Attitudes towards data collection, management and development, and the impact of management on economic value of sea angling in the UK

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Executive summary

Understanding sea angler attitudes towards management is important, so that it can be considered in the development of approaches for the management of recreational fisheries. The aim of this study was to inform the government about sea anglers' views on the future development and management of recreational sea angling, what they value most, and their participation in data collection. This was achieved through a mixture of interviews and online surveys that consisted of: an initial consultation to obtain views and focus research questions; an online survey of sea angler attitudes towards sea angling development, management data collection and funding; and interviews to explore and ground truth attitudes expressed in the survey. Survey questions were co-designed with stakeholders and included: sea angling activity; involvement in data collection; views on fish stocks; a choice experiment to assess willingness-to-pay; funding; management; and demographic information. The online survey was widely publicised, leading to 1,527 respondents. 747 completed all questions, and 805 responded to the choice tasks. There was some bias in the respondents, with a higher proportion of respondents aged over 55 than in the general population of sea anglers. There was a variety of responses, but some key messages could be extracted, and these are summarised below.

Behaviour
Sea anglers were motivated by both catching fish and the quality of the environment in which they fish; 30.0% and 29.5% respectively said that this was 'most important'. Catch-based motivations emphasised the importance of catching a variety of fish species (42% saying this was most important), as well as catching a wild fish (19.5%) and a lot of fish (18.4%). A healthy and beautiful environment to fish in was the most important environmental factor (41.4% saying this was most important) and about half of respondents showed a personal attachment to the place they fished most recently. Around 60% of respondents were satisfied and 19% were dissatisfied with their most recent sea angling experience.

Data Collection
Over two-thirds of respondents said that they were willing to provide catch and participation data in future through surveys. However, there was less appetite to provide economic and social impact data, which contrasts with previous surveys and may be a result of survey wording. Logistic regression suggested that those that had already provided data were significantly more likely to want to contribute in future. Three-quarters of respondents agreed that data provided should be used to: demonstrate the impact and benefits of sea angling; to inform sea angling development; and to inform management measures controlling what is being caught.

Fish stocks
The biggest perceived threats to fish stocks were damage to habitats (91% 'important' or 'very important'), overfishing by commercial operators (99% 'important' or 'very important'), and pollution (92% 'important' or 'very important').

Management measures
Most respondents (94%) were aware that sea bass is subject to a daily bag limit, although knowledge of other regulations varied. 68% of respondents correctly identified the minimum landing size for sea bass and half of respondents were able to correctly identify the MLS for cod. The lower levels of awareness of other regulations may suggest areas for greater communication efforts.

Respondents felt that current regulations on commercial fishing were less effective than those applied to recreational angling. 63% felt that the MLS for sea bass was effective in recreational angling, but only 53% thought this was the case in commercial fishing, with only 18% thinking it was 'very effective'. Qualitative responses and interviews suggested that more conservation zones, recreation-only zones, better enforcement and education, and banning damaging fishing methods should be prioritised in future management.

Funding

35% of respondents said angling development should be funded by a sea angling licence, but ground truthing interviews suggested that this was highly conditional on the use of the funds for sea angling development and tighter control of commercial fishing. No single funding option had a majority support from respondents. Regression analysis suggested that those who opposed contributing a fee for sea angling had significantly different attitudes on most issues to other respondents.

Willingness to Pay

Many studies estimate total economic impact from sea angling based on expenditure. This measures the monetary funds that sea angling brings to the area where it is located and how it flows through the economy. However, economic impact does not account for the non-monetised benefits of angling (e.g. relaxation, experience) and cannot be used to assess the impact on economic value of future changes in management. Choice experiments are used to assess willingness-to-pay (WTP) for a hypothetical change in the angling experiences (e.g. catches, size of fish, bag limits etc.) and to estimate the economic value of sea angling (i.e. the consumer surplus derived from sea angling). This can be used to understand the impact of management on the value of sea angling and support evidence-based decision making. Here, a choice experiment was carried out to assess the impacts of regulations, catch, retained catch, and cost on angling preferences and to assess how willingness-to-pay changes in response to different management strategies. Respondents chose between three trips with different attributes (e.g. catch, species, size of fish, bag limit, cost) for their favoured target species of cod or bass, completing four of these choices each. Statistical models were then used to identify the factors that influence trip choice and to estimate the marginal willingness-to-pay (MWTP) to catch-and-keep and catch-and-release cod and sea bass. The MWTP depended on the method, but was £22 for the first cod caught-and-kept and £30 for the first sea bass caught-and-kept. There was a reduction in additional willingness-to-pay with each extra fish caught-and-kept. The value of trips was largely derived from keeping the fish, rather than from releases due to minimum landing size (MLS), bag limits, or catching and keeping other fish, suggesting that catching fish to eat is important. Generally, anglers stated that catch, catch retention, MLS, and bag limit were considered most often in their trip choices, but cost and number of other fish caught were less important.

Future Management

Future management needs to balance the interests and value of recreational sea angling with other sectors, notably the commercial fishing sector. Improving environmental conditions and fish stocks is important in retaining the support of recreational sea anglers, by involving them in data collection and support for some funding measures. There is potential to increase knowledge of sea anglers about management measures and involve them in data collection more. Regulations need to take account of both the WTP to catch and keep as well as to catch and release fish, reflecting the higher value of retained fish when considering bag limits.

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1 Introduction

Recreational sea angling (RSA) is a high participation activity with significant economic and social benefits (Hyder *et al*., 2017; Hynes *et al*., 2017; Hyder *et al*., 2018; Radford *et al*., 2018). In other parts of the world, these benefits are well recognised, and some stocks are managed for recreational purposes only. The impacts of recreational sea angling on fish stocks is recognised in Europe and has brought recreational fisheries into conflict with commercial fisheries. In addition, management measures for recreational sea angling have been introduced and include: closed seasons and areas, minimum landing sizes, and bag limits (e.g. sea bass and western Baltic cod). The importance of RSA has been recognised by the European Parliament (European Parliament, 2018) and RSA is included in the UK Fisheries Bill. However, there is little understanding how management measures impact on participation, effort, or the benefits generated by recreational sea angling. It is important to develop a better understanding of how changes in policy and management impact on the benefits provided by sea angling and the value sea anglers place on their activities.

Over 800,000 people in the UK have been sea angling in the past year (Hyder *et al.*, 2020) and has significant economic, social and environmental benefits, as well as impacts on fish stocks due to the volume of catches (Armstrong *et al.*, 2013; Hyder *et al.*, 2018). In England, RSA had a total economic impact of £2.1bn, supporting around 23,600 jobs in 2012, and generated income in deprived coastal communities (Brown *et al*., 2012; Armstrong *et al*., 2013; Roberts *et al*., 2017). Economic impact identifies, from a macro-economic perspective, the monetary funds a particular project or industry brings to the area where it is located (EFTEC, 2015). Hence, this approach calculates the impact of the demand for MRF on the regional or national economy. This is done using an Input-Output (IO) model, which is a quantitative static approach to represent the interdependencies between multiple economic sectors (EFTEC, 2015; Parkkila et al., 2010). The IO method measures the potential impact of an increase in activity in one sector on the direct output of the sector, indirect and induced effects, employment, and GVA on the total economy due to this change in activity. The direct effect relates to the increased production output, indirect effects capture the increase in production in the other sectors, and the induced effect is where more employment is generated which allows households to increase their income and spending. The direct, indirect and induced effects are summed to get the total economic impact of an activity. While RSA economic impact assessments are values based on reported monetary transactions, they do not account for values which are not visible in any markets. In order to estimate these 'non-market values' specialist valuation methods such as stated preference choice experiments are required.

In addition to economic factors, there is a need to better understand the impact of policy and management measures relating to recreational sea angling, the attitudes of anglers towards them and sea angler behaviour in response to different regulation. Some regulatory measures, particularly the bag limit on sea bass, have caused some conflict and controversy amongst sea anglers within a wider context in which recreational angling is competing with commercial fishing for a share of the stock. Allocation decisions between commercial and recreational fisheries are made implicitly when management measures are imposed with limited assessment of the impact that this might have on expenditure by sea anglers. In addition, some sea anglers and angling organisations have opposed data collection initiatives which seek to monitor the impact of recreational angling on stocks, due to perceived disparity with monitoring of commercial marine fishing.

As the UK leaves the EU, there is potential to reconsider and redesign the management and governance of recreational sea angling in UK waters. The UK Fisheries White Paper set the goal of ‘world class fisheries management’ post-EU exit that incorporates recreational fisheries. Several goals have been set for recreational fisheries which include: recreational-only angling opportunities; integration within frameworks accounting for societal benefits and impacts; learning from best practice in other countries and co-management; and integrating recreational angling into decision-making. Similar recommendations were made by the PECH committee of the European Parliament in their position statement on recreational fisheries, highlighting the need for robust data (catches and economic), inclusion in future regulation, rules for management, and financial support (European Parliament, 2018). Hence, understanding sea angler attitudes towards marine management, sea angling development, funding and data collection is particularly timely. As such, there is a need to better understand angler attitudes about: management of fish stocks; management of recreational sea angling; and collection of data on angler behaviour, catches and impact. In addition, it is important to understand how anglers respond to different potential management measures both in descriptive terms and in terms of how changes in management measures impact the non-market value anglers derive from angling activities.

1.1 Aims

This study was commissioned by the Department for Food and Rural Affairs (Defra) to provide new research into the attitudes of recreational sea anglers in England. Defra commissioned the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and Substance to undertake the research which took place between March 2018 and March 2019.

The overall aim of the research was to inform the government about sea angler views on the future development and management of recreational sea angling, what they value most and their participation in data collection. This aim was delivered through the following objectives:

1. To assess attitudes towards data collection, management, and development of sea angling.
2. To evaluate the impact of potential management approaches on the economic value of sea angling
3. To consider the implications for the future management of sea angling.

This involved a mixture of semi-structured interviews and online surveys, and required significant communication and engagement with the angling community. The report is structured by the individual objectives, with each addressed in an individual section.

2 Attitudes towards data collection, management and development of sea angling

2.1 Introduction

Management of fisheries is more about managing people than fish, as the effectiveness of fishery management relies upon behavioural changes by people (Hilborn, 2007). This is important for recreational fisheries, as motivations vary between individuals (Fedler and Ditton, 1994; Arlinghaus, 2006; Beardmore et al., 2011). For example, fishers that primarily fish for food will have higher harvest rates than fishers that release their catch (e.g. Beardmore et al., 2011). Indeed, considering angler motivations and how any proposed management impacts on motivation is essential to ensure coastal regions that rely on marine recreational fisheries for a source of income are not negatively affected. Responses to fishing regulations vary greatly between anglers, meaning that the average angler does not exist. The need to include angler heterogeneity in the management process has led to the development of social-ecological systems to investigate optimal management strategies (Hunt, 2013; Arlinghaus et al., 2016; 2017).

For many years, sea angling has been close to an open-access activity in Europe with management limited to MLS, local seasonal closures, and gear and bait restrictions. However, restrictions have been implemented (e.g. seabass bag limits and closed seasons) in recent years that have been controversial within the sea angling community (Maydew, 2016). Consequently, there has been a need to determine how fishers respond to different management measures with the hope this will reduce future conflict and increase compliance with management. Assessments of sea angler attitudes to management can be done in two ways: firstly, through experiments that assign monetary values to determine preferential management options (e.g. Drymon and Scyphers, 2017); however, these surveys often don't capture the full extent of fisher views about RSA management. Alternatively, deploying semi-structured interviews that ascertain how fishers feel about different management measures is better at quantifying the social impacts.

Surveys of angler attitudes in other regions of Europe have found a wide range of views that vary between different sections of the population. For example, in Portugal well-educated and high-income anglers agreed with existing MRF regulations, whereas fishers that perceived the need for more limitations and better enforcement of commercial fishing were less likely to agree with the existence of sea angling regulation (Veiga *et al*., 2013). Moreover, fishers in the USA that support management generally consider that management should focus upon providing enough fish for recreational fishermen, incorporating stakeholder interests in the policy process, and monitoring and enforcing recreational fishing regulations (Brinson and Wallmo, 2013). Furthermore, anglers prefer management measures that focus on restoring habitat, establishing minimum size limits, and providing artificial habitat (Brinson and Wallmo, 2013). These management preferences were mirrored by those of Irish sea bass fishers, who were willing to trade long-term sustainability for harvested fish (Grilli *et al*., 2019). Though, the views on what management should focus on tend to vary between anglers and will depend on other factors (e.g. historical fishing rights).

Although surveys have explored recreational angler behaviour, motivations and catches, there has not been a national survey on the attitudes of recreational sea anglers in England toward management measures. Furthermore, due to the large variation in angler attitudes found across demographic groups (Brinson and Wallmo, 2013; Veiga *et al*., 2013) the results from other surveys cannot be used to fill this data gap. Hence, the current survey will address this gap and provide decision makers with a baseline measure of fishers' attitudes and preferences to management, which will make assessing the impact of any changes to the status-quo possible.

As the UK leaves the EU, there is potential to reconsider and redesign the management and governance of recreational sea angling in UK waters. Hence, there is a need to understand sea angler attitudes towards marine management, sea angling development, funding and data collection. In addition, it is important to understand how anglers respond to different potential management measures both in descriptive terms and in terms of how changes in management measures impact the non-market value anglers derive from angling activities. Here, sea angler attitudes towards marine management, sea angling development, funding and data collection are investigated. An initial consultation, online survey, and follow-up surveys were carried out to seek views and ground truth outcomes.

2.2 Methods

Semi-structured interviews and an online survey were used to assess sea angler attitudes towards data collection, management, and development. Firstly, an initial consultation of a small number of individuals from the angling community was done to inform the survey design (Section 2.2.1). Then an online survey was used to collect information from a larger set of individuals (Section 2.2.2). Finally, semi-structured interviews were conducted with several respondents to seek clarification and ground truth outcomes from the online survey (Section 2.2.3).

2.2.1 Initial consultation

To inform the survey design, eleven semi-structured consultative interviews were held with individuals, representatives from sea angling organisations and government. In addition, information was provided by others who were not available for telephone interview and consultation was undertaken with a key sea angling stakeholder forum[1]. The purpose of this was to: understand the stakeholder landscape within which the research questions were to be explored; collate the initial views of agencies, organisations and individuals; get support for the work; and seek practical advice on communications and support to assist the recruitment of survey participants. The consultation included the following: background in sea angling and (if relevant) organisational role; views on the future of sea angling management, development, funding, decision making and data collection; opinions about current management of sea angling; priorities for research; and advice on communications and survey recruitment (a full list of questions is in Annex 1). This exercise meant that an element of co-design was present in research instrument construction, something recommended in the Fisheries White Paper.

2.2.2 Online survey

2.2.2.1 Design and implementation

The online survey was grouped into six sections: avidity; data collection; fish stocks; choice experiment (see Section 3); funding; management; and demographics. A full description of

[1] The Angling Trust Marine and Conservation Access Group https://www.anglingtrust.net/page.asp?section=867&sectionTitle=Marine+Conservation+%26+Access+Group

the survey can be found in Annex 2, but a short summary of each section is provided below. Sea angling activity included questions about the numbers of trips in the past year, last trip (location, satisfaction, identification), motivation (catch, place, environment), and target species. To identify most recent location, respondents placed a pin on a map, and this was used to determine the region fished. Assessment of data collection was done using questions about involvement in studies (current and historic), willingness to provide data, and potential use of data. Potential sources of funding were explored and ranked, including licensing, government, and levies on various industries. Perceived threats to fish stocks were examined by ranking different pressures and identification of additional pressures. Views on management were assessed by asking about existing measures (knowledge, opinions, assessment), potential levels of compliance, and future management options. Finally, demographic information was provided by each respondent (age, gender, income, disability, location).

It was necessary to minimise the numbers of questions to reduce the respondent burden, so the total number of questions was limited. Survey questions were developed based on the research aims, other comparable research, and the initial consultation exercise. The online survey was designed to be comparable with other surveys (e.g. 2018 National Angling Survey, Brown, 2019). In addition, demographic information was collected to allow comparison with population surveys of sea angling including the Watersports Participation Survey. This is a face-to-face omnibus survey of 12,000 UK households that includes questions on sea angling participation and activities[2].

The survey was developed using the online platform Qualtrics (www.qualtrics.com). The ability of this platform to customise questionnaires using JavaScript and HTML was essential to creating a questionnaire that accommodated both attitudinal questions and choice experiments (see Section 3). In most instances a five-point Likert scale was deployed to allow differentiation in attitudinal responses, with two extremes and a neutral midpoint. Likert scales are one of the most reliable ways to measure attitudes, opinions and behaviours. (Likert, 1932; Jarvis, 1999). The survey included a confidentiality statement to ensure compliance with data security legislation and best practice, and a formal consent statement at the start. The survey was piloted with 100 respondents to the 2018 National Angling Survey[3] and a further 100 from the Sea Angling Diary Project (www.seaangling.org). Following the pilot, survey questions were revised for the final survey (see Annex 2).

Sea anglers were able to access the survey via a web link and the whole survey took around 20 minutes to complete. Respondents had to be 16 years or over in age and contacts were provided for both Cefas and Substance to ask questions about the research and raise any technical issues. An email address for Substance was provided at the end of the survey for people who were willing to be interviewed in more detail for follow-up and ground-truthing (Section 2.2.3). A web page was established to provide further detail about the research (purpose and use) with text agreed between Substance, Cefas and Defra (Annex 3). This web page also contained a link to the survey and contact details[4].

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[2] https://www.britishmarine.co.uk/Resources/Publications/2019/April/Watersports-Participation-Survey-2018

[3] This was run by Substance for the Environment Agency to inform the National Angling Strategy 2019-2024. www.substance.net/nationalanglingstrategy

[4] A copy of the statement made available on the web page is in the Appendix (the web page itself is no longer available).

There is no list of sea anglers or licence required, so it was not possible to use probabilistic methods to get a representative sample of the general population of sea anglers. Instead, an online approach was used with the survey publicised widely through different media, meaning that respondents were self-selecting. An invitation email including the survey link and a link to the information web page was sent to 1,502 members of the Sea Angling Diary project, 2,290 respondents to the National Angling Survey in 2018 who had been sea angling within the last 12 months. Significant additional publicity was done to increase the number of responses through: Substance social media channels and e-newsletter; promotion on the Sea Angling Diary Facebook and Twitter pages; and promotion by stakeholders on some sea angling forums, including World Sea Fishing Forum. Finally, the invitation email was distributed to stakeholder contacts and the Angling Trust Marine Conservation and Access Group.

2.2.2.2 Analysis

All survey data were cleaned in preparation for analysis and a basic descriptive assessment of the responses to all questions was done. The full range of responses in Likert scales was provided and the mean rating was calculated to combine all individual responses into a single score[5]. There are issues with averages with Likert scales as this assumes a consistent difference between categories. This may not be true, but a simple average still provides an indication of the strength of opinion of respondents.

To assess the factors driving responses, several questions were selected for further analysis using logistic and ordinal regression models. Logistic regression is used for modelling binary response variables (e.g. testing whether a variable is true or false) (see e.g. Freedman, 2009). Ordinal logistic regression can model responses consisting of more than two categories that can be meaningfully ordered (e.g. 'Low', 'Medium' and 'High' have a natural ordering) (see e.g. McCullagh 1980). The choice of predictors used in a model has a major impact not only on the outcome, but also on the relative effect of each predictor. Therefore, it is important to have a statistically robust way to choose the set of predictors for each model. The process used begins with a maximal model that includes all predictor variables. At each step, the algorithm tries to remove one variable from the model (Zhang, 2016). The reduced model (with one less predictor variable) that has the lowest AIC (Akaike Information Criterion) is chosen for the next step. This process moves towards a model with fewer variables and a lower AIC. However, as a variable's importance depends on the other variables in the model, a 'mixed' process was used that also allows previously removed variables to be considered at each stage and reincorporated into the model if they reduce the AIC. This process continued until removing or adding another variable reduced the descriptive power of the model more than it would simplify the model. Through this process, the resultant model included only the variables that were the best predictors for the chosen response variable. This model allowed inference about the effect of each independent variable on the response variable. An associated p-value was also calculated to represent the statistical significance of each independent variable on the response.

A wide range of predictor variables was chosen for the initial maximal models to allow the observation and prediction of a range of patterns in the survey responses. The predictor variables selected were: protestor; avidity; bass angler; cod angler; prefers bass; prefers cod; motivation; and participation in research (see Table 1 for definitions). In addition, demographic variables were also used including age, income, and gender (Table 1). Data were cleaned and

[5] This is done by assigning a value from 1 to 5 to each response, multiplying the count of responses by that value and dividing it by the total number of responses.

only responses with complete cases for all predictors and the response variable were used in building the models. Whilst the age and income variables were already grouped, they both had low representation in some categories. To deal with this, these variables were also considered with some categories merged to ensure sufficient representation in every category. For example, for the further grouping of age, all ages between 18-54 were merged into one category.

Logistic regression models were developed to predict angler opinion on provision of data (B3), funding (E1) and impact of management on sea angling activity (F5). The logistic regression models were fitted using the *glm* function with a binomial distribution from R statistic computing project (www.r-project.org). Ordinal regression models were developed to predict angler opinion on effectiveness of management (F4), changes in expenditure, physical activity and enjoyment due to bass management (F6) and effectiveness of commercial management (F8). For the effectiveness of management (F4), the 'Fished More' options were removed due to the small number of responses. Ordinal regression models were fitted using the *polr* function from the *MASS* package in R (www.r-project.org). The p-values were found by comparing the t-value to the standard normal distribution. This is strictly only valid with infinite degrees of freedom, but large samples approximate this case. The odds ratios confidence intervals were then generated from this by exponentiating the predicted confidence interval for the coefficients estimated by the model. Testing for 95% statistical significance then became equivalent to whether 1 is included in the 95% confidence interval. A Brant test was performed using the *Brant* package in R (www.r-project.org) on the ordinal regression models to assess the validity of the proportional odds assumption (Brant, 1990). This was used to test the validity of the assumption for both the whole model as well as each predictor variable (Brant, 1990). The p-values for the whole model are included in the report, with a significant result (<0.05) indicating that the assumption is not valid for the model. The condition number of the Hessian can be used to identify that an ordinal regression model is poorly defined, with values of over 10^4 or 10^6 indicating potential problems with optimisation, unidentifiable parameters and a need to simplify the models (Christensen, 2015; 2018).

Table 1. Variables used in logistic and ordinal regression models.

Predictor	Definition
Protestor:	Answered 'No' to contributing to a Sea Angling Development Fund.
Boat angling activity	Number of days spent angling from a boat.
Shore angling activity	Number of days spent angling from the shore
Bass angler	Participants with a non-zero number of bass sessions in the previous 12 months.
Cod angler	Participants with a non-zero number of cod sessions in the previous 12 months.
Prefers bass	True for an angler if their most preferred species to catch was sea bass and false otherwise.
Prefers cod	True for an angler if their most preferred species to catch was cod and false otherwise.
Motivation	Top ranked motivation for sea angling
Participation in research	Participated in research projects (current and historic)
Demographic information	Age, income, gender

2.2.3 Follow-up survey and ground truthing

All respondents to the online survey were invited to take part in a follow-up interview to provide further qualitative information. In total, 25 people responded to this request and 20 were interviewed over the phone. The interviews were semi-structured and based on the survey questions. This provided both illustrative qualitative material and a 'ground truthing' of some survey responses. Interviewees were told to expect the interview to take around 30 minutes, but no time limits were imposed on participants to allow for maximum feedback, and many exceeded this length. Questions were divided into topics that aligned with sections of the survey that included: site factors (motivations); attitudes to current management measures for cod and sea bass; attitudes to future management measures for cod and sea bass; funding options for sea angling development; sustainability of sea angling and marine fisheries; and data collection. A full set of questions is included in Annex 4.

All interviews were recorded, and detailed notes were made. A systematic, manual analysis was undertaken for each respondent to code responses by subject area and response. Utilisation of software such as Nvivo (www.qsrinternational.com/nvivo/home) was considered, but a manual approach was more efficient given the relatively small number of interviews, limited time, and lack of resources for full transcription. This involved reviewing each question by individual respondent and assigning answers to categories. This allowed a distribution of the frequency of responses for each survey question, to provide an overview of the attitudes of interviewees, as well as identify individual responses for reporting.

Initially, a stratified sample of survey responses was going to be taken, but this was not possible due to data protection. This, along with the limited number of responses, meant that the numerical values associated were not significant nor representative. Instead, they simply provide a 'snapshot' of the breadth of attitudes of those who were interviewed and a means of comparing their attitudes to the results in the survey. The manual coding of responses was used to identify interview responses and quotes relating to the key subject areas. This allowed a presentation of the range and illustrative examples of sea angler attitudes.

2.3 Results

2.3.1 Initial consultation

The initial consultation consisted of eleven interviews from across the angling community which helped to shape the survey design, highlighting priority issues for stakeholders that needed to be included in the full surveys. The main additions were to: include questions about commercial as well as recreational fishing; be explicit that the survey asked for attitudes about wider marine management and decision-making, as well as more specific control measures; assess options funding of sea angling and what this might be used for to help development; and investigate the motivation of sea anglers.

2.3.2 Online survey

In total, 1,527 anglers responded to the survey. 747 completed all questions and 805 completed the choice tasks. This represented a completion rate of 49% for the whole survey and 53% for the choice tasks. Dropouts were thought to be due to the length of the survey, as the number of dropouts increased towards the end of the survey. All available responses were reported for each question, so the total number of respondents varied.

2.3.2.1 Activity, location, attachment, motivation, and target species

The mean number of days sea angling in the preceding 12 months was 18 and 7 days from shore and boat, respectively, with a median of 10 and 4 days (Table 2). This was higher than the average of 9.4 and 3.3 days each year from the shore and boat, respectively, from the 2018 Watersports Participation Survey 2018. This difference suggests respondents were more avid than the general sea angling population, but this was expected due to the non-probabilistic nature of the sample. In total, 616 locations were allocated to regions (Figure 1). The most fished regions were the South West (35.6%) and the South East (24.0%), with the East (11.4%) and North West (9.7%) also popular (Table 3; Figure 1).

Table 2. Number of days spent sea angling in the last 12 months in the UK (n=1,354).

	Number of days		Number fishing from platform	Not fishing from platform
Type	**Median**	**Average**		
Shore	10	17.9	1,141	213
Boat	4	6.6	701	653

Figure 1. Map of locations of most recent fishing trip (all locations recorded, n=1,159).

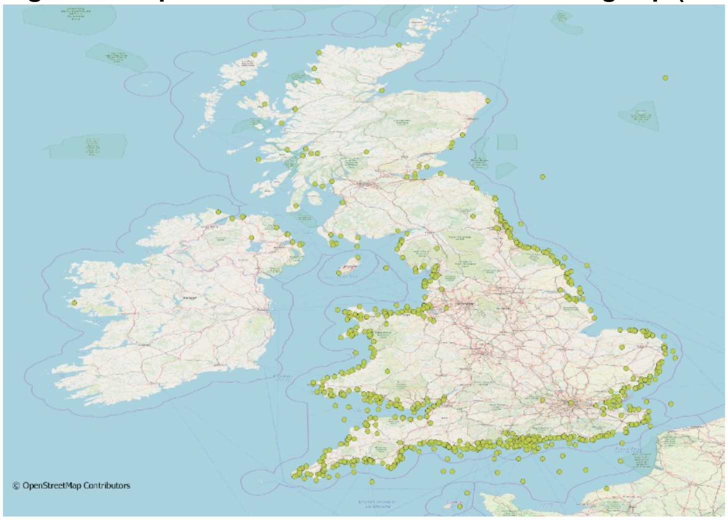


Table 3. Region of most recent trip (count and % of successfully geocoded locations) (n=616).

Region	Count	%
East	70	11.5
East Midlands	2	0.3
London	1	0.2
North East	46	7.5
North West	60	9.7
Northern Ireland	3	0.5
Other	1	0.2
Scotland	0	0
South East	148	24.0
South West	219	35.7
Wales	17	2.9
West Midlands	0	0
Yorkshire and the Humber	49	8.0

Around 60% of respondents were satisfied with their most recent sea angling experience, but 19% were dissatisfied (Table 4). There was an affinity to place associated with most recent trip locations for some respondents, with over 50% of respondents agreeing ('strongly' or 'somewhat') that the place was very special, that they were attached to that place, and that they had a lot of memories of that place (Table 5; Figure 2). However, there was less agreement that the place fished most recently was better than other places and that it could not compare to other sites (Table 5; Figure 2). This suggests that although people may have strong personal attachment to a place they fish, this may not necessarily be because it is the most productive or enjoyable. Therefore, sea anglers have several factors to consider when selecting a site, that are not necessarily based solely on quality.

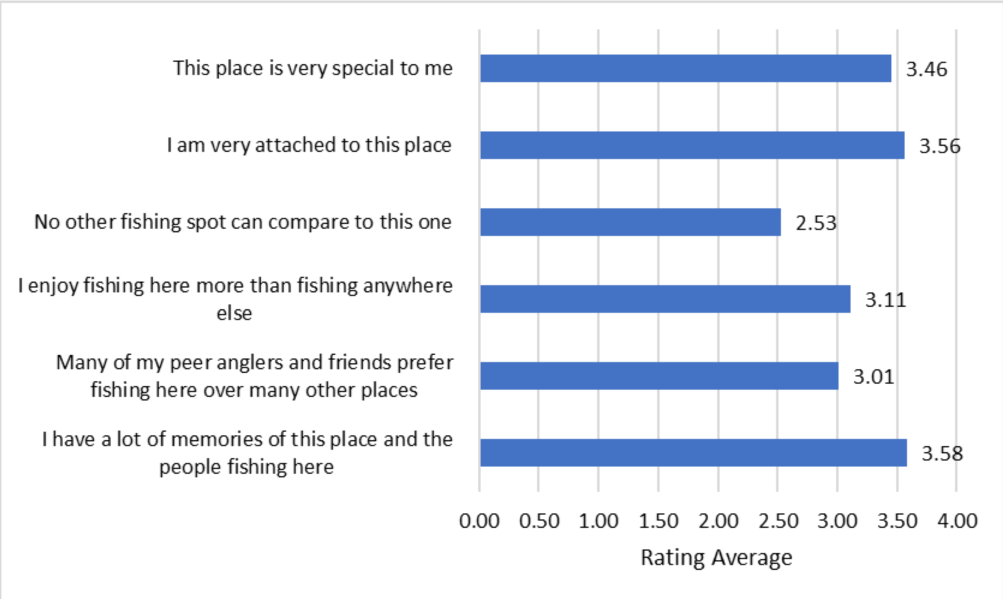
Table 4. Count of satisfaction with most recent recreational sea angling session.

Response	Count	%
Very Dissatisfied	59	5.1
Dissatisfied	161	13.9
Neither	238	20.5
Satisfied	515	44.4
Very Satisfied	186	16.1
Total	1159	100

Table 5. Percentage of different agreement levels regarding attachment to the place where the individual fished on the last trip.

Response	Strongly agree (%)	Somewhat agree (%)	Neither agree nor disagree (%)	Disagree (%)	Strongly Disagree (%)
This place is very special to me	21.4	27.1	34.1	10.9	6.6
I am very attached to this place	22.0	31.8	31.7	9.4	5.1
No other fishing spot can compare to this one	3.8	10.7	41.2	23.4	21.0
I enjoy fishing here more than fishing anywhere else	9.8	24.7	41.0	16.1	8.5
Many of my peer anglers and friends prefer fishing here over many other places	6.8	22.7	44.9	16.3	9.3
I have a lot of memories of this place and the people fishing here	26.4	30.5	25.3	10.6	7.2

Figure 2. Rating average of responses to statements about sense of place.



Marginally more respondents ranked catching fish than quality of the environment as the ‘most important’ aspect of fishing (30.0% and 29.5%, respectively) (Table 6). When all responses are averaged using their respective ranks, this is reversed although the difference remains very marginal (3.55 for environment and 3.46 for catch - Figure 3). For catch motivations, respondents rated ‘catching a variety of species of fish’ highest, followed by ‘catching wild fish’ and 'catching lots of fish regularly' (Table 7). For environmental motivations, respondents rated 'a healthy/beautiful natural environment' as the most important factor by some distance, followed by 'easily accessible/convenient fishing' (Table 8).

Table 6. Count (%) of different importance levels regarding individual motivations for sea angling.

Rank	1 (Most important) (%)	2 (%)	3 (%)	4 (%)	5 (Least important) (%)
Catching fish	30.0	23.0	22.4	12.3	12.5
Quality of the environment	29.5	30.5	15.7	14.8	9.6
Social aspects of fishing	9.2	19.1	27.6	29.3	14.8
Solitude/getting away from it	12.5	20.6	29.6	28.1	9.2
Another aspect of fishing	18.9	6.9	4.8	15.6	53.9

Figure 3. Rating average of responses to statements about motivation.

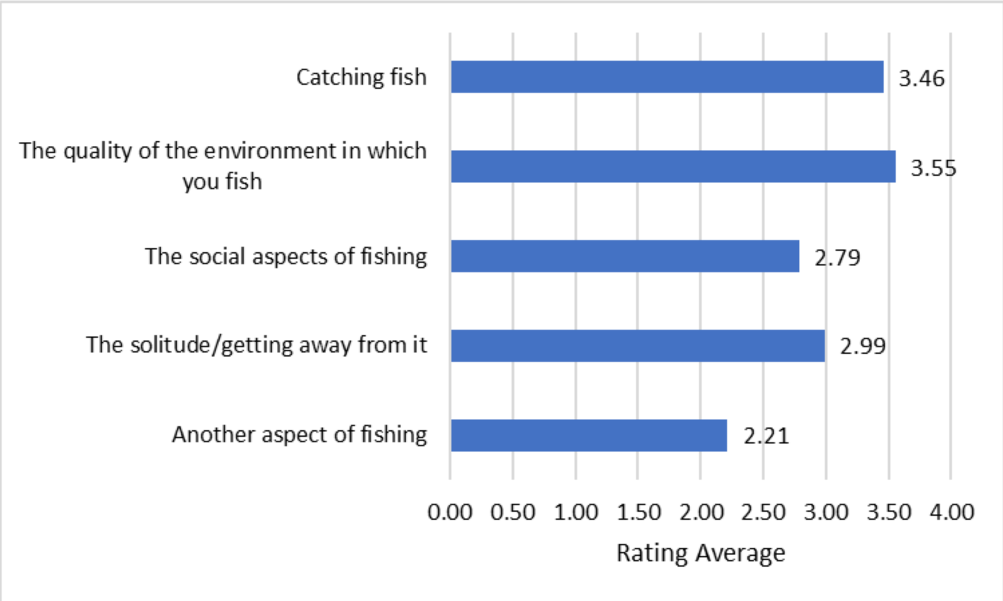


Table 7. Count of stated motivations for sea angling.

Response	Count	%
Catching lots of fish/catching regularly	189	18.4
Catching larger fish	176	17.1
Catching a variety of fish species	432	42.0
Catching wild fish	200	19.5
Not applicable	7	0.7
Other	24	2.3
Total	1,028	100

Table 8. Count of stated motivations for sea angling.

Response	Count	%
A healthy/beautiful natural environment	588	57.2
Being away from other people	102	9.9
Good facilities (e.g. car parking, toilets)	60	5.8
Easily accessible/convenient fishing	247	24.0
Not applicable	6	0.6
Other	25	2.4
Total	1028	100

There was a large range in the number of days targeting cod and sea bass, with individuals fishing for 0 to over 50 sessions in the past 12 months (Table 9). Around 30% of respondents spent one to five days targeting sea bass and cod, but 34 and 41% had not targeted sea bass and cod, respectively (Table 9). This specialisation was also reflected in the top three most preferred species with 38 and 22% preferred sea bass and cod, respectively (Table 10). There was a variety of other species that sea anglers like to catch including mackerel, pollack, plaice, smoothhound, black sea bream, rays, conger eel and whiting (Table 10). However, preference does not equate to them fishing for or catching these species:

Table 9. Count of number of recreational sea angling sessions targeting cod and sea bass in the past 12 months.

Number of days	Sea bass		Cod	
	Count	%	Count	%
0	341	34.3	411	41.4
1-5	306	30.8	283	28.5
6-12	163	16.4	160	16.1
13-20	78	7.9	74	7.4
21-30	40	4.0	29	2.9
31-50	35	3.5	25	2.5
51+	31	3.2	12	1.2
Total	994	100	994	100

Table 10. Percentage of three most preferred species to catch when recreational sea angling in England.

Species	1st choice (%)	2nd choice (%)	3rd choice (%)
Sea bass	38.3	18.6	9.2
Cod	21.6	16.6	12.5
Mackerel	4.9	8.5	13.6
Pollack	4.5	8.3	7.1
Plaice	3.5	4.7	7.7
Smoothhound	3.2	3.5	3.1
Black bream	2.6	1.3	3.9
Rays	2.0	4.9	5.8
Conger eel	1.4	1.7	2.3
Whiting	0.7	2.8	4.2

2.3.2.2 Data collection

Over half of the respondents had provided data to the Sea Angling Diary Project between 2016 and 2019 and one third had provided data to the National Angling Survey in 2018 (Table 11). This reflected the method of recruitment for the survey, from those respondent populations. However, it also implies that just under 15% had not been involved in either survey, so were recruited using more general survey promotion. Around 30% of respondents were currently involved in other angling-based scientific research and 11% had participated previously (Table 12). There was some variation in willingness to provide data in future, particularly between respondents who had previously participated in data collection before and those who had not; and among respondents who were not willing to support a recreational sea angling licence (defined as ‘protestors’). Providing ‘participation/activity data’ and ‘catch data’ were the most popular choices among respondents willing to provide data in future (Table 13).

Table 11. Percentage of respondents that had contributed to research projects (n=953).

Response	Sea Angling 2012 (%)	Sea Angling Diary (Sea Angling 2016-19) (%)	National Angling Survey 2018 (%)
Yes	8.1	53.2	33.1
No	72.9	34.9	41.2
Don’t Know	19.0	11.9	25.7
Total	100	100	100

Table 12. Count of participation in other angling-based research or scientific studies in the last 6 years.

Response	Count	%
Yes, I am currently doing so	269	28.2
Yes, I used to	104	10.9
No	495	51.9
Don’t Know	85	8.9
Total	953	100

Table 13. Count of willingness to provide data for new scientific studies (n=747).

Data	Count	%
Participation/activity data	499	66.8
Spending data	334	44.7
Social impact data	261	34.9
Catch data	504	67.5
Species tagging	281	37.6
Other	98	13.1
None of the above	143	19.1

There was greater appetite to provide catch data than economic or social impact data, which is the opposite to Sea Angling 2012 (Table 14). This may be partially due to language/terminology used, as ‘spending’ could appear intrusive compared to ‘economic impact data’, for instance. Overall, respondents who wanted to participate in future data collection were more likely to have participated before, with 81% having taken part in a previous study compared with 19% who had not (Table 14). Around 36% that had not already participated in a study did not want to participate in future (Table 14).

Table 14. Count of willingness to provide data divided between those that have and have not participated in a previous scientific study.

Participated previously?	Want to participate?			
	Yes		No	
	Count	%	Count	%
Yes	612	80.6	125	64.5
No	147	19.4	69	35.6
Total	759	100	194	100

Diagnostics for the logistic regression fits are provided (Table 15). The outcomes of the logistic regression for different types of data provision showed that a variety of factors were important in explaining responses to data provision and this varied between data types (Table 16). For all data types apart from ‘others’, those that already provided data were significantly more likely to want to contribute in future than those that do not already provide data and protestors were much less likely to agree to provide data (Table 16). Anglers whose main motivation for going angling was catching fish (rather than non-catch motivation like relaxation, spending time with family) were also significantly more willing to contribute participation data (Table 16).

Boat anglers were significantly more likely to provide data on expenditure, social interactions, and tagging, and environmental motivation was important for other data types (Table 16).

Table 15. Diagnostics for the logistic regression model for different types of data provision.

	Variable					
Diagnostics	**Catch**	**Activity**	**Spend**	**Tagging**	**Social**	**Other**
AIC	487	486	551	521	513	321
McFadden's Pseudo R^2	0.0789	0.0749	0.0452	0.101	0.07	0.0309
Null deviance	517	511	565	556	537	319
Null degrees of freedom	407	407	407	407	4.7	407
Residual deviance	475	472	539	499	499	309
Residuals degrees of freedom	402	401	402	397	401	402

Table 16. Logistic regression results for different types of data provision. Predictors are the variables left in the model and bold indicates significance.

Variable	Predictor	Estimate	Standard error	t-statistic	p-value
Activity	**Intercept**	**0.732**	**0.365**	**2.002**	**0.045**
	Catch motivation	**-0.504**	**0.232**	**-2.175**	**0.030**
	Unsure protestor	-0.408	0.368	-1.108	0.268
	Conditional protestor	0.220	0.336	0.655	0.512
	Protestor	**-0.793**	**0.340**	**-2.332**	**0.020**
	Cod angler	-0.403	0.232	-1.735	0.083
	Participated in research	**0.910**	**0.254**	**3.590**	**<0.001**
Spend	Intercept	-0.379	0.319	-1.187	0.235
	Boat angling activity	**0.018**	**0.008**	**2.374**	**0.018**
	Unsure protestor	**-0.671**	**0.337**	**-1.993**	**0.046**
	Conditional protestor	-0.021	0.288	-0.072	0.943
	Protestor	**-0.822**	**0.316**	**-2.601**	**0.009**
	Participated in research	**0.580**	**0.251**	**2.312**	**0.021**
Social	**Intercept**	**-0.976**	**0.360**	**-2.711**	**0.007**
	Boat angling activity	**0.025**	**0.008**	**3.179**	**0.001**
	Unsure protestor	-0.288	0.355	-0.813	0.416
	Conditional protestor	0.438	0.295	1.483	0.138
	Protestor	**-0.691**	**0.343**	**-2.015**	**0.044**
	Cod angler	**-0.560**	**0.225**	**-2.491**	**0.013**
	Participated in research	**0.692**	**0.277**	**2.496**	**0.013**
Catch	Intercept	-0.073	0.334	-0.220	0.826
	Boat angling activity	**0.021**	**0.009**	**2.308**	**0.021**
	Unsure protestor	-0.162	0.361	-0.450	0.653
	Conditional protestor	0.364	0.326	1.117	0.264
	Protestor	**-0.851**	**0.332**	**-2.565**	**0.010**
	Participated in research	**0.987**	**0.253**	**3.907**	**<0.001**
Tagging	Intercept	-0.260	0.948	-0.275	0.783
	age 25 - 34	0.737	1.555	0.474	0.635
	age 35 - 44	0.006	0.965	0.006	0.995
	age 45 - 54	-0.462	0.918	-0.503	0.615
	age 55 - 64	-0.933	0.900	-1.037	0.300
	age 65 or over	-1.494	0.908	-1.647	0.100
	Boat angling activity	**0.017**	**0.008**	**2.198**	**0.028**
	Unsure protestor	-0.540	0.357	-1.510	0.131
	Conditional protestor	0.171	0.298	0.574	0.566
	Protestor	**-0.689**	**0.338**	**-2.038**	**0.042**
	Participated in research	**1.099**	**0.287**	**3.829**	**0.000**
Other	**Intercept**	**-3.305**	**0.593**	**-5.573**	**<0.001**
	Catch motivation	0.767	0.531	1.444	0.149
	Environmental motivation	**1.104**	**0.531**	**2.080**	**0.037**
	Social motivation	1.225	0.627	1.954	0.051
	Solitude motivation	1.007	0.620	1.624	0.104
	Participated in research	0.724	0.427	1.695	0.090

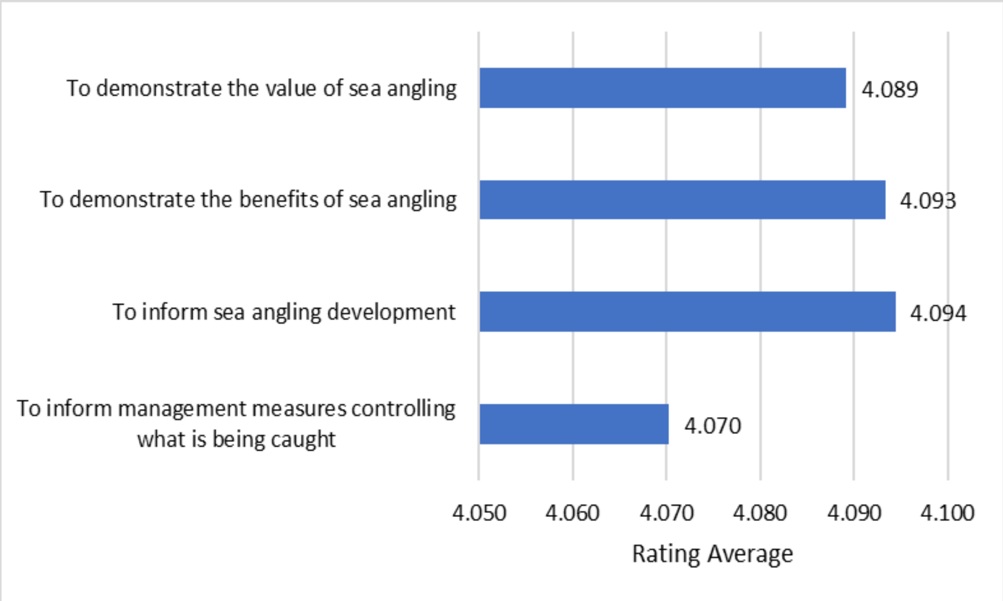
2.3.2.2.1 Use of data

There was very broad agreement with all the potential uses of data suggested, with over 75% of respondents agreeing to use of data to demonstrate the impact or benefits and inform development or management (Table 17). The latter of these is perhaps particularly notable given the hostility of some anglers to the use of catch data to inform management control measures for sea angling. When all responses were considered in a rating average, informing sea angling development is the most preferred use (Figure 4).

Table 17. Percentage of agreement levels with different uses of angling data (n=953).

Use of data	Strongly agree (%)	Agree (%)	Neither agree nor disagree (%)	Disagree (%)	Strongly disagree (%)
Value of sea angling	36.1	40.6	20.7	1.4	1.3
Benefits of sea angling	34.0	44.9	19.0	0.6	1.5
Sea angling development	33.4	46.3	18.1	1.1	1.3
Inform management	41.1	34.5	17.7	3.5	3.2

Figure 4. Average rating of level of agreement with different uses of angling data.



Diagnostics of fits for the ordinal regressions showed that proportional odds assumptions held for modelling value and activity. However, for stock data the conditional number of Hessian is high indicating a poor fit and the low p-value from the Brant test highlights issues with using the proportional odds assumption for modelling stock (Table 18). Regression showed that a variety of factors were important in explaining responses to data use for value, activity and stock, and this varied between uses (Table 19). Those that already provided data were significantly more likely to agree to all uses of data, those that do not already provide data and protestors were much less likely to agree to any use of data (Table 19). Boat anglers were more likely to agree to provide data on value (Table 19). Cod anglers, those with incomes between £60,001 and £100,000, and environmental motivation were more likely to agree to using data to support stock assessment (Table 19).

Table 18. Diagnostics for the ordinal regression model for predictors of acceptable uses of data.

Variable	Term	Value	Activity	Stock
Fitting	AIC	1185	924	1007
	Equivalent degrees of freedom	9	8	18
	Residual deviance	1167	908	971
	Conditional number of Hessian	12451	402	91612
	Log-likelihood	-583	-454	-486
Brant test	Chi-squared	22.13	12.04	59.4
	Degrees of freedom	15	12	36
	p-value	0.1	0.44	0.01

Table 19. Odd ratios and 95% confidence intervals for predictors of acceptable uses of data derived from ordinal regression. LCI and UCI are the lower and upper confidence interval, respectively. Significant indicated if the odds ratio is significantly different to 1 and is in bold.

Variable	Predictor	Odds Ratio	LCI	UCI	Significant
Value	**Boat angling activity**	**1.018**	**1.005**	**1.032**	**TRUE**
	Protestor	**0.432**	**0.257**	**0.730**	**TRUE**
	Unsure protestor	0.953	0.543	1.672	FALSE
	Conditional protestor	1.420	0.868	2.334	FALSE
	Participated in research	**2.596**	**1.703**	**3.985**	**TRUE**
Activity	**Protestor**	**0.244**	**0.135**	**0.433**	**TRUE**
	Unsure protestor	0.552	0.302	1.003	FALSE
	Conditional protestor	0.840	0.495	1.417	FALSE
	Participated in research	**1.848**	**1.187**	**2.885**	**TRUE**
Stock	**Cod angler**	**1.450**	**1.012**	**2.079**	**TRUE**
	Shore fishing activity	0.992	0.984	1.000	FALSE
	Income £20,001 to £40,000	1.030	0.663	1.599	FALSE
	Income £40,001 to £60,000	1.309	0.761	2.263	FALSE
	Income £60,001 to £100,000	**3.467**	**1.625**	**7.872**	**TRUE**
	Income £100,001 to £200,000	0.686	0.192	2.521	FALSE
	Income over £200,000	0.405	0.013	12.454	FALSE
	Income prefer not to say	1.184	0.693	2.032	FALSE
	Environmental motivation	**1.875**	**1.258**	**2.816**	**TRUE**
	Protestor	**0.293**	**0.169**	**0.504**	**TRUE**
	Unsure protestor	0.591	0.330	1.051	FALSE
	Conditional protestor	0.942	0.559	1.577	FALSE
	Participated in research	**1.707**	**1.131**	**2.577**	**TRUE**

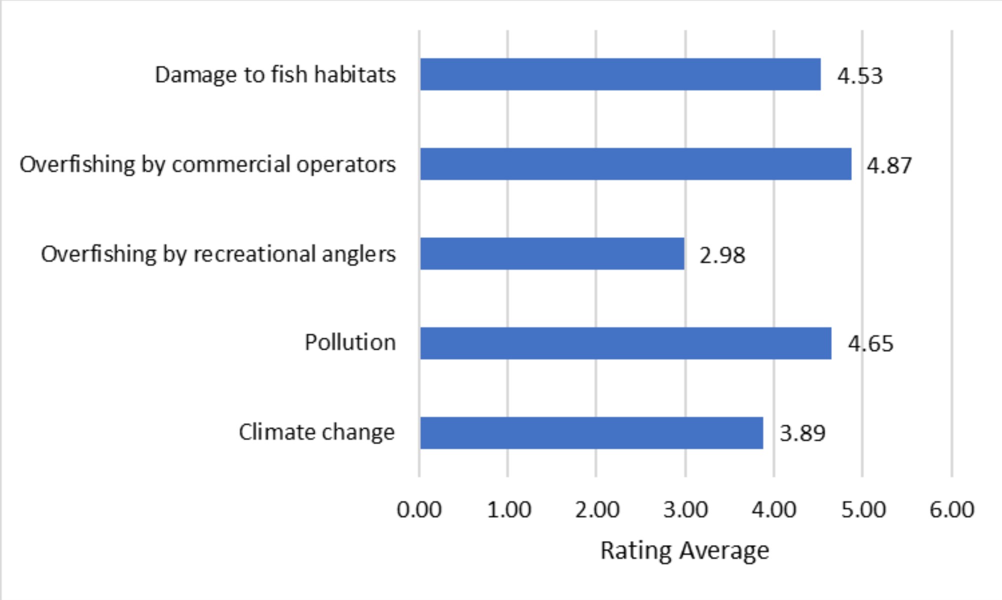
2.3.2.3 Fish stocks

The biggest perceived threats to fish stocks were damage to habitats (91% 'important' or 'very important'), overfishing by commercial operators (99% 'important' or 'very important'), and pollution (92% 'important' or 'very important') (Table 20). Climate change was also significant but only 12% rated overfishing by recreational anglers as very important, although 26% said this was an important threat (Table 20). When all responses were numerically coded and averaged across all anglers, overfishing by commercial operators was the threat identified as most important (4.87) followed by pollution (4.65) (Figure 5).

Table 20. Percentage agreement levels for different threats to marine fish stocks (n=939).

Threat	Very important (%)	Important (%)	Neither (%)	Unimportant (%)	Very unimportant (%)
Damage to fish habitats	68.3	23.1	4.3	2.6	1.8
Overfishing by commercial operators	89.1	9.8	0.5	0.2	0.3
Overfishing by recreational anglers	12.0	26.0	25.6	21.2	15.2
Pollution	76.1	15.9	6.1	1.2	0.8
Climate change	35.1	34.4	18.2	8.4	3.8

Figure 5. Rating average of responses about the importance of threats to marine fish stocks.



Respondents were asked to comment on other factors affecting fish stocks in an 'open text' field. These were coded and counts made for frequency of occurrence of each code category. The most frequent comments related to taking undersized fish (22%), followed by damaging fishing methods (15%) and illegal fishing (13.3%) (Table 21). Other issues raised were predation (11.5%), lack of education (9.6%), lack of enforcement (9.2%) and inshore commercial activity (8.3%) (Table 21). There was considerable overlap between these categories, and some relate to the issues previously identified (Table 20).

Table 21. Count and examples of different categories of free text comments about threats to marine fish stocks.

Code Category	Count	%	Example comments
Taking undersized fish	48	22.0	'Keeping under sized fish', 'Anglers keeping undersized fish - appears to be an increasing problem.'
Damaging fishing methods	32	14.7	'Habitat damage due to destructive commercial fishing methods.'
Illegal fishing	29	13.3	'Illegal and unreported catches.'
Predation	25	11.5	'Predation by seals, cormorants, and various cetaceans.'
Lack of education	21	9.6	'Lack of education, and insufficient advertising of catch by laws.'
Lack of enforcement	20	9.2	'The lack of enforcement of laws and bylaws on both commercial and recreational fishermen but mostly the commercial sector.'
Inshore commercial activity	18	8.3	'Trawlers netting too close to the shore, if a 5 mile no commercial fishing limit were imposed it would give the fish a safe corridor around the whole of the UK.'
Current regulations	12	5.5	'Fish being discarded because of commercial quotas.'
Invasive species	8	3.7	'Non-native species affect our native ecosystem.'
Lack of conservation zones	5	2.3	'No protection to nursery areas and no ban on commercial inshore fishing.'
Lack of representation for recreational anglers	1	0.5	'Lack of a single voice to make anglers point of view.'

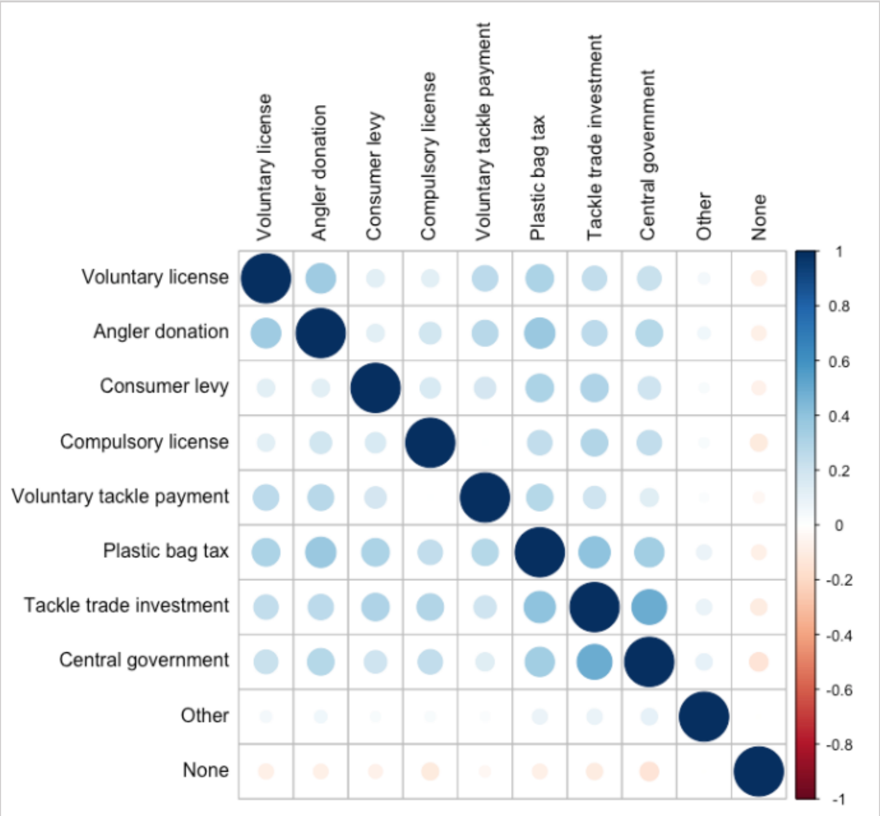
2.3.2.4 Funding

Respondents were asked which forms of funding should help to develop sea angling. The most favoured option was government funding (41%), but around 35% of respondents supported a compulsory sea angling licence to help fund the development of angling (Table 22). 22.7% supported a voluntary licence, so more than one third of respondents supported some form of licence. A plastic bag tax on tackle sales (32%) and tackle trade investment (31%) were also relatively strongly supported (Table 22). However, no single funding option had a majority support from respondents. There was no correlation above 0.5 between any distinct funding strategy; the largest correlations are between 'Tackle trade investment' and 'Central government' (0.496); and 'Tackle trade investment' and 'Plastic bag tax' (0.401) (Figure 6).

Table 22. Count of support for different mechanisms for funding sea angling development (n=761).

Method	Count	%
Voluntary sea angling licence	173	22.7
Angler donations (e.g. voluntary addition to freshwater licence for sea angling)	157	20.6
Consumer levy (tax) on tackle sales	121	15.9
Compulsory sea angling licence	267	35.1
Voluntary payment on tackle sales	54	7.1
Plastic bag tax on tackle sales	240	31.5
Tackle trade investment	232	30.5
Central government	359	41.2
None of the above	86	11.3
Other (please specify)	88	11.6
Total	1,777	100

Figure 6. Correlation between different mechanisms for funding sea angling development.



Diagnostics for the logistic regression fits are provided (Table 23). Logistic regression for funding strategies showed that a variety of factors were important in explaining responses and this varied between strategies (Table 24). Protestors were significantly more likely to oppose licencing (Table 24). Income also appeared to be important, with those on lower incomes opposed to a compulsory licence and those on higher incomes more supportive (Table 24).

Table 23. Diagnostics for the logistic regression model for different funding strategies.

Diagnostics	Variable Voluntary	Compulsory
AIC	392	433
McFadden's Pseudo R^2	0.0919	0.243
Null deviance	420	546
Null degrees of freedom	407	407
Residual deviance	382	413
Residuals degrees of freedom	403	398

Table 24. Logistic regression results for different funding strategies. Predictors are the variables left in the model and bold indicates significance.

Variable	Predictor	Estimate	Standard error	t-statistic	p-value
Voluntary license	Intercept	-0.347	0.260	-1.335	0.182
	Prefer bass	-0.442	0.271	-1.630	0.103
	Unsure protestor	**-1.420**	**0.419**	**-3.391**	**0.001**
	Conditional protestor	-0.466	0.301	-1.549	0.121
	Protestor	**-2.284**	**0.485**	**-4.710**	**0.000**
Compulsory license	Intercept	0.110	0.335	0.328	0.743
	Income £20,001 to £40,000	**0.580**	**0.295**	**1.964**	**0.050**
	Income £40,001 to £60,000	**0.955**	**0.367**	**2.601**	**0.009**
	Income £60,001 to £100,000	0.711	0.427	1.664	0.096
	Income £100,001 to £200,000	**2.139**	**1.007**	**2.124**	**0.034**
	Income over £200,000	14.378	882.743	0.016	0.987
	Boat angling activity	0.013	0.009	1.471	0.141
	Unsure protestor	**-1.674**	**0.367**	**-4.566**	**0.000**
	Conditional protestor	**-0.626**	**0.307**	**-2.043**	**0.041**
	Protestor	**-4.082**	**0.583**	**-7.001**	**0.000**

2.3.2.5 Management

2.3.2.5.1 Knowledge of current regulations

Respondents were asked about their knowledge of current regulations for sea angling. Most participants were aware that sea bass is subject to a daily bag limit (94%) (Table 25). However, some respondents incorrectly thought that cod (11% respondents) and mackerel (10%) were also subject to a bag limit, with around 6% thinking that none of the listed species were subject to a bag limit (Table 25). Around two thirds (68%) of respondents correctly identified the minimum landing size for sea bass as 42cm, and half of respondents (50%) were able to correctly identify the MLS for cod as 35cm (Table 26). It is highly likely that the high profile that the bag limit on sea bass has had and associated campaigns for a sea bass minimum landing size and on the bag limit, mean awareness of these is higher. The lower levels of awareness of other regulations may suggest areas for greater communication efforts.

Table 25. Count of knowledge regarding whether species are currently subject to a daily bag limit in the UK.

Species	Count	%
Cod	82	10.9
Whiting	10	1.3
Sea bass	705	93.6
Mackerel	77	10.2
None of the above	42	5.6

Table 26. Count of agreement regarding MLS for cod and sea bass in UK waters.

Sea bass MLS (cm)	Count	%	Cod MLS	Count	%
42cm	510	67.7	35cm	378	50.2
46cm	176	23.4	39cm	106	14.1
50cm	27	3.6	42cm	150	19.9
None of the above	40	5.3	None of the above	119	15.8
Total	753	100	Total	753	100

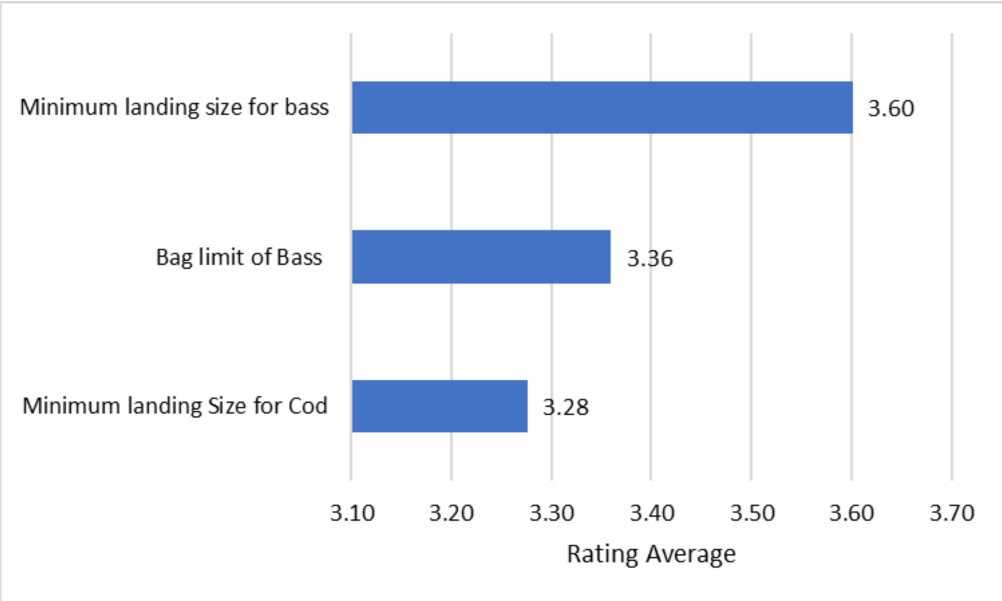
2.3.2.5.2 Effectiveness of current sea angling regulations

In terms of the effectiveness of current regulations in helping to achieve sustainable fish stocks, 48% of respondents thought the bag limit for sea bass was effective and 63% felt the minimum landing size for sea bass was effective (Table 27). Around 51% thought that the minimum landing size for cod was effective (Table 27).The minimum landing size for sea bass had the highest rating average (3.6) indicating this was thought to be the most effective management measure (Figure 7).

Table 27. Percentage of opinions on levels of effectiveness of different management measures for recreational sea angling in helping achieve sustainable marine fish stocks.

Measure	Very Effective (%)	Somewhat Effective (%)	Ineffective (%)	Very ineffective (%)	Don't Know (%)
MLS for sea bass	20.6	42.6	18.1	13.8	4.9
Bag limit of Sea bass	17.3	30.3	28.6	19.0	4.9
MLS for Cod	14.3	36.5	23.6	13.4	12.1

Figure 7. Rating average of responses on levels of effectiveness of different management measures for recreational sea angling in helping achieve sustainable marine fish stocks



Diagnostics of fits for the ordinal regressions showed that proportional odds assumptions held for all fits, but the condition number of Hessian for the bass MLS indicated a poor fit (Table 28). Regression showed that a variety of factors were important in perceptions about the effectiveness of management measures and this varied between measures (Table 29). Protestors perceived management measures to be less effective than other groups (Table 29). Cod anglers and those that prefer sea bass thought that sea bass management measures had been more effective than other groups (Table 29). Sea bass MLS and bag limits were thought to be more effective by those that preferred sea bass, and conditional protestors thought the sea bass bag was less effective than other groups (Table 29). Finally, cod and sea bass anglers felt that the cod MLS was effective in comparison to other groups, but boat anglers had the opposite view (Table 29).

Table 28. Diagnostics for the ordinal regression for effectiveness of sea angling management measures.

Variable	Term	Bass MLS	Bass BL	Cod MLS
Fitting	AIC	982	1051	911
	Equivalent degrees of freedom	13	9	9
	Residual deviance	956	1033	893
	Conditional number of Hessian	28559014	164	8525
	Log-likelihood	-478	-517	-446
Brant test	Chi-squared	12.58	8.37	9.37
	Degrees of freedom	18	12	12
	p-value	0.82	0.76	0.67

Table 29. Odd ratios and 95% confidence intervals for predictors of the effectiveness of sea angling management measures from ordinal regression models. LCI and UCI are the lower and upper confidence interval, respectively. Significant indicated if the odds ratio is significantly different to 1 and is in bold.

Variable	Predictor	Odds Ratio	LCI	UCI	Significant
Bass MLS	**Prefers bass**	**1.638**	**1.061**	**2.536**	**TRUE**
	Prefers cod	1.480	0.872	2.521	FALSE
	Bass angler	0.661	0.425	1.026	FALSE
	Cod angler	**1.844**	**1.216**	**2.805**	**TRUE**
	Unsure protestor	1.336	0.711	2.515	FALSE
	Conditional protestor	0.697	0.410	1.180	FALSE
	Protestor	**0.393**	**0.220**	**0.698**	**TRUE**
	Solitude motivation	1.534	0.858	2.761	FALSE
	Participated in research	1.532	0.989	2.378	FALSE
Bass bag limit	**Prefers bass**	**1.521**	**1.028**	**2.257**	**TRUE**
	Bass angler	0.675	0.441	1.030	FALSE
	Cod angler	1.351	0.921	1.985	FALSE
	Unsure protestor	0.597	0.328	1.083	FALSE
	Conditional protestor	**0.518**	**0.310**	**0.861**	**TRUE**
	Protestor	**0.284**	**0.161**	**0.498**	**TRUE**
MLS Cod	**Bass angler**	**0.615**	**0.401**	**0.942**	**TRUE**
	Cod angler	**2.715**	**1.758**	**4.224**	**TRUE**
	Boat angling activity	**0.981**	**0.967**	**0.995**	**TRUE**
	Unsure protestor	1.376	0.738	2.570	FALSE
	Conditional protestor	0.675	0.390	1.165	FALSE
	Protestor	**0.421**	**0.233**	**0.754**	**TRUE**

2.3.2.5.3 Impact of current sea angling regulations

Respondents were asked about how current management measures impacted on participation levels and socio-economic factors related to sea angling.

2.3.2.5.3.1 Impact on participation

The majority of respondents reported no impact of the management measures on the amount of sea angling activity done in the last 12 months (Table 30). Further analysis was undertaken for those who responded, ‘Fished less’ and those who responded, ‘No impact’. Almost no respondent said that any measure has meant that they fished more, which is a notable result. Therefore, those who responded ‘Fished More’ or ‘Not applicable’ were excluded from further analysis. As such logistic regression analysis of a binary choice between ‘fished less’ and ‘no impact' was undertaken to understand how different groups within the respondent population differed. Diagnostics for the logistic regression fits are provided (Table 31). A variety of factors were important in the different models, but no predictors were significant although there is indication that those motivated by the environment or solitude and boat anglers may have fished less as a result of the sea bass bag limits (Table 32).

Table 30. Count of reported impact of management measures on the amount of recreational sea angling.

	Fished Less		No Impact		Fished More		Not Applicable	
	Count	%	Count	%	Count	%	Count	%
MLS for sea bass	68	9.0	563	74.8	2	0.3	120	15.9
Bag limit for sea bass	125	16.6	513	68.1	2	0.3	113	15.0
MLS for Cod	22	2.9	582	77.3	3	0.4	146	19.4

Table 31. Diagnostics for the logistic regression model for the impact of management on angling activity.

	Variable		
Diagnostics	Bass MLS	Bass bag limit	Cod MLS
AIC	248	384	116
McFadden's Pseudo R^2	0.0336	0.0712	0.163
Null deviance	248	392	122
Null degrees of freedom	407	407	407
Residual deviance	240	364	102
Residuals degrees of freedom	404	398	401

Table 32. Logistic regression results for the impact of management on angling activity. Predictors are the variables left in the model and bold indicates significance.

Variable	Predictor	Estimate	Standard error	t-statistic	p-value
Bass MLS	**Intercept**	**-2.544**	**0.484**	**-5.258**	**0.000**
	Boat angling activity	-0.016	0.011	-1.369	0.171
	Solitude motivation	-1.539	1.028	-1.497	0.134
	Participated in research	0.689	0.498	1.383	0.167
Bass bag limit	Intercept	-17.045	832.933	-0.020	0.984
	Male	15.260	832.933	0.018	0.985
	Non-binary	17.421	832.934	0.021	0.983
	Other	0.592	1889.972	0.000	1.000
	Boat angling activity	0.014	0.008	1.760	0.078
	Environment motivation	-0.641	0.336	-1.911	0.056
	Solitude motivation	-0.894	0.506	-1.767	0.077
	Unsure protestor	-0.474	0.545	-0.869	0.385
	Conditional protestor	0.641	0.412	1.556	0.120
	Protestor	0.692	0.435	1.592	0.111
Cod MLS	**Intercept**	**-3.376**	**0.721**	**-4.681**	**0.000**
	Prefer bass	1.042	0.583	1.787	0.074
	Boat angling activity	-0.049	0.037	-1.333	0.182
	Solitude motivation	-16.247	1468.180	-0.011	0.991
	Unsure protestor	-0.284	0.942	-0.302	0.763
	Conditional protestor	-1.784	1.171	-1.524	0.128
	Protestor	0.905	0.716	1.264	0.206

2.3.2.5.3.2 Impact on socio-economic factors

The management measures for sea bass have resulted in no change to expenditure, physical activity or enjoyment due to management for about two thirds of respondents (Table 33). However, 23% reported a decrease in enjoyment, 19% reported a decrease in personal spending on angling, and 17% a decrease in physical activity due to management (Table 33). Few people reported any increase in socio-economic factors (Table 33).

Table 33. Count of impact of management measures on sea bass on expenditure, physical activity, and enjoyment of sea angling.

Category	Decreased		No Change		Increased		Not Applicable	
	Count	%	Count	%	Count	%	Count	%
Expenditure on sea angling	142	19.0	479	64.1	45	6.0	81	10.8
Amount of physical activity sea angling	130	17.4	502	67.2	39	5.2	76	10.2
Enjoyment of sea angling	168	22.5	476	63.7	43	5.8	60	8.0

Diagnostics of fits for the ordinal regressions showed that proportional odds assumptions held for all fits. However, the condition number of the Hessian indicated a poor fit for the model of spend (Table 34). Regressions showed that there were differences in the impact of management on spend, physical activity and enjoyment of sea angling. Most groups felt that management had a negative impact with strong effects of age, species preference, participation in research and boat angling (Table 35). However, those with solitude motivation felt that management had improved expenditure, physical activity, and enjoyment, and environmental motivation through that physical activity had increased (Table 35).

Table 34. Diagnostics for the ordinal regression model for the changes in spend, physical activity and enjoyment due to the management measures.

Variable	Term	Spend	Physical activity	Enjoyment
Fitting	AIC	982	1051	911
	Equivalent degrees of freedom	13	9	9
	Residual deviance	956	1033	893
	Conditional number of Hessian	28559014	164	8525
	Log-likelihood	-478	-517	-446
Brant test	Chi-squared	12.58	8.37	9.37
	Degrees of freedom	18	12	12
	p-value	0.82	0.76	0.67

Table 35. Odd ratios and 95% confidence intervals for predictors of the changes in spend, physical activity and enjoyment due to the management measures from ordinal regression. LCI and UCI are the lower and upper confidence interval, respectively. Significant indicated if the odds ratio is significantly different to 1 and is in bold.

Variable	Predictor	Odds Ratio	LCI	UCI	Significant
Spend	Age 25 - 34	3.072	0.126	105.989	FALSE
	Age 35 - 44	**0.120**	**0.018**	**0.821**	**TRUE**
	Age 45 - 54	**0.157**	**0.026**	**0.983**	**TRUE**
	Age 55 - 64	**0.073**	**0.012**	**0.434**	**TRUE**
	Age 65 or over	**0.118**	**0.020**	**0.706**	**TRUE**
	Prefers bass	**0.546**	**0.337**	**0.876**	**TRUE**
	Boat angling activity	**0.983**	**0.967**	**0.999**	**TRUE**
	Unsure protestor	1.875	0.850	4.188	FALSE
	Conditional protestor	**0.430**	**0.219**	**0.829**	**TRUE**
	Protestor	**0.422**	**0.199**	**0.883**	**TRUE**
	Catch motivation	0.695	0.423	1.137	FALSE
	Solitude motivation	**2.661**	**1.201**	**6.025**	**TRUE**
	Participated in research	**0.522**	**0.296**	**0.909**	**TRUE**
Physical activity	Age 25 - 34	9215.704	0.234	NA	FALSE
	Age 35 - 44	**0.116**	**0.017**	**0.860**	**TRUE**
	Age 45 - 54	**0.122**	**0.020**	**0.833**	**TRUE**
	Age 55 - 64	**0.048**	**0.008**	**0.312**	**TRUE**
	Age 65 or over	**0.063**	**0.010**	**0.418**	**TRUE**
	Bass angler	0.667	0.385	1.136	FALSE
	Environmental motivation	**1.876**	**1.054**	**3.413**	**TRUE**
	Solitude motivation	**3.318**	**1.434**	**8.011**	**TRUE**
	Unsure protestor	1.823	0.780	4.300	FALSE
	Conditional protestor	0.682	0.332	1.369	FALSE
	Protestor	0.515	0.237	1.095	FALSE
Enjoyment	Age 25 - 34	0.160	0.006	4.296	FALSE
	Age 35 - 44	**0.045**	**0.006**	**0.304**	**TRUE**
	Age 45 - 54	**0.078**	**0.011**	**0.488**	**TRUE**
	Age 55 - 64	**0.030**	**0.004**	**0.179**	**TRUE**
	Age 65 or over	**0.040**	**0.006**	**0.244**	**TRUE**
	Prefers bass	0.671	0.422	1.063	FALSE
	Boat angling activity	0.990	0.979	1.001	FALSE
	Solitude motivation	**2.829**	**1.321**	**6.239**	**TRUE**
	Unsure protestor	1.218	0.563	2.639	FALSE
	Conditional protestor	0.711	0.368	1.356	FALSE
	Protestor	**0.390**	**0.190**	**0.787**	**TRUE**

Respondents believed that around half of other anglers comply with management measures surrounding sea bass and cod (Table 36). Whilst this is a very subjective measure, it does suggest that greater education about management measures is needed and the development of social norms about acceptable behaviour.

Table 36. Percentage of opinions about the level of compliance by other anglers with different management measures.

Management	Median (%)	Average (%)	Respondents (%)
MLS for sea bass	55.0	55.6	747
Bag limit of one sea bass per day per angler	50.0	51.6	747
MLS for cod	50.0	50.7	747

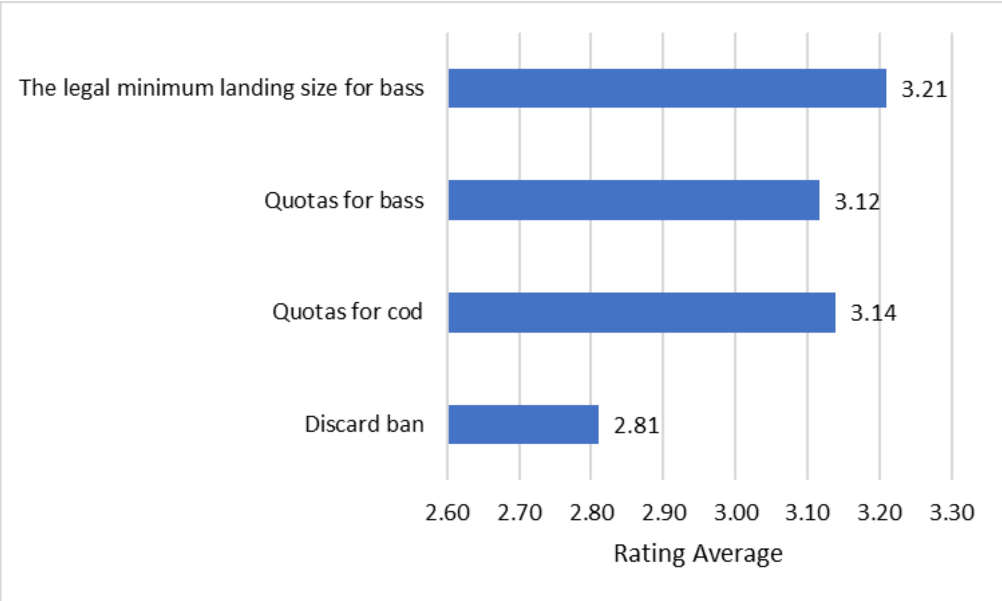
2.3.2.5.4 Effectiveness of regulations on commercial fishing

Respondents felt that regulations on commercial fishing were less effective than those applying to recreational angling (Table 37). Overall, the minimum landing size for sea bass was deemed to be the most effective (53%) while the discard ban was by far thought to be the least effective measure (43%) (Table 37). However, the fact that a minority of respondents think that the measures are 'somewhat ineffective' or 'very ineffective' is perhaps unexpected (Figure 8).

Table 37. Percentage of respondent perceptions of effectiveness of management measures for commercial marine fisheries in helping to achieve sustainable marine fish stocks (n=749).

Measure	Very effective (%)	Somewhat effective (%)	Neither (%)	Somewhat ineffective (%)	Very ineffective (%)
MLS for sea bass	17.8	34.9	14.6	16.3	16.6
Quotas for sea bass	19.1	29.2	13.9	19.8	18.0
Quotas for cod	18.6	28.8	16.2	21.1	15.5
Discard ban	14.7	21.6	20.8	15.8	27.1

Figure 8. Rating average of responses about the effectiveness of management measures for commercial marine fisheries in helping to achieve sustainable marine fish stocks.



The Brant test suggests that the proportional odds assumption is valid for modelling quotas and discard ban, but that it is problematic for the sea bass MLS model (Table 38). However, protestors and conditional protestors responded significantly differently and were less likely to think commercial measures were effective (Table 39). The higher the number of days spent fishing for sea bass, the higher the likelihood of reporting the MLS for sea bass to be an ineffective measure for commercial fisheries (Table 39). Protestors and conditional protestors (for cod) were significantly less likely to believe that sea bass and cod quotas were effective (Table 39). In addition, the higher the number of days spent fishing for sea bass, the higher the likelihood that a respondent would feel the cod quota was an ineffective measure (Table 39).

Table 38. Diagnostics for the ordinal regression model for the effectiveness of commercial fisheries management measures.

Variable	Term	MLS bass	Bass Quota	Cod quota	Discard ban
Fitting	AIC	1268	1274	1287	1300
	Equivalent degrees of freedom	9	9	9	5
	Residual deviance	1250	1256	1269	1290
	Conditional number of Hessian	109	16544	129	1898
	Log-likelihood	-625	-628	-635	-645
Brant test	Chi-squared	33.1	20.2	19.6	1.44
	Degrees of freedom	15	15	15	3
	p-value	0.00451	0.164	0.187	0.697

Table 39. Odd ratios and 95% confidence intervals for predictors of the effectiveness of commercial fisheries management measures from ordinal regression. LCI and UCI are the lower and upper confidence interval, respectively. Significant indicated if the odds ratio is significantly different to 1 and is in bold.

Variable	Predictor	Odds Ratio	LCI	UCI	Significant
MLS bass	**Bass angler**	**0.662858**	**0.448734**	**0.976754**	**TRUE**
	Cod angler	1.305825	0.903905	1.888544	FALSE
	Unsure protestor	0.653857	0.369913	1.15326	FALSE
	Conditional protestor	**0.594637**	**0.359005**	**0.981114**	**TRUE**
	Protestor	**0.408842**	**0.237085**	**0.701446**	**TRUE**
Bass quota	Bass angler	0.719561	0.48961	1.055573	FALSE
	Boat angling activity	0.992837	0.983703	1.002002	FALSE
	Unsure protestor	0.650727	0.370846	1.139354	FALSE
	Conditional protestor	**0.517062**	**0.314146**	**0.847497**	**TRUE**
	Protestor	**0.329402**	**0.19212**	**0.56154**	**TRUE**
Cod quota	**Bass angler**	**0.685**	**0.471**	**0.995**	**TRUE**
	Environmental motivation	1.341	0.895	2.013	FALSE
	Unsure protestor	0.731	0.414	1.289	FALSE
	Conditional protestor	0.616	0.374	1.013	FALSE
	Protestor	**0.376**	**0.219**	**0.644**	**TRUE**
Discard ban	Boat angling activity	0.992	0.984	1.001	FALSE

2.3.2.5.5 Future management of recreational sea angling and commercial fishing

The survey included 'open text' fields for respondents to comment on the following question: '*If the regulation and management of recreational sea angling was a blank sheet of paper, what would be the top priority for you?*'. A similar question was also asked about the regulation of commercial fishing. Results were coded into subject areas with examples highlighted. In response to the first question about recreational fishing in the future, almost one fifth of respondents (18%) gave responses that were pro-regulation, including bag limits, minimum landing sizes (suggestions for both increases or decreases), as well as suggesting areas where fishing was restricted or banned (Table 40). Around 13% of responses related to improving or maintaining fish stocks, mostly stating importance of improving or maintaining fish stocks to ensure sustainable fishing (Table 40). 11% of responses related to protecting the marine environment (pollution, predation and litter and conservation zones) and another 11.39% related to the regulation and control of commercial sea fishing, including no netting zones, effective management of commercial activity, and more effective regulation/banning of gill nets and trawling close to the shore (Table 40).

Table 40. Count and examples of different categories of response to open question about priorities for management of sea angling.

Category	Count	%	Example comments
Regulations (pro)	124	18.1	Bag limits, size limits - increased or decreased, areas where people cannot fish.
Fish stocks	86	12.6	Improve and maintain fish stocks, sustainable fishing.
Protecting the marine environment	78	11.4	Pollution, coastal environments, predation, litter.
Regulations and controls on commercial fishing	78	11.4	No netting zones, effective management of commercial activity, make gill nets illegal, trawling too close to shore.
Enforcement	58	8.5	Policing, fisheries officers, enforcing size limits and bag limits, 'no point having regulations without proper size limits'.
Education	40	5.8	Education anglers on reasons for regulations, and safe handling of fish.
Regulations (against)	29	4.2	Sea anglers should be 'left alone'.
For licences	25	3.7	Calls to introduce a licence with transparent use of the money.
Against licences	21	3.1	Keep sea angling a free sport.
Safety/accessibility/facilities for anglers	21	3.1	Life jackets compulsory, accessibility of coastline.
Promotion of sea angling	14	2.0	Get younger anglers involved.
Breeding grounds	12	1.8	Protected breeding grounds and programmes.
Representation of sea anglers and government funding	8	1.2	A louder and more organised voice for sea angling, more money from government to develop sport.
Bait	4	0.6	Ban use of live fish as bait, bait availability.

Priorities for managing commercial fishing related to 'reducing damaging/unsuitable fishing methods' (14.0%), such as pulse and beam trawling, gillnets and other indiscriminate methods; 'enforcement' (13.5%) including more policing, spot checks, and stricter penalties for breaking rules; and 'increasing regulation measures' (11.0%) including increasing the minimum landing size for certain commercially targeted species (Table 41).

Table 41. Count and examples of different categories of response to open question about priorities for the management of commercial angling

Category	Count	%	Example comments
Reduce damaging / unsustainable methods	98	14.0	Stop commercial methods that damage the seabed e.g. pulse/beam trawling, gillnets, indiscriminate methods.
Enforcement	94	13.5	More policing, spot checks, stricter penalties for those breaking the rules.
Increase regulation measures	77	11.0	Increase MLS for certain commercially targeted species.
Distance to shore increase	73	10.5	Increase the distance from the shore that commercial vessels are allowed to enter (ranges from 3 - 12 miles).
Discards ban	68	9.7	Ban on discards, penalties for those who discard unwanted fish, must incorporate into quotas.
Control foreign commercial activity	63	9.0	Minimise access for non-British boats, have a 'pay by the day' policy for foreign vessels.
Conservation zones / management	61	8.7	No-go fishing areas, particularly for spawning grounds/nurseries, conservation zones to be rotated annually/seasonally to account for variation and allow to recover (as with crop rotation in agriculture).
Re-evaluation of quotas	55	7.9	Current quotes need to be reduced, not sustainable, poorly enforced, need a re-haul and re-evaluation.
Scientific evidence to support policy	10	1.4	More science needed on breeding ecology, movement of fish, efficacy of current regulations and 'maximum sustainable yield'.

2.3.2.6 Demographic profile

Around 31% of respondents were 65 or over and 39.1% were aged 55-64, with only 3.8% under 34 (Table 42). The Watersports Participation Survey provides data on the sea angling population in the UK and estimated that 17% of sea anglers were 65+ and 29% were under 34 in 2018. This suggested there was a bias in the sample toward older anglers. The sample was mainly male (97%) with just 1.5% females responding (Table 43). About 21% of respondents had some form of long-term illness or disability (Table 44).

Table 42. Age of respondents and comparison to the general angling population estimated in the Watersports Participation Survey (WPS).

	This survey		WPS 2018
Age	**Count**	**%**	**%**
18 – 24	10	1.3	11.9
25 – 34	13	1.7	17.7
35 – 44	54	7.2	18.3
45 – 54	142	19.0	16.2
55 – 64	292	39.1	19.6
65 or over	231	30.9	17.0
Prefer not to say	5	0.7	NA
Total	747	100	100

Table 43. Gender of respondents.

Gender	Count	%
Female	11	1.5
Male	727	97.3
Non-binary	4	0.5
Other	3	0.4
Prefer not to say	2	0.3
Total	747	100

Table 44. Disability or long-term medical condition of respondents.

Disability?	Count	%
Yes	157	21.0
No	570	76.3
Prefer not to say	20	2.7
Total	747	100

Around a quarter earned between £0 and £20,000 each year and 34% earned between £20,001 and £40,000. The concentration at the lower end of the income scale may reflect the large number of retired respondents (Table 45). The largest single proportions of diarists were from the South West and South East of England, which broadly reflects known distributions of sea anglers (Table 46) Comparisons with the WPS showed that respondents from Scotland, Northern Ireland and the east of England were under-represented in the survey (Table 46).

Table 45. Gross income categories of respondents.

Income	Count	%
£0 to £20,000	188	25.17
£20,001 to £40,000	251	33.60
£40,001 to £60,000	117	15.66
£60,001 to £100,000	61	8.17
£100,001 to £200,000	16	2.14
Over £200,000	4	0.54
Prefer not to say	110	14.73
Total	747	100.00

Table 46. Home region of respondents and comparison to the general angling population estimated in the Watersports Participation Survey (WPS).

	This Survey		WPS 2018
Region	**Count**	**%**	**%**
East	91	12.5	3.6
East Midlands	41	5.6	2.3
West Midlands	33	4.5	5.3
London	18	2.5	5.5
South East	144	19.7	17.7
South West	140	19.2	14.7
North East	45	6.2	6.6
North West	74	10.1	11.9
Yorkshire and the Humber	49	6.7	6.6
Scotland	22	3.0	8.3
Wales	65	8.9	9.2
Northern Ireland	6	0.8	8.9
Other	2	0.3	0.2

2.3.3 Follow-up survey and ground truthing

Semi-structured interviews were conducted with twenty individual respondents to the survey. These were recruited from people who responded to a request at the end of the survey and contacted Substance. As such, this was a self-selected group of respondents from the survey and not necessarily representative of the survey sample, nor the general population of sea anglers. However, they still provide a useful panel to test the outcomes of the survey. It had been intended that interviewees would be chosen from survey respondents at random, but this was not possible due to data protection. For context, the survey responses will be referred to in this section.

2.3.3.1 Motivation

As in the survey, interviewees rated catching fish and the environment as the most important factors. Examples of this are:

> *'It's a lifestyle thing - I love to be outside.'*

> *'To enjoy the sport and enjoy the natural environment.'*

> *'I love catching fish – not for the table, for fun.'*

Some interviewees commented on the importance of both aspects of fishing: '*It's always nice to have good scenery but catch is the most important thing*'. The potential for solitude when fishing was the least common factor discussed in the interviews, reflecting the survey (13%), although this was often featured in descriptions of the environment in which they fished: *'I spend a lot of time on my own in a pleasant environment.*'

2.3.3.2 Attitudes to current management measures

A broad range of views were expressed about current management measures including bag limits and MLS.

2.3.3.2.1 Sea bass bag limit

In the survey, 48% of respondents felt the current sea bass bag limit was very or somewhat effective and this was supported by some (eight) interviewees who were in favour of the sea bass bag limit for species conservation reasons. One said: '*I have no problem with regulating to preserve the species*'. Three interviewees said they were against the measure saying that it was too restrictive for recreational anglers:

> *'The current bag limit for pleasure anglers is ridiculous – 4 would be a realistic figure.'*

However, all interviewees commented that they feel regulations are stricter for recreational anglers than for the commercial sector, despite the difference in impact on the environment.

2.3.3.2.2 Minimum landing size for sea bass and cod

63% of survey respondents were in favour of the MLS for sea bass a view supported by eleven interviewees, with some stating that they felt that it needed to increase:

> *'What we have now is fine, but bigger would be more sustainable.'*

One respondent was against the minimum landing size and said there was a need for a maximum landing size instead:

> *'The size limit covers mature bass that should be allowed to be left to breed. I think one or two little ones should be allowed but no big ones.'*

Of the interviewees that commented on this measure, nine felt that the current regulations for sea bass were biased against recreational sea anglers. Every interviewee that commented on the minimum landing size for cod were in favour, such as:

'99% of people I know are fine with the minimum landing size and stick to it.'

This showed stronger support among interviewees than in the survey, which were more mixed. Generally, interviewees were more in favour of the current management measures for recreational angling than not, but most felt that measures for commercial fishing did not go far enough, suggesting that support is conditional:

'Measures are fine for recreational fishing but have not gone nearly far enough with regards to commercial fishing.'

'Great – fully agree with all the current management for bass and cod if it is sufficiently backed up in legislation for commercial fishermen.'

Seven interviewees were unaware of minimum landing sizes for cod and two were unaware of the MLS for sea bass.

2.3.3.3 Attitudes to future management measures

A range of views were expressed about future management measures, outlined below.

2.3.3.3.1 Sea bass bag limit

Seven interviewees supported the use of a bag limit in the future management of sea bass, and all of them said that the bag limit should either remain the same or become stricter. Some examples of this included:

'Bag limit for recreational is fine - if you're taking more than two per day you are selling them so you're a commercial fisherman and should pay tax.'

'If taking bass was illegal it wouldn't bother me at all… I would be happy on a total ban for recreational fisherman and the commercial - within quotas at limits.'

All interviewees that commented on the bag limit communicated the importance of applying equally strict regulations to the commercial sector, as they felt this was not currently reflected in legislation and needed to be addressed in the future:

'It doesn't feel right not to impose a catch limit on commercial fishermen when they do on recreational anglers.'

Other views included a total species ban to aid recovery of stocks, and emphasis on the importance of enforcing the bag limit.

2.3.3.3.2 Minimum landing sizes for sea bass and cod

There was broad agreement that the future management of sea bass should retain the minimum landing size, but if anything, should be increased:

'The MLS is good as it is, but it could be increased further.'

Two interviewees suggested a '*complete ban by recreational anglers for three, four or five years*' to allow stocks to recover sufficiently and to give time to devise a better-informed management plan. This approach did have some support in the survey where 38% of respondents thought that overfishing by recreational anglers was a very important or important threat to marine fish stocks targeted by recreational anglers. It was suggested by most interviewees that the '*cod size limit should go up – they aren't given a chance to breed*.'

Enforcement was important to those providing feedback regarding all future management measures, particularly for those commenting on sea bass regulations. All interviewees that commented on sea bass (n=7) said that any future regulations needed to focus on the negative impact of the commercial sector and that further restrictions on recreational anglers would be both disproportionate and ineffective if this did not happen. Examples are:

> *'When compared with commercial activity the restrictions become annoying for recreational anglers. I feel that commercial anglers get away with a lot in terms of bad practice.'*

> *'No use in restricting shore anglers when you compare the impact of commercial fishing activity.'*

2.3.3.4 Future sustainability of sea angling

Respondents provided a range of ideas about improving the sustainability of sea angling, relating to both recreational and commercial fishing. These included existing methods, such as bag limits and conservation areas, in addition to other options such as education and improved enforcement.

2.3.3.4.1 Recreational sea angling

Several interviewees felt that for recreational angling, conservation, no-fish and 'pleasure angling only' zones should be created, and that zone rotation should be introduced. Interviewees also felt that enforcement and education were important to underpin this:

> *'Regulations need to be better enforced.'*

> *'Recreational sea anglers should be educated so they can self-regulate.'*

> *'Sea angling as a hobby can be a good way of developing understanding of the oceans and fish ecology, which is important for the next generation to act sustainably.'*

More research into the impacts of recreational angling on the environment was also a suggestion, in order to highlight the disparity between recreational and commercial angling with regards to environment degradation.

2.3.3.4.2 Commercial fishing

For commercial fishing, many responses were focused around banning damaging fishing methods such as beam trawls and gillnets, as well as ensuring strict enforcement and creating conservation zones:

'Seine nets should be banned, and all commercial nets should have much smaller mesh and shouldn't be allowed to come close into the coast.'

'No go areas need to be enforced - definitely for big trawlers, their access needs limiting.'

Respondents felt that management should be holistic and multi-species for both commercial and recreational fishing and that measures for recreational angling alone would be futile:

'There's no sense in managing the recreational catch of bass while so many are killed in commercial by-catches.'

There was also a focus on the importance of scientific research to support policy when regulating commercial fishing activity based on environmental impact.

2.3.3.5 Sea Angling development and funding

In terms of the funding of the future development of sea angling, three main possibilities were mentioned by interviewees: sea angling licences (with views both for and against); government funding; levies (on tackle trade or commercial fishing boats). Five interviewees supported a sea angling licence and seven opposed it.

More respondents were against the idea of a rod licence than for it, for a variety of reasons:

'If you make people pay, they will just go coarse fishing only because the quality of sea fishing at the moment is so bad.'

'The cost of administration for the licence would render it unviable.'

'Over-governing will cause the same problems we see with freshwater angling - it's ok bringing regulations in, but from freshwater I can see they are not properly enforced.'

'I don't think recreational anglers should fund anything at all, apart from supporting local tackle shops, bed and breakfasts and hotels.'

Others were in favour of a sea angling licence, but this support was highly conditional on funds being used for conservation and the management of sea angling:

'Sea anglers should put some money towards it – but only if it goes towards MCZs and other conservation management methods.'

'Many other countries have sea angling licences and if that money is used to regulate and manage then that's ok.'

The most common recommendation for funding was from the government. Some said local government should allocate funding as it is a local resource and impacts and management differs regionally:

'I haven't seen anything in my local authority's leisure policies that include recreational sea angling - this is a local resource so should be treated locally.'

Others said that there was a national responsibility to fund sea angling:

> *'Funding from a central pot to match fund a collective body might be a good incentive.'*
> *'It needs government intervention to enhance the marine environment.'*

Around a fifth of respondents advocated a commercial fishing vessel levy and a smaller proportion felt that a 'tackle tax' would be a fair way to fund sea angling as it would be proportional to usage and impact:

> *'Companies that hold the large amounts of quotas- levy them to pop into a sea angling fund.'*

> *'Taxing tackle is the only fair way, as what you pay will be proportional to what you take from the environment.'*

However, some were against the idea of a tackle levy, because tackle sales are already taxed:

> *'We already pay VAT on tackle so I don't think there should be a tackle levy.'*

2.3.3.6 Views on the Fisheries White Paper

Most interviewees were not aware of the content of the Fisheries White Paper in any detail and so were unable to comment on it. One interviewee felt that although the paper mentions recreational angling, the full value of sea angling is not recognised by those in charge:

> *'Until we have a fisheries minister who truly understands and accepts the relative value of sea angling, the full potential of sea angling is unlikely to be realised.'*

2.3.3.7 Data collection and use

There were several suggestions made regarding what data should be collected. Most interviewees supported the collection of catch data to help inform the development of sea angling, from both recreational and commercial activity:

> *'Catch data and expenditure should be recorded to provide a picture of recreational sea angling's impact so that it can be compared with the impact of commercial fishing.'*

> *'Critical that the under 10m vessel recording goes ahead, because it's important to know what is being taken out of the fisheries by them.'*

Economic data surrounding the industry of sea angling was also mentioned as important, particularly to enable comparison with the economic value of commercial fishing:

> *'Let's compare the economic contribution of recreational and commercial angling - I bet recreational contribute much more.'*

Other data collection that was supported was surveying other non-angling shore users, as well as monitoring bait sales as a means of validating catch returns.

One interviewee felt that while surveys are a useful way to collect data, this method may exclude sections of the sea angling community that may not be computer literate but have important data to contribute:

> *'The oldest ones are not 'tech savvy' but hold the greatest wealth of experience and knowledge, so it's worth getting out to beaches and piers to talk to them.'*

There were several suggestions made regarding what data should be collected.

Some interviewees thought that data collected on sea angling should be used to inform fisheries ecology and scientific research:

> *'Information from sea anglers must be used to supplement science.'*
>
> *'Specialist knowledge can supplement science and policy to inform management.'*
>
> *'Ultimately science is the most important factor to consider.'*

It was also felt that data should be used to compare impacts of commercial and recreational sea angling:

> *'All returns- recreational and commercial - must be recorded and reported to show comparison to inform legislation.'*

Other uses suggested included enforcement of legislation, to show the public the value (economic and social) of sea angling, and to enable more regional management of over-fishing.

2.4 Discussion

2.4.1 Motivations

Sea anglers were motivated by both catching fish and the quality of the environment in which they fish. Catch based motivations emphasised the importance of catching a variety of fish species most, which is interesting as a large proportion of the survey respondents were thought to be specialised anglers, that target specific species, such as sea bass. This emphasis on a desire for a plentiful variety of fish reflects some findings in other surveys (Peirson *et al.*, 2018; Brown, 2019).

A healthy and beautiful environment to fish in was by far the most important site factor (again reflecting findings in other recent surveys), and other elements (such as facilities) had much lower ratings of importance. Some qualitative work suggested that people may have downgraded the importance of facilities as they feared that if development of facilities was undertaken, it may result in a sea angling licence. However, in other studies, the importance of facilities to help access has been emphasised by sea anglers (Brown, 2019).

The majority of respondents were satisfied or very satisfied with their most recent sea angling experience, with only a small minority saying they were very dissatisfied. In addition to this most respondents indicated that the place where they most recently fished was chosen for more sentimental reasons (i.e. memories, a personal attachment). However, there was less indication that a site would be chosen due to it being 'better' than other places they had fished.

Qualitative work supported this, suggesting while having a 'successful' trip (i.e. catching fish) is important, there are numerous other factors that are considered when selecting a site.

These outcomes should help inform future plans for management of recreational fisheries, suggesting that an emphasis on bountiful stock and healthy environment are both important motivators for sea angling participation.

2.4.2 Management measures

2.4.2.1 Sea angling

Knowledge of management measures was variable. Whilst most respondents could correctly identify the bag limit regulation for sea bass, only two thirds could specify the minimum landing size for sea bass and only half could do so for cod. In addition, respondents felt that a significant proportion of other anglers did not adhere to regulations. This suggests the need for greater outreach and education within the recreational sea angling community to help create sustainable fish stocks. Educating sea anglers so they can 'self-regulate' was discussed by interviewees and some respondents felt that education on other aspects such as how to safely handle fish was important.

In terms of effectiveness of regulations, only half of respondents felt that minimum landing sizes for cod were effective at helping create sustainable fish stocks and the same proportion for the bag limit on sea bass. Around two thirds felt that the minimum landing size for sea bass was effective, with avid sea bass anglers more likely than others to think this. Qualitative research emphasised the support of sea bass anglers for a well-managed, protected and recovered stock and conservation-conscious attitudes.

For most respondents, management measures had no impact on activity, although a minority fished less as a result. Almost nobody said that the management measures meant that they fished more frequently. There was also little impact on socio-economic factors such as spending, activity levels or enjoyment, although around one fifth spent less due to the measures and levels of enjoyment had gone down more amongst older sea anglers. Boat anglers were most likely to report a decrease in personal spending as a result of the management measures, which may have potential economic impact implications.

Respondents and interviewees felt that management measures would not be effective in improving fish stocks without being more closely observed by other recreational anglers and without tighter controls on commercial fishing. However, it must be noted that one fifth of survey respondents had not fished for sea bass or cod in the last 12 months, so impact of measures specific to sea bass and cod are unlikely to have affected them in the same way.

2.4.2.2 Commercial fishing

Sea anglers were very supportive of measures to help increase marine fish stocks, but this was contingent on better control of and stronger measures for commercial fishing. Throughout the survey and the qualitative work, many participants felt that current management measures did not address the negative impacts of the commercial sector on fish stocks anywhere near enough. Over 90% of respondents felt that the biggest dangers to fish stocks were the impact of overfishing by commercial operators, damage to habitat and pollution. Only one third thought that overfishing by recreational anglers damaged fish stocks. Respondents felt that current regulations were less effective within the commercial sector than those applied to recreational angling. Qualitative research highlighted a clear parallel between those who opposed a recreational sea angling licence, and those who felt strongly about the impact of commercial fishing. This is also reflected in the significantly different responses given by 'protestor' respondents to the survey (who are against a licence).

There was a focus on environmentally damaging practices in the commercial sector and recommendations made included banning methods that affect habitats and organisms, such as trawling, gillnets and longlines. Reforming the current discard regulations was a key piece of feedback from the interviewees and the discard ban was deemed to be the most ineffective current commercial management measure. Many participants believe that in order to develop sea angling as a recreational activity, the priority should be the recovery of fish stocks, for damaging commercial practices to be banned and for regulations to be enforced. The introduction of new demographics to sea angling was thought by participants to be contingent on a higher chance of catching fish, and this highlights how crucial the recovery of fish stocks is for recreational sea angling development.

In terms of future management, the emphasis from qualitative research was that tighter controls on commercial fishing activity and practices was the most important factor to help create sustainable fish stocks and improve recreational angling. However, interviewees also said that the recreational sea angling community was not represented strongly enough and that this was needed to improve education of the community around the need for sustainable practices. Qualitative research suggested that more conservation zones, recreation-only zones, better enforcement and education, and banning damaging fishing methods should be prioritised in future management.

2.4.3 Funding

When asked how sea angling development should be funded, more respondents suggested government funding than any other one option, followed by a sea angling licence. However, no one option for funding received majority (>50%) support. Qualitative work suggested there were some differences of opinion between a desire for national government funding to protect the marine environment and develop sea angling and local government in coastal areas taking more responsibility.

The introduction of a compulsory sea angling licence was supported by around one third of respondents in the survey, which is perhaps higher than expected. It almost exactly matches support for this option shown in the recent National Angling Survey (Brown, 2019). Qualitative research reflected this division of opinion, but also emphasised that where support occurred, it was highly contingent on stricter regulation of the commercial sector and demonstrably transparent use of funds to develop sea angling; and to protect the environment, sustainability, and ecosystem management. Examples of other countries that use licence fees to fund management were used to support this.

The income of respondents to the survey played an important role in predicting their response to the suggestion of a compulsory licence, with the lowest and highest earners least likely to agree. This may relate to affordability at the lower end of the income scale. Regression analysis highlighted the significantly different attitudes of 'protestors' – those who in the choice experiment questions stated that they would not pay into a sea angling development fund – to other groups. This group consistently differed from the baseline on a range of issues, suggesting that their opposition to a sea angling licence is linked to dissatisfaction in other areas of sea angling management.

2.4.4 Data collection

Respondents were more willing to contribute to data collection about their participation and catches than for social or economic impact. This is a surprising result given the lower levels of participation in catch surveys than socio-economic surveys previously (Armstrong *et al.*, 2013) and the opposition from some sea anglers and sea angling organisations to the collection and use of catch data.

Respondents were much more likely to agree to contribute data (of all types) if they had been involved in data collection in the past, highlighting the importance of engaging anglers in scientific research to encourage future contributions. The fact that 'protestors' were more likely to disagree with contribution of data in all categories highlights the continued difference of this group throughout the survey. Respondents were also more willing to contribute to data collection if catching fish was their main motivation for going angling. This indicates that these anglers may be more engaged in contributing to an understanding of fish stocks, if they have an understanding that data can help improve their chances of catching fish.

Interviewees recognised the value of data collection, particularly catch data, but they placed greater emphasis on the importance of data collection from within the commercial sector. Qualitative research also suggests that those who disagreed with contributing data in the survey may do so because of a perceived disparity between the recreational and commercial sectors; and that better collection of data from commercial fishers would have a greater impact.

2.4.5 Limitations

The self-selecting nature of the sample responding to this survey method means that these results may not be representative of the general sea angling population. Around 75% of respondents had completed other surveys including the National Angling Survey in 2018 or were part of the Sea Angling Diary. Given that both of those populations are themselves self-selected, there is a high degree of self-selection for those who chose to do this survey.

The demographic data suggests that the survey sample was older and more male than the sea angler population in general. Respondents to the survey were also more avid than the 'average' UK sea angler and this had some effect on results (for example, the higher the avidity, the more likely an angler was to agree with management measures). The survey was long and quite complex, and this means that it required a level of dedication to complete this survey, which will have further influenced the sample towards more avid and engaged anglers.

In addition, the focus of the survey on the management of sea angling appeared to increase participation of anglers that target some species (such as sea bass and cod which are subject to management measures) and this might suggest that the sample is more specialised than the sea angler population in general. However, there is no comparable data to confirm this. More respondents and interviewees targeted sea bass than other species and this specialisation is unlikely to reflect the sea angling population in general.

Qualitative research largely supported the findings of the survey but provided some more nuanced understanding of attitudes. This emphasised the contingent nature of support for management measures, data collection and licensing being conditional on greater controls of commercial fishing.

3 Impact of management on economic value of sea angling

3.1 Introduction

There are several options for assessing angler preferences for management, including traditional consultations such as public meetings and opinion surveys (Smith, 1983). It is difficult to use these approaches to assess the impact of changes in multiple attributes of a good, as typically occurs with changes in management. The alternative is to use preference-based approaches that involve examination of trade-offs anglers make through actual or hypothetical choices of angling experiences. These can be used to provide information on the value of characteristics of the angling experience (e.g. management measures, catch) or produce estimates of the economic value generated through comparison with market-based characteristics (e.g. costs of access).

Several studies have accounted for the market value of sea angling though examining expenditure (tackle, bait, boat hire etc.) (Drew, 2004; Armstrong *et al*., 2013), but these methods do not account for the consumption of non-market goods (e.g. fish that are caught) and services (e.g. the sea angling experience). While sea angler expenditures measured in economic impact studies represent benefits to local and national economies, they are costs to sea anglers themselves. The difference between expenditure and what anglers are willing to pay for their angling experiences represents the consumer surplus created by recreational angling activities (Hynes *et al*., 2017).

Two major preference-based approaches exist: stated (SP) and revealed preference (RP). RP methods use observable behaviour to make inferences about trade-offs anglers make in their decisions of when or where to go angling (e.g. site demand and site choice models - Drew, 2004; Hunt, 2005; Pascoe *et al*., 2014). RP methods have the advantage of being based on actual behaviour, but this is also a limitation as preferences cannot be examined for goods or services for which behaviour does not exist (e.g. potential or proposed new management measures). SP methods can elicit preferences when management scenarios are hypothetical (Freeman *et al*., 2003), including future management regulations. SP techniques utilise individuals' declarations of choices, evaluations or agreements and disagreements, making them independent of resource use. SP methods include contingent valuation (Wheeler and Damania, 2001; Drew, 2004), contingent behaviour (Barry *et al*., 2011) and SP choice experiments (SPCE). SPCEs elicit preferences by asking individuals to choose between hypothetical experiences or goods described by several relevant attributes.

SPCE techniques employ random utility maximisation theory (RUM) that assumes individuals make choices that will maximise their aggregate preferences (utility) (McFadden, 1974). SPCEs have several advantages over similar stated preference methods such as contingent valuation. Both utilise the consumer theory of demand in which goods and services are viewed as bundles of attributes that consumers value (Lancaster, 1966), but SPCEs allow the influence of attributes to be examined in isolation (Lew and Larson, 2014). Hence, SPCEs can efficiently estimate the relative marginal value of different characteristics of angling experiences relevant to anglers. This allows comparisons to be made between, for example, the value of catching and keeping an extra fish compared to the value of catching and releasing an extra fish. These can be used to model and simulate fishery management outcomes at a larger scale (Lee *et al*., 2017). This makes them a particularly suitable method for informing policy decisions regarding the consumption of multi-attribute environmental goods and services such as recreational sea angling trips. SPCEs have been applied to a wide range of topics, ranging from environmental valuation to health, and are increasingly used in recreational fisheries (Bateman et al., 2002, Freeman, 2003, Adamowicz, 2004).

The robustness and credibility of SPCEs and WTP values derived using these methods are the subject of debate. The main concerns relate to the hypothetical nature, convergent validity, framing effects, cognitive difficulty (Hanley et al., 2001, Bateman et al., 2002, Rakotonarivo et al., 2016). However, it is essential to obtain information on economic values in the absence of a market setting for prospective policy actions, as is the case with sea angling. For potential management measures that have not been implemented, this can be done most efficiently and robustly using SPCE studies, so this approach is supported by governments (e.g. HM Treasury, 2018). The hypothetical nature of SPCEs is both a strength and weakness (Hunt, 2005). The weakness relates to the potential for hypothetical bias as the outcome does not reflect actual behaviour and often provides different results to RP methods (Hanley et al., 2001, Bateman et al., 2002). However, SPCEs are the most efficient and robust valuation tool available for non-market goods and prospective management policies. Hypothetical bias can be mitigated through good experimental design that includes an accurate description of the good or policy, robust statistical design, and ad-hoc questions (e.g. pre-testing, post-evaluation) (Johnston et al., 2017). In addition, robust development of the survey instrument, valuation scenario, choice of attributes and levels, can improve reliability of SPCE by enhancing validity, consequentiality and incentive compatibility (Champ et al., 2017).

The major benefit of SPCE compared to other SP and RP methods is the potential to analyse trade-offs across multiple attributes of a good or policy. Examination of changes in individual preferences and WTP with attributes allows investigation of the effect of multiple management actions (Hanley et al., 2001; Bateman et al., 2002). This does result in a higher cognitive burden for respondents that can lead to attribute non-attendance and inconsistent answers (Hess and Rose, 2009; Colombo et al., 2013). The SPCE literature regarding framing effects and presentation of choice tasks summarises these issues and provides advice on the number of attributes and levels or the number of choice situations to minimise respondent fatigue (Louviere et al., 2011; Hess and Daily, 2014; Caussade et al., 2005; Meyerhoff et al., 2015). In addition, framing effects are less important when respondents are familiar with the good or service (Loomis and Ekstrand, 1998). The key to a robust outcome is to ensure careful design and testing of the approach for the SPCE to minimise the sensitivity of estimates to the design. The reliability of estimates including WTP can be tested, and advances in econometric modelling and statistical design can be used to account for design elements, resulting in robust and credible information (Bateman et al., 2002; Hess and Daily, 2014). Ultimately, SPCE are an effective tool for exploring WTP values when they are rigorously developed following state-of-the-art guidance and modelling approaches (Johnston et al., 2017).

SPCEs have been used to examine how recreational angler preferences respond to changes in catch and management. Previous studies have used a range of different choice task formats including dichotomous choice tasks (Hicks, 2002; Lawrence, 2005; Oh and Ditton, 2006; Oh *et al*., 2005; 2007; Carter and Liese, 2010; 2012; Lee *et al*., 2014), ranking tasks (Lew and Larson, 2012; 2015) and resource allocation tasks (Kenter *et al*., 2013). However, to date very few UK studies have utilised SPCEs to examine recreational sea angler preferences for changes in catch and management. In this research, a SPCE was designed to assess recreational sea angler preferences and WTP for catch, keep, and release of cod and sea bass under varying levels of bag limits and minimum landing sizes.

3.2 Methods

3.2.1 Design

Discrete dichotomous choice tasks were used as these are thought to offer a more dependable option for use in welfare analysis (Johnston *et al*., 2017) than other choice formats. Four consecutive choice tasks were presented to participants alongside instructions in the online survey of angler attitudes. As SP methods estimate changes in economic welfare brought about by changes in the world, it is important that participants understand the valuation scenario that they are being asked to express preferences about (Johnston *et al*., 2017). To achieve this, an explanation was provided to participants before starting the choice task, this described management approaches to deliver the goals of the UK's 25-year environment plan to improve the health and sustainable exploitation of fish stocks.

For each choice task sea anglers were asked to choose between two hypothetical fishing trips (trips A and B) and a third option to do something other than go fishing (trip C) (Figure 9. An example of a choice card used in the angler attitudes SPCE.). This non-participation opt-out created an easy way for respondents to avoid the choice task (Kontoleon and Yabe, 2003) without forcing respondents to choose a scenario that is not favoured (Banzhaf *et al*., 2001; Louviere *et al*., 2000). For each of the four choice questions, participants were instructed to compare only the trips shown and indicate their preference if these were the only trips available. Participants were reminded of their budgetary constraints (i.e. that money spent on an angling trip would not be available for other purchases) and were instructed to treat the trips as identical except for the differences listed on the choice card. Short descriptions were provided on the choice card of each attribute, with further explanation available within pop up boxes that could be selected. This included the current levels of management measures (e.g. current MLS, bag limits). In order to ensure that participants only considered the trips shown on the current choice card survey validation was used to prevent participants from switching between choice tasks.

Figure 9. An example of a choice card used in the angler attitudes SPCE.

Section D: Trip Choice Scenario D1

Please compare **Trip A**, **Trip B** and **Trip C** in the table below and indicate which you would prefer to take. If **Trip A** or **B** is not desirable to you, please choose **Trip C**. Please compare only the trips on this page and assume that the trips listed are identical except for the trip characteristics listed in the table.

These are hypothetical options and not necessarily based on current regulations. Imagine these are the only options available to you and remember that taking any trip would cost the amount shown and so reduce your ability to make other purchases. There is no right or wrong answer but it is important that your responses reflect your true opinions as responses may be used to inform and advise on fisheries policy.

Use your mouse/ keypad to hover the cursor over each of the Trip Characteristics to see an explanation of each.

Trip Characteristics		Trip A	Trip B	Trip C
Regulations	Bag Limit of Bass	3	0	Do Something Else (Not Sea Angling)
	Minimum Landing Size of Bass (cm)	42cm	55cm	
Catch	Total number of Bass caught per trip	3	4	
	Number of Bass caught at or above the Minimum Landing Size	3	3	
Catch you can keep	Number of Bass you can legally keep	3	0	
	Number of Other Fish Caught (which can be kept)	3	2	
Cost	**Annual** Payment to the Recreational Sea Angling Development Fund	£40	£5	
Which would you choose		○	○	◉

In each choice task, respondents compared two fishing trips described using seven trip attributes: 1. the bag limit of the target species; 2. the minimum landing size of the target species (in cm); 3. the total number of the target species caught on the trip; 4. the number of target species caught at or above the minimum landing size; 5. the number of target species that can legally be kept on the trip; 6. the number of other fish caught on the trip; and 7. the cost of the trip expressed as an annual payment to a recreational sea angling development fund.

A catch disposition approach was adopted following Carter and Liese (2012). The bag limit, the total number of target species caught, and the number of the target caught at or above the minimum landing size were derived attributes, which were not included in the experimental design or the final choice models. In this way, it is left up to the participant to infer the number of the target species released due to the MLS and the number of fish released due to the bag limit. In modelling angler choice responses, the total catch, bag limit and the catch above the MLS were replaced with the catch that can be legally kept, the number released due to the bag limit, and the number released due to the size limit.

A realistic set of trip characteristics and levels were defined for cod and sea bass (Table 47). Each of the attributes used in the experimental design had four levels, which were identical for both cod and sea bass except for the MLS. MLS was coded as 0 for the current MLS (35cm for cod and 42cm for sea bass), 1 for 10% increase, 2 for 20% increase, and 3 for 30% increase. A D-efficient fractional factorial design was constructed from these attributes using the software package NGene 1.2.0 (© ChoiceMetrics, 2014).

In order to express the trade-offs being made by participants in economic terms each trip choice must have an associated cost. In the context of recreational sea angling deriving an appropriate cost attribute is difficult as generally neither licences nor entry fees are acceptable to recreational sea anglers, and trip costs have their own problems which may introduce significant bias into the SPCE. After extensive discussions with angling experts and managers a donation to a recreational sea angling development fund was chosen as the cost attribute.

The resulting design consisted of 24 choice situations grouped into six blocks of four. Each participant was presented with one full block consisting of four choice tasks, the order of which was randomised for each participant.

Table 47. Attributes and attribute levels used in choice modelling, cod and sea bass choice cards. All attributes relate to the target species unless otherwise stated.

Attributes	Choice Modelling	Cod Choice Tasks	Sea bass Choice Tasks
Bag limit	N/A	0/1/2/3	0/1/2/3
Minimum landing size	0/1/2/3	35cm/39cm/ 42cm/46cm	42cm/46cm/ 50cm/55cm
Total number caught	N/A	2/3/4/5/6/7/8	2/3/4/5/6/7/8
Number caught above the minimum landing size	N/A	1/2/3/4/5	1/2/3/4/5
Number that can legally be kept	0/1/2/3	0/1/2/3	0/1/2/3
Number of other fish that can by kept	0/1/2/3	0/1/2/3	0/1/2/3
Number released due to bag limit	0/1/2/3	N/A	N/A
Number released due to MLS	0/1/2/3	N/A	N/A
Cost	1/2/3/4	£5/£10/£20/£40	£5/£10/£20/£40

A pilot of the choice task was sent to 200 sea anglers. This showed the need to change the trip attributes, reduce the number of target species, and restrict the management measures considered. In addition, significant changes were made to reduce the length and increase the clarity of the choice task instructions. In the final SPCE, anglers were asked to define their activity and experience of sea bass and cod and then allocated to the species that they had more experience with. If the sea angler stated that they had an equal amount of experience with both cod and sea bass, then that participant was assigned at random. As a result, sea anglers that completed the choice tasks were able to understand the situations described as they had knowledge and experience of the species for which the catch and management attributes apply. This avoids the need to target specific sea angling sub-populations and ensure that the choice situations are relevant (Lawrence, 2005).

The full survey was deployed within the broader online survey on angler attitudes (see Section 2.2.2 and Annex 2 for a full description). This was done using the online platform Qualtrics (www.qualtrics.com). The ability of this platform to customise questionnaires using JavaScript and HTML was essential to creating a questionnaire that accommodated both attitudinal questions and SPCE questions. A SPCE questionnaire requires randomisation of choice situations, dynamic allocation of participants to different design groups and survey branching to ensure that certain participants receive appropriately tailored questions.

3.2.2 Analysis

SPCE results are typically modelled using a random utility (RUM) framework (McFadden, 1974) that assumes angler trip choices reflect the maximisation of their utility subject to budgetary constraints. A wide range of methods and model specifications exist for the analysis of choice data using RUM frameworks. A conditional logit modelling approach was used to assess angler trip choices, where the choice among alternatives was treated as a function of the characteristics of the alternatives rather than characteristics of the decision-maker. The conditional logit estimates mean coefficients that represent the influence that each attribute has on the probability of choosing each of the alternative trips.

The choice data was separated into anglers who stated that they had more experience targeting sea bass and those with more experience of targeting cod. Separate models were then run for cod and sea bass to account for the different baseline MLS's used. In each of these models an alternative specific constant was included (ASC_SQ) to represent the status quo alternative (e.g. to do something else and not go sea angling, trip C). Hence, the ASC_SQ indicated the probability that all else being equal anglers would prefer the status quo (i.e. no change in management measures).

In addition to partitioning the sample according to target species, anglers who did not agree with paying into an angling development fund in order to improve the health of fish stocks were removed from the sample. The inclusion of these 'protestors' risks undermining attempts to simulate a realistic market within this SPCE and as such could bias subsequent estimates of willingness-to-pay. Responses to the choice situations could therefore reflect strategic behaviour or protests on the payment mechanism rather than angler preferences for trips. Hence, anglers that stated that they would not pay into a fund in the follow-up questions were excluded from the choice analysis. It should be noted that this reduced the sample size and potentially the representativeness of results.

3.3 Results

3.3.1 Choice experiment

Each choice situation elicited a choice between two different fishing trips and a third option to do something other than go angling. There were 805 anglers that made 3,205 choices, with an even split between the three-trip choice for all species (Table 48). Fifteen anglers dropped out before completing the fourth and final choice situation (3 targeting cod, 12 targeting sea bass), resulting in 3,205 out of 3,220 potential choice occasions (Table 48).

Table 48. Anglers trip choices (n= 805 anglers, 3220 choice occasions). Numbers are presented with % in brackets.

Choice	Frequency (%)	Choice Card Target: Cod	Choice Card Target: Sea bass
Angling Trip A	1082 (34%)	317 (34%)	765 (34%)
Angling Trip B	1098 (34%)	298 (32%)	800 (35%)
Trip C (something else)	1025 (32%)	314 (34%)	711 (31%)
Total Choices made	3205	929	2276
Number of Anglers	805	233	572

Following the choice tasks, participants were asked whether they would contribute to a Sea Angling Development Fund with 50% of respondents agreeing to pay under certain conditions and 27% stating they would not pay (Table 49). The results were similar for cod and sea bass, with 68 out of 230 (30%) and 152 out of 560 (27%) that would not pay for cod and sea bass, respectively.

Table 49. Angler responses to protestor follow up question

Response	Count	%
Would Pay (unconditional)	123	15
Would Pay (conditional)	281	35
Don't know	139	17
Would not pay	220	27
Missing	42	5

After the choice tasks respondents were also asked how often they considered each of the characteristics in the choice scenarios (attribute attendance) when selecting their trip. The trip characteristic which anglers most frequently stated they always considered in the choice task were MLS, while cost was most frequently reported as never being considered (Table 50). This may suggest that the chosen cost levels were not high enough to get noticed.

Table 50. Angler responses to attribute attendance follow up questions (n = 772).

Response	Total Catch (%)	MLS (%)	Bag Limit (%)	Catch > MLS (%)	Keep (%)	Other Fish (%)	Cost (%)
Always	53	64	53	55	56	45	46
Sometimes	30	22	26	27	20	35	24
Never	17	14	21	18	23	20	30

3.3.2 Choice modelling

All choice models reported were corrected for protestors (i.e. anglers identified as protestors have been removed). Hence, 220 anglers who stated that they would not pay if the fund was implemented tomorrow were removed from further analysis. The results of a conditional logit model fitted to the choice responses corrected for protestors, showed a non-significant alternative specific constant for cod and a weakly significant alternative specific constant for sea bass (Table 51).

The minimum landing size (MLS) had a negative but insignificant effect on choice preferences for both cod and sea bass. The number of target fish that can legally be kept had a positive and statistically significant influence on trip choices for both cod and sea bass (Table 51). For cod, increasing the number of fish caught and then released due to MLS had a positive but insignificant impact on choice preferences, whereas for sea bass it was significant. For catching and releasing sea bass due to the MLS, keeping one, two or three sea bass had a positive and significant effect on angler trip choice compared to catching and releasing no sea bass (Table 51). The number of cod caught and released due to the bag limit had no significant impact on angler choice preferences for one or two cod (relative to the base case of catching and releasing zero cod), but three cod had a significant and positive impact on angler trip choices (Table 51).

Catching and keeping one other (non-target) species on a cod trip had no significant effect on trip choices relative to catching and keeping zero fish (Table 51). However, for catching and keeping two other fish a positive and weakly significant ($p < 0.10$) impact on choice preferences was found (Table 51). For catching and keeping three other fish, a significant and positive preference relative to catching and keeping zero other fish was found. For sea bass the effect of catching and keeping one, two, or three other fish had a positive and significant effect on choice preferences (Table 51). The expected negative coefficient was found for cost for both cod and sea bass indicating that increasing costs has a negative impact on angler choice preferences (Table 51).

The mean willingness-to-pay for catching and keeping fish ranged from £22 for one cod to £48 for three cod and £30 for one sea bass to £34 for three sea bass (Table 52). For cod, the only other significant results were releasing three cod due to the bag limit (£16) and keeping three other fish (£24) (Table 52). However, for sea bass all effects were significant with marginal willingness-to-pay varying from £7 to £24 depending on the scenario (Table 52). There was uncertainty in these estimates indicated by the large confidence intervals around the means (Table 52).

Table 51. Conditional logit model of angler's trip choices for target species sea bass and cod corrected for protestors (n = 570 anglers). * p < 0.10, ** p < 0.05, and *** p < 0.01.

	Cod (n = 162 decision makers, 648 choices)		Sea bass (n = 408 decision makers, 1632 choices)	
Attributes	**Coefficient**	**P > z**	**Coefficient**	**P > z**
ASC_SQ	0.424	0.413	0.538	0.072*
MLS	-0.004	0.851	-0.001	0.950
Keep one target fish	0.906	0.002***	1.182	<0.001***
Keep two target fish	1.685	<0.001***	1.272	<0.001***
Keep three target fish	1.925	<0.001***	1.351	<0.001***
One target fish released due to MLS	0.082	0.737	0.287	0.051*
Two target fish released due to MLS	0.224	0.402	0.420	0.011**
Three target fish released due to MLS	0.295	0.314	0.466	0.008***
One target fish released due to bag limit	0.185	0.486	0.403	0.011**
Two target fish released due to bag limit	0.497	0.120	0.763	<0.001***
Three target fish released due to bag limit	0.658	0.022**	0.851	<0.001***
Keep One Other Fish	0.408	0.116	0.415	0.010**
Keep Two Other Fish	0.567	0.068*	0.730	<0.001***
Keep Three Other Fish	0.984	0.003***	0.959	<0.001***
Cost	-0.040	<0.001***	-0.040	<0.001***

Table 52. Conditional Logit mean marginal Willingness-to-pay estimates (Delta method) to catch and keep and catch and release fish on angling trips. 95% confidence intervals in parenthesis, corrected for protestors (n = 570). Bold indicates significance, grey not significant.

Fish	MWTP for catch and:	Conditional Logit		
		One Fish	**Two Fish**	**Three Fish**
Cod	Keep	**22.39* (6.59 to 38.19)**	**41.64* (23.08 to 60.21)**	**47.56* (30.27 to 64.84)**
	Release due to minimum landing size	2.02 (-9.55 to 13.59)	5.53 (-6.45 to 17.51)	7.29 (-6.15 to 20.72)
	Release due to exceeding bag limit	4.56 (-7.94 to 17.06)	12.27 (-1.89 to 26.44)	16.25* (3.76 to 28.74)
	Keep Other Fish Species	10.08 (-1.97 to 22.14)	14.01 (-0.89 to 28.91)	**24.31* (8.70 to 39.91)**
Sea bass	Keep	**29.80* (19.60 to 40.00)**	**32.07* (22.41 to 41.72)**	**34.05* (25.84 to 42.27)**
	Release due to minimum landing size	**7.25* (0.43 to 14.07)**	**10.60* (3.62 to 17.59)**	**11.76* (3.85 to 19.67)**
	Release due to exceeding bag limit	**10.16* (2.73 to 17.59)**	**19.25* (11.04 to 27.46)**	**21.46* (14.55 to 28.37)**
	Keep Other Fish Species	**10.46* (3.12 to 17.80)**	**18.41* (9.37 to 27.46)**	**24.17* (15.34 to 33.01)**

3.4 Discussion

Coefficients for the ASC_SQ variables from the conditional logit models (Table 52) showed that cod anglers were more likely to choose one of the proposed angling trips than to do something other than going fishing. This was not the case for sea bass, where there was a greater probability of choosing to do something other than going fishing than a trip with changed catch regulations, although this result was only weakly statistically significant ($p < 0.10$). This could be attributed to a greater number of anglers in the sea bass sample having preferences for current regulations. For both cod and sea bass anglers, increasing the MLS of cod or sea bass had no significant impact on choice probabilities, indicating that anglers were indifferent to increasing cod or sea bass MLS all else being equal.

Both cod and sea bass anglers exhibited a positive preference for trips with increasing catch and keep of the target species. This was true for catching one two or three cod or sea bass. Increasing marginality was found for two cod caught and kept (£41.64) which were valued at almost twice that of one cod caught and kept (£22.39). However, catching and keeping three cod only added an additional £5.92 compared to mean MWTP for two cod. The average sea bass angler in our sample had positive and statistically significant preferences for catching and keeping an increasing number of sea bass. Mean MWTP for catching and keeping sea bass showed a greater amount of marginality than cod, with the value of the second sea bass caught and kept only increasing mean MWTP by £2.27 (compared to the value of catching and keeping one fish, £22.39) and the third fish only adding £1.98. The high value anglers attribute to the first sea bass caught and kept may be a result of anglers habituating to sea bass bag limits and accepting a shift to catch and release for subsequent catches of sea bass. It showed that the average angler in this sample values catching and keeping, but the marginal value of an extra fish caught and kept decreased substantially. Further analyses are needed to assess whether MWTP decreases further with an increasing number caught and kept as this study could only consider a maximum of three target fish caught and kept.

Sea bass anglers showed positive and significant preferences for catching and releasing undersized sea bass (i.e. sea bass released due to a bag limit). The MWTP values showed the marginality of these values, with the first undersized sea bass caught and released being valued at £7.25 and decreasing increments for catching and releasing two (£3.25) and three (£1.16) undersized sea bass. The MWTP for catching and keeping sea bass was over four times the MWTP for catching and releasing undersized sea bass. While this suggests that anglers value being able to catch and keep sea bass, this difference decreased with increasing catch quantity. For an increasing number of sea bass caught and released due to a bag limit (i.e. sea bass above the MLS), a positive and significant influence on angler choice preferences was found. The average angler valued catching and releasing sea bass due to a bag limit more than an MLS, which was unsurprising as fish released due to the bag limit are likely to be bigger. Mean MWTP for catching and releasing due to the bag limit was less than three times that for catching and keeping sea bass. The difference between the first undersized sea bass released and the second was only £3.25, and for legally sized sea bass the difference is £9.09. This difference in marginality for catching oversized sea bass was likely driven by sea bass anglers practising catch and release and shows that the average bass angler values being able to catch and release a legally sized bass more than an undersized bass. For cod only catching and releasing three legally sized (i.e. due to the bag limit) cod was significant and approximately a third of the MWTP of catching and keeping three cod.

Anglers generally showed positive preferences for catching an increasing number of non-target species on angling trips. For cod this effect was only significant for catching and keeping three non-target fish relative to the base case of zero. In comparison the mean MWTP to catch and keep three non-target species (£24.31) was approximately half that of catching and keeping three cod (£47.56), and larger than that for catching and releasing three cod due to a bag limit (£16.25) (i.e. legal sized cod). For sea bass, anglers had a statistically significant preference for trips in which they catch and keep one, two or three non-target species. Mean MWTP for catching and keeping one, two or three non-target fish is very similar to that for releasing one, two or three legally sized sea bass. As the non-target species caught were not specified it is likely that anglers were interpreting this trip attribute in different ways.

There was large variation in WTP for catching and releasing sea bass due to different management options and some limited evidence for cod. A strong desire to consume fish has been demonstrated by the large positive willingness-to-pay for the retention of both cod, bass and other species. As a result, it is important to maintain the ability for anglers to retain fish through measures such as bag limits. However, for sea bass, it is unclear how the value of recreational trips might change with increased bag limits due to a relatively large amount of value being attributed to the first sea bass caught. Hence, value maximisation may not be as straightforward as simply increasing bag limits as aggregated value will be determined by the relative number of fish caught and kept and caught and released by the wider population of anglers. In addition, catching and retaining the target species had more value than other non-target fish, so simple displacement to other species will not retain a similar level of value despite satisfying the need to retain fish for food. However, as the other species were not specified in this study further investigation of the relative value of substitutes is warranted. In addition, there were clear differences between the outcomes for cod and sea bass, suggesting that willingness-to-pay does not generalise across species, despite some similar trends. As a result, more data is needed on a broader range of species to help assess variation between species.

Given the sample is self-selecting, there is potential for bias in the estimates. Comparison with the characteristics of the sea angling population derived from a face-to-face survey of 12,000 households in the UK (Watersports Participation Survey) showed that respondents to the survey fished more and were older than the general sea angling population. However, the sampling strategy employed in this research was the most efficient and effective option available. There is no list of sea anglers (e.g. as provided by the licence system that exist in other countries), making the use the use of probabilistic sampling techniques challenging and very resource intensive. A separate postal or telephone survey would have to be done, but it is unlikely that this would generate sufficient numbers of responses due to the low participation rate of sea anglers amongst the general population (2%) and poor response rates to these types of survey. Moreover, the topic of this research is attitudes towards management options and data collection, so a more informed and participative sample may provide the best route to access the specialist information needed. The use of self-selected samples is a common issue in the stated preferences literature, particularly due to the increase of internet-based surveys (Lindhjem and Navrud, 2011, Johnston et al., 2017). To mitigate against this, the sample size for this survey is adequate in relation to recent guidance (Rose and Bliemer, 2013). In addition, the pre-test of the survey and qualitative post-validation of results both increased the robustness of quantitative results (Johnston et al., 2017). Post-stratification and reweighting would be challenging in this survey due to limited sampling and would therefore need to avoid excessive reweighting (Baker et al., 2013). The specialist nature of the information provided by respondents meant that it may be beneficial to obtain a sample with extensive experience and expertise (Train, 2009). Hence, the sample used in this research is deemed to be internally consistent and provide robust results for informed and participative sea anglers.

Further analysis is needed to ensure the robustness of the outcomes. There was limited time to analyse the data and many potential models. The conditional logit model was chosen from first principles as the most simple and robust approach, but there are many other potential models that could be applied. For example, the mixed logit model could be used instead of the conditional logit. The mixed logit would allow relaxation of some assumptions made within the conditional logit model. The conditional logit model assumed that anglers are homogenous in responses to the characteristics of the choice alternatives, but a mixed logit can account for heterogeneity in angler preferences. As a result, mixed logit models allow estimation of a distribution of individual WTP values, that are likely to be more realistic than simple mean estimates produced by the conditional logit approach. Hence, further analysis is needed using a suite of modelling approaches to assess the robustness of the outcomes before these values can be used to support decision making. Once the analysis and outcomes from the model are robust, it would be possible to use MWTP from the choice experiments alongside the catches from the UK sea angling survey to assess changes in value due to different bag limits.

4 Implications for the future management of sea angling

4.1 Attitudes towards data collection, management and development of sea angling

The research analysed the attitudes of recreational sea anglers to a range of issues: their behaviour and motivations, involvement in data collection, effectiveness of management measures and funding for sea angling. Descriptive analysis allowed for an understanding of the range and distribution of attitudes held across all respondents and regression analysis highlighted the difference between some groups. The self-selected nature of the survey means that results should not be considered representative of all sea anglers in England, but they are nonetheless important.

The most important motivations were catching a variety of fish species and being in a healthy and beautiful environment. This suggests that future management should target maintaining and improving both to retain and increase participation in sea angling.

The appetite for sea anglers to be involved in data collection generally is very encouraging and can be built upon to help increase the involvement of sea anglers in citizen science to inform future management. The willingness to provide data about catches and participation (which was higher than for social and economic data) is surprising and significant. Appropriate use of the data to inform the future development of sea angling, inform management measures and highlight the impact of sea angling will help encourage ongoing and wider participation.

There is a widespread view that fish stocks are being harmed by damage to habitats and overfishing by commercial operators. More sea anglers think that recreational management measures are more effective than commercial management measures, and qualitative research suggests that sea anglers think there is a bias in this regard against recreational sea angling. To increase the support of recreational anglers for future management, it is important to ensure that recreational sea angling is dealt with fairly and to be transparent and consistent about the application of management measures.

Although knowledge of the bag limit for sea bass was widely known, knowledge of other management measures amongst respondents was mixed. There is also a widely held belief that some other sea anglers do not adhere to current regulations. Work could be undertaken with sea angling organisations and individual anglers to develop better knowledge and to encourage more sustainable practices.

There is no unified view about how sea angling development should be funded in future, with none of the options presented receiving majority support. However, government funding and a sea angling licence were the options most heavily supported, with just under one third supporting a licence. That support was conditional on the use made of funding for sea angling development and there being better management of commercial fishing and improvements in stocks. Further research and feasibility need to be conducted if any of the funding options are to be taken forward.

Regression analysis has shown that those who would not contribute to a compulsory sea angling development fund hold significantly different attitudes to other groups on a range of topics and efforts could be made to engage these more in future management.

4.2 Impact of management on economic value of sea angling

This study has provided WTP estimates for recreational catch of cod and sea bass. The research has also differentiated between WTP for catching and keeping and catching and releasing as a result of catch regulations. Breaking down angler preferences by the number of target and other fish caught and released led to estimation of the marginality of angler preferences for catching-and-keeping and catching-and-releasing an increasing number of fish. For cod, the mean angler WTP for catching and keeping an additional target fish started relatively high but decreased after two fish caught and kept. For sea bass the mean value of the first fish was higher than cod, but the second fish was only worth an additional £2.27 and the third an additional £1.98. Cod anglers appeared to put a higher value on catching and keeping more than one cod than on catching-and-keeping one sea bass, which could be a result of the perceived difficulty of catching even one legally sized cod.

By estimating separate values for catching and keeping and catching and releasing it has been shown that mean angler WTP for sea bass is largely derived from keeping the fish. Mean MWTP (from the conditional logit model) for catching and keeping one sea bass was more than four times that of catching and releasing due to an MLS, and almost three times that for catching and releasing one sea bass due to a bag limit. While it is difficult to draw definite conclusions for cod due to the lack of significance in the WTP estimates, catching and keeping three cod is worth almost three times that of catching and releasing three cod due to a bag limit. There appears to be a larger difference between WTP estimates to keep and to release cod than for sea bass, suggesting that anglers targeting sea bass have stronger preferences for catch and release than those targeting cod.

These results have implications for the management of recreational angling. The presence of varying levels of marginality in preferences for the number of fish caught on a trip must be accounted for in order to avoid mis-stating the aggregate value of recreational angling trips if the marginal value of increasing catch is not considered. The importance of considering both WTP for catch and keep and WTP to catch and release target species due to catch regulations has also been highlighted. Relying solely on WTP to keep fish risks misstating the potential impact of changes in catch regulations. There was a high degree of uncertainty in the modelling approach used, so further analysis is needed before results can be used to support decision making. However, data collected has the potential to be used alongside catch data from sea angling surveys to assess changes in value that result from changes in catch regulations such as sea bass bag limits. This is very important and could be used to show the change in value under different bag limits for sea bass as part of the evidence to inform future management measures.

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Annex 1. Initial consultation interview questions

A. Their organisation

Please briefly describe what your organisation does and what your role is.

In what ways is your organisation affected by the future development and management of sea angling?

B. Views on the Future of Sea Angling

1. The Future: A Blank Sheet of paper

For the first few questions we'd like you to imagine there's a blank sheet of paper and think about how you would organise the management, development and resourcing of sea angling in an ideal world?

1.1 What do you think the management of sea angling – and marine fisheries more broadly – should achieve? What is the ultimate aim?

1.2 In order to achieve this, how should sea angling organisations be involved in decision making:

- At EU level?
- At national government level?
- In management and funding decisions?

1.3 In this ideal world, what management measures would you implement to make marine fisheries more sustainable? Specify:

- Management measures for recreational sea angling.
- Management measures for commercial fisheries.
- Management measures for other coastal activities and users.

1.4 What data collection would it be important to have to ensure that the management of sea angling – and marine fisheries more broadly – was effective? Think about:

- Types of data (e.g. catch, economic, social).
- How should it be collected?
- How should it be used?
- Should there be any conditions on this data collection?

1.5 How should the management of sea angling be developed to maximise its public benefits?

- e.g. How to increase participation? Maximise economic benefits? How make more environmentally friendly? etc.

1.6 In an ideal world, how do you think sea angling management and development should be funded?

- Open response.

Prompts – should any of these be used?

- Taxation / public funding.
- Compulsory licence.

- Voluntary licence.
- Donations / charitable.
- Using freshwater Rod Licence income.
- A levy on other marine users (commercial fishing, conservation, other coastal activities).
- Angling trades investment.
- Other.

2. Context

2.1 In terms of the wider context in which sea angling operates, what do you think are the most important issues over the next 5 years that may affect the development and management of sea angling?

- Prompts: political; legislation; governance; funding; economy; within angling.

3. The Current Situation

Obviously, there isn't a blank sheet of paper, so what these questions are about you views on the current situation.

3.1 Structure: what is your view about the involvement of sea angling in current decision-making structures – relating to policy; management measures and funding? Think about what works and what doesn't work?

3.2 What is your view about the current management measures in place on sea anglers? E.g. Are they too strong, not strong enough? What else might be put in place?

- Prompts: Increased bass MLS, Bass C+R, Cod MLS etc.
- Others?

3.3 What effect do you think these have had to date?

3.4 What is your view on the management of other sectors involved in marine fisheries?

- Commercial fishing.
- Conservation groups.
- Other coastal activities / sports / groups.

3.5 What benefits do you think that sea angling creates for society as a whole?

- Prompts: Economic, social, health, community.

4. Views on this research

4.1 What issues do you think are most important for Substance to ask sea anglers about in the survey?

- Governance and management.
- Management measures.
- Sea angling development.
- Funding sea angling.

4.2 Are there any approaches or messages that are important in promoting the survey?

- Get feedback on the comms.

5. Promoting the research

5.1 We will be developing a survey for distribution in the autumn. Will you be able to help distribute survey publicity and links to your contacts/members/customers?

- What do we need to do to help you do this (e.g. lead in times)?

5.2 Are there any groups or people we should particularly involve/target?

Annex 2. Online survey

Sea Angler Attitudes Survey

Thank you for taking part in the Sea Angler Attitudes Survey. We really appreciate your help in completing this survey which will take approximately 20 minutes.

The Survey

The aim of the Sea Angler Attitudes research is to inform the government about sea anglers' such as yourselves, views on the future development and management of recreational sea angling and data collection. There are some big opportunities for sea angling and sea anglers, with significant changes to how the sport is developed and managed. This is your chance to have real input, which will be reported to government.

Who is running the research?

This research is run by Centre for Environment, Fisheries and Aquaculture Science (Cefas) and Substance. It is funded by the Department for Environment, Food and Rural Affairs (DEFRA).

Why is the survey being done?

This survey aims to find out about recreational sea anglers' views on the future development and management of recreational sea angling, what they value most and how they can contribute to it. It is for sea anglers in England.

This survey is part of a wider research project which also involves consultation with sea angling organisations and interviews with sea anglers.

The study will help inform policy decisions about the development and management of marine fisheries and recreational sea angling, with some important new developments that you can be involved in.

You can find out more about the aims of this project here.

What will data be used for?

If you agree to complete this survey you will be asked about your fishing habits, your views regarding catch regulations, and your preferences for characteristics of different sea angling sessions. The data collected will be used to produce a report to be presented to Defra and be used by officials and policymakers to inform future sea angling strategies.

Your responses will be anonymised and will be available only to researchers with both scientific and ethical approvals. A summary and full report will also be made available publicly, so that sea anglers, angling organisations and other interested parties can see it. No personal information which could be used to identify you will be published or shared. The more people willing to take part, the better the quality of the information produced.

You can withdraw from this study at any time and do not need to specify a reason.

You can find out more about how we process your information in our Personal Information Charter here.

Contact
For questions about this research: Adam Brown, Substance: [email address removed]

For TECHNICAL difficulties: Barnaby Andrews, CEFAS: [email address removed]

Informed Consent

Clicking on the "Agree" button below indicates that:

- You have read and understood the information provided on the previous page.
- You have been given the opportunity to ask questions regarding your participation in this study.
- You understand that your participation is voluntary and that you are free to refuse to answer questions and can withdraw from the study at any time, without giving a reason.
- You understand that taking part in the study involves completing an online survey. You understand that information you provide will be used for research purposes including online reports and scientific publications.
- You understand that the research data may be accessed by researchers working at, or in collaboration with, the Centre for Environment Fisheries and Aquaculture and the School of Environmental Science at UEA in related ethically approved studies but that at all times your personal data will be kept confidential, in accordance with data protection guidelines.
- You are aged 18 years or older. If you do not wish to participate in this research, please decline participation by clicking on the "disagree" button.

Agree
Disagree

Section A: Your Sea Angling Activity

A1. Please use the sliders below to indicate the number of different days on which you went Recreational Sea Angling in the last 12 months in the UK, from the shore, or from a boat.

A2. Please use the search box and the map below to select the approximate location of the place where you most recently went recreational sea angling in the UK.

A3. Overall, how satisfied are you with your most recent recreational sea angling experience at the place you have identified in the previous question?

A4. With regard to the place you have identified above, how much do you agree or disagree with the following statements?

- This place is very special to me.
- I am very attached to this place.
- No other fishing spot can compare to this one.
- I enjoy fishing here more than fishing anywhere else.
- Many of my peer anglers and friends prefer fishing here over many other places.
- I have a lot of memories of this place and the people fishing here.

A5. Please rank the following aspects of fishing from 1 (most important) to 5 (least important). Although all may be important to you, please try and say which matters most.

- Catching fish.
- The quality of the environment in which you fish.
- The social aspects of fishing.
- The solitude/getting away from it all.
- Another aspect of fishing.

A6. In relation to catching fish, please say which of the following aspects of your sea angling experience are most important to you? Although all may be important to you, please try and say which one matters most, most of the time.

- Catching lots of fish/catching regularly.
- Catching larger fish.
- Catching a variety of fish species.
- Catching wild fish.
- Not applicable.
- Other.

A7. In relation to the place/environment where you fish most often, which of the following is most important to you? Although all may be important to you, please try and say which one matters most to you, most of the time.

- A healthy/beautiful natural environment.
- Being away from other people.
- Good facilities (e.g. car parking, toilets).
- Easily accessible/convenient fishing.
- Not applicable.
- Other.

A8. Please use the slider below to indicate the number of sessions in which you have specifically tried to catch cod and bass in the past 12 months?

- 0 days.
- 1-20 days.
- 21-40 days.
- 41-60 days.
- 61-80 days.
- 81-100 days.

A9. Please tell us what your top 3 most preferred species to catch when recreational sea angling in the UK are? *(Please enter the species in the boxes provided where 1 is your favourite to catch 2 is your second favourite and 3 is your third favourite, if you don't have a second or third favourite then just leave these boxes blank).*

Section B: Your Involvement in Management

B1. Have you provided information about your angling to any of these research studies?

- Sea Angling 2012.
- Sea Angling Diary (Sea Angling 2016-2019).
- National Angling Survey 2018.

B3. Would you be willing to provide data for new studies collecting any of the following types of data? (Please tick all that apply).

- Participation/activity data.
- Spending data.
- Social impact data.
- Catch data.
- Species tagging.
- Other.
- None of the above.

B4. Please state how much you agree or disagree that each of the following uses of angling participation data would encourage you to participate in data collection efforts?

- To demonstrate the value of sea angling.
- To demonstrate the benefits of sea angling.
- To inform sea angling development.
- To inform management measures controlling what is being caught.

Section C: Your Views on Fish Stocks

C1: Please rank the following from 'very important' to 'very unimportant' in terms of the threat they pose to marine fish stocks targeted by recreational anglers? (Please rank in order of importance from very important to very unimportant).

- Damage to fish habitats.
- Overfishing by commercial operators.
- Overfishing by recreational anglers.
- Pollution.
- Climate change.

C2: What other factors do you believe threaten fish stocks targeted by recreational anglers? [Open text]

Section D: Trip Choice Scenarios

The UK Government's 25 Year Environment Plan 'A Green Future' includes goals for improving the health of fish stocks and for ensuring the sustainable exploitation of fish populations. Achieving these goals will help the development of sea angling by encouraging more people to fish and people to fish more often. A range of methods to achieve this are being explored including the conservation of spawning grounds, restocking programmes and the reduction of mortality through changes to catch regulations. Alongside work to improve fish stocks, there is a need to support the development of sea angling generally through getting people into angling and making sea angling more accessible and enjoyable.

However successfully achieving these goals will cost money and one option amongst several to help raise this money is to have compulsory payments into a sea angling development fund. Although there are no proposals for this at present, such a fund could be managed by an independent body, support sea anglers, and help to improve sea angler catches.

On the following pages, you will be asked to make a series of choices between two different one day sea angling trips in the UK (Trip A and Trip B) and a third option (Trip C) to not go sea angling at all. Trips A and B will be described in terms of the following trip characteristics:

Regulations

Bag Limits - i.e. the number of bass which you can keep per trip. Currently you are only allowed to keep one bass per day.

Minimum Landing Size - i.e. the smallest bass which you can legally keep which currently is 42 cm.

Bass caught above the minimum landing size - i.e. the number of bass you catch (whether kept or not) at or above the minimum landing size.

Catch

The TOTAL number of bass you catch on the trip - i.e. the number of bass you might expect to catch on a trip - whether or not they are above or below the minimum landing size and whether or not they are kept.

The number of bass you catch that you can legally keep - i.e. they meet or exceed the minimum landing size and are within the bag limit for this trip.

Cost

Cost - an annual mandatory payment to the Sea Angling Development Fund, money from which would be used to improve sea angling development.

The purpose of this exercise is to understand how important different trip characteristics are to you when deciding to go on a sea angling trip. Please treat each trip choice separately and assume that the trips presented are the only ones available to you.

Section D: Trip Choice Scenario D1

Please compare Trip A, Trip B and Trip C in the table below and indicate which you would prefer to take. If Trip A or B is not desirable to you, please choose Trip C. Please compare only the trips on this page and assume that the trips listed are identical except for the trip characteristics listed in the table.

These are hypothetical options and not necessarily based on current regulations. Imagine these are the only options available to you and remember that taking any trip would cost the amount shown and so reduce your ability to make other purchases. There is no right or wrong answer, but it is important that your responses reflect your true opinions as responses may be used to inform and advise on fisheries policy.

Use your mouse/ keypad to hover the cursor over each of the Trip Characteristics to see an explanation of each.

Trip Characteristics		Trip A	Trip B	Trip C
Regulations	Bag Limit of Bass	0	3	Do Something Else (Not Sea Angling)
	Minimum Landing Size of Bass (cm)	46cm	46cm	
Catch	Total number of Bass caught per trip	5	3	
	Number of Bass caught at or above the Minimum Landing Size	2	3	
Catch you can keep	Number of Bass you can legally keep	0	3	
	Number of Other Fish Caught (which can be kept)	0	3	
Cost	**Annual** Payment to the Recreational Sea Angling Development Fund	£10	£20	
Which would you choose		●	○	○

Section D: Trip Choice Scenario D2

(As Section D: Trip Choice Scenario D1, above but with attribute levels varying according to the experimental design)

Section D: Trip Choice Scenario D3

(As Section D: Trip Choice Scenario D1, above but with attribute levels varying according to the experimental design)

Section D: Trip Choice Scenario D4

(As Section D: Trip Choice Scenario D1, above but with attribute levels varying according to the experimental design)

Section D Choice Follow Ups

D3. Please select which, if any, of the reasons below explain why you are unsure about contributing to a Sea Angling Development Fund. Please tick all that apply; and if none, select "None of the above".

Section E: Funding for Sea Angling

E1. Currently, most national angling development is funded by the Environment Agency and Sport England. Below are some other forms of funding which could be used to help develop angling, please tick all that you agree with.

- Voluntary sea angling licence.
- Angler donations (e.g. voluntary addition to freshwater licence for sea angling).
- Consumer levy (tax) on tackle sales.
- Compulsory sea angling licence.
- Voluntary payment on tackle sales.
- Plastic bag tax on tackle sales.
- Tackle trade investment.
- Central government.
- None of the above.
- Other (please specify).

Section F: Management of Recreational Sea Angling

F1. Which of these species is currently subject to a daily bag limit in the UK?

- Cod.
- Whiting.

- Mackerel.
- Bass.
- None of the above.

F2. What is the legal minimum landing size for bass in UK waters?
- 42cm.
- 46cm.
- 50cm.
- None of the above.

F3. What is the legal minimum landing size for cod in UK waters?
- 35cm.
- 39cm.
- 42cm.
- None of the above.

F4. What is your opinion on the effectiveness of the following management measures for recreational sea angling in helping achieve sustainable marine fish stocks?
- Minimum landing size for bass.
- Bass bag limit.
- Minimum landing size for cod.

F5. What impact have the following management measures had on the amount of recreational sea angling you have done in the last 12 months?
- Minimum landing size for bass.
- Bass bag limit.
- Minimum landing size for cod.

F6. Do you think that the recreational sea angling management measures on bass have increased or decreased the following?
- Your personal spending on going sea angling.
- The amount of physical activity you have undertaken while sea angling.
- Your enjoyment of recreational sea angling.

F7. What percentage of anglers do you think comply with the following management measures?
- Minimum landing size for bass.
- Bass bag limit.
- Minimum landing size for cod.

F8. What is your view about the effectiveness of the following management measures for commercial marine fisheries in helping achieve sustainable marine fish stocks?
- The legal minimum landing size for bass.
- Quotas for bass.
- Quotas for cod.
- Discard ban.

F9. If the regulation and management of recreational sea angling was a blank sheet of paper, what would be the top priority for you?
[open text]

F10. If the regulation and management of commercial angling was a blank sheet of paper, what would be the top priority for you?
[open text]

Section G: About You

G1. What is your age?

- 18-24.
- 25-34.
- 35-44.
- 45-54.
- 55-64.
- 65+.
- Prefer not to say.

G2. Which of the following do you identify as? Please tick one only.

- Female.
- Male.
- Non-binary.
- Other.
- Prefer not to say.

G3. Please look at the table below and select the group that best represents your total personal income from all sources before deductions for income tax, national Insurance etc.

- £0 to £20,000.
- £20,001 to £40,000.
- £40,001 to £60,000.
- £60,001 to £100,000.
- £100,001 to £200,000.
- Over £200,000.

G4. Do you consider yourself to have a disability or long-term (expected to last more than 12 months) medical condition that impacts on your ability to carry out day-to-day activities?

- Yes.
- No.
- Prefer not to say.

G5. Can you please tell us the first half of your postcode? For example, if your postcode is X123 4YZ then enter X123, if your postcode is X12 3YZ then enter X12.

Annex 3. Project information webpage

Sea Angler Attitudes Research - Project Overview

The Sea Angler Attitudes Research is some **exciting new research** for sea anglers to have input about the future management and development of sea angling.

Research company Substance is working with Cefas to do the research, funded by Defra.

Aim
The aim of the research is to inform the government about **sea anglers' views** on the **future development** and **management** of recreational sea angling, what they **value most** and data collection.

A key element of the work is the **Sea Angler Attitudes Survey** – click here to take it.

Context

Recent years have seen an **improvement in knowledge** about recreational sea angling in England (and the UK more broadly). In particular, Sea Angling 2012 and the Sea Angling Diary project have sought to find out what sea angling is worth and what sea anglers catch.

There have also been some important **changes to sea angling management** – such as minimum landing sizes and bag limits.

However, the wider context for the management of marine fisheries is changing over the next few years, not least due to the **UK's exit from the European Union and the new Fisheries Bill**.

This means that it is an appropriate time for **sea anglers to help to collaboratively shape future policy and management** of the activity and the future of marine fisheries more generally. It is an opportunity for a '**blank sheet of paper review'** of:

- The promotion of sea angling.
- How sea angling can be sustainable within wider management of marine fisheries.
- How best to realise sea angling's many benefits.
- Sea angler involvement in providing information to help management.
- The funding of sea angling.

To do this, **Substance and Cefas are running a new survey** for anybody who fishes in the sea for recreational purposes in England.

Use of the research

The study will help inform **policy decisions** about the development and management of marine fisheries and recreational sea angling. The report produced will be presented to Defra and be used by officials and policymakers to inform future sea angling strategies – relating to the protection of marine fish stocks and the development of sea angling in the UK. A summary and full report will also be made available publicly, so that sea anglers, angling organisations and other interested parties can see it.

Who is involved?

The project is funded by, and reports to, Defra, the government department responsible for marine fisheries. It is commissioned and managed by Cefas and undertaken in conjunction with Substance.

In the early stages of the project, Substance has **consulted with a wide range of sea angling organisations** and other related and interested organisations. This included: The Angling Trust, Angling Trades Association, BASS, Association of IFCAs, the Institute of Fisheries Management, businesses and others.

How will data be handled?

Data gathered will be predominantly via an online survey. All responses will be anonymised, and data only used in aggregate. All data gathering will be in accordance with the new GDPR arrangements. Substance is accredited with the highest possible data security standards, ISO27001.

Subjects covered will include

Sea angler **experience and motivations**.
Views on management **measures**.
Sea angler preferences related to **different angling scenarios**.
How sea angling development should be **paid for**.
What **information** should be collected to help development, and how data should be used.

What is the scope of the project?

The study is being undertaken by Defra and focuses on recreational sea angling, with a focus on England at this stage. It involves *anybody* who fishes for recreation in the sea.

Who should get involved?

Everyone who has an interest in the future of sea angling. The survey will be publicised as widely as possible, through all available channels and involving as many organisations as possible.

Project timetable

Initial **consultation** - September and October 2018.

Survey – early 2019.

Final Report – spring 2019.

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Annex 4. Follow-up interview questions

Sea Angler Attitudes Research

Interview Questions

1. Your fishing

1.1 Please describe your sea angling habits:
- How long have you been doing it?
- How often do you go – e.g. last 12 months?
- Where do you fish?
- What do you fish for most often / and how this varies throughout the year?

1.2 Has your sea angling experience improved/got worse/stayed the same over the last 5-10 years?
- How has it changed?
- Why has it changed?

1.3 What is your main motivation for going sea angling?

1.4 What factors are important in picking a sea angling site?

1.5 If you think about a recent sea angling trip which was very satisfactory, which factors were most important in making it a good experience?
- Catch.
- Surrounding environment.
- Social aspects / solitude.

1.6 If you think about an unsatisfactory recent trip, what was it made it unsatisfactory?

2. Current Situation

2.1 What are your views on the current management measures for bass and cod?
- Bass bag limit.
- MLS for sea bass.
- MLS for cod.

2.2 What are your views on the current involvement of angling bodies in national and European decision making?

2.3 What are your views on the current development of sea angling?
- What are the main issues faced?
- What is being done?
- Funding?

3. The Future

3.1 What do you think should be in place in terms of management measures for sea bass and cod?

- Sea bass bag limit.
- MLS for sea bass.
- MLS for cod.

3.2 What else should be done to ensure sustainable sea angling and marine fisheries?
- Recreational.
- Commercial.

3.3 What should be done to enhance co-management of marine fisheries?
- How should sea anglers be involved in decision making?

3.4 What should be done to help sea angling develop?
- Prompts from survey.

3.5 How should sea angling development be funded in future?
- Prompts from survey.

3.6 Are you aware of the Marine Fisheries White paper / Bill? What are your views on this?

4. Data Collection

4.1 What data should be collected to help inform sea anglers?
- From sea anglers.
- From others.

4.2 How should this data be collected and used?

4.3 Have you been involved in any angling-related data collection?

5. Any other comments

- Would you like to make any other comments about the future of sea angling in terms of its management, development or funding?