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Participation, catches and economic impact of sea anglers resident in the UK in 2016 & 2017

Annex 2. Implementing a diary panel to report sea angling catches in 2016 and 2017

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Executive Summary

Marine recreational fishing is an important activity in terms of economics, wellbeing, and fish catches. Under the Data Collection Framework, all EU countries must report catches of certain species by their marine recreational fisheries. This requires collection of effort and catch per unit effort from independent surveys. There are many ways to collect catch per unit effort data, but one cost-effective approach is through catch diaries. In 2016 and 2017, catches by UK sea anglers were calculated from two surveys: 1) the UK-wide Watersports Participation Survey to estimate total effort in terms of numbers of people who went sea angling in each year; and 2) a nationwide panel of sea anglers recording their catches and releases of all species during the year (panel survey), to estimate mean catch per angler. The panel survey is the focus of this report, where diarists were recruited to complete a monthly online diary, recording their fishing activity, location, and catches. Data on their spending on fishing sessions and large items related to sea angling were also requested at certain points throughout each year.

In 2016, 507 diarists agreed to complete diaries and 1495 sea anglers had signed up by the end of 2017. Of these, 432 and 1216 entered fishing data in 2016 and 2017, respectively. Most of these were from England, but targeted recruitment in both years increased the contribution from the other UK countries. More diarists were in the higher avidity (frequency of fishing) categories in 2016, but additional targeting and face to face recruitment in 2017 led to increased numbers of less avid anglers in the panel, reducing the potential for avidity-related bias in catch and other estimates. In 2016, a total of 5410 fishing sessions were recorded and 10602 in 2017, with most fishing activity recorded in the south east and south west of England. The fish that were caught in the highest numbers were whiting, mackerel, lesser spotted dogfish, and sea bass. Sharks, dogfish, Atlantic cod, European eel, and sea bass all had high release rates in each year. The average spend per fishing session was between £65 and £117, being slightly higher in 2017, and most capital expenditure was on fishing rods and reels, followed by boats and kayaks. This report describes the diary methodology and the results for the panel. The subsequent step of raising the panel data to the UK population of sea anglers, using national participation rates from the Watersports Participation Survey, is presented in a separate report (Annex 4).

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1 Introduction

To assess catches or spend by marine recreational fishers typically requires two separate surveys: one to estimate total fishing effort of the population (e.g. total number of anglers, boats or days fished during the year) and a second survey of a representative sample of the population to estimate their average catch or spend per unit effort (catch or spend per day or per angler during the year) (ICES, 2010; Pollock et al., 1994). The estimation of effort can involve off-site surveys such as nationwide postal or telephone surveys, and on-site surveys such as aerial surveys; estimation of catch per unit effort can be done using on-site (e.g. creel surveys) or off-site (e.g. logbooks) approaches (ICES, 2010; Jones and Pollack, 2013; Pollock et al., 1994). These approaches are reviewed in detail elsewhere (ICES, 2010; Jones and Pollack, 2013; Pollock et al., 1994), but a discussion of the approaches relevant to catch and spend per unit effort is provided below.

The use of a representative panel of people for off-site recording of all their catches in diaries, or the direct on-site recording of catches through interviews at randomly selected fishing sites, are the most common methods for collection of marine recreational fisheries catch data. These provide data on the number of fish kept or released, and information on the fishing trip (e.g. platform such as shore or boat, fishing location, fish length). There are several sources of bias that can cause issues with diary panel data (Table 1), particularly if there is an element of self-selection in recruitment to the panel. The latter can result in a panel that is not fully representative of the population in characteristics such as age, home location, avidity, skill, or experience which could affect catches. In some cases, these biases can be minimised at the design stage. For example, existing data on regional distribution of anglers and their age and avidity composition derived from large scale randomised population surveys could allow selection of a representative panel from a larger pool of anglers to match the population characteristics. This requires a sufficiently large pool of anglers to select from, which is very challenging. An alternative in the case of a self-selected panel is to correct for the bias at the analysis stage by reweighting the panel to match population characteristics from the randomised population survey. For example, one of the largest potential sources of self-selection bias is ‘avidity bias’, where people who fish more regularly are more likely to volunteer for the panel (Table 1; Thomson, 1991). It is possible to correct for avidity bias if there is an independent data set on the numbers of people in the population in different avidity characteristics, based on a separate randomised population survey. Other biases such as incorrect recall, rounding and prestige bias are also prevalent (Matlock, 2014; Osborn and Matlock, 2010; Tarrant et al., 1993) and cannot be fully corrected at the analysis stage. More experienced and skilled anglers may be more aware of surveys and be more motivated to participate in them. Correcting for this would require the large-scale population surveys to collect information that is able to categorise anglers by skill and experience.

Estimates of catch from on-site surveys also suffer from avidity bias. For example, in roving creel surveys the probability of encountering an angler increases with the length of time the angler is present at the fishing site, although this bias can be corrected for if the length-of-stay can be obtained for each angler. Non-response can be an issue if the willingness of an angler to be interviewed is affected by what has been caught. Other biases such as rounding, telescoping and prestige bias are reduced in on-site surveys as sampling is done during or immediately after the fishing trip. On-site surveys collect data from non-residents, which is not possible with off-site diary panels resulting in a need for different approaches to cover tourist fisheries. A strong advantage of off-site diary panel

surveys is that they can provide data on more subjects than on-site surveys at a lower cost per sample (Bellanger and Levrel, 2017). It is also possible to use randomised household, mail, and phone surveys of the population to collect catch data, but this requires people to recall information on fishing trips and catches, resulting in high potential for recall bias, telescoping etc.

Table 1: The different types of bias in recreational fisheries surveys.

| Bias type | Definition |
|---------------|---|
| Avidity | Bias due to the increased probability of sampling fishers who participate more frequently. |
| Coverage | Bias caused by not sampling a platform, region, or time of year. |
| Non-response | Bias due to the difference between people who do and do not respond to survey. |
| Recall | Bias arising when fishers do not correctly past recall events or experiences. |
| Rounding | Bias arising because anglers round their catch or other data to multiples (e.g. of 5 or 10). |
| Telescoping | Where respondents remember a particularly good event occurring more recently than it did. For example, a fisher may report a trip with lots of catches as being within the survey recall period when it occurred several weeks prior. |
| Prestige Bias | Where fishers exaggerate the number and/or size of the fish they caught |

In 2012, a survey of sea angling participation, effort, catch, economic impact and social benefits was carried out in England (Armstrong et al., 2013). This used a mixture of on-site and off-site methods. Annual fishing effort (number of angling trips by platform) was estimated from questions added to an Office of National Statistics (ONS) randomised survey of over 12000 households in Great Britain, and the average catch per unit effort for kept and released fish taken by shore and private boat anglers was estimated using on-site interviews throughout the year at stratified random selections of segments of coastline. Charter boat catches were estimated from logbooks kept by a random selection of charter boats taken from a list frame of over 400 vessels. Economic impact was estimated using the ONS survey of effort (in numbers of anglers) and an online survey of expenditure (spend per angler), with an input-output methodology used to calculate total economic impact, full time equivalent jobs (FTEs), and Gross Value Added (GVA) (Armstrong et al., 2013; Roberts et al., 2017). This found that around 2.2% of the UK population participated in the sport, spending around £1.23 billion during the survey year and taking around 25% of the total commercial and recreational catch of European sea bass (Armstrong et al., 2013; Roberts et al., 2017). More limited surveys have taken place in Scotland, Wales, and Northern Ireland, and have focused more on participation, spatial activity and economic evaluation rather than catch estimation (McMinn, 2013; Monkman et al., 2015; Radford and Riddington, 2009).

In this annex, catches by UK sea anglers in 2016 and 2017 were calculated from two survey approaches: 1. estimation of numbers of sea anglers from the Watersports Participation Survey (Annex 1); and 2. estimation of mean annual numbers and weights of retained and released fish of all species caught by individual anglers recruited to a nationwide diary panel. The diary panel kept a journal of their fishing sessions and the species, fish sizes, and amounts caught in their fishing trips throughout the year¹. This report describes the diary development, recruitment of the panel, and unraised results from the panel. The total expenditure and annual catch by all UK sea anglers are provided in Annexes 3 and 4.

¹ <https://www.seaangling.org/>

2 Methods

Three survey elements were undertaken, covering the whole of the UK:

1. A nationwide face-to-face survey to estimate fishing participation and effort, using questions added to the Watersports Participation Survey (see Annex 1).
2. Recruitment of a sample of people who fish for recreation in the sea and who were willing to keep catch diaries in 2016 and 2017, using an online diary tool.
3. A diary panel survey involving the completion of catch diaries throughout 2016 and 2017 by the recreational sea fishers identified in step (2), and the archiving and analysis of data reported using the online diary tool, as well as economic data.

The data collected in the panel survey were then raised to the total population using data from the Watersports Participation Survey (Annex 1). The raising procedure and outcomes are provided in other Annexes covering expenditure (Annex 3) and catch (Annex 4).

2.1 Recruitment

Recruitment of diarists in 2016 and 2017 involved the identification of a representative sample of people who fish for recreation in the sea and who were willing to keep catch diaries, using an appropriate, cost-effective method. Recruitment for the 2016 survey took part in one phase and for 2017 took place in two phases. Phase one for both surveys was conducted during the autumn/winter months with the aim of obtaining an initial sample of 600 and 1000 in 2016 and 2017, respectively, that began providing catch data in January. From July 2017, 'rolling' recruitment was implemented to engage new diarists at a time when they were fishing and to address some bias in the diary panel profile. The second phase recruitment aimed to increase the sample size to 1500 by the start of 2018. In addition, a more representative sample including an increased proportion of less avid anglers was recruited using face-to-face approaches. The details of the two phases of recruitment are described in detail in below.

Regional sampling targets for recruitment of diarists were set to ensure a distribution of diarists across the UK that matched, as far as was possible, the participation rates from the Watersports Participation Survey (Annex 1). This varied between 2016 and 2017 (Table 2). For the 2016 survey, most recruitment was done by contacting existing members of Substance's angler database by email, as well as asking angling clubs and federations to help publicise the study. Methods common to both phases of 2017 recruitment were: contacting the existing angler database by email; contacting those who were already part of the 2016 study by email; face-to-face recruitment at sea angling locations and sea angling events; print and electronic publicity to angling tackle shops, charter boats and clubs (only in Northern Ireland, Scotland, and Wales in 2016); editorial and advertising in angling press both in print and online; and social media. Significant amounts of effort were put into publicising the diary across a wide range of channels (Table 3).

In June 2017, a rolling recruitment approach was adopted with phases of recruitment throughout the rest of the year and people were able to join the study at any time rather than just at the start of the year. This was done to achieve a larger diary panel and to enable recruitment of less avid diarists that may only go fishing during the summer months. Several adjustments to the process were made to

increase participation. More face-to-face recruitment was done in the summer holidays (July and August 2017) to identify occasional anglers (Table 3) and was continued throughout the autumn. 'Rolling recruitment' was implemented into 2017, so diarist became part of the project immediately, providing data in the second half of 2017 and were enrolled automatically for 2018. In addition, the branding was revised as the 'Sea Angling Diary project' to make the project and publicity relevant to any year and facilitate rolling recruitment.

Table 2. Target number of diarists for recruitment by area in 2016 and 2017.

| Year | Stratum | Target number |
|------|--|---------------|
| 2016 | Not fished in 2015 | 29 |
| | Northern Ireland | 31 |
| | Scotland | 39 |
| | North Sea and eastern Channel (IVa, b, c and VIId) | 222 |
| | Western Channel and Celtic Sea | 168 |
| | Irish Sea | 86 |
| | West of Scotland/north Ireland (VIa) | 10 |
| | Other (not fished in 2015) | 15 |
| | England and Wales | 501 |
| | Total | 600 |
| 2017 | Northern Ireland | 60 |
| | Scotland | 70 |
| | Wales | 110 |
| | England | 770 |
| | Total | 1000 |

Diarists joining the study part way through the year did require some amendments to diarist management and data analysis. To facilitate this, diarists were categorised as:

- Type 1: signed up in and started in January 2017.
- Type 2: joined diary from July to September 2017.
- Type 3: joined diary from October 2017 onwards.

Type 1 are hereafter referred to as the initial 2017 sample, and Types 1, 2 and 3 as the final sample. The number of each type of publicity method used in each year is shown in Table 3.

Table 3. Recruitment methods utilised and number of contacts made. Direct email reflects contact with the Substance angler database. The numbers relate to each individual category of diarist related to timing of recruitment.

| Publicity | Method | 2016 | 2017 initial | 2017 final |
|----------------------|----------------------|-------|--------------|------------|
| Direct email | Email | 17500 | 17619 | 15933 |
| Charter boats | Email/telephone/post | 0 | 264 | 255 |
| Clubs | Email/telephone/post | 87* | 145 | 143 |
| Tackle shop | Email/telephone/post | 0 | 333 | 326 |
| Federations | Email/telephone/post | 13 | 11 | 11 |
| Events/angling sites | Face-to-face | 0 | 9 | 35 |
| Magazines, etc. | Press release sent | 11 | 7 | 3 |
| Forums/websites | Press release sent | 12 | 16 | 13 |
| Posters | Print distributed | 0 | 1000 | 500 |
| Leaflets | Print distributed | 0 | 1000 | 500 |
| Flyers | Print distributed | 0 | 20000 | 10000 |

*In 2016 only clubs in Northern Ireland, Scotland and Wales were contacted.

2.2 Catch Diary

On signing up to the study, diarists were provided with a pack containing:

- A fish identification booklet, tape measure, and waterproof notebook to record details of location, methods, and catches on each session.
- An explanation of the requirement to record fishing sessions (including location, duration, method, and catches) and transcribe this to an online diary system (www.seaangling.org/tool) each month.
- Access to the online diary tool and a guidance document for using the system.

Packs were distributed to each respondent via post and diarists were provided with a username and login for the online diary tool. To maintain privacy, the data were anonymised so that no individual angler could be identified, and no entry linked to an individual. Each fishing location recorded was grouped into a region, so that no individual marks were shared. All personal data was removed from the database at the time of data analysis.

The diary tool was developed by Substance in consultation with Cefas. Design was based on the need to capture required data (session date, location, duration, platform, method, catches, lengths, and numbers kept and returned), but also maximise utility for the user. This included: the addition of optional fields for diarists to record weather, tide, and other notes; provision of a dashboard; and an 'annual report' summarising sessions and catches.

The online diary tool was created, hosted, and maintained by Substance built using a range of open source technologies. Hosted on a Linux OS running Apache, it was written in PHP using the CodeIgniter web application framework with a MySQL database backend. The front-end was built using the Bootstrap framework allowing creation of a responsive user interface with charts being provided by HighCharts and tabular information being enhanced through DataTables.

The diary tool was overhauled in 2017 to improve it following user feedback. This included a redesign, simplification of data entry processes, easier editing, and a session summary page. Other gradual improvements have been made since. The diary tool enabled recording of fishing activity, details of fishing sessions including the location and duration (hours), catches, and catch details (species, length, fate). Diarists had to record whether they fished in a month or not, as an absence of data entry could not be assumed to be no fishing. Diarists were asked to 'lock' their month once all data had been entered for the month, so that it was clear that data entry was complete. To maximise data entry, significant effort was put into development of a system that was user friendly and provided summary statistics of an individual anglers catches. The structure was hierarchical and started with a 'Calendar' page with a simple one click to record no fishing activity (Figure 1). If fishing had occurred, then a 'Session' was added that included location duration and method (Figure 2). If catch was identified on the Session screen, then a 'Catch' page was generated where all details were captured (Figure 3).

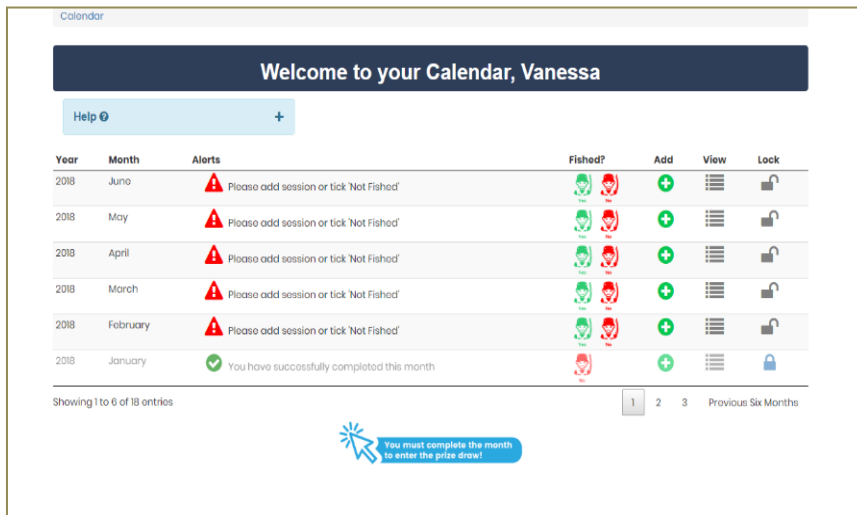


Figure 1. The fishing calendar page².

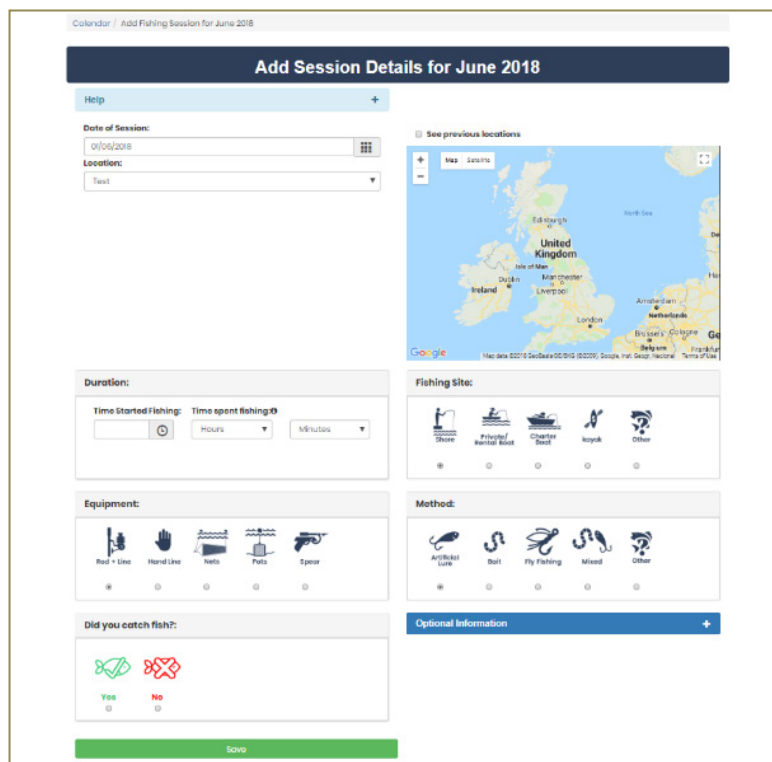


Figure 2. The fishing trip data entry page².



² Note screenshots are of the 2018 version of the diary tool accessible at <https://www.seaangling.org/>.

Calendar / Manage Fishing Sessions for June 2018 / 01/06/18 00:00 - Test

Catch Details

Help ⓘ +

Species: Length Known (y/n): Length if known (cm):

 Number of Fish KEPT: ⓘ
 Number of Fish RETURNED: ⓘ

| Species | Family | Count | Length | Total Caught |
|---------|---------|---------|---------|--------------|
| No data | No data | No data | No data | No data |

Figure 3. The catch data entry page².

Diarists were sent reminders by email three times every month to help maximise response rates. Two of the emails used a mail merge to specify for each diarist what data were missing for that month. In addition, at various stages, diarists who had not logged in, had not entered data, or had missing data were contacted by telephone. To further help recruit and encourage data entry, incentives were provided in the form of prize draws for tackle and, subsequently from summer 2017, Amazon vouchers.

2.3 Economics

Three surveys on expenditure were carried out relating to sessions in May, August, and November 2016 and two surveys were undertaken in July and December 2017. These surveys collected information on expenditure on major items (capital spend) and spend on the last trip (trip spend). Respondents were asked about fishing effort in the previous month, spend on their most recent trip, and major item expenditure in the past 6 months. The location, date and duration of their previous trip was requested in order to give context to the trip spend. Trip spend was partitioned into travel (fuel, public transport, other costs), accommodation and food (accommodation, food, drinks and snacks), and fishing costs for the day (bait, terminal tackle, parking, pier fees, charter boat fees, boat fuel). In the major item element of the surveys, respondents were asked about their spending in the preceding six months on: fishing rods and reels; clothing specifically bought for fishing; other fishing equipment excluding terminal tackle (e.g. rests, boxes, lighting); terminal tackle (weights, hooks, line, lures etc.); boats/kayaks (used mostly for sea fishing); boat engines/equipment (including electronic equipment etc.); and other major items.

3 Results

3.1 Recruitment

Significant efforts were made to recruit diarists to take part in the diary panel using online and face-to-face approaches (Table 4). Around one third of those expressing an interest went on to sign up for the diary (Table 4). The reasons for not joining the study were due to lack of time, interest, or information, but time was the most common reason (Table 5).

The majority of those agreeing to keep a diary were resident in England, followed by Wales, Scotland, and Northern Ireland, with proportions varying between years (Table 6). Almost three times the number of anglers signed up in 2017 compared to 2016, giving a total of 1495 diarists by the end of 2017 (Table 6). Recruitment was very close to the target in total and all regions apart from Northern Ireland, where accessing diarists was very challenging (compare Table 2 and Table 6). Diarists representing the full spectrum of adult ages were recruited, with the highest numbers in the 35-64 year age range (Table 7). Comparison with the demographics of the sea angling population from the WPS showed that the diary panel had a higher proportion in the south west and east of England and less in Northern Ireland, Scotland and Wales (Table 8). In addition, ages from 18-35 were underrepresented in the diary and over 55 years overrepresented in the diary panel (Table 8).

Table 4. The responses and numbers signed up to diary from each type of publicity.

| Mode | Category | 2016 | 2017 |
|---------------------|---|-------|-------|
| Existing diarists | Signed up to diary | --- | 202 |
| Direct email | Emails sent | 17619 | 17619 |
| | Completed initial survey from emails sent | 3739 | 2273 |
| | Expressed interest from emails sent | 1385 | 821 |
| | Signed up to diary from emails sent | 507 | 269 |
| Face to face events | Signed up to diary from face-to-face | --- | 265 |
| Other methods | Signed up via other methods | --- | 759 |
| Total | Signed up by all methods | 507 | 1495 |

Table 5. Reasons given for not being interested in participating in the diary.

| Reason | 2016 | 2017 |
|----------------|------|------|
| Time | 209 | 252 |
| Information | 71 | 54 |
| Not interested | 193 | 76 |
| Other | 377 | 559 |

Table 6. Number of diarists signed up and entering data from different home locations.

| Location | 2016 | | 2017 initial | | 2017 final | |
|---------------------|-----------|------|--------------|------|------------|------|
| | Signed up | Data | Signed up | Data | Signed up | Data |
| East Midlands | 17 | 14 | 34 | 30 | 58 | 44 |
| East of England | 43 | 39 | 85 | 79 | 141 | 120 |
| London | 12 | 10 | 20 | 17 | 38 | 28 |
| North East | 26 | 23 | 55 | 49 | 79 | 66 |
| North West | 49 | 38 | 75 | 67 | 108 | 91 |
| South East | 84 | 80 | 173 | 161 | 304 | 235 |
| South West | 92 | 90 | 222 | 206 | 343 | 274 |
| West Midlands | 18 | 16 | 30 | 30 | 44 | 39 |
| Yorkshire & Humber | 32 | 28 | 38 | 38 | 62 | 55 |
| England Total | 373 | 338 | 732 | 677 | 1177 | 952 |
| Northern Ireland | 25 | 23 | 31 | 30 | 66 | 50 |
| Scotland | 34 | 31 | 73 | 71 | 103 | 92 |
| Wales | 44 | 40 | 85 | 83 | 125 | 110 |
| Republic of Ireland | 0 | 0 | 2 | 0 | 10 | 1 |
| Other | 0 | 0 | 7 | 6 | 11 | 9 |
| France | 0 | 0 | 2 | 2 | 3 | 2 |
| Grand Total | 476* | 432 | 932 | 869 | 1495 | 1216 |

*Note that some of the initial diarists that signed up dropped out and requested removal of their data accounting for the difference between the initial number of 507 and the 476 given in this table

Table 7. Age profile of the diarists signed up and entering data.

| Age | 2016 | | 2017 initial | | 2017 final | |
|-------------------|-----------|------|--------------|------|------------|------|
| | Signed up | Data | Signed up | Data | Signed up | Data |
| Under 16 | 0 | 0 | 0 | 0 | 3 | 2 |
| 16-17 | 0 | 0 | 8 | 8 | 24 | 16 |
| 18-34 | 34 | 28 | 110 | 94 | 204 | 131 |
| 35-54 | 190 | 172 | 397 | 369 | 637 | 504 |
| 55-64 | 165 | 152 | 278 | 269 | 411 | 369 |
| 65+ | 87 | 80 | 139 | 129 | 215 | 194 |
| Prefer not to say | 0 | 0 | 0 | 0 | 1 | 0 |
| Grand Total | 476 | 432 | 932 | 869 | 1495 | 1216 |

Table 8. The proportion of diarists entering data by region and age in comparison with the population of sea anglers from the Watersports Participation Survey (WPS).

| Type | Category | 2016 | | | 2017 | | |
|----------|--------------------|--------|------------|------|--------|------------|------|
| | | Number | Proportion | WPS | Number | Proportion | WPS |
| Location | East Midlands | 14 | 0.03 | 0.01 | 44 | 0.04 | 0.01 |
| | East of England | 39 | 0.09 | 0.04 | 120 | 0.10 | 0.03 |
| | London | 10 | 0.02 | 0.03 | 28 | 0.02 | 0.06 |
| | North East | 23 | 0.05 | 0.04 | 66 | 0.05 | 0.09 |
| | North West | 38 | 0.09 | 0.11 | 91 | 0.07 | 0.10 |
| | South East | 80 | 0.19 | 0.21 | 235 | 0.19 | 0.13 |
| | South West | 90 | 0.21 | 0.14 | 274 | 0.23 | 0.20 |
| | West Midlands | 16 | 0.04 | 0.05 | 39 | 0.03 | 0.04 |
| | Yorkshire & Humber | 28 | 0.06 | 0.05 | 55 | 0.05 | 0.06 |
| | England Total | 338 | 0.78 | 0.68 | 952 | 0.78 | 0.72 |
| | Northern Ireland | 23 | 0.05 | 0.09 | 50 | 0.04 | 0.10 |
| | Scotland | 31 | 0.07 | 0.10 | 92 | 0.08 | 0.10 |
| | Wales | 40 | 0.09 | 0.13 | 110 | 0.09 | 0.07 |
| | Other (non-UK)* | 0 | 0.00 | 0.00 | 12 | 0.01 | |
| Age | Under 16 | 0 | 0.00 | ---- | 2 | <0.01 | ---- |
| | 16-17 | 0 | 0.00 | 0.00 | 16 | 0.01 | 0.02 |
| | 18-34 | 28 | 0.06 | 0.37 | 131 | 0.11 | 0.27 |
| | 35-54 | 172 | 0.40 | 0.40 | 504 | 0.41 | 0.40 |
| | 55-64 | 152 | 0.35 | 0.18 | 369 | 0.30 | 0.21 |
| | 65+ | 80 | 0.19 | 0.05 | 194 | 0.16 | 0.10 |

*The Other (Non-UK) category include diarists with a home address in the Republic of Ireland, Channel Islands, the Isle of Man or France.

Table 9. The number of diarists entering session data in each quarter.

| Quarter | 2016 | 2017 initial | 2017 final |
|-----------|------|--------------|------------|
| Quarter 1 | 408 | 863 | 947 |
| Quarter 2 | 348 | 796 | 884 |
| Quarter 3 | 309 | 744 | 1013 |
| Year | 432 | 869 | 1216 |

3.1.1 Withdrawals

In the first three quarters of 2016, withdrawals from the survey were steady, with the implementation of sea bass regulations and concerns regarding the survey given as the main reasons for withdrawing (Figure 4). In 2017, a large increase in the number of participants dropping out of the survey in the fourth quarter was seen, with the number of withdrawals being consistent in quarters one to three. This increase may have been due to concerns over data and fisher interest, which were given as reasons for dropping out in 2017 (Figure 4).

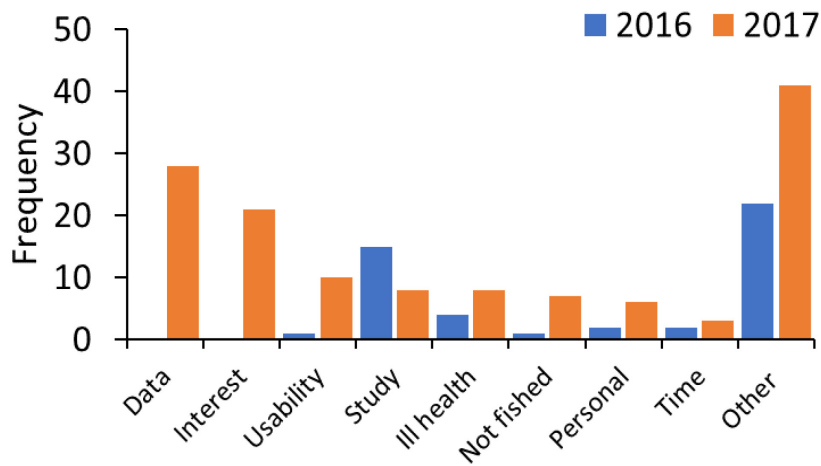


Figure 4. The reasons for dropping out of the diary in 2016 (blue) and 2017 (orange).

3.1.2 Data quality

On entering data, automated validated methods were used to assess the robustness of the data entered (e.g. a pollack that is 5m or a blue shark that is 0.2 kg). Errors and location anomalies were found that were identified throughout each year and corrected as necessary (Figure 5). The main concern was problems with the location in 2017, where errors were made using the location pin and map function of the online diary tool (Figure 5). Errors were found where incorrect catch data, ICES area, or platform were entered (Figure 5). In addition, there were errors with shore sessions, where the location pin was placed in the sea (Figure 5).

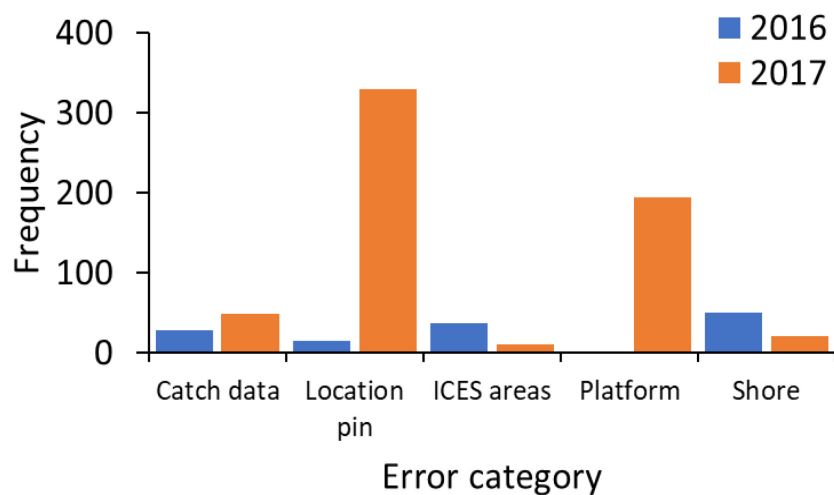


Figure 5. Frequency of different types of errors identified and corrected.

3.1.3 Representativeness of the sample

Avidity represents the frequency of fishing of individual anglers, and it is likely that there is avidity bias in the survey, as more keen and avid anglers are more likely to sign up to a diary (Table 10). This was reflected in the fact that rare anglers were underrepresented in the panel, but some of the biases can be corrected in the analysis phase using the Watersports Participation Survey (Annexes 3 & 4). The diarists were from a range of avidity categories with most being in the regular or frequent categories (Table 10). The diarists' initial stated avidity was compared with their recorded avidity at the end of each year (Table 11). This showed that in both years, more fishers fished rarely, once or not at all than expected, and fewer fishers fished occasionally, regularly or frequently than they expected (Table 11). This could be due to anglers being overestimating how many trips they will take or not recording all their trips.

Table 10. The stated avidity of the diarists entering data. * indicates that the smallest category was 12 days or less in 2016.

| Avidity | 2016 | | 2017 initial | | 2017 final | |
|-------------------------|-----------|------|--------------|------|------------|------|
| | Signed up | Data | Signed up | Data | Signed up | Data |
| Once | ---- | ---- | 18 | 16 | 38 | 29 |
| Rare - 2-5 days | ---- | ---- | 82 | 77 | 176 | 134 |
| Occasional (6-12 days)* | 184 | 167 | 198 | 187 | 307 | 258 |
| Regular (13-35 days) | 146 | 136 | 285 | 269 | 426 | 369 |
| Frequent (> 35 days) | 129 | 115 | 288 | 261 | 466 | 355 |
| Other | 17 | 14 | 58 | 56 | 79 | 68 |
| Not provided | 0 | 0 | 3 | 3 | 3 | 3 |
| Total | 476 | 432 | 932 | 869 | 1495 | 1216 |

Table 11. The stated and actual avidity of fishers in 2016 and 2017 that provided all 12 months of data. Rarely: 2-5 times; Occasional: 6-12 times; Regular: 13-35 times; Frequent: >35 times. Diff. is the difference between stated and actual avidity.

| Avidity | 2016 | | | 2017 | | |
|------------------|--------|--------|------|--------|--------|------|
| | Stated | Actual | Diff | Stated | Actual | Diff |
| Other/no fishing | 9 | 51 | +42 | 43 | 98 | +55 |
| Once | 0 | 21 | +21 | 12 | 62 | +50 |
| Rarely | 0 | 68 | +68 | 61 | 121 | +60 |
| Occasional | 115 | 47 | -68 | 141 | 141 | 0 |
| Regular | 98 | 72 | -26 | 195 | 131 | -64 |
| Frequent | 74 | 37 | -37 | 162 | 61 | -101 |
| Total | 296 | 296 | ---- | 614 | 614 | ---- |

3.1.4 Fishing Activity

Despite there being more diarists in 2017 (both initial and final) than 2016, anglers in 2016 were more avid (Table 12). In 2016, anglers fished for longer and went more often than in 2016 (Table 12). As there were more diarists in 2017, there were nearly twice as many fishing hours recorded as in 2017 (47,462) than 2016 (25,279) (Table 12).

Table 12. Summary of the fishing activity of the diarists in each year.

| Item | 2016 | 2017 initial | 2017 final |
|---|-------|--------------|------------|
| Total diarists in study | 476 | 932 | 1,495 |
| Total diarists fishing in year | 348 | 677 | 878 |
| Total sessions recorded | 5410 | 9663 | 10,602 |
| Average number of sessions per diarist in the study | 11.4 | 10.4 | 7.1 |
| Average number of sessions per diarists who fished | 15.5 | 14.3 | 12.1 |
| Average session length | 4.7 | 4.4 | 4.5 |
| Total fishing hours recorded | 25279 | 42527 | 47462 |
| Average number of hours per diarist in the study | 53.1 | 45.6 | 31.7 |
| Average number of hours per diarists who has fished | 74.6 | 62.8 | 54.1 |

In both years, most diarists were fishing by Quarter 2 (Table 13). The rolling recruitment in 2017 resulted in 878 diarists recording fishing sessions, which was more than twice as many as in 2016. Fishing activity of the 2016 and 2017 initial panel was highest in summer, with more fishing in January in 2017 than in 2016 (Figure 6; note that 2017 final panel shows more activity in autumn due to rolling panel recruitment).

Table 13. The number of diarists fishing in each quarter.

| Quarter | 2016 | 2017 initial | 2017 final |
|-----------|------|--------------|------------|
| Quarter 1 | 228 | 436 | 444 |
| Quarter 2 | 261 | 464 | 482 |
| Quarter 3 | 230 | 463 | 590 |
| Year | 348 | 677 | 878 |

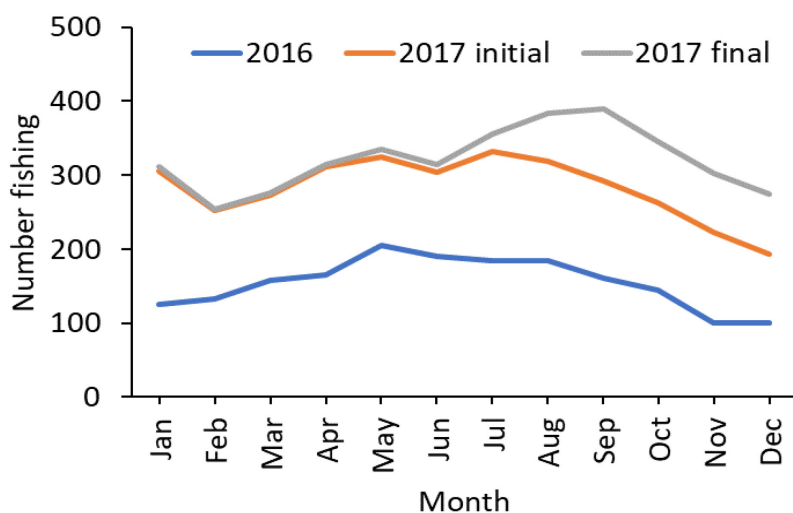


Figure 6. The number of diarists recording fishing activity in each month.

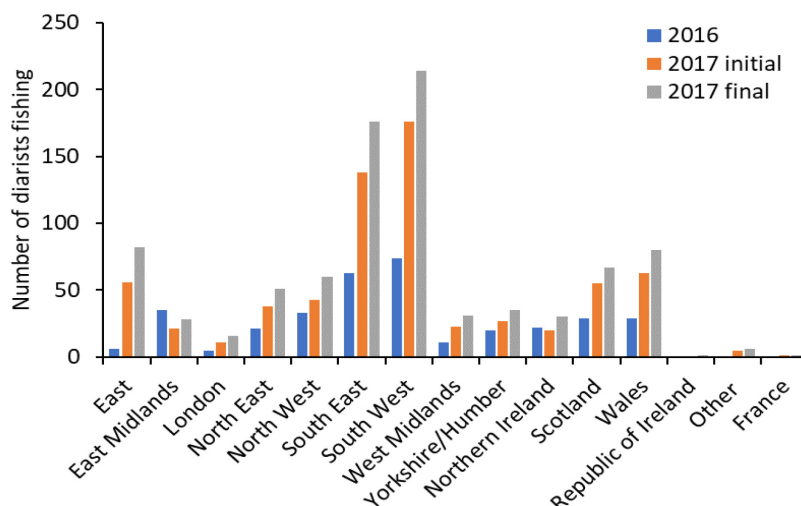


Figure 7. The number of diarists recording fishing activity in each region.

Most diarists recording fishing activity were based in the south east and south west of England, in both 2016 and 2017, followed by the east of England, Wales and Scotland (Figure 7). Although the north west of England had a large proportion of diarists (Table 8), there were fewer diarists recording fishing activity than other regions with a similar number of diarists.

In 2016, approximately half the number of fishing sessions were recorded in each quarter compared with 2017 (Table 14). At the end of 2017, over 10000 fishing sessions had been recorded. These fishing sessions were mainly from around the UK (Figure 8), with a small number in each year from elsewhere (Table 15). Most sessions were in the Western English Channel, Bristol Channel and Eastern English Channel, with very few in the Northern North Sea and the Celtic Sea areas. Outside the UK, most sessions were in Ireland, the Mediterranean or Scandinavia.

Table 14. The number of fishing sessions recorded in each quarter.

| Quarter | 2016 | 2017 initial | 2017 final |
|-----------|------|--------------|------------|
| Quarter 1 | 853 | 1944 | 1956 |
| Quarter 2 | 1599 | 2827 | 2865 |
| Quarter 3 | 1671 | 3076 | 3490 |
| Quarter 4 | 1287 | 1816 | 2291 |
| Year | 5410 | 9663 | 10602 |

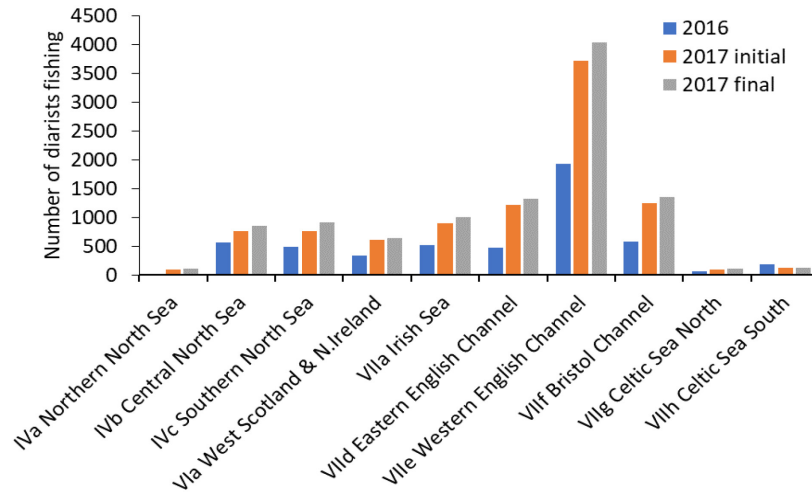


Figure 8. The number of diarist fishing in the UK by ICES area.

Table 15. Fishing sessions recorded outside UK waters by ICES area.

| ICES area | 2016 | 2017 initial | 2017 final |
|-----------------------------------|------|--------------|------------|
| Ila2 Norwegian Sea - non NEAFC | 6 | 10 | 10 |
| IIIa Skagerrak and Kattegat | 28 | 2 | 2 |
| Va2 Icelandic Shelf | 0 | 3 | 3 |
| VIIb West of Ireland | 5 | 1 | 1 |
| VIIj2 SW Ireland East - Non NEAFC | 33 | 14 | 14 |
| VIIIa Bay Biscay North | 6 | 0 | 0 |
| IXa Portuguese Waters East | 2 | 0 | 0 |
| 22 Sound and Belt - Belt Sea | 6 | 0 | 0 |
| 23 Sound and Belt – Sound | 1 | 0 | 0 |
| 37.1 Western Mediterranean Sea | 8 | 50 | 55 |
| 37.2 Central Med - Ionian Sea | 0 | 1 | 2 |
| Non-ICES Identifiable | 5 | 34 | 36 |

The most fishing sessions recorded were in England, which is as expected given the location of most diarists, followed by Wales, Scotland and Northern Ireland in both 2016 and 2017 (Figure 9). Fewer took place in the Crown dependencies of Isle of man, Jersey, and Guernsey. Outside the UK, most fishing sessions recorded were in Ireland (Figure 10), followed by Norway, Spain and France, with quite a few countries having less than 10 in each year.

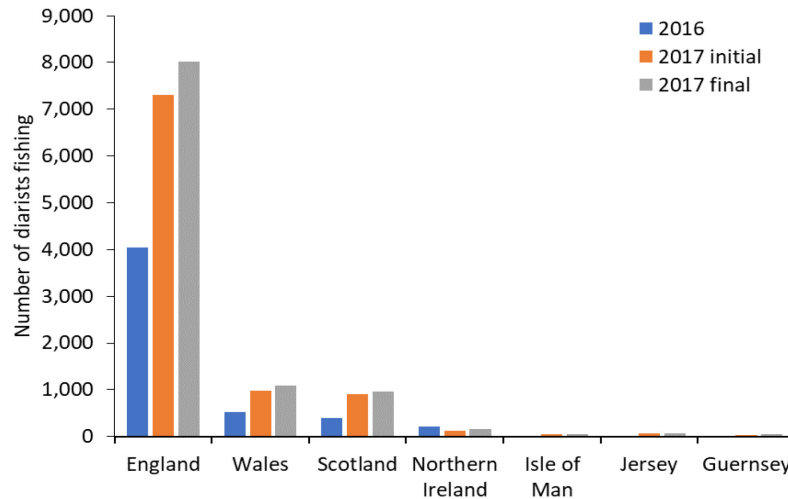


Figure 9. The number of fishing sessions in each country or Crown dependency.

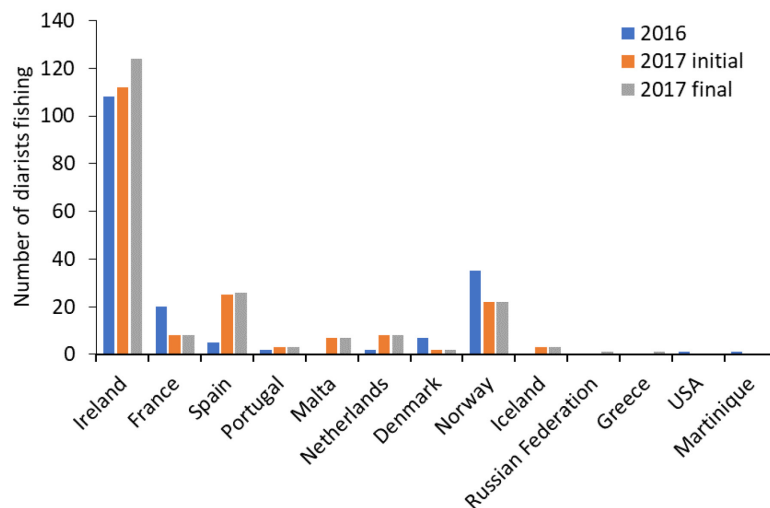


Figure 10. The number of fishing sessions by UK resident sea anglers outside the UK.

3.1.5 Catch records

The total number of fish records was higher in 2017 (94288) than 2016 (50986), which was expected since there were more diarists (Figure 11). The percentage of fish released was very similar in 2016 (76.8%) and 2017 (77.6%), with over three quarters of all fish caught released (Figure 11). A total 106 species and other species category were caught using all gears at all locations over the two years, with sea anglers catching 100 fish species in the UK. Nearly 75% of the total number of fish recorded in both years were attributed to ten species. Additionally, the top nine of these species were the same in both years (Figure 12). The top four species caught, by number, were whiting, mackerel, lesser spotted dogfish, and sea bass. The percentage of recorded catch for each species did not vary substantially between the results from 2016 and 2017. For the European Union Data Collection Framework (DCF) species, the most caught were the sharks and dogfish, followed by sea bass and Atlantic cod (Table 16). Of all these species, the majority were released rather than kept, with 97%

and 95% of sea bass returned in 2016 and 2017 respectively. One hundred percent of eels caught were released in 2016, and 97% in 2017, and 98% of sharks and dogfish were released in each year. When the fish were grouped, most fish caught in both years were common roundfish, with approximately 70% released in both years(Table 17).

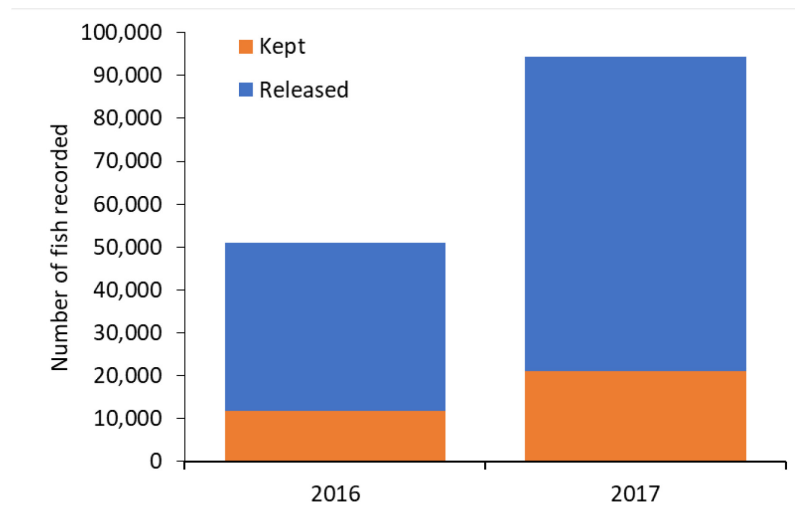


Figure 11. The total number of fish retained and released recorded by diarists.

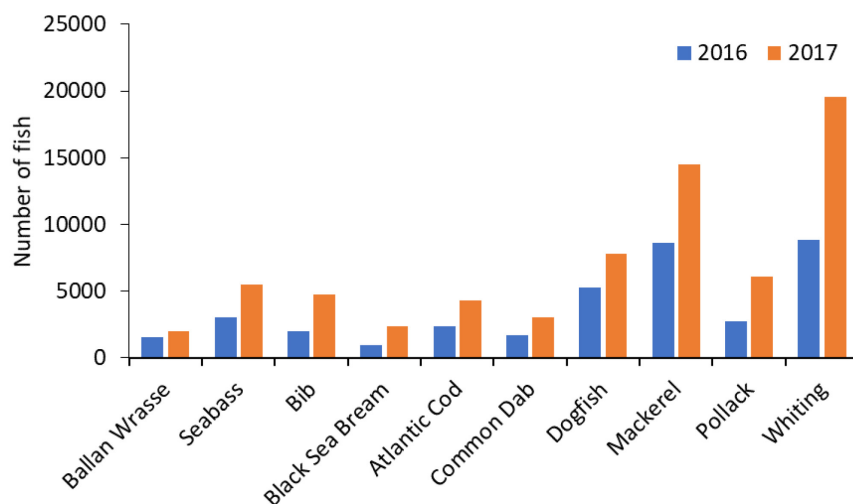


Figure 12. The total numbers of fish recorded by diarists for the ten most caught species.

Table 16. The numbers of DCF species retained and released, and release rates.

| DCF species | 2016 | | | 2017 | | |
|------------------------|------|----------|--------------|------|----------|--------------|
| | Kept | Released | Released (%) | Kept | Released | Released (%) |
| Cod | 614 | 1747 | 74 | 1058 | 3241 | 75 |
| Freshwater Eel | 0 | 99 | 100 | 10 | 374 | 97 |
| Salmon | 0 | 0 | --- | 0 | 1 | 100 |
| Sea bass | 105 | 2922 | 97 | 256 | 5248 | 95 |
| Sharks and dogfish | 129 | 6866 | 98 | 236 | 10421 | 98 |
| Sharks Skates and rays | 65 | 910 | 93 | 196 | 2048 | 91 |

Table 17. The fish kept and released for each fish group.

| Groups | 2016 | | | 2017 | | |
|-------------------------|-------|----------|--------------|-------|----------|--------------|
| | Kept | Released | Released (%) | Kept | Released | Released (%) |
| Common round fish | 7971 | 21720 | 73 | 16068 | 42316 | 72 |
| Crabs and lobsters | 37 | 213 | 85 | 315 | 2741 | 90 |
| Dogfish & shark species | 129 | 6866 | 98 | 236 | 10421 | 98 |
| Flatfish | 759 | 3596 | 83 | 1121 | 6011 | 84 |
| Other fish species | 2602 | 2571 | 50 | 2366 | 4248 | 64 |
| Rare & Unusual Species | 4 | 23 | 85 | 16 | 43 | 73 |
| Seabreams & Mulletts | 220 | 983 | 82 | 743 | 2032 | 73 |
| Skates & Rays | 65 | 910 | 93 | 196 | 2048 | 91 |
| Tuna | 0 | 0 | --- | 1 | 0 | --- |
| Wrasse | 20 | 2297 | 99 | 28 | 3338 | 99 |
| Total | 11807 | 39179 | 77 | 21090 | 73198 | 78 |

Catches were recorded by diarists across all ICES areas, with reasonable numbers of fish recorded in all areas apart from the Northern North Sea in 2016 (Table 18). The highest release rates of between 90 and 100% in one year were in the Bristol Channel, the Celtic Sea North and West of Ireland, and the lowest release rate of 31% in the Northern North Sea in 2016 but the latter may be due to the small number of fish recorded (Table 18).

Table 18. The fish kept and released by area.

| Area | 2016 | | | 2017 | | |
|---|-------|----------|--------------|-------|----------|--------------|
| | Kept | Released | Released (%) | Kept | Released | Released (%) |
| IVa Northern North Sea | 31 | 14 | 31 | 483 | 3118 | 87 |
| IVb Central North Sea | 1680 | 2920 | 63 | 2047 | 3874 | 65 |
| IVc Southern North Sea | 2713 | 4377 | 62 | 3122 | 11177 | 78 |
| VIa West of Scotland and Northern Ireland | 746 | 3946 | 84 | 1461 | 5663 | 79 |
| VIIa Irish Sea | 960 | 4991 | 84 | 1677 | 7992 | 83 |
| VIIId Eastern English Channel | 978 | 4766 | 83 | 2205 | 9865 | 82 |
| VIIe Western English Channel | 3714 | 12128 | 77 | 8822 | 22157 | 72 |
| VIIIf Bristol Channel | 511 | 3900 | 88 | 743 | 7052 | 90 |
| VIIg Celtic Sea North | 42 | 652 | 94 | 161 | 482 | 75 |
| VIIh Celtic Sea South | 351 | 883 | 72 | 145 | 774 | 84 |
| Non-UK ICES areas | 81 | 602 | 88 | 224 | 1044 | 82 |
| Total | 11807 | 39179 | 77 | 21090 | 73198 | 78 |

More detail on the records of catches for Atlantic cod and sea bass are provided in Table 19. On average, each diarist in 2016 caught 107 fish, and 88 in 2017 (initial), with 82 and 69 returned in each year respectively (Table 19). Of these in 2016, 20 were sea bass and 16 cod, and in 2017 (initial) 16 were sea bass and 17 cod (Table 19). On average, per session, 9 fish were caught in 2016, and 8.5 in 2017 (initial), and approximately 7 were returned per session in each year (Table 19).

Table 19. Catch rates of Atlantic cod and sea bass.

| Category | 2016 | | | 2017 initial | | | 2017 final | | |
|-----------------------------------|-------|------|------|--------------|------|------|------------|------|------|
| | Total | Bass | Cod | Total | Bass | Cod | Total | Bass | Cod |
| Kept total | 11807 | 105 | 614 | 18134 | 210 | 915 | 21090 | 256 | 1055 |
| Returned total | 39179 | 2922 | 1747 | 64280 | 4734 | 3049 | 73198 | 5210 | 3239 |
| Total | 50986 | 3027 | 2361 | 82414 | 4944 | 3964 | 94288 | 5466 | 4294 |
| Kept (%) | 23.2 | 3.5 | 26.0 | 22.0 | 4.2 | 23.1 | 22.4 | 4.7 | 24.6 |
| Returned (%) | 76.8 | 96.5 | 74.0 | 78.0 | 95.8 | 76.9 | 77.6 | 95.3 | 75.4 |
| Total number of diarists | 476 | 148 | 144 | 932 | 304 | 229 | 1495 | 366 | 275 |
| Average fish kept per diarist | 24.8 | 0.7 | 4.3 | 19.5 | 0.7 | 4.0 | 14.1 | 0.7 | 3.8 |
| Average fish returned per diarist | 82.3 | 19.7 | 12.1 | 69.0 | 15.6 | 13.3 | 49.0 | 14.2 | 11.8 |
| Average fish total per diarist | 107.1 | 20.5 | 16.4 | 88.4 | 16.3 | 17.3 | 63.1 | 14.9 | 15.6 |
| Total number of sessions | 5410 | 845 | 576 | 9663 | 1564 | 862 | 10602 | 1680 | 960 |
| Average kept fish per session | 2.2 | 0.1 | 1.1 | 1.9 | 0.1 | 1.1 | 2.0 | 0.2 | 1.1 |
| Average returned fish per session | 7.2 | 3.5 | 3.0 | 6.7 | 3.0 | 3.5 | 6.9 | 3.1 | 3.4 |
| Average total catch per session | 9.4 | 3.6 | 4.1 | 8.5 | 3.2 | 4.6 | 8.9 | 3.3 | 4.5 |

The average catch in each session did not vary greatly with avidity, except with the highest avidity category (Table 20). Anglers who fished between 1 and 35 times a year caught an average of between 9 and 10 fish per session (Table 20). For those who fished more than 35 times a year, the average catch was 7.6 fish (Table 20). There was also little variation in the duration of each session, although those who fished the most frequently had slightly shorter sessions (Table 20). This led to a very similar catch rate per hour for all the groups (Table 20).

Table 20. The fish caught and catches per session of the different avidity categories.

| Avidity | Count of Diarists | Total Fish Caught | Count of Sessions | Average catch per session | Session duration (hours) | Average catch per hour |
|--------------------|-------------------|-------------------|-------------------|---------------------------|--------------------------|------------------------|
| 1-5 times | 292 | 6,961 | 723 | 9.6 | 4.8 | 2.0 |
| 6-12 times | 171 | 13,917 | 1,497 | 9.3 | 5.1 | 1.8 |
| 13-35 times | 147 | 27,871 | 3,018 | 9.2 | 4.6 | 2.0 |
| More than 35 times | 67 | 33,665 | 4,425 | 7.6 | 4.0 | 1.9 |
| Overall | 677 | 82,414 | 9,663 | 8.5 | 4.5 | 1.9 |

3.2 Economics

In 2016 and 2017, angler spend data was collected at points throughout the year. In each, anglers were asked to provide information about spend on their last trip and spend on major items over the preceding six months. Around 200 diarists responded in 2016 and 400 in 2017 (Table 21). The total capital expenditure in each year was similar, with an average of £558 in 2016, £591 for the first half of 2017 and £395 for the second half of the year (Table 22 and Table 23). In 2016, the results for each

major item are shown in Table 21. The highest total capital expenditure was on fishing rods and reels, followed by boats and kayaks.

Table 21. Summary of the economic survey. * the total number of diarists responding in each year is lower than the total number of diaries completed, because some people did all surveys in each year.

| Survey | Jun 2016 | Oct 2016 | Dec 2016 | All 2016 | Jul 2017 | Dec 2017 | All 2017 |
|---------------------|----------|----------|----------|----------|----------|----------|----------|
| Diarists responding | 209 | 173 | 150 | 304* | 407 | 436 | 267* |

Table 22. The major expenditure in 2016, broken down by each major item.

| Major item | Respondents | Spend per angler | Proportion |
|-------------------------|-------------|------------------|------------|
| Fishing rods and reels | 164 | £161 | 0.29 |
| Fishing Clothing | 149 | £58 | 0.10 |
| Other fishing equipment | 119 | £30 | 0.05 |
| Terminal tackle | 211 | £72 | 0.13 |
| Boats/kayaks | 27 | £111 | 0.20 |
| Boat engines/equipment | 40 | £63 | 0.11 |
| Any other major items | 42 | £63 | 0.11 |
| Overall | 916 | £558 | 1.00 |

Table 23. The average major item spend by individual angler in 2017.

| Survey | Average major item spend (£) |
|---------------|------------------------------|
| July 2017 | £592 |
| December 2017 | £395 |

4 Discussion

This report provides the approach and findings of the diary surveys capturing catch and spending data from sea anglers who were part of the Sea Angling study in 2016 and 2017. The results presented here are raw data from the diaries, and the data raised in separate Annexes for the UK in terms of expenditure (Annex 3) and catch (Annex 4).

As the first online angling diary of its kind in the UK, recruitment for the Sea Angling 2016 diaries was slower than in 2017, and the survey initially attracted the more avid anglers and those aged between 34 and 64. Recruitment for the 2017 study was both more intensive and spread over a longer time period and so reached more people. Recruitment methods were adapted to attempt to address some imbalances in the 2016 sample, particularly the over representation of older and more avid anglers, and the geographical biases. Targeting anglers face-to-face in the summer months, who were more likely to be occasional anglers, was successful in that in 2017 there was a larger sample of less avid anglers than in 2016. However, many of those recruited in this way did not provide data. More effort was also spent on recruiting anglers who fish in Wales, Northern Ireland, and Scotland, to collect more data in these regions. As the sea angling surveys continue in future years, and the sample size increases, the aim is to continue to improve the balance of diarists across the avidity, region and age categories and reduce the biases in the results.

Most recorded fishing was between April and September and most sessions were in the English Channel and Bristol Channel, with fewer recorded in the Celtic Sea or Northern North Sea. Initial catch results from the 2017 study were very similar to the results from 2016. European sea bass and cod remain among the most important species caught, and unraised data on release rates for bass and cod were consistent in 2016 and 2017. However, in 2016, a lower proportion of bass catches were recorded as kept compared with 2017, and recorded catches were slightly lower in 2017. For cod, a similar proportion was kept in both years. Total catches per diarist for cod were also similar across the two years. Sea bass catches per diarist dropped slightly in 2017. These data will be raised to the UK population level, in Annex 4, and provide a picture of catches and releases.

The economics surveys showed a higher average session spend in 2017 compared with 2016, based on the raw diary data, while total capital expenditure was similar in both years. Highest capital spend in 2016 was on fishing rods and reels, and boats and kayaks. These data will be raised to the UK population level, in Annex 3, to provide an estimate of the total economic impact, FTEs supported and GVA created by sea angling spend.

There are challenges with raising diary data to the national level because of biases in the data, and the raw diary data can be difficult to interpret without the raised values. Other data collection methods are available which may have lower biases, but these can be very costly. The diary survey is a cost-effective way of collecting data on a cross-section of the sea angling community, and careful analysis to account for bias can lead to robust results. In addition, diary approaches do not cover tourist anglers, so is not covered within this survey.

Sea Angling 2012 used several different survey methods to determine participation, spend and catches, including online recording four times a year, on-site surveys, and charter boat surveys (Armstrong et al., 2013). In 2016 and 2017, a monthly diary was carried out, which provided data from

a sample of anglers. While this does not include the on-site element, the diary method has allowed for ongoing recruitment across years, with diarists continuing to enter data for as long as the surveys are running. In the long term this will save time recruiting all diarists each year, and time has been invested in developing the online tool for longer term use. Providing a notebook, measuring tape and identification chart in these surveys aimed to reduce error inherent in recalling catches when entering data each month, and the higher frequency of data entry (monthly versus quarterly) allows for higher resolution data to be collected. In the 2016 and 2017 surveys, charter boats are not specifically targeted, and so there is likely to be less representation of this fishing method when compared with 2012.

The data here provide information for the first two years of the diary surveys, and further recruitment in coming years is expected to increase the sample size and representation of different avidity groups and regions of the UK. More years of catch data will allow trends in catches to be seen and identify any responses to management measures. To monitor changes in marine recreational fishing and to support future development, diary panels should continue to be used to collect data on UK activity. These could be supplemented by on-site surveys or other methods, to add further information and to reach a different sample of anglers. Technology can be used to increase accuracy of the results, such as mobile phone apps which are used to record data in real-time, reducing the recall bias which exists when fishers enter data after a fishing session has finished. They can also collect other valuable information such as location and duration automatically, reducing the time demands on survey participants.

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We are passionate about what we do because our work helps tackle the serious global problems of climate change, marine litter, over-fishing and pollution in support of the UK's commitments to a better future (for example the UN Sustainable Development Goals and Defra's 25 year Environment Plan).

We work in partnership with our colleagues in Defra and across UK government, and with international governments, business, maritime and fishing industry, non-governmental organisations, research institutes, universities, civil society and schools to collate and share knowledge.

Together we can understand and value our seas to secure a sustainable blue future for us all, and help create a greater place for living.

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Innovative, world-class science is central to our mission. Our scientists use a breadth of surveying, mapping and sampling technologies to collect and analyse data that are reliable and valuable. We use our state-of-the-art Research Vessel Cefas Endeavour, autonomous marine vehicles, remotely piloted aircraft and utilise satellites to monitor and assess the health of our waters.

In our laboratories in Lowestoft and Weymouth we:

- safeguard human and animal health
- enable food security
- support marine economies.

This is supported by monitoring risks and disease in water and seafood; using our data in advanced computer models to advise on how best to manage fish stocks and seafood farming; to reduce the environmental impact of man-made developments; and to respond to serious emergencies such as fish disease outbreaks, and to respond to oil or chemical spills, and radioactivity leaks.

Overseas, our scientists currently work in Commonwealth countries, United Kingdom Overseas Territories, South East Asia and the Middle East.

Our customer base and partnerships are broad, spanning Government, public and private sectors, academia, non-governmental organisations (NGOs), at home and internationally.



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