the length (38cm) of shore caught pollack (22cm). Small boat anglers are likely to keep more fish than the average shore angler due to the higher probability of catching "plate" size fish.

Review and considerations regarding the utility of the IMREC diary

It is envisaged that the IMREC diary programme will collect catch data on an ongoing basis for many years, as once potential data biases are understood and accounted for, it is far more efficient than onsite surveys. The diary is still in its infancy compared to more established jurisdictions. However, Ireland is continuing to actively recruit diarists and expect to build a large dataset. As diarists contributing to this programme are self-selecting, there is a higher probability of catch bias than data collected through probability-based surveys. This can lead to inherent bias in the dataset due to avid anglers being more likely to take part and log sessions compared to the occasional/infrequent angler. Highly motivated, frequent anglers with a desire to contribute to fisheries science are more likely to continue submitting sessions (Crandall et al., 2018) thus raising catch numbers in analysis stage. Avidity bias is expected within the IMREC Diary as enthusiastic anglers are more likely to fish at a higher rate and be aware of such projects due to their increased interactions with fishing related media compared to those who fish occasionally (Armstrong et al., 2013).

To attempt to detect and subsequently account for sampling biases, it is appropriate to compare them to probability-based surveys (Venturelli et al. 2017). The onsite surveys did not sample the West stratum in 2022, so, it is difficult to make direct comparisons between CPUE estimates made through the diary programme and the onsite surveys. However, some clear similarities are apparent. Seven of the top ten most caught species were the same for both methods (mackerel, pollack, lesser spotted dogfish, ballan wrasse, European seabass, whiting and flounder). Mackerel and pollack were identified as the two most common species caught along the Irish coastline in both the IMREC Diary and onsite surveys. High mackerel and pollack catches were largely driven by small boat catches in both the dairy dataset and the onsite surveys, but all fishing types contributed to catches for both species.

Indications of sampling bias was also recorded. According to the diary, pollack was the most caught species from small boats, slightly higher than mackerel. The onsite surveys found that pollack was the second most common catch, after mackerel. This difference could be attributed to the type of angler who is more likely to contribute to a diary programme. Likewise, release and retained rates of popular species differ between data collection methods. Nearly 40% of all pollack catches recorded during the onsite small boat and shore surveys were retained, whereas around 10% of pollack catches recorded in the diary were retained. It is likely that type of angler who contributes to a diary programme is favourably

disposed to fisheries management programmes. A sampling bias towards this type of angler may lead to higher release rates than the general angling population. Also, more specialised anglers who focus on a particular species, for example, may be more likely to release their catches (Ferter et al, 2013) as they would usually comply with length restrictions in place for this species. In contrast, Lewin et al (2021) could see no clear link between avidity and higher release in either their on-site or off-site survey results.

Small boat angling catches were dominated by mackerel in the diary whereas shore caught mackerel records were highest in the onsite surveys. This is likely another example of sampling bias due to the data collection method (Ferter et al. 2021). In random probability surveys such as the roving creel method used here, samplers are likely to encounter anglers who target mackerel from accessible platforms such as piers. This cohort may be less likely to contribute to a catch diary as they are often occasional anglers who do not target other species. It is also notable that European seabass was the most caught shore species in Ireland, according to the diary data. Although, European sea bass catches were also relatively common according to the onsite survey (second most common catch), the difference in released CPUE between both data collection methods is markedly different (0.08 for the onsite surveys compared to 0.69 for the diary). The diary figure is high due to the input of one successful, diarist who consistently targets European sea bass along the west coast. This bias and others like those discussed above must be accounted for in future analyses.

These observations are important in the context of estimating total harvest, as any inherent sampling bias due to the diary must be accounted for prior to its use in estimating MRF catches. As both surveys are running concurrently, a comparative analysis is planned for 2024, when the onsite survey of the Western regional stratum is complete. This was allow for the identification of the magnitude of any biases within the IMREC diary dataset, which can subsequently be accounted for. It will increase confidence in using the IMREC diary data to provide multi-species catch estimates.

Although the shortcomings of relying on self-selecting diary programmes to estimate MRF catches have been considered above, they also have advantages. Comparisons between the number of trips recorded in the IMREC diary and on-site surveys show the benefits of offsite data collection methods. During 2022, 621 shore trips were recorded through the diary compared to 130 from on-site surveys. The number of small boat trips recorded through the diary was 89, compared to 36 from on-site data. The broad geographical representation of diarists allows for data collection within regions that have proved difficult to survey sufficiently during onsite sampling. Although the East coast is a more densely populated area, it is interesting to observe that more diary catch reports have come from the West coast. This result illustrates one advantage compared to on-site sampling. Sampling in large coastal regions with low populations such as the West of Ireland is logistically difficult and

time consuming due to the size and number of potential fishing locations (Ferter et al. 2022). It is important to be aware of the potential bias present as high angler avidity related to this area may lead to overestimations of catches. Findings from the IMREC pilot study report (Ryan et al, 2021) attributed 31% of overall fishing activity to this area. This contrasts with the high participation figures from the diary, highlighting the need for further analysis on angler avidity and success rate of diarists in this region.

Typically, small boat and kayak anglers are difficult to sample during random on-site surveys, as evidenced by the low number of interviews completed. It should be noted that this report concerns only onsite surveys of the East stratum, which is more populated. As the pilot study highlighted, encountering small boat anglers for interview is even more difficult on the West coast. However, collection of catch data from small boat angling is vital to analyse overall impacts on fish stocks along the Irish coast. This is highlighted by the data collected during this survey which found that the success rate of small boat anglers was high compared to shore anglers. This observation is true for both the diary and the onsite survey. Self-reporting with a tool such as the online angling diary allows for the collection of catch data which is difficult to accrue through classical on-site survey methods. This complementary data stream will ultimately improve the robustness of catch rate estimates.
The diary data also provides evidence of seasonal drop off in angling activity. This observation is similar Ryan et al. (2021) findings on angler activity with the peak of the summer months seeing on average more than 6 sessions per angler compared to 3 or less in the winter months. Over 66% of fishing sessions recorded along the East coast were in the summer while over 82% of records submitted along the west coast were in the summer stratum. This information will inform weighting procedures in future work.

Recruitment and retention of MRF diarists can be challenging (Crandall et al, 2018, Hyder et al, 2021). The diary programme used proven recruitment techniques to increase participation. Following each media launch to promote the diary, increases in recruitment levels were observed. This translated into an active diarist rate of 36%. Media launches can increase awareness of citizen science programmes and have the potential to recruit new anglers while also reminding other previously engaged anglers of the benefits that can be gained by providing session data (Crandall et al 2018; Skov et al 2021). Continuous stakeholder engagement and awareness of the project is required to continue to improve recruitment and engagement figures.

Concluding remarks

Since the initiation of the IMREC programme in 2019, a considerable amount has been learnt about the MRF sector in Ireland. The ongoing accumulation of catch data is continuously improving catch estimates of important angling species. Data collected during 2023 will be combined with the information reported in this report to provide a complete overview of MRF catches around the coast of Ireland. This information is circulated to

relevant stakeholders to meet some of Ireland's requirements under the Common Fisheries Policy.

Although the IMREC diary may have difficulties associated with the sampling biases discussed above, it collects a large amount of catch data at temporal and regional scales which is not feasible through the on-site survey programme alone. The diary programme also promotes angler engagement and education. Ongoing refinements and increased diarist recruitment will assist in improving the quality of the emerging data from this source leading to its eventual full integration into the catch size estimate models.

Alternatively, probability based on-site surveys, can collect catch data from occasional/infrequent anglers that may not be aware of, or have no desire to take part in the angler diary. These data streams are being combined to fill key knowledge gaps in Irelands recreational angling sector. They can be assessed for differences in output due to variations in the data collection methods and subsequently to examine for biases in the angling diary. For example, characterising the avidity levels of anglers in more detail will also be a useful exercise in determining success rates at trip/hourly level and aid in reducing the impact of bias in this dataset. If these issues can be accounted for, the results show the potential value of the IMREC diary to gather data year-round without the resources required for a survey team to conduct random on-site angling surveys continuously. However, probability-based surveys will have to be maintained on a rolling basis, to continue to validate diary data and to maintain regular contact with stakeholders in the sector.

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