MMO1163: Mapping recreational sea anglers in English waters

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Abbreviations

Abbrev.	Phrase
BNG	British National Grid
CI	Confidence intervals
d_w	days of operation per week
EU	Europe/ European
FK	Fisher knowledge
GES	Good Environmental Status
ICES	The International Council for the Exploration of the Sea
IFCA	Inshore Fisheries and Conservation Authority
Km	Kilometres
MCAA	Marine and Coastal Access Act 2009
MCZ	Marine Conservation Zones
MEDIN	Marine Environmental Data and Information Network
MMO	Marine Management Organisation
MPLA	Marine plan area (Annex B)
MPS	Marine Policy Statement
MSP	Marine spatial plan, marine spatial planning (alt. maritime spatial planning) according to context
MSSQL	Microsoft SQL Server
m_y	months of operation per year
OSGB	Ordnance Survey Great Britain
OSGB36	Ordnance Survey Great Britain 1936
OTR	Open-text reference
OTS	Open text sample
P	Probability
pMPA	Proposed marine protected area (see Definition of Terms)
RSA	Recreational sea angling
RSA	Recreational Sea Angling
RSAs	Recreational Sea Anglers
RSF	Recreational sea fishing
SD	Standard deviation

T-SQL	Transact Structural Query Language. A language used to interact with relational databases.
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
WGS84	World Geodetic System 1984

Definition of Terms

Term	Definition
Acquisition	The extraction of open text samples to a database for classification. Also includes some basic processing and filtering (e.g. discarding of duplicates), translating written numbers to digit representations, conversion of content to well-formed data (e.g. date extraction) and stripping of mark-up.
Activity	General term used to denote that an indicator of the magnitude of angling effort is being described. The units will vary, and the indicator will typically be a proxy for relative activity levels. For example, the number of open text submissions to an online forum by month can be used as a proxy measure of monthly activity.
Aggregate	A reporting term meaning to summarise one or more variables by a particular function (e.g. sum, count, average)
Category	See lexicon category.
Category (nested)	See lexicon category.
Classification	Process of assigning meaning to open text samples, according to a set of classes (or variables) in which we have an interest. Also see *tag* and *tagging*.
Expansion	General process of programmatically adding words to the lexicon (and gazetteer, via substitution) to improve yields.
Framing layer	A polygon vector layer which is used for reporting purposes to group intersecting gazetteer points. Different framing layers were used to report on afloat, shore and charter boat data. Charter boat spatial data were extremely sparse hence the framing layer is a point vector layer of the home ports.
Gazetteer	List of named locations with geospatial coordinates which are used to associate one or more places to an open text sample. Separate gazetteers were used for afloat and shore platforms.
Gazetteer (Afloat)	Spatial layer containing named point vectors compiled from multiple georeferenced sources. The afloat gazetteer contains points relevant for boat and kayak angling.
Gazetteer (Shore)	Spatial layer containing named point vectors compiled from multiple georeferenced sources. The shore gazetteer contains points relevant for shore angling.
Georeference	Process of associating a known location with coordinates from a recognised coordinate system. This allows us to produce spatial maps.
Lexicon	A dictionary of words related to sea angling in England.

Lexicon category	Words in the lexicon are categorised by the subject they refer to (e.g. species, charter boat). Within a category, words are grouped by their parts of speech to facilitate automation.
Lexicon nested category	A nested category contains two or more lexicon categories. An example is the species category; the species category contains a nested category for each distinct species.
MPLA	Marine plan areas define the designated regions across England that are separated for the purpose of marine planning and management.
Open text sample	A single piece of text relating to angling activity (e.g. a trip) which is typically authored by a single person. This usually refers to a single post to a forum, a blog article, or a single response to content by another party.
Parts of speech	A category to which a word is assigned in accordance with its syntactic function, e.g. proper noun and verb.
Platform (Afloat)	Angling activity occurring from a boat or kayak. This general term is used when data are merged from kayak, private boat or charter boat platforms, or if the activity was not from the shore, but a more specific platform could not be determined.
pMPA	Proposed Marine Protected Areas from 2012. Not to be confused with marine plan areas (see below).
Quartile	See tertile, but 4-bins.
Quintile	See tertile, but 5-bins.
Season (2-bin)	Months, grouped into two seasons according to: • *Summer*: April, May, June, July, August, September • *Winter*: October, November, December, January, February, March
Season (4-bin)	Months, grouped into four seasons according to: • *Spring*, March, April, May • *Summer*, June, July, August • *Autumn*, September, October, November • *Winter*, December, January, February
Snowball sampling	The technique of building up a sample from using some initial set of samples as informants, or otherwise extracting additional samples from that initial set.
Substitution	Process of programmatically adding alternate place names to the gazetteer by replacing words with their synonyms (e.g. beach and sands, in West Beach and West Sands).
Tag	Key element of the data mining method. Multiple tags are assigned to open text samples, and they assign strict meanings to the text. Alternatively, they may be considered as analogous with levels of

	a categorical variable (variable: platform; levels: afloat, shore, charter) against which we can perform further processing, analysis and reporting.
Tagging	Programmatically assigning a word in the lexicon to an open text sample. For example, a platform tag must be in ‘charter boat’, ‘kayak’, ‘shore’, ‘private boat’ or ‘afloat’. However, the corresponding lexicon categories have hundreds of alternative words of different parts of speech for each tag. By restricting the tag, we can very easily report by platform, but ensure we maximise the number of open text samples from which we extract meaningful data.
Tertile	A 3-bin quantile, which recodes a continuous variable (e.g. angling hours per km^2) to a qualitative variable by placing numbers into three different bins so that each bin has an approximately equal count of the continuous variable samples.
Value	Value is an ordinal indicator of the importance of a site or species to sea anglers. Note it is not a monetary value. The term value is used in preference to intensity or effort because the data mining methodology cannot reasonably distinguish—to 100% accuracy—the difference between an expression of interest in a particular site or species and the physical attendance of an angler at a site or a catch. Moreover, in the context of this report, value of species and sites to anglers is of more importance than counts of catch or effort, although value will be highly correlated with these metrics.
Value record	A data record, attached to an open text sample, derived from the classification processing using tags from which we can assign the value of activity at, and the value of association of species with, spatial areas. See ‘value’ above and Table 4.
Vote counting	Analogous to k-nearest neighbours used for classification in machine learning. Here open text samples are classified according to the category which receives the most tags. Used to assign season and platform.

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Executive Summary

Introduction

This report provides insights into the spatial distribution of recreational sea angling in England. The research was commissioned to support the development and implementation of marine plan policies, and to assist the Marine Management Organisation (MMO) and Inshore Fisheries Conservation Authorities (IFCAs) to manage impacts on Marine Protected Areas and uses of the marine environment.

The aim of this project was to: Identify all relevant data (angling literature, directed surveys, and local/fisher knowledge) and apply transparent and validated methods that produce shapefile data that can be used for marine spatial planning (MSP), via the production of high resolution maps of recreational sea angling activity. The main outputs from the research are 12 map layers and accompanying data and descriptions which will be available at https://www.gov.uk/guidance/explore-marine-plans. This report provides a full technical description of methods, results, a discussion and recommendations. There is a separate non-technical summary document available with this report, it is an abridged version of this technical report meant to provide some context to the spatial layers available online for lay people.

Methods

A variety of different data sources were utilised. Public online user generated content, angling literature, available datasets and other sources were identified. Online data was extracted using data mining methods and this was used to identify sites for recreational sea angling and spatiotemporal trends in the distribution of activity and catches across England were estimated. Sources were collated and primary outputs were validated by stakeholders and IFCAs with regional knowledge, and adjustments made. Final outputs were summarised in the form of this report, full datasets and high resolution maps provided to MMO.

Results

Spatial layers were generated that show the distribution of recreational sea angling from the shore around the English coast and found to accord well with expert stakeholder knowledge. Species specific knowledge was not as comprehensive as knowledge of site activity levels. For charter boats, more trips were found to occur in the summer although activity patterns were higher than shown in previous research. General ground fishing was the most popular fishing ground type across England, and the top three ranked species across all MPLAs were cod, skates and rays, and whiting. Data on private boat and kayak platforms were poor in comparison to charter boat records which were poorer than for onshore activity.

Discussion

A total of 503,681 activity records (afloat and shore) were extracted, which is a much larger number than previous survey methods have used. In this case, the application of more statistically efficient survey methods was limited by time, resources and overall cost. A wider reaching validation exercise is recommended than was possible here to supplement and further validate future work. The data mining method used here is repeatable with some caveats. Evidence suggests a decline in the use of angling blogs and forums, and a shift towards the use of social media, so the nature of open text records will change over time. Some data used may be out of date. Data generated by this methodology can be a useful tool for highlighting gaps in knowledge of the distribution of recreational sea angling in England, and for determining ideal resolutions of outputs with regards to legislative requirements.

1. Introduction

1.1 Background

Marine recreational fishing is a high participation activity, with significant economic and social benefits. In Europe, 8.67 million individuals' fish for 77.6 million days, spending 5.89 billion euros annually, with a total annual economic impact of 10.5 billion euro supporting around 100,000 jobs (Hyder et al., 2018). Marine recreational fisheries provide such an inherently valuable commodity that some consider them to be self-subsidizing (Kleiven et al., 2019). However, marine recreational fisheries can also have a significant impact on fish stocks, accounting for 2-43% of all removals (commercial and recreational) (Radford et al., 2018) and they have the potential for a broad range of environmental impacts (Lewin et al., 2019), including both positive (contributions to beach cleans and environmental reporting) and negative (litter, angling debris) aspects. Around one million people or 2% of the population of Great Britain fish in the sea each year (Armstrong et al., 2013a), and recreational sea angling (RSA) has an impact on stocks, with, for example, 25% of sea bass removals in England in 2012 estimated to be by anglers (Armstrong et al., 2013a).

The importance of marine recreational fisheries was recognised by the European Commission, leading to requirements under the Data Collection Framework since 2002 and EU Control Regulation 1224/2009 since 2009 to report catches by RSAs. In the United Kingdom (UK), there is regular data collection within the Sea Angling Diary Project (www.seaangling.org) by Substance and Cefas. The programme generates understanding of participation patterns, catches and expenditure across the UK. Additional studies have been done on other aspects of RSA in England (Brown et al., 2013; Drew, 2005; Lawrence, 2005), including highlighting factors affecting participation (Brown, 2012). The importance of RSA has been recognised by PECH (the European Parliament's Committee on Fisheries) in the 2018 Resolution (2017/2120) (European Parliament, 2018) and in the UK Fisheries White Paper (Defra, 2018). However, there are significant challenges in monitoring recreational fisheries due to the diverse (many platforms and gears) and dispersed (spatially and temporally) nature of the activity (Jones and Pollock, 2013; Hyder et al., 2018).

The marine environment is experiencing increased demands from different sectors, including energy generation, marine leisure activities, commercial and recreational fishing etc. Understanding and managing the multiple uses is essential, and MSP has become a cornerstone of good marine governance in many jurisdictions (e.g. European Commission, 2014; MaPP, 2016; The White House, 2010; Vince, 2014). In the UK, MSP seeks to: (i) manage human activity to protect sensitive ecosystems; (ii) achieve a sustainable marine economy; (iii) ensure a strong, healthy and just society; and (iv) live within environmental limits. The MCAA 2009 states that the needs of all UK users of the marine environment should be considered in management decisions and created the legislation which allowed for the creation and ongoing management of Marine Conservation Zones (MCZs).

RSA is a diverse and dispersed activity with large spatial and temporal variation in activity and catches (Armstrong et al., 2013a). The effects of RSA on individual species, habitats and ecosystems is likely to be most detrimental in areas designated as threatened under the Convention for the Protection of the Marine Environment of the North-East Atlantic (known as OSPAR). In addition, MSP (e.g. the United Nations Convention on the Law of the Sea (UNCLOS)), EC 2014 Directive 2014/89/EU (The European Parliament and The Council of the European Union, 2014)) requires high-resolution data on RSA activity (Monkman et al., 2015a, 2018a). However, regular sea angling data collection in England has focussed on provision of catches, activity and economic impact at a regional level to provide data for fisheries management. As a result, it is not at the resolution needed to support MSP (Monkman et al., 2015; Monkman, Kaiser and Hyder, 2018).

There are few examples that study the interactions between MSP and RSA, and there is little information on spatial activity of RSA at the scales required for MSP across the UK. The exception is a study conducted in Wales, where multiple disparate sources of data were brought together to create activity maps (Monkman et al., 2015; Monkman, Kaiser and Hyder, 2018). As a result, there is a need for a greater understanding of the spatial and temporal distribution of sea angling activity in England to support MSP.

1.1.1. Marine Spatial Planning Policy Context

The MCAA 2009 provides the legal basis for a plan-led system for the UK marine environment (Defra, 2009). The purpose of marine planning under the MCAA is to help achieve sustainable development in the marine area. In July 2014, the European Parliament and the Council adopted Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning to create a common framework for maritime spatial planning in Europe (European Commission, 2014). While each European (EU) country will be free to plan its own maritime activities, local, regional and national planning in shared seas would be made more compatible through a set of minimum common requirements.

All four UK administrations adopted the UK MPS in March 2011. On adoption of the MPS, the MCAA placed a duty on the UK Government to implement marine strategy plans for England. The marine strategy plan requires:

- assessment of the marine environment, maintaining objectives to deliver Good Environmental Status (GES) and a framework for continued assessments in delivering GES.
- documenting monitoring programmes required to chart progress for all indicators and targets.
- defining the work programmes required to achieve GES.
- delivery on the marine strategy to ensure that the MMO can integrate economic, social and environmental considerations to meet legislative requirements in continuing to deliver GES in English waters.

1.2. Sea Angling Definition and Geographic Scope

RSA is a subset of activity within the broader category of recreational sea fishing (RSF). The International Council for the Exploration of the Sea (ICES) definition of RSF is ‘the capture or attempted capture of living aquatic resources mainly for leisure and / or personal consumption, and covers active fishing methods including line, spear, and hand–gathering and passive fishing methods including nets, traps, pots, and set–lines' (ICES, 2013). Legal definitions exclude subsistence fishing and fishing where the catch is sold or otherwise traded on export, domestic or black markets (Food and Agriculture Organization of the United Nations., 2008; Pawson et al., 2008) and Hyder et al. (2018) lists the current definitions in use across Europe. RSF is usually synonymous with angling, particularly in the context of the United Kingdom (UK) (Pawson et al. 2008). However, angling pertains to fishing with lines, and within the UK this is almost entirely with rod and reel. The extent of non-angling RSF was outside the scope of this project.

Within England, sea angling is usually done from three platforms: (i) shore; (ii) private boats; and (iii) charter boats. Sea angling also occurs on manually powered vessels, with kayak angling in particular becoming more popular in recent years (personal observation). There is no significant for-hire sector, where anglers hire a boat without a skipper. This platform delineation is common worldwide in marine recreational fisheries assessments and represents the different challenges involved in collecting data and variation in fisheries and economic variables between these platforms.

This report only considers sea angling in England, defined as "any fishing for marine species primarily using rod and line or hand-held line where the purpose is recreation and not for the sale or trade of the catch" (Armstrong et al. 2013a) from the shore, charter boats and private afloat platforms. The methods employed could identify kayak angling, but data were too sparse to draw meaningful conclusions.

1.3. Aims and Objectives

The aim of this project was to: 'Identify all relevant data (angling literature, directed surveys, and local/fisher knowledge) and apply transparent and validated methods that produce robust high-resolution maps that can be used for marine spatial planning (MSP).'

To achieve this, the main objectives were to:

- compile public sources of sea angling activity to provide robust data on spatial and temporal distributions along with changes in activity.
- validate this using stakeholder knowledge.
- produce a thoroughly documented and well-formed data set from which reported results were derived, including the MEDIN compatible metadata descriptors.

This work aims to produce data resources on the spatiotemporal extent of RSA that are fit to support and guide marine authorisation and enforcement decisions made by the MMO in MSP and related management decisions. This includes balancing the interests of RSAs with other uses and manage impacts on the marine environment.

It is accepted that this is a desktop exercise and project outputs are entirely limited by the extent of pre-existing data. The project also identified knowledge gaps so the MMO and IFCAs can most efficiently prioritise resource allocation to ensure data on RSA is of sufficient quality and resolution to meet all legislative requirements.

Activities undertaken to meet the project aims included:

- a review of current extent of information which can be used to map the spatial distribution of RSA activity for shore, private boat and charter boat platforms.
- (within the limits of pre-existing data), provide outputs on the spatial and temporal distributions of sea angling activity across England at a resolution suitable for MSP.
- qualify the distribution of spatiotemporal activity by species.
- validate with stakeholders those outputs which are of high enough resolution for MSP.
- openly disclose data limitations and appropriate use.
- discuss possible approaches to eliminate knowledge gaps.
- fully document all spatial outputs according to published metadata standards ensuing all consumers have full knowledge of the data lineage and its appropriate use and limitations.

This report makes extensive use of text and data mining to extract spatial data. The method is successful because automation enables the extraction of meaningful data from large volumes of public open text data (i.e. the common written word). The method can be applied to any open text, including text published on the World Wide Web (e.g. blogs, forums and social networks forums) and in traditional print media. This approach has been shown to be effective in producing qualitative information on the spatiotemporal distribution of angling from the shore (Monkman, 2013; Monkman et al., 2015a, 2018a, 2018b) and more broadly (Martin et al., 2014; Barbini et al., 2015; Giovos et al., 2018). These sources are called fisher knowledge (FK) and this has become recognised as an important source of fisheries data (Johannes et al., 2000; Richardson et al., 2006; Hind, 2014, 2015). This process was preceded by a consultation exercise with sea angling and marine stakeholder organisations and individuals, who provided both local knowledge and identification of datasets. Interim results were also subject to validation by stakeholders.

The main outputs from the research are 12 map layers and accompanying data and descriptions which will be available via the data portal at https://www.gov.uk/guidance/explore-marine-plans. This report provides a full technical description of methods, results, a discussion and recommendations. There is a separate non-technical summary document available with this report, it is an abridged version of this technical report meant to provide some context to the spatial layers available online for lay people.

2. Methods

2.1 Overview

This project performed a desk-based analysis of existing FK to develop spatial map(s) of the sites sea anglers' use across England. Interannual patterns in activity and the value of different species to anglers were additional deliverables. The methods used follow those of previously validated research work undertaken in collaboration with Bangor University and Cefas (Monkman et al., 2018a, 2018b) to describe sea angling activity in Wales (Monkman et al., 2015a).

The method involves mining public FK by using computational techniques to extract meaningful and well-formed data from open text. These well formatted data can then be used to produce qualitative temporal and spatial maps to provide relative indicators of the value of species and fishing areas across the seasons.

In the UK fishery, afloat activity is underrepresented in public FK, so all currently available information on activity (online and published) was reviewed. In addition, the extent of on-the-water mooring boat storage facilities - which facilitate rapid launching to angling grounds - was mapped.

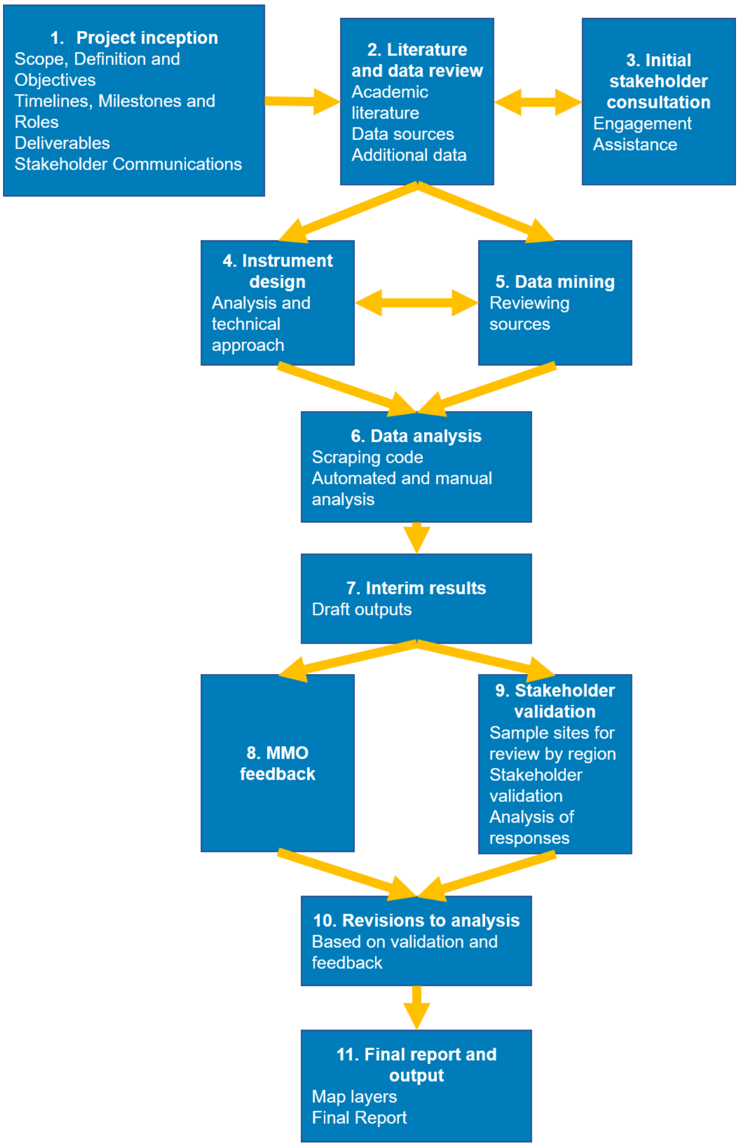
In summary the method involved the following stages, illustrated in Figure 1:

1. Project inception: This confirmed scope, definitions and objectives with MMO and stakeholders; confirmed timelines and deliverables; and identified initial stakeholder consultees.
2. Literature and data review: Searches and reviews were made to identify and summarise academic literature relating to sea angling activity, locations and species; data sources such as sea angling websites, forums and social media pages, with links recorded for the data scraping exercise; and additional data from stakeholder and statutory organisations, notably the IFCAs.
3. Initial stakeholder consultation: An initial exercise was undertaken with sea angling stakeholder organisations and individuals, consisting of semi-structured interviews (as well as one group presentation) to inform them of the project, identify other data sources and secure agreement for assistance in the validation exercise.
4. Instrument design and data mining: These were informed by the preceding stages and consisted of designing the analysis and technical approach, creating a gazeteer, creating a species list, and reviewing data sources. This identified some gaps, filled, where possible, with further data review (such as additional regional data sources and a census of afloat platform facilities). This element also included the acquisition of sea angling magazine archives and sea angling books.
5. Data Analysis: This included the implementation of a scraping code, open text analysis and both manual and automated assessment of data source value and reliability to assign confidence in each source.
6. Interim results: Interim results produced some draft outputs with map layers and data about individual sites for use in the validation.

7. Stakeholder validation: This was undertaken with both angling stakeholders (individuals and representatives of sea angler organisations) and IFCAs, facilitated by the Association of IFCAs. It involved providing reviewers with samples of sites and data about them, with a proforma feedback spreadsheet where they could indicate agreement or otherwise.
8. MMO feedback: MMO also provided feedback on the maps and data produced to help inform production of final outputs.
9. Revisions: A number of revisions were made based on the validation as well as adjustments to the final data layers and maps.
10. Final Report and Final Outputs: A Final Report was produced alongside spatial data layers of sea angling activity and MEDIN compatible metadata descriptors.

A full technical description of methods is provided in the rest of this section, with results in Section 3 and a discussion Section 4.

Figure 2. Summary of tasks, highlighting interactions and flow of data and knowledge.



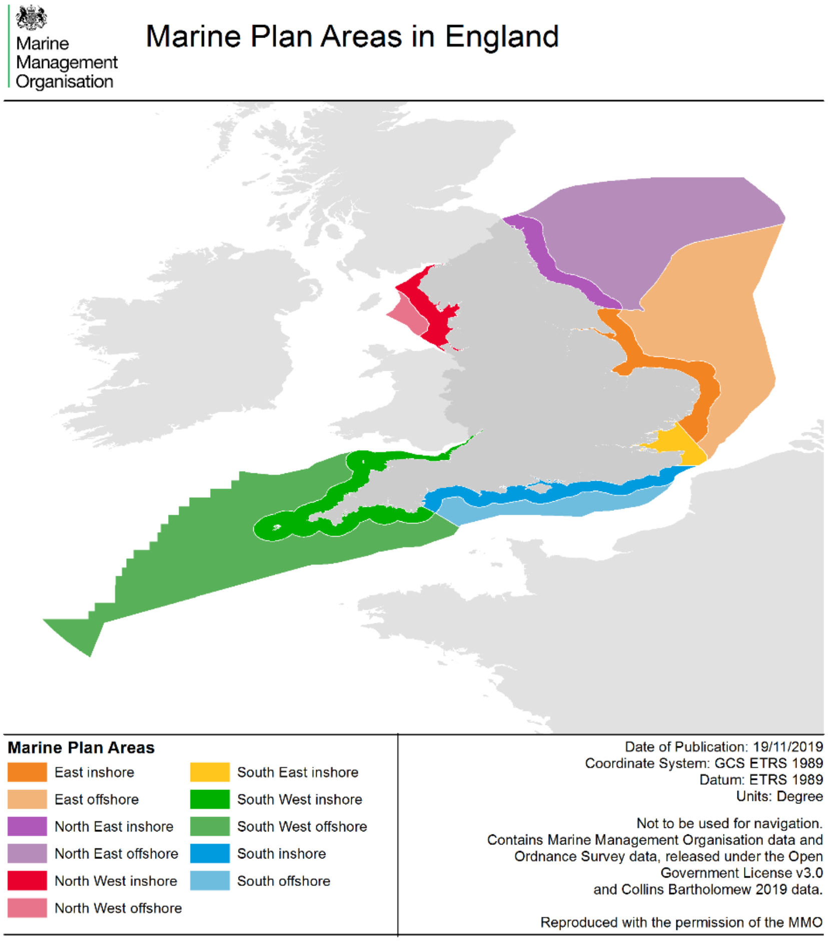
2.1.1. General

All the following apply, unless otherwise stated. All figures reported using the ± convention refer to standard deviation (SD). All confidence intervals (CI) use an α = 0.05. Statistical moments were calculated using native Microsoft SQL Server functions. Quantiles were calculated using the Microsoft SQL Server function PERCENTILE_CONT, with the exception of shore spatial outputs which used the Python library pandas qcut and cut functions (McKinney, 2010).

2.2. Spatial Extent

The spatial extent is that defined by the 11 MPLA in England, published in 2015. The offshore limits are defined by that of the outer limit of the Exclusive Economic Zone and England's territorial waters. Inshore, the MPLAs extend to the mean high water spring tide. The MPLAs are available under an Open Government License online[5]. The extent of these areas is shown in Figure 3 and a more detailed overview is provided in Annex A.

Figure 4. Spatial scope, delimited by the extent of the MPLAs in England. Copyright Bartholomew (2014). Reproduced with permission of the Marine Management Organisation and Ordnance Survey. Open Government License.



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[5] Marine plan areas available at https://data.gov.uk/dataset/ceecc6a3-297b-4a72-b2ca-d430324b546f/marine-management-organisation-marine-plan-areas

2.3. Literature and Data Review

Searches were made to identify all texts of potential relevance within the project scope. This included: (i) academic papers and reports; (ii) studies or other works commissioned or held by governmental organisations; (iii) social media relating to sea angling; (iv) sea angling literature; and (v) other grey literature. The authors held pre-existing reference databases of academic and government sponsored research and studies. These references were updated using standard Google Scholar searches. The methods employed in Monkman et al. (2015, 2018a, 2018b) require the identification of as many FK sources as possible to maximise data yields, hence social media and sea angling literature were identified using exhaustive web searches and snowball sampling. Searches were carried out over a two-week period by three project team members working independently, until no further sources were identified. All potential sources were recorded and the list is reproduced in Supplementary Materials A, available from MMO alongside this report.

Sources were manually reviewed for their suitability in three contexts: (i) contribute words to the lexicon (e.g. species names; section 2.6.2.1) or georeferenced place names to the gazetteer (section 2.6.3); (ii) provide open text from which to extract spatiotemporal activity data; and (iii) provide detailed spatiotemporal activity data in their own right (direct inclusion). The decision to exclude a potential source was made by the expert judgement of the project team following manual review. The reasons for exclusion are recorded in the Supplementary Materials and summarised in Annex A.

2.4. Stakeholder Engagement

Stakeholder engagement fulfilled three purposes: (i) to contribute additional sources to the literature and data review outlined in section 2.3; (ii) to validate and contribute to the compilation of the gazetteer and lexicon outlined in section 2.6.2.1 and section 2.6.3; and (iii) to validate results derived from FK (see section 2.6). All stakeholder engagement was led by Substance with support from the Angling Trust who facilitated contact with anglers known to have good local knowledge and who had expressed a willingness to engage in sea angling research projects.

The first engagement phase covered stakeholder recruitment to the project and requests to contribute to purposes (i) and (ii) in this section. Stakeholders were contacted during February and March 2019 and Substance introduced the project at the Angling Trust Marine Conservation and Access Group. This initial phase disclosed project aims, the parties involved, and the intended use of contributed data. It also secured ongoing collaboration from a number of stakeholders (e.g. for future validation).

Semi-structured telephone interviews were conducted with eight stakeholders in fulfilment of section 2.4 purposes (i) and (ii). Interviewees were asked for the spatial extent of their local knowledge and if they would be willing to be contacted to help in final validation (Questions, Annex E). Ongoing contact by volunteers with the project team was encouraged for the submission of additional information and the exchange of ideas. Further methods for the validation phase of the stakeholder engagement are given in section 2.7.2. All interviewees had participated in sea angling for more than 40 years and were willing to contribute to validation.

2.5. General Geoprocessing

Where necessary, all conversions between British National Grid (BNG) and World Geodetic System (WGS84) used the Ordnance Survey Great Britain 1936 (OSGB36) WGS 1984 Petroleum transformation. Conversion between the geographic ETRS89 and WGS84 projections used the ETRS_1989_To_WGS_1984 geographic transformation. All transformations were carried out in ESRI ArcMap 10 (ESRI, 2010).

Some geoprocessing tasks were performed with ETGeo Wizards and Geospatial Modelling Environment 0.7.2 RC2 (Beyer, 2015). Extensive use was made of native support for geoprocessing in Microsoft SQL Server 2012 (MSSQL) using the WGS84 geography type, particularly where data-intensive or multi-threaded tasks were required. Exports between different spatial file formats were mostly mediated through text based Well Known Text (WKT) feature definitions. Interaction with WKT features were handled in native T-SQL and Python. Additional tasks used GPSBabel (Lipe, 2019), Google Earth Pro (Google, 2019) and GDAL ogr2ogr.

All spatial outputs are accompanied by metadata which details the processing workflows executed to derive the outputs from source data. These metadata will become publicly available and form part of this methodology. The associated spatial outputs will also become available in the public domain and these are listed in Annex I.

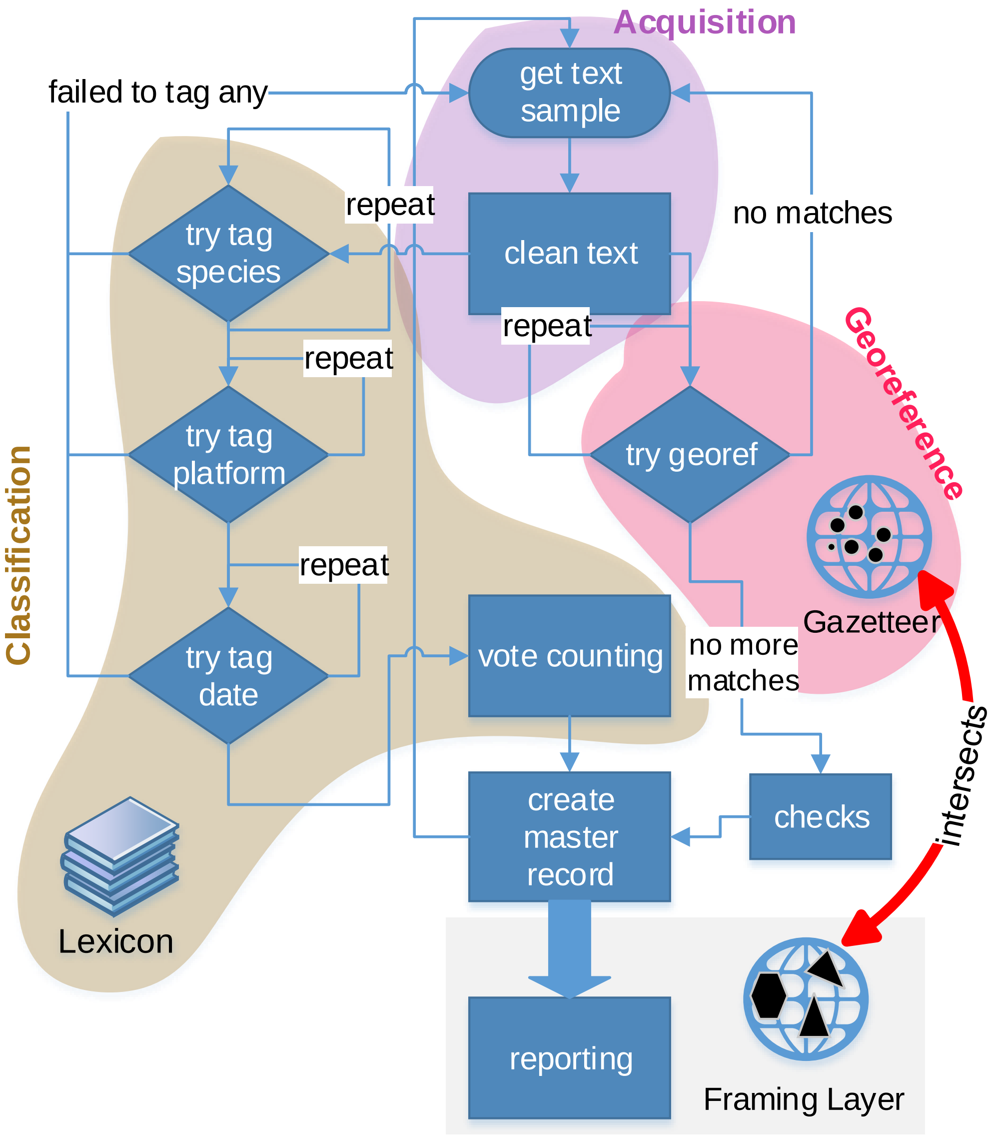
2.6. Data Mining of Open Text

The data mining of open text was used to map: (i) spatiotemporal value by species for shore angling; (ii) temporal distribution of activity, species, and grounds preferences for charter boats by home port; and (iii) spatiotemporal activity and species preferences for afloat angling platforms. The following methodological description applies to (i), (ii) and (iii).

Only publicly available texts were used. Ethical issues were considered, such as the potential impact on web published sites and data privacy (Monkman et al., 2018c) and no sources were accessed which required user authentication. Where the downloading of open text was automated, then the website’s robots.txt was obeyed. Data were stored in an encrypted MSSQL database and all downloaded open text samples (OTS) were deleted after processing.

Figure 5 gives an overview of the data mining process. The first two stages were compilation of the two separate gazetteers for afloat and shore (section 2.6.4.1), and the lexicon (section 2.6.2.1). Data acquisition (Figure 6) and georeferencing are covered in detail in section 2.6.1 and section 2.6.4.2, respectively. In brief, classification uses the lexicon and gazetteer to generate multiple labels (henceforth *tag*) for each OTS according to the text matches found; the process is detailed in section 2.6.2.

Figure 7. Overview of the data mining process. Gazetteer is a point vector of named places, compiled from multiple sources. Separate gazetteers were used for afloat and shore platforms. The framing layer is used to aggregate point data to polygon vectors (with the exception of charter boats). The lexicon is a dictionary of words used to tag open text records.



2.6.1. Acquisition

Where an online source contained small volumes of open text then data were acquired manually. This was common when contributing additional species and place names to the lexicon and the shore gazetteer respectively (as in section 2.6.2.1, and section 2.6.4.1). The bulk of open text was automatically acquired by writing custom content acquisition routines for each source. Routines were written in Python with the package Scrapy (Scrapy, 2017). Duplicates were prevented by checking for a match on the first 50 characters of the OTS against previously acquired samples. During the acquisition process OTSs were cleaned to improve processing efficiency. For example, apostrophes, invalid punctuation, XML, HTML and CSS, and non-ASCII characters were all removed. Several other tasks were performed at this stage; basic processing and filtering, translating textual number representations to digits (used in species catch classification) and conversion of content to well-formed data (e.g. date extraction). The Python package dateparser (ScrapingHub, 2019) was used to extract poorly formed or partial dates (e.g. Sept 2009) from OTSs.

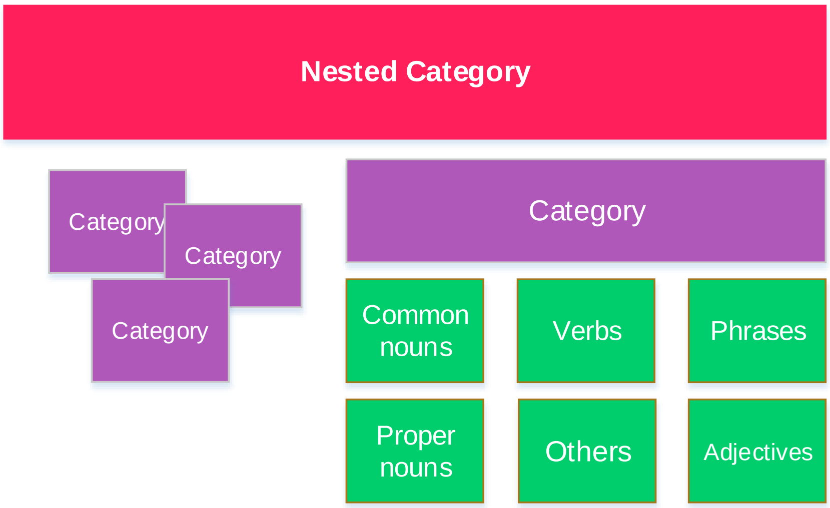
Sea angling books and magazines were used in gazetteer and lexicon compilation. Materials were provided in digital format (pdf and images) and in hard copy from which data were extracted. Hard copies were digitised to pdfs using optical character recognition. Where pdfs had embedded text content, the text was extracted using Python with the Tika package (Mattmann, 2019). For digital images (e.g. JPEGS) and images embedded in pdfs, the EAST implementation of the resnet neural network (Ren et al., 2017; Argman, 2019) was used to recognise text. Our own machine learning model was then used to group EAST extracted text from information embedded in the original document image to extract related paragraphs as contiguous text. Google's Tesseract application, with the Python wrapper package PyTesseract (Hoffstaetter, 2019) was then used to extract text from these contiguous labelled regions. All data were written to an MSSQL database for further processing. Some sources contained maps with named locations. These maps were manually georeferenced in Google Earth and then exported to the shore gazetteer.

2.6.2. Text Tagging and Classification

2.6.2.1 Lexicon

The lexicon is a list of keywords which are categorised according to the subject they refer to (within the subject domain, i.e. sea angling in England). To correctly tag OTSs, categorised lists of meaningful words are required for platform, species, gear type, date and location (and others). Within a *lexicon category* (henceforth *category*); example,   words are grouped by their parts of speech (noun, verb etc.). Using parts of speech allows words to be programmatically manipulated by natural language processing libraries, including automatic category *expansion* (defined in the next paragraph). Nested categories contain multiple categories, grouping alike entities together e.g. species (Figure 8). The lexicon was compiled from previous papers (Monkman et al., 2015a, 2018b, 2018a) and expert knowledge.

Figure 9. Category hierarchy, used in tagging open text samples. A nested category contains > 1 categories. A *category* example would be private boat and a *nested category* example would be species.



Open text—particularly from social media sources—can deviate from formal English, hence two methods were used to automatically expand the lexicon (henceforth *expansion*): (i) the Python NLTK (Bird et al., 2009) package was used to conjugate verbs and generate singular and plural common noun forms; and (ii) common spelling errors were produced for some *categories* using an algorithm based on the Levenshtein distance for words of more than four letters in length. Spelling errors were manually reviewed for the chance generation of common words (hypothetical example, *wrasse* to *was*) and such instances were removed manually.

Table 1. Truncated example of a lexicon category "*Bait (Mackerel)*". Asterisked entries give an example of automatically generated words which expand the category. This increases tagging rates and the number of value records. Phrases are never expanded.

Adjectives	Common Nouns	Proper Nouns	Verbs	Phrases
frozen	flapper	mackerel	bait	"mackerel for bait"
	flappers*		baited	
	sliver		livebait	
	slivers*		livebaited*	
			livebaiting*	

The lexical categories collated are summarised in Table 2. The additional categories listed are used in final reporting to reduce error, e.g. by identifying species used as bait, or whether the OTS is likely to refer to an actual angling trip.

Table 3. Number of words and phrases in the lexicon by phrase group. *Typos*, typos were automatically generated for the listed parts of speech; *P/C.*, automated word expansion, singularisation and pluralisation of nouns, and conjugation of verbs.

Lexicon Category	n	Typos	P/C	Example	Use
Afloat	122	Proper nouns, nouns, verbs	Yes	anchored	Tag platform
Charter Boats	532	nouns, verbs	Yes	chartered, Tracy Jane	Tag platform
Kayak	47	No	No	kayak, dorado	Tag platform
Gear	33	No	Yes	Beachcaster, rod	Tag as angling
Gear Non-Angling	11	No	Yes	Netting, spear	Tag as not angling
Private Boat	34	No	Yes		Tag platform
Metrological	41	No	Yes	heavy, pounds	Tag as a trip or catch
Session	113	No	Yes	arrived, before high	Tag as a trip
Bait (Mackerel)	56	No	Yes	fillet, livebait	Remove extraneous mackerel species tags
Bait (Herring)	42	No	Yes	fillet, livebait	Remove extraneous herring species tags
Food (Haddock)	21	No	Yes	chips	Remove extraneous haddock species tags
Bait Species	40	No	Yes	Lug, softie	Required for removal of extraneous species tags
Grounds	51	No	No	reef, hard ground	Charter boat grounds tagging
Day	60	No	No	Monday	Temporal tagging
Month	320	Yes	No	January	Temporal tagging
Season	14	No	No	Winter	Temporal tagging
Species	10,230	nouns	Yes	Mackerel, mackies	Tag species

2.6.2.1. Species List

The species list was collated from: (i) historical data held by the project team; (ii) data manually transcribed from authoritative websites; and (iii) stakeholder contributions. During consultation, stakeholders contributed additional names as outlined in section 2.4. The final list contains 163 species which have been recorded in English waters.

Species classified as rare and unusual, squid species or bait species (e.g. sand eel) were excluded from all processing. The final list contained 10,230 distinct names and aliases for different species and is summarised in Annex J. Finally, *witch* and *shad* were excluded as they have homonyms which are in common use. It was also impractical to include an unspecified species grouping for the large pelagic sharks (excluding tope) because of the frequent incongruous use of *shark* in OTSs. Several species are difficult for anglers to identify, or anglers may otherwise not provide a full name for these species in open text because the assumption is that the more commonly encountered species is being referred to (personal observation). Unspecified classes were created for these species Table 4, and tagging only used a specific species tag (e.g. ballan wrasse) if the species name was unambiguous. However, if a specific species was mentioned in an OTS, then all further unqualified references were tagged as that specific species. This approach also limited double counting.

Table 5. Common names referred to colloquial species aliases. Processing was case sensitive and unusual spelling for the colloquial names is common.

Common Name	Colloquial Name
Rockling (Unspecified)	Rockling
	Slug
Goby (Unspecified)	Goby
Blenny (Unspecified)	Blenny
Sole (Unspecified)	Sole
Weeverfish (Unspecified)	Weaver
	Weever
Gurnard (Unspecified)	Goudies
	Gurnard
Mullet (Unspecified)	Mullet
	Grey mullet
Pipefish (Unspecified)	Pipefish
Eel (Unspecified)	Eel
Bream (Unspecified)	Bream
Sea Scorpion (Unspecified)	Scorpion fish
	Sculpin
Wrasse (Unspecified)	Wrasse
Sea Scorpion (Unspecified)	Sea scorpion
	Sea scorp
	Seascorp

Common Name	Colloquial Name
	Rock sculpin
	Pig fish
	Millers thumb
	Father lasher
	Granny fish
	Bull rout
	Bullhead
	Clobberhead
	Clockamunjy
	Cockamunjy
	Devil fish
	Devilfish
	Devil's fish
	Snotty bully
Flatfish (Unspecified)	Flat fish
	Flatfish
	Flattie
	Flatty
Skate/Ray (Unspecified)	Skate
	Ray
	Raymond
	Raymondo

2.6.3. Classification

The tagging process is an implicit method to classify open text. Each OTS is searched for matches with the words in the categories and tagged when matches occur. To further decrease error rates, vote counting was used for platform, and allocation of season and month. With vote counting, the category with the most tags is used to label the OTS. For example, take the fictitious open text “we collected some bait from the shore and booked with the skipper of Titanic”. This OTS would be classified as platform charter boat (Charter: [skipper, Titanic = 2 votes]; Shore: [shore = 1 vote]).

The output of this whole process is one or more value records for each successfully tagged OTS (Table 6). Table 7 has an example of two value records (some fields omitted). From subsampling, 93% of the OTSs used for spatial and report outputs are an angling trip record. The validation process of section 2.7.2 lead to refinements to classification which are covered in section 2.7.2.1.

Table 8. Example of two *value records* for a single open text sample (*sample Id* = 1). Fields are largely self-explanatory however, *Is catch*, means the sample has been classified as a fish capture. *Intertidal* is an identifier which links the value record to a unique single feature (polygon) in the framing layer. *N* is the count of species tags per species.

Example 1)						
Sample ID	Gazetteer source	Platform	Is catch	Season	Month	Month as Nr.
1	local knowledge	shore	1	winter	December	12
date	Name	IFCA	MPLA	intertidal	species	n
30/12/2005	Cod corner	North West	North West	1234	cod	2
Example 2)						
Sample Id	**Gazetteer source**	**Platform**	**Is catch**	**Season**	**Month**	**Month as Nr.**
1	local knowledge	shore	1	winter	December	12
date	Name	IFCA	MPLA	intertidal	species	n
30/12/2005	Cod corner	North West	North West	1234	whiting	5

2.6.4. Georeferencing

2.6.4.1. Gazetteer Compilation

The gazetteer was compiled from the sources listed in Table 9. Sources were ranked according to their quality as indicated in the table. The gazetteer was expanded by replacing words in place names with common substitutions. For example, a beach may be called *beach*, *sand* or *sands,* e.g. North Beach would be expanded to include *North Sand* and *North Sands*.

To optimise searches, features were removed if: (i) they were over 1 km from the Ordnance Survey Strategic Coastline polyline; (ii) did not intersect an IFCA polygon; or (iii) duplicated by name within 0.1 degrees (WGS84) with the higher ranked feature being retained. All road and street features were removed if they were over 100 m from the coastline polyline.

Table 10. List of sources from which the shore and afloat gazetteers were compiled; afloat, source contributed to the afloat gazetteer; shore, source contributed to the shore gazetteer.

Source Name	**Rank**	**Used**	**Description**
Local Knowledge	1	Shore	Colloquial names derived from data mining and stakeholder contributions.

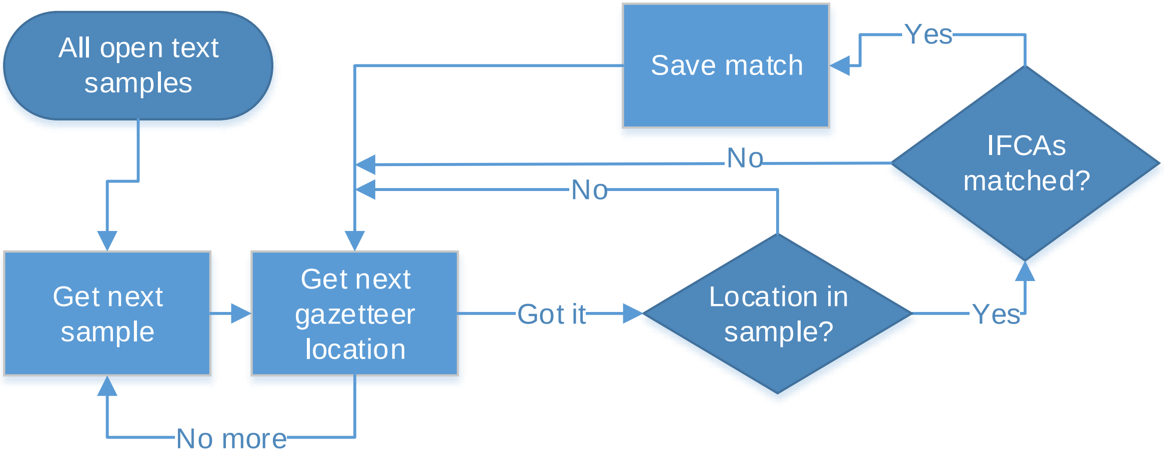
Source Name	Rank	Used	Description
UKHO Constructs	2	Shore	UKHO shoreline constructs layers, provided by the MMO. Provides names of piers, harbours etc.
UKHO Marine Use	3	Shore	UKHO Marine Use layer, provided by the MMO. Provides names of piers, harbours etc.
OS Open Names Gazetteer	4	Shore, Afloat	"A comprehensive dataset of place name, road numbers and postcode". Filtered to retain place names only. https://www.ordnancesurvey.co.uk/business-government/products/open-map-names
UKHO SeaCover	5	Shore, Afloat	Polygons of named sea features. Provided by the MMO.
UKHO Gazetteer	6	Shore, Afloat	UKHO gazetteer of named sea features, point data.
MEDIN	7	Shore, Afloat	UK marine gazetteer of sea features. Public data.
Geonames.org.uk	8	Shore, Afloat	Creative commons licensed set of point data of named features compiled from multiple sources. https://www.geonames.org/about.html
Geograph.org.uk	9	Shore, Afloat	https://www.geograph.org.uk/. Public, crowd-sourced named locations for the UK.
Substituted names	10	Shore	Substitutions, as previously described.

2.6.4.2. Georeferencing Open Text Samples

An outline of the logical georeferencing process appears in Figure 10. Every OTS was georeferenced against multiple named locations by logically iterating over every named location within the gazetteer and checking for a match in the OTS text. If a match occurred, then the IFCA which intersects the gazetteer place was checked against the list of IFCAs associated with the OTS (Annex D). If there was a match then the sample was tagged with the unique identifier for the current gazetteer record. The same OTS was then searched again for the next gazetteer named location.

A sliding window was used to prevent substring matches causing misassignment. For example; consider if the place names *North Beach Promenade* and *North Beach* were in the gazetteer. Using a sliding window ensures we only match on *North Beach Promenade* (the more specific location) and not *North Beach*, thereby avoiding a false match. This is important for two reasons: (i) it is necessary to search the entire (IFCA matched) gazetteer space to implement the spatial outlier algorithm introduced in 2.7.2.1; and (ii) angling sessions may be reported at more than a single location.

Figure 11. Georeferencing process summary.



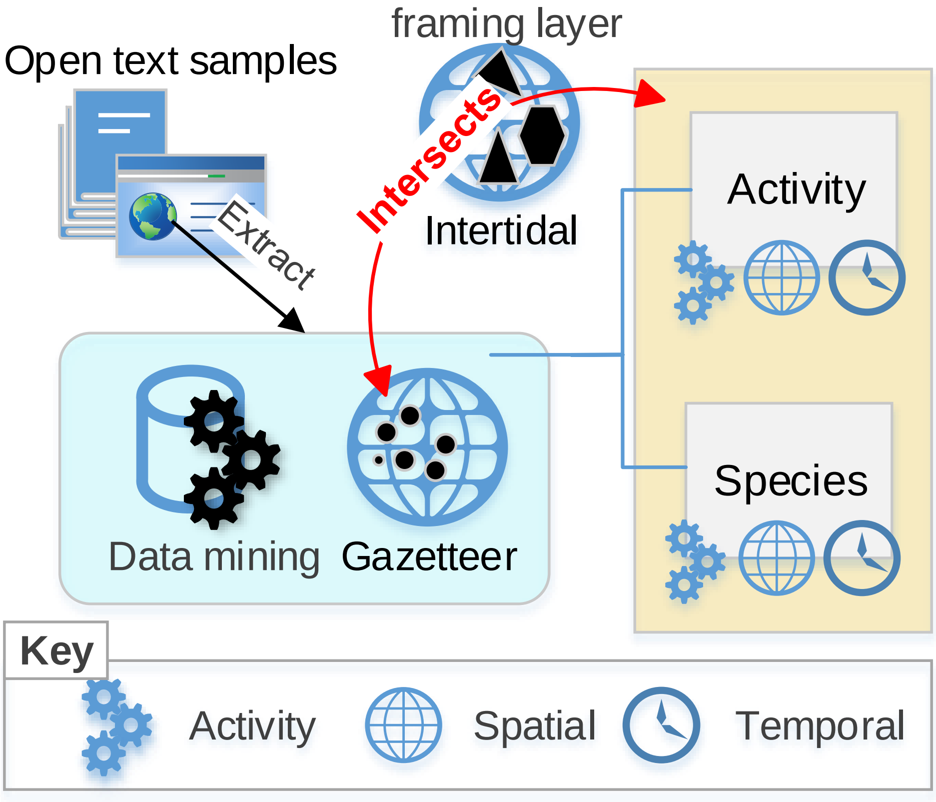
Post processing, the database table of georeferenced sites was reviewed and additional measures were taken to remove extraneous records. A particular problem arose from pollution of the gazetteer from the geograph.org.uk crowd-sourced data. The Geograph database introduced a large number of common words into our gazetteer which were purged following several full georeferencing iterations. An additional post-processing step was the removal of spatial outliers described in section 2.7.2.1

The gazetteer was checked for names used in common language and instances were removed from all further processing. This was primarily achieved by an iterative review process during algorithm development. Test outputs were aggregated by the text record count by the named location in the gazetteer. All named locations with a count greater than 10 were manually reviewed and removed when the place name could not reasonably be distinguished from a word commonly used in open text. Matches with the gazetteer were reviewed and where words or phrases had exceptionally high frequency matches, a random selection of 10 user generated texts were checked for phrase context, and where 80% of the use was associated with a spatial location, then the data were retained.

2.7. Shore

Key outputs were derived from mining of open text data, as outlined in Figure 12, and the data mining methodology is outlined in Methods 2.6 (Results 3.1). The intertidal layer (Defra, 2004) was used as the framing layer for all spatial outputs. The intertidal layer defines the extent of the shore according to substrate classification. Intertidal polygons were edited to better represent the extent of sea features (e.g. beaches) and to reduce overlap between different substrate types. Edits were made so that polygons fell entirely within the IFCA and MPLA feature layers supplied by the MMO.

Figure 13. Data mining methods for shore angling. Grey boxes are result outputs for this report. Blue keyed icons indicate key variables associated with the results. For example, all outputs have the temporal clock icon, hence all records will be associated with a temporal variable (season or month etc.). Both *Activity* and *Species* are reported with the *intertidal* framing layer (Defra, 2004).



2.7.1. Value of Activity and Species Calculations

A monthly value was calculated by counting every value record (example, Table 11) within a month and dividing by the total count. Only open text values classified with a date between 2000 and 2019 were included. Expressing formally; let |R| be the count of all value records, and $|R_i|$ be the count of all value records for the ith month, then the angler value V_i for the ith month is $V_i = |R_i|/|R|$.

For species value outputs, the species list (Annex J) was aggregated to match that used in Sea Angling 2012 Annex 4 (Armstrong and Hyder, 2013). The percentage species values by 4-bin season and MPLA were calculated by summing all species tags in open text within a given MPLA (i.e. summing the value *n* in Table 12). The sum of species references within each level of the factors of a 4-bin season and species was then divided by the MPLA sum and expressed as a percentage. The basic principle of the calculation is the same as that expressed in Equation 1. However, we are aggregating by species and season rather than individual months, in addition to summating *n* rather than counting *n*.

2.7.2. Validation

Every effort was made to recruit stakeholders across all IFCA regions (Annex C) both during stakeholder engagement (Methods 2.4) and once interim analysis was complete. The Association of IFCAs assisted with the engagement of IFCA staff in each IFCA region to review a sample of results; and Substance and the Angling Trust recruited individual sea anglers to also review sample data. The three outputs which were validated included:

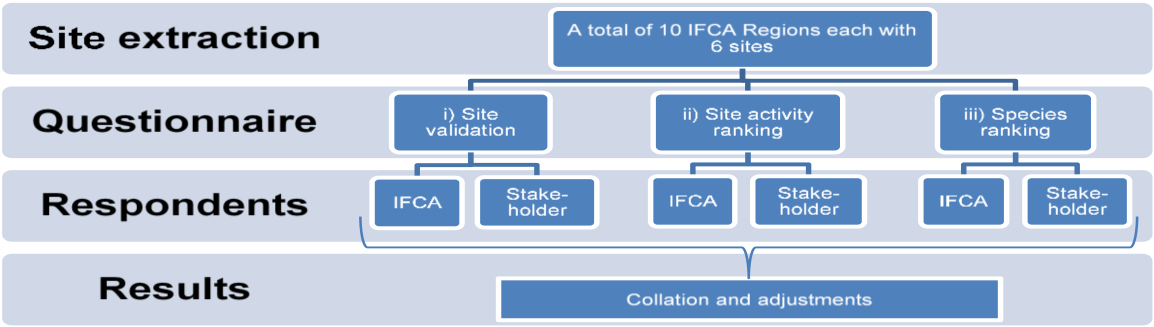
i) the ***sites*** (i.e. whether the reported sites are used for the purposes of recreational sea angling).

ii) the ***site activity ranking/value,*** *(i.e*. whether the provided activity ranking of high, medium or low was correct: output data: *overall*, Annex I).

iii) ***species ranking/value*** (a list of three species associated with each site in a) winter/spring and b) summer/autumn, ranked as high, medium or low with regards to its association with the site compared with the region as a whole: output: *species*, Annex I).

Layers showing site activity values and species association values ranked locations as a 3-bin quantile (3, high; 2, medium; 1, low; 0, none detected). A random sample of six *intertidal* areas (layer: *intertidal*, Annex I) was chosen per IFCA region, with the same areas used for all three outputs, due to their associations. Where there was more than one respondent in an IFCA region, the same locations were used. Please note that the three species could all be ranked low for a single location, as the rankings are inter-IFCA, not -inter-location. Figure 14 illustrates the sampling regime.

Figure 15. The structure of the validation method. IFCA refers to the Inshore Fisheries Conservation Authority. Stakeholder refers to individual sea angler stakeholders participating**.**



Respondents were sent: (i) a questionnaire in Excel format (Annex F); (ii) an explanatory letter (Annex H); (iii) a map of the IFCA region with six intertidal locations labelled for spatial context (Annex G); and (iv) a detailed map showing the precise extent of the six intertidal areas (Annex G). The agreement metric (by location) is the difference between the output value rank and the value rank provided by the respondent (e.g. rank pair high, low ⊢ 3 - 1 = 2), henceforth this is referred to as agreement distance. See Table 13 for number and type of respondents.

Respondents that had no knowledge of the randomly selected sites within their IFCA region were provided with new sites selected from within a smaller area that was more relevant to their local knowledge.

After questionnaire distribution, Substance engaged with respondents to offer advice and check progress. Respondents that had no knowledge of the randomly selected sites within their IFCA region were provided with new sites selected from within a smaller area that was more relevant to their local knowledge.

Table 14. Respondent number by region.

Region	IFCA	Stakeholder	Total
Cornwall	0	1	1
Devon and Severn	1	0	1
Eastern	1	0	1
Isles of Scilly	1	0	1
Kent and Essex	0	2	2
North East	1	1	2
North West	3	0	3
Northumberland	1	2	3
Southern	1	0	1
Sussex	0	1	1

For both the site activity and seasonal species validation, statistical confidence was calculated using Monte Carlo- like sampling. The interpretation of the Monte Carlo approach here is conceptually easy; it is the probability of achieving better agreement by random chance than by that observed between the respondent survey responses and our value rankings. Using a random sampling approach allows the estimation of the probability with no prior assumptions of the probability density function of the observations.

Firstly, the mean agreement distances were calculated for each IFCA, and also across all survey responses, according to the general equation below, where r_1 and r_2 are the numerical ranks we recorded and those from respondents, respectively.

$$\bar{D} = {}^{1}/_{n} \sum_{1}^{n} |r_1 - r_2| \qquad (1)$$

Samples were then drawn randomly with replacement from the activity ranks 1 (low), 2 (medium) and 3 (high) for each location with a response. The mean distance was then calculated between the randomly generated value rank and our value rank. This was repeated (n = 1 x 10^6). A probability of getting an agreement distance less than that between the survey and our outputs (i.e. better agreement) is then calculated according to:

$$p = \frac{1}{n} \cdot \sum_1^i \begin{cases} 1, \bar{d}_i \leq \bar{D} \\ 0, \bar{d}_i > \bar{D} \end{cases} \tag{2}$$

Where $\bar{d}_i$ is the i^{th} mean distance and $\bar{D}$ is given in (1). The assumption is that drawing with replacement from {high, medium, low}, with *p*(high) = *p*(medium) = *p*(low) is a reasonable approximation of how a respondent—with no prior knowledge—would rank any given location. It is also assumed that such a respondent would distribute a ranking independent of their other rankings. We suggest that independence is a reasonable assumption because the locations sampled are a small fraction of the total number of locations available for angling across the coast.

2.7.2.1. Post Adjustment Analysis

Validation results and the comments of individual respondents were examined. Particular attention was paid to results for a given location with mean agreement distance ($\sum distance/participant\ nr$) > 1. Each key stage of the processing was analysed; key stages comprised: (i) loading extracted text to the database; (ii) extraction of data using matched terms in the lexicon; (iii) georeferencing of each unit of open text by lookup with the gazetteer; (iv) the T-SQL used to aggregate extracted data; and (v) post-processing and reporting of T-SQL aggregated data. A background of erroneous species records is expected, this is not problematic provided rates are similar within factor levels (species, space, time) as the intention is not to produce population estimators.

Validation results and qualitative feedback were used to amend data, including where there was an over-representation of species and erroneous species in a region. This is described in full in the results (Section 3).

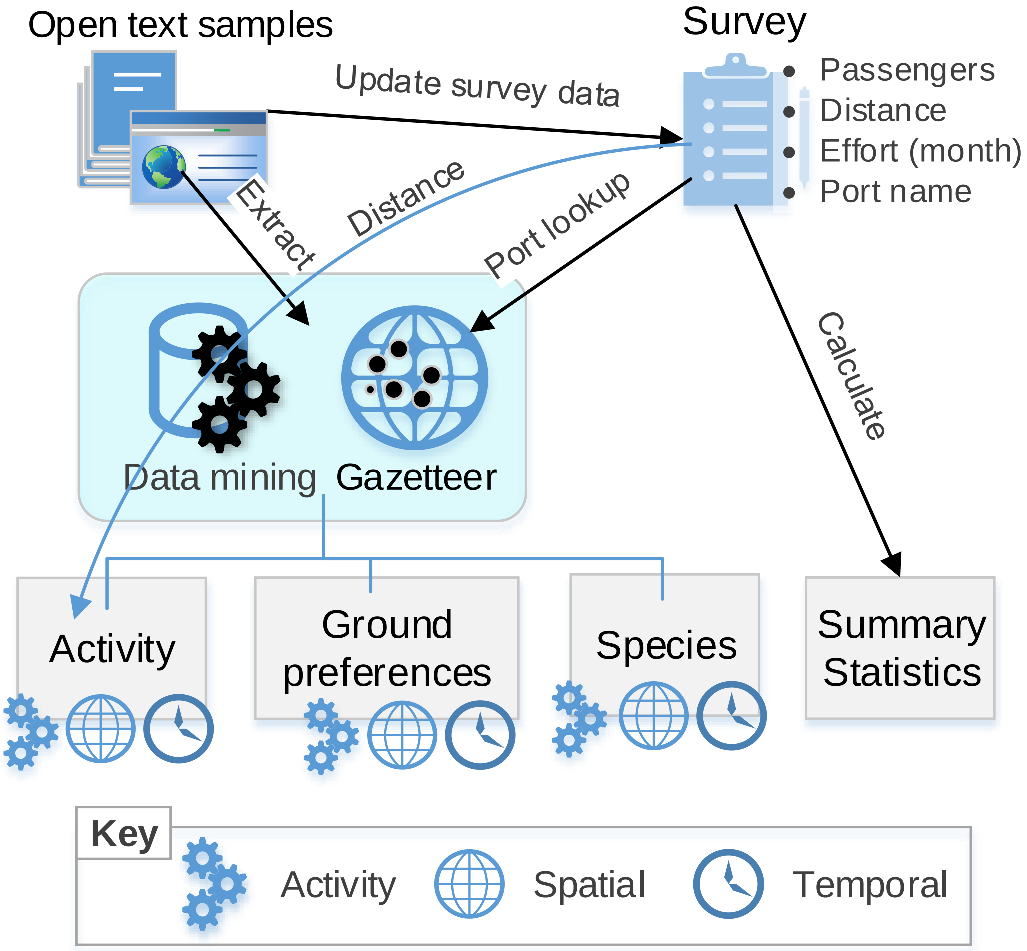
To resolve duplicate place names in the gazetteer, two approaches were used. Firstly, at the request of the MMO, data were reported at the MPLA level, which cover a significantly larger angler population than the Isles of Scilly IFCA. Secondly, locations associated with an OTS were classified as spatial inliers or outliers. Any outlier tags were removed from the OTS. A spatial outlier was defined as a point whose mean distance from all other points exceeded the mean distance between all points.

2.8. Charter Boats

2.8.1 Data Mining

Data mining of open-text references (OTRs) was used to provide spatiotemporal indicators of relative activity, ground preferences and species preferences. The data mining methods shared the same approach as the shore methods in section 2.7. The exception was that data were insufficient to provide high resolution maps of where angling takes place. Figure 16 outlines the data collated. ‘Ground preferences’ refers to the type of ground over which angling is reported to take place. ‘Activity’ is an indicator of how activity changes across a year, and ‘species’ provides an indicator of species value, as described in the shore methods of section 2.7.

Figure 17. Data mining methods for charter boats. Grey boxes are result outputs for this report. Blue keyed icons indicate key variables associated with the results. For example, all outputs have the temporal clock indicator, hence records will be associated with a temporal variable (season or month etc.). Activity is reported by distance as indicated by the connecting arrow.



Boat details, from which summary statistics were calculated, were provided by Substance and were collected during previous angling survey work to form a charter boat register. This register was updated from OTSs and by manual review. The register included named operating ports and the shore gazetteer (section 2.6.3) was used to spatially reference these ports. The register also included survey responses to charter trip days per annum.

2.8.1.1. Summary Statistics

Summary statistics for maximum operating distance, maximum passengers and annual trips were aggregated by MPLA. The register had multiple missing values across boats. Missing values were imputed for all discrete variables (e.g. maximum passengers) by assigning the proportion of charter boats (whole fleet) across levels of the variable. Then on a port-by-port basis, missing values were assigned per boat according to those proportions (Table 15), prioritising by the factor levels with highest frequency.

Table 16. Charter boat proportions by operating distance and maximum passenger number; (nm, nautical miles).

Operating Distance		Passengers	
Distance (nm)	Proportion	Number.	Proportion
3	0.047	3	0.0023
20	0.252	4	0.0048
60	0.692	5	0.0095
150	0.009	6	0.0334
		7	0.0310
		8	0.0597
		9	0.0263
		10	0.2673
		11	0.0263
		12	0.5394

Maximum angler trips per annum were estimated from the register. The register recorded days of operation per week (d_w) and months of operation per year (m_y), from which annual estimates were calculated as follows: Let the constants mean days per month $m = 30.437$, mean weeks per month $w = 4.348$ and mean days per year $y = 365.256$. Let the operational month factor be; $m_f = {}^{d_w w}/_{m}$. Let the operational year factor be; $y_f = {}^{m_y}/_{12}$. Operational trips per year are; $T = m_f \cdot y_f \cdot y$. Maximum angler trips per year for a given boat is $T * passengers$. For fleet aggregations, mean imputation of angling trips each year—stratified by port and operating distance—were used for boats with missing data.

2.8.1.2. Grounds, Activity and Species

The list of ground types was derived by review of the register and of FK. Ground types are described in Table 17. OTSs were scanned for terms associated with these ground types, species and temporal indicators, and tagged accordingly. Reporting of grounds summed unique trips as extracted from OTSs, noting that multiple grounds can be fished in a single trip. Reporting of species summed the frequency of species references in OTSs. OTSs will largely correspond to the reporting of a trip, however, there will be a small degree of OTSs which are not directly reporting a trip.

Table 18. List of ground types.

Ground Type	Description
Estuary	All fishing occurs within the bounds of an estuary. This will almost always refer to large estuarine systems, e.g. River Mersey.
General ground	Fishing over other grounds, typically associated with anchoring.
Deep open Water (Pelagic Sharks)	Mainly large pelagic shark species, porbeagle, blue, thresher and mako.
Rough	Includes hard, high-rugosity substrates i.e. reefs, rock pinnacles and similar seabed structures.
Sandbanks	Significant sandbank structures, usually deposited by the interaction of conflicting current streams.
Wrecks	Wrecks where some portion of the structure is raised above the seabed.

The data layer *cb_reports_all* (Annex J) lists all matched species (> 100) present in the species list (Annex I) however, this is impractical to provide in a pivoted table report. The vector layer *cb_spp_pvt_sans_dist_pts* (Annex J) provides a summary for five species groups, which are shown in Table 19.

Table 20. List of five species groups provided in the data layer *cb_spp_pvt_sans_dist_pts* (Annex J).

Sea bass	Cod	Skates/Rays	Flatfish	Sport shark
Sea bass	Cod	Skate/ray (Unspecified)	Flatfish (Unspecified)	Smooth hound
		Thornback ray	Brill	Spurdog
		Blonde ray	Dab	Tope
			Place	
			Turbot	

2.8.2. StakMap

StakMap was one of the first national audits of marine recreation data in England and was compiled by the Southwest Food and Drink organisation during 2012-2013 (Natural England, 2013). StakMap comprises multiple GIS layers and covered multiple coastal use types. Interviews were held with a non-random sample of volunteers recruited during targeted stakeholder groups. Respondents marked the spatial extent of their activity on a paper map, which was subsequently digitised. Data differentiates between shore and afloat activity and also provides a layer obtained from charter boat operators have an area more than 100 km^2. The GIS layers provide user numbers by month of the year within respondent-defined spatial extents.

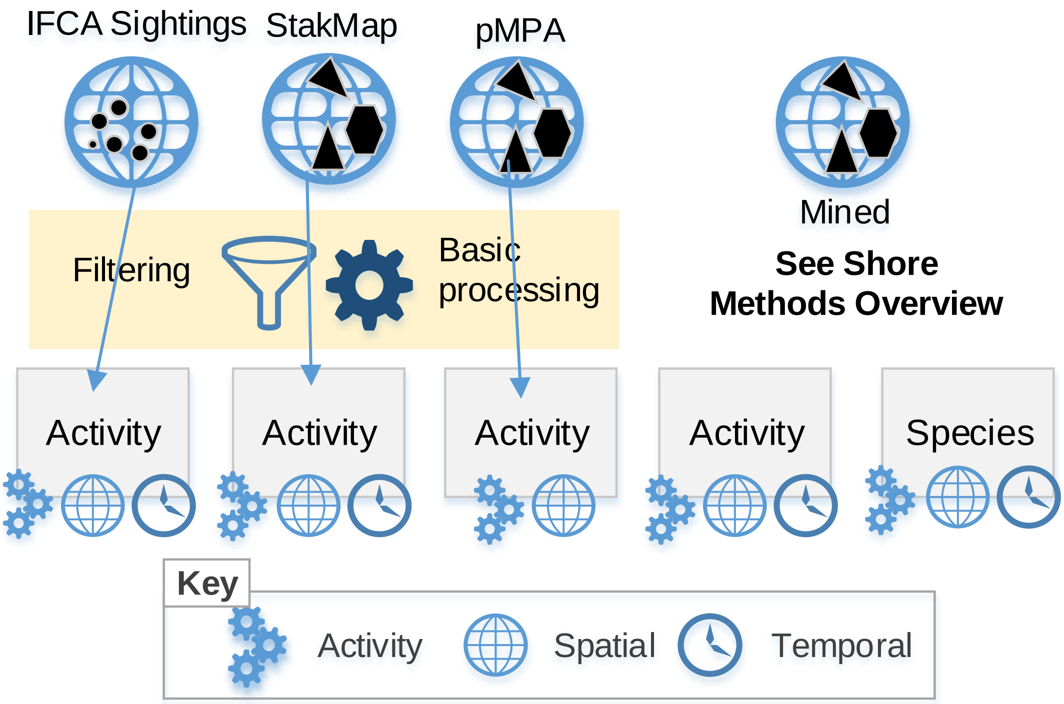
Only the polygon vector layer *CB_activity_individual* (as named in the source data from Natural England) was used. *CB_activity_individual* contains mixed resolution spatial data and by-monthly activity records that are not available in the other

StakMap layers, which describe charter boat activity. Records were filtered to retain the activity types *angling*, *artificial bait fishing* and *natural bait fishing* [*sic*]. All features greater than 500 km^2 were removed. Monthly binary activity records were summed to their corresponding 4-bin season and overlapping polygons were dissolved summing by intersecting 4-bin season fields and standardised by the polygon area in km^2. Data were displayed using a quintile.

2.9. Afloat Platforms

Spatially referenced afloat platforms are poorly represented in open text published by anglers, as is high resolution spatial data from other sources. Nevertheless, three additional sources were available (IFCA sightings, StakMap and the pMPA survey of Kenter et. al, 2013) which required some basic processing and filtering. An overview is given in Figure 18.

Figure 19. Summary of sources and outputs for the afloat platform. Data mining methods have been previously summarised.



2.9.1. Data Mining

2.9.1.1. Afloat Gazetteer and Georeferencing

Similar to georeferencing of the shore OTSs, georeferencing of open text for afloat platforms consisted of two separate feature sets. The first feature consists of point vectors compiled from sources that contain named sea features; these are then filtered to remove extraneous points which are within 100 meters of the mean low water spring boundary. The framing layer was derived from the UKHO Seacover layer of named sea features whose features match the types listed in Table 10 and which have less than 100 km^2 per given feature over the whole layer. The layer is functionally equivalent to the intertidal layer described. With the exception of the different framing layer, Table 21 summarises the data mining process for afloat platforms.

Table 22. List of pertinent UKHO Sea Cover feature types. Polygons with these types were retained in the layer to which intersecting point vectors from the main afloat gazetteer were aggregated.

List of pertinent UKHO Sea Cover feature types			
Anchorage	Creek	Pinnacle	Seamount(s)
Bank	Deep	Reef	Shingle
Basin	Flat	Ridge	Shoal
Bay	Hole	Rock	Skerries
Channel	Inlet	Sandbank	Sound
	Ledge	Sands	Strait

2.9.2. IFCA and MMO Sightings

The MMO and IFCAs are responsible for fisheries enforcement and during routine fisheries enforcement patrols the details of observed vessels are recorded. These observation records contain the observation time, spatial coordinates and vessel details. The vessel details are sufficient to distinguish between commercial and recreational vessels, and between angling and non-angling activity. Both the MMO and the IFCAs provided fisheries enforcement observation records and these were merged into a single file and filtered to remove irrelevant observations.

2.9.3. The StakMap Survey

An overview of the StakMap project and data is provided in section 2.8.2. The polygon vector layer *RA_activity_individual* (as named in the source data from Natural England) was used for the analysis. *RA_activity_individual* contains mixed resolution spatial data and monthly activity records on angling activity that is not available in the other recreational angling StakMap layers. *RA_activity_individual* maps spatial activity from anglers across multiple platforms, including additional charter boat polygons (but distinct from the charter boat layer *CB_activity_individual*). It differs from the *CB_activity_individual* as it records the species which anglers target or catch (which is unclear in the original metadata) within each polygon.

Records were filtered to retain the activity modes *charter boat fishing*, *private boat fishing*, *private kayak* and *wreck fishing*. [*sic*]. All features greater than 500 km^2 were removed. Monthly binary activity records were summed to their corresponding 4-bin season and overlapping polygons were dissolved summing by intersecting 4-bin season fields and standardised by the polygon area in km^2. Data were displayed using a quintile.

2.9.4. The Potential Marine Protected Areas Survey

The study conducted by Kenter et al. (2013) was a multi-agency project, conducted between October 2012 and March 2013. The project set out to assign a notional value of the then newly proposed marine protected areas to recreational users, including anglers. Data were gathered using an online questionnaire, with respondents being entirely self-selecting and recruited via multiple promotional channels.

The relevant portion of the work included an interactive map with which participants indicated the number of visits they had made to a random selection of the proposed marine protected areas. Although the raw data could not be obtained, the report contained the tabulated angler visitor numbers by the proposed marine protected area, which were manually extracted. The extracted data was then matched to a spatial layer of the marine protected areas, provided by Natural England, by a common unique area key.

The survey separated recorded respondent visitor numbers per annum which was divided by the area (km^2) of the marine protected area to give a *visit intensity* (units, visits $year^{-1}$ km^{2}).

2.9.5. Launch and Storage Facilities

Powered private boats often required specialised launch facilities. Road access was also required and most required either slipway access or otherwise be stored in facilities with direct access to open water. This included moorings, marinas and harbour facilities that provided quick launching and protection from the worst weather. Smaller boats can also be launched from beaches with a suitable vehicle, but we did not include possible beach launches in this project.

2.9.5.1. Slipways

Slipway locations were collated and cross validated using two primary sources; Google Earth satellite imagery (Google 2013) and boatlaunch.co.uk (Campbell 2015). Campbell (2015) classified slipways as one quarter tidal, one half tidal, three quarters tidal, all of the tidal range, no ramp and non-tidal. Classifications reflect the availability of the physical slipway ramp to the tide, beyond which anglers launching a boat need to venture onto the beach substrate, hence a one quarter tidal slipway becomes dry for approximately three quarters of the tidal cycle. Launch quality tends to be correlated with the ramp extent, so a full tidal ramp is typically of better quality and generally subject to a higher number of launches per unit time than one quarter tidal ramps – although there will be exceptions dictated by ramp seasonal availability and launch costs, for example.

The classification of non-tidal meant that launching was inside a locked water area. ‘No ramp’ meant that no ramp was available, typical of beach launches where no obstructions prevent a vehicle trailing the boat to the water’s edge. Slipways were reviewed in Google Earth, and those which appeared inaccessible were excluded. Slipways crowd sourced under the boatlaunch.co.uk website (Campbell 2015) were validated by website users and the site administrator.

2.9.5.2. On-Water Boat Storage Facilities

A point-in-time estimate of the relative recreational angling boat numbers stored in moorings, marinas and harbours across England was estimated from visual counts of angling boats located in on-water boat storage facilities using satellite imagery.

Polygons were drawn around the extent of on-water boat storage (Figure 20) using Google Earth Pro (Google Earth, 2019) and the total number of all sea-worthy boats and the facility type were recorded. Each polygon was drawn to the approximate limits of the storage facility type which was classed as a buoyed mooring or permanent facility. Permanent facilities include harbours, marinas, pontoons, quays and docks.

Figure 21. An example of on-water boat storage: Benthall beach and harbour (mid-point: 55°33’01.6”N 1°37’35.71”W) in Google Earth (Google, 2019). In this example, the extent of the moorings and harbour were drawn (white polygons). The number of boats were then counted and recorded in the polygon description for further processing.

Google Earth was used to conduct a manual census of on-water facilities, which were identified and then mapped. However, the quality and availability of imagery meant it was impossible to accurately identify sea angling-centric boats present in order to provide a point estimate of their number/proportion. To do this, Google Street View and Google Earth imagery were used to estimate the proportion of different boat classes at the sampled location. Boats were categorised as angling, commercial, sailing and other (e.g. powerboats). A ~35% proportional random sample was taken by stratification of facility type (moorings and not moorings) and a 3-bin quantile ranking of facilities by the boat counts estimated in Google Earth. Where the imagery was unclear then another location was randomly selected until the sample quota was met. Table 23 outlines the sample design.

Table 24. Proportional sampling design used to assess on-water boat storage facilities. Size rank is a 3-bin quantile rank of the estimated number of boats within the facility. N_h is the census like count of facilities undertaken; n is the sample number; n/N_h is the stratification sampling fraction, which is used in the finite population correction (see Kish (1995) pp40-45).

Facility Class	Size Rank	N_h	n	n/N_h
Marina	1	79	26	0.341
Marina	2	80	27	0.325
Marina	3	77	26	0.338
Mooring	1	108	36	0.333
Mooring	2	101	34	0.337
Mooring	3	105	35	0.343

The total number of RSA-centric boats for non-sampled on-water facilities were imputed by multiplying the estimated proportion of RSA-centric boats by the boat Google Earth count at each facility. Sample numbers were a significant proportion of the population of on-water facilities, hence reported confidence intervals were derived by applying a finite population correction. The code snippet used for the finite population correction is given in Annex K. Population estimates were calculated according to standard stratified sampling methods (Kish, 1995), accepting the finite population correction.

3. Results[6]

Twelve data layer outputs were created by this project (for further details please see Annex I) and are available for public access online at data.gov.uk:

cb	Register of charter boats
cb_grounds	Proxy indicator of the grounds favoured by charter boats
cb_pivot_dst_pts	Total angler trip days per year for charter boats stratified by the operating distance license
cb_reports_all	All occurrences where species co-occurred with charter boat names
cb_spp_pvt_sans_dist_pts	Proxy indicator of species captured by charter boats
overall	Proxy indicator of relative shore marine angling activity
raw (shore)	Disaggregated data of all records of fish species names found to co-occur with named spatial location(s) and a temporal reference
raw (afloat)	Deaggregated data of each species co-occurrence with named spatial location and a temporal indicator (predominantly trip reports).
seasonal	Proxy indicator of relative shore marine angling activity
species	Proxy indicator of relative shore marine angling activity, aggregated by species and season (Winter: October to March; Summer: April to September)
species_full_join	Same as species but includes all possible stratification combinations
ugc_afloat	Angling trips divided by the polygon area in square kilometres

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[6] Information on data and the spatial layers within these results, including links to downloads will be available at https://portal.medin.org.uk/portal/start.php. They may be found using terms listed in Annex I.

3.1 Shore

A total of 471 sources were identified and evaluated (summary, Annex A; detailed list, Supplementary Materials). Of these, 60 contributed to the gazetteer of place names and 55 unique sources were used for spatial mapping. A total of 379,808 distinct OTSs were extracted, of which 125,736 had text matches with named locations from the shore gazetteer. A breakdown of the number of intertidal regions and species detected in open text is provided in Table 25, which shows comparatively similar rates in which no RSA activity were detected within intertidal polygons across MPLAs (mean ±SD = 49.6% ±7.3, min = 38.3%, max = 57.6%[7]).

Table 26. Total number of intertidal regions (n_t) and number of intertidal regions in which an angler value was assigned (n_d). Open Text Nr. is the count of open texts from which species value data were extracted. Similarly, total count of any angler-related species (n_t) and unique species (n_d) extracted from open text by MPLA. Species are listed in Annex J.

MPLA	Open Text Nr.	Intertidal	Species
East Inshore	7612	n_t = 384 n_d = 196 (51%)	n_t = 33,211 n_d = 76
North East Inshore	9504	n_t = 290 n_d = 179 (62%)	n_t = 40,149 n_d = 89
North West Inshore	9032	n_t = 653 n_d = 277 (42%)	n_t = 43,612 n_d = 77
South East Inshore	7879	n_t = 560 n_d = 252 (45%)	n_t = 31,373 n_d = 91
South Inshore	23,247	n_t = 1041 n_d = 582 (56%)	n_t = 145,935 n_d = 103
South West Inshore	9218	n_t = 1475 n_d = 686 (47%)	n_t = 48,829 n_d = 96

When overall activity is considered by month, there is variability in angling activity throughout the year, as shown in Figure 22. Peaks of activity occur in June and October, as well as several other months showing above average activity (April, May, August). There is also a reduced observed activity in March. An example of the map data in layer *overall* (description in Annex I) appears in Annex L.

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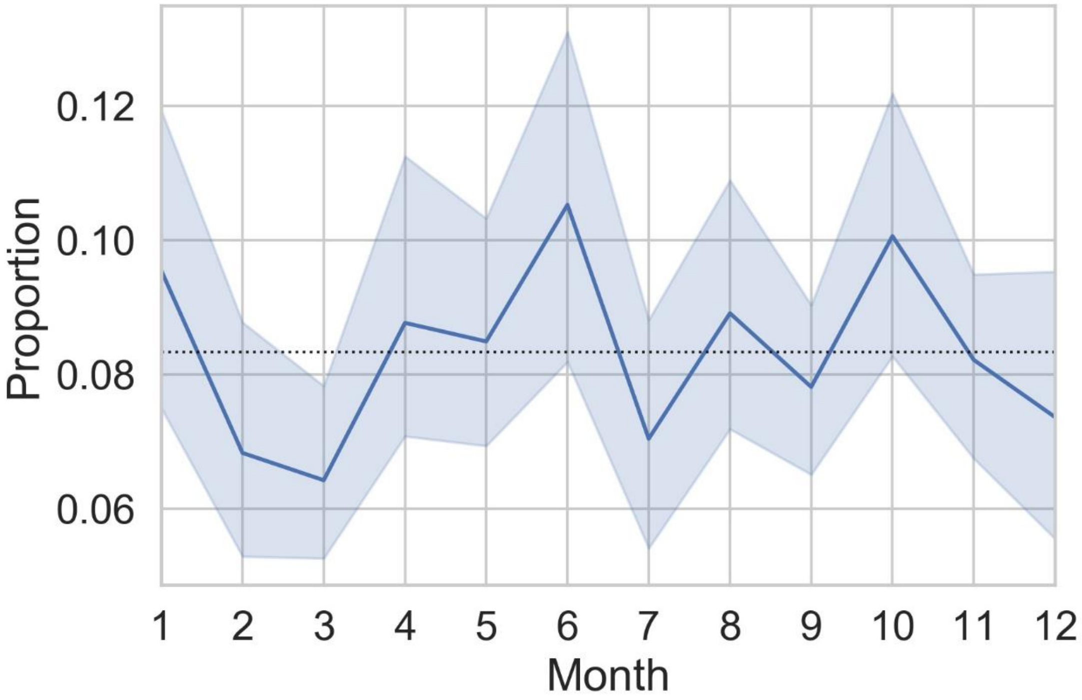
[7] Min is North East Inshore (100-62% detected (Nd); Max is North West Inshore (100-42% detected (Nd)).

Figure 23. Relative angling activity with 95% confidence interval as indicated by species frequencies extracted from open text. The dotted line is the mean expected activity level (y=$^{1}/_{12}$). The month range is January (Month 1) to December (Month 12). Confidence interval is calculated with factor levels of year, displayed as the blue shaded area around the species frequency line (blue thick line).



Examining the distribution of value ranks between 4-bin seasons shows that the distribution of ranks is invariant across seasons, with no clear trend to indicate a reason as to why there was difference in sea angling activity between all four seasons (Figure 24). The North East Inshore and South Inshore MPLAs had the fewest intertidal areas without a value ranking (Table 13; North East Inshore, range = 45.2% – 50.3%; South Inshore, range = 53.4% – 59.2%). The North East and East Inshore MPLAs tended to have the highest comparative levels of autumn and winter activity (Table 27), and this is also reflected in the breakdown of value by species and season. An example map of the 4-bin season output is shown in Annex O. All mapped outputs will be available from MMO at https://www.gov.uk/guidance/explore-marine-plans.

Figure 25. Mean percentage number of 3-bin quantile ranks across all MPLAs excluding intertidal areas with no detected activity. Error bars are standard deviation.

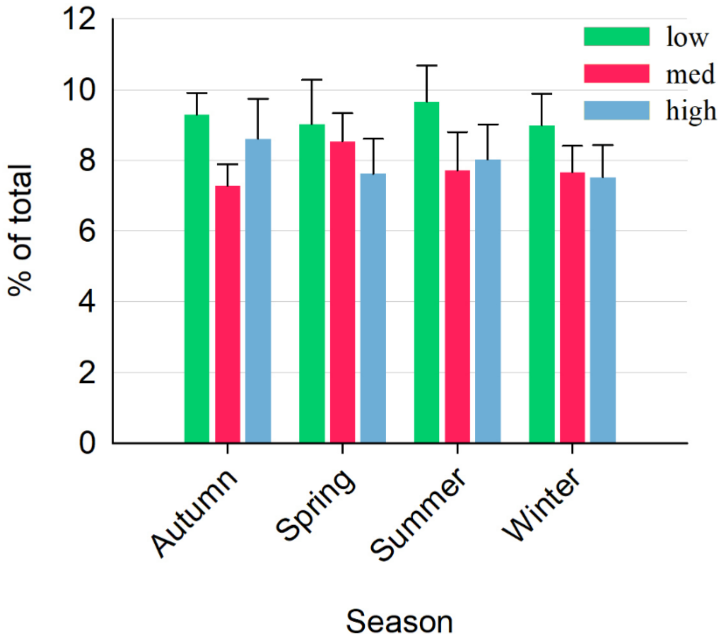


Table 28. Percentage of high, medium and low tertile rankings by MPLA and season. *Nd%* is the percentage of intertidal areas in which no value was assigned.

MPLA	Season	High %	Medium %	Low %	Nd %
East Inshore	Spring	7.5	9.3	7.6	61.7
	Summer	7.3	8.5	9.1	60.9
	Autumn	9.6	7.1	9.0	59.6
	Winter	8.0	7.6	9.5	60.7
North East Inshore	Spring	5.9	8.7	9.9	49.7
	Summer	6.9	8.9	8.4	50.3
	Autumn	10.4	7.7	8.6	45.2
	Winter	9.1	8.4	7.2	49.3
North West Inshore	Spring	8.5	8.9	8.0	68.5
	Summer	7.9	6.7	10.1	69.4
	Autumn	8.0	7.5	9.1	69.4
	Winter	7.5	8.2	9.4	68.9
South East Inshore	Spring	7.8	9.2	8.6	65.9
	Summer	7.9	8.7	9.0	65.9
	Autumn	7.8	7.6	9.2	67.1

MPLA	Season	High %	Medium %	Low %	Nd %
	Winter	6.8	8.3	9.1	67.7
South Inshore	Spring	8.5	7.7	9.0	56.0
	Summer	8.4	7.2	11.1	53.4
	Autumn	8.2	6.1	10.4	57.0
	Winter	7.2	6.9	9.3	59.2
South West Inshore	Spring	7.6	7.4	11.0	64.9
	Summer	9.8	6.4	10.3	64.3
	Autumn	7.6	7.5	9.6	66.6
	Winter	6.5	6.7	9.6	69.3

The top three ranked species across all MPLAs were cod, whiting and sea bass (mean; cod, 15.8% ±9.0; whiting, 12.9% ±6.5; sea bass, 12.2% ±4.2). Cod and sea bass also featured in the top five ranked species for each MPLA, with the exception of the North East Inshore MPLA (Figure 26). Ray species, flatfish species and whiting also had high values for the majority of the MPLAs (Figure 27). A detailed breakdown of fluctuations in species ranking values by MPLA and 4-bin season is given in Annex O. These data show the high levels of cod as a recreational target species in autumn and winter. This is particularly evident in the East and North East Inshore MPLAs, where cod has a maximum value in the autumn of 7.4% and 13% respectively. The South West MPLA has the lowest value among the MPLAs for cod, which is partially replaced by sea bass in spring, summer and autumn. A general pattern across all MPLAs is a shift from sea bass toward the gadoids with the onset of winter. Example spatial outputs are provided in Annex P and Annex Q.

Figure 28. Top five valued species by MPLA.

3.1.1. Validation

3.1.1.1 Overall Site and Activity Validation

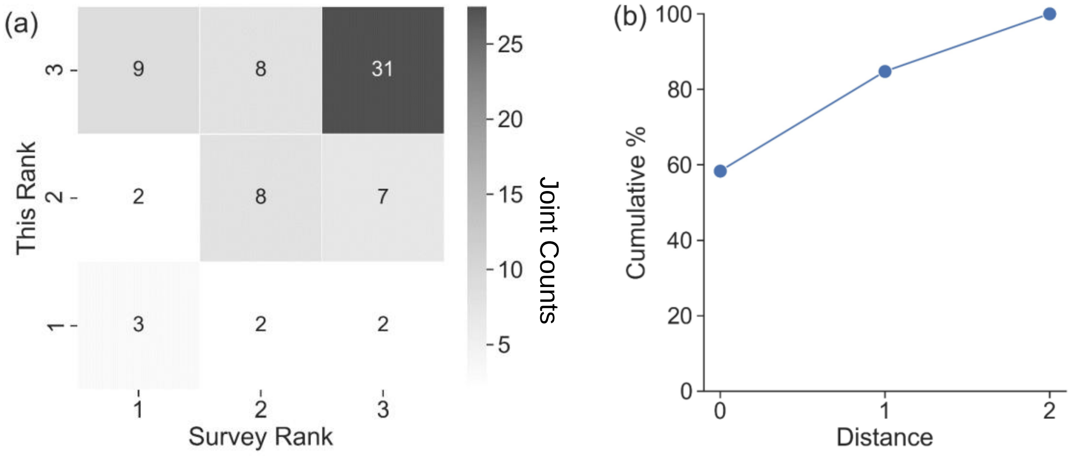
Across the sampled sites, 56 of the 60 (93%; 10 IFCAs, six sites per IFCA) were confirmed to be valid sites used for recreational sea angling and were ranked for site activity by respondents. The Isles of Scilly and North West IFCA regions had the lowest coverage, with 50% and 33% of sites not ranked by any respondent, respectively. These two IFCAs also had the lowest agreement with our activity rankings. When considered across all samples, agreement was highly unlikely to be as extreme as that observed by chance alone (Table 29, $p < 0.0001$).

Table 30. Overall activity validation for 3-bin quantile rankings of location value. 'Response %' summarises the percent of sites to which respondent 1, 2 and 3 (where applicable) provided a ranking. '%' is the percent of sites which were ranked per IFCA. Results grouped under Monte Carlo sampling show the outputs of calculating the mean agreement distance between this project's location value estimates and $1x10^6$ randomly generated location value estimates. The probability (*p*) is the probability of getting a closer distance than that actually observed (Actual mean dist.) by chance. '*' refers to significance. 'Chance mean dist.' is the mean distance calculated from the random samples and 'Nr. nearer' is the number of times each random sample was nearer (ie. better agreement) to the respondents location value ranking than those for this project. 'All' repeats the method for all rankings.

IFCA	**Response %**				**Monte Carlo Sampling**			
	1	**2**	**3**	**%**	**Actual mean dist.**	**Chance mean dist.**	**Nr. nearer**	***p***
Cornwall	83			83	0.40	0.94	24,601	0.025*
Devon and Severn	100			100	0.67	1.00	128,002	0.128
Eastern	83			83	0.60	0.93	86,007	0.086*
Isles of Scilly	67			67	1.50	1.00	888,821	0.889
Kent and Essex	33	100		100	0.75	0.94	141,320	0.141
North East	100	100		100	0.25	0.94	171	<0.001*
North West	17	33	33	50	0.80	0.92	209,743	0.210
Northumberland	83	83	100	100	0.56	1.00	56,206	0.056*
Southern	100			100	0.67	1.00	127,711	0.128
Sussex	83			83	0.00	0.77	0	0*
All	75	79	67	80	0.57	0.92	21	<0.0001*

Overall agreement was good, with 42 (58%) of all surveyed sites with a response being in perfect agreement with our assessment and 61 (85%), Figure 29. b) being within a quantile distance of ≤1. Of the sites where validators were in full agreement with the assigned activity level, 31 (74%) were high.

Figure 30. Agreement measures for overall location value (shore) between the validation survey and this project. (a) shows the joint counts of quantile value rankings between this project (*This Rank*) and the validation survey outputs (*Survey Rank*). Quantile value rankings are 1 = low; 2 = medium, 3 = high. (b) is the cumulative percent distance between this rank and survey rank.



3.1.1.2 Species Validation

Species validation had a reduced completion rate compared to the overall value assessment, with 45 (75%) of sampled sites having at least one respondent providing a rank for species. Site coverage was particularly poor for the Southern (0%) Sussex (29%) and North West (33%) IFCA regions. Out of 576 species that required validation in the winter/spring, summer/autumn, across the ten regions, rankings were provided for 291 (51%). This is lower than the 76% completion rate for site activity rankings. A breakdown of completion rate by region can be found in Table 31 for summer/autumn species and for winter/spring species.

Table 32. The percentage of response rates for the species validation by region and season.

	Summer/Autumn		Winter/Spring	
Region	Response (%)	No response (%)	Response (%)	No response (%)
Cornwall	44	56	44	56
Devon and Severn	100	0	100	0
Eastern	100	0	100	0
Isles of Scilly	44	56	22	78
Kent and Essex	67	33	64	36
Northumberland	65	35	67	33
North East	61	39	58	42
North West	17	83	19	82
Southern	0	100	0	100

	Summer/Autumn		Winter/Spring	
Region	Response (%)	No response (%)	Response (%)	No response (%)
Sussex	39	61	22	78

When considered across all samples, agreement was found to be highly unlikely to be as extreme as that observed by chance alone (Table 33, p < 0.0001), under the methodological assumptions. Out of the 175 site-specific species rankings that were provided by validators and able to be compared with generated data, 71 were in full agreement (41%) with a further 47% showing a one level disagreement. 13% of responses showed a two-level disagreement with assigned rank. A breakdown of agreement with species rankings by region can be seen in Table 34.

Table 35. Percentage agreement of primary species output rank with validation responses for Summer/Autumn and Winter/Spring.

Region	Summer/Autumn			Winter/Spring		
	Full agreement (%)	1 Level disagreement (%)	2 Level disagreement (%)	Full agreement (%)	1 Level disagreement (%)	2 Level disagreement (%)
Cornwall	40	60	0	40	60	0
Devon and Severn	28	72	0	33	67	0
Eastern	56	22	22	33	56	11
Isles of Scilly	50	50	0	25	50	25
Kent and Essex	21	54	25	48	39	13
Northumberland	50	25	25	9	73	18
North East	55	9	36	67	33	0
North West	100	0	0	50	50	0
Southern	0	0	0	0	0	0
Sussex	83	17	0	50	25	25

Mackerel and haddock catches were over-represented in pre-validation species outputs. Examination of raw acquired text showed that the use of mackerel as a bait was greatly inflating erroneous incidences of OTSs being tagged with mackerel. Bait species were excluded (e.g. squid and sandeel), but mackerel are an important recreational species (Armstrong et al., 2013a), so cannot be excluded. Post-validation investigations revealed that haddock catches were appearing as inshore catches because of anglers reporting their pre-angling fish and chips meal. Refinements were made for haddock, mackerel and herring (also a bait species) to remove erroneous species tags.

An additional classifier was used to identify mackerel as bait in an OTS so tag creation could be skipped. The *mackerel as bait* category was created by reviewing 1,000 OTSs tagged as mackerel. Applying this method correctly reduced misclassification rates (false positive, mackerel as catch/target when bait) from 37% to an estimated 6%, with < 5% false negatives (i.e. catch/target identified as bait). Validators identified catches of sea bass on the Isles of Scilly as inaccurate, as the species is not present. Examination of processing stages showed that duplicate place names in the gazetteer was causing this issue. The controls in place to limit this problem were insufficient under these conditions: (i) when a named location was common within an IFCA; (ii) where the OTS source covered many IFCAs; or (iii) where sample sizes within an IFCA were low. A further problem identified from examination of the OTSs was the term *bass rod*, hence all species records which arose from sentences associated with *bass rod* and *flattie rod* (and some other colloquial terms) were excluded.

Table 36. Species validation for 3-bin quantile rankings of location value*Response %,* percent of sites to which respondents provided a ranking; *Column %,* percent of sites with at least 1 ranked species; Probability (*p*), chance of getting a closer distance than that observed by chance; *Chance mean dist*, mean distance calculated from the random samples; *Nr. nearer,* number of times each random sample had better agreement than our rankings. The row *All* repeats the method for all rankings.

IFCA	Response %				Monte Carlo Sampling			
	1	2	3	%	Actual mean dist.	Chance mean dist.	Nr. nearer	*p*
Cornwall	67			65	0.92	0.74	926,055	0.926
Devon and Severn	100			100	0.71	0.85	44,894	0.045
Eastern	100			100	0.63	0.92	2,681	0.003
Isles of Scilly	27			27	0.73	0.98	88,722	0.089
Kent and Essex	36	98		67	0.86	0.91	290,684	0.291
North East	51	68		61	0.90	0.90	435,612	0.436
North West	13	25	19	18	0.33	0.96	0	0
Northumberland	100	15	100	67	0.79	0.82	306,864	0.307
Southern	0			0	0.00	0.00	0	
Sussex	31			33	0.29	0.90	79	0.436
All	75	79	67	80	0.57	0.92	43	<0.0001

Overall agreement was fair with 162 (39%) of all surveyed sites with a response being in perfect agreement with our assessment and 196 (87%, Figure 15) b) being within a quantile distance of ≤1. Of the sites where validators were in full agreement with the assigned activity level, 105 (65%, Figure 31). a) were high. Further examination of agreement by IFCA show that five IFCAs had > 90% agreement within an agreement distance ≤ 1 (Table 37).

Figure 32. Agreement measures for location species value (shore) between the validation survey and this project. (a) shows the joint counts of quantile value rankings between this project (*This Rank*) and the validation survey outputs (*Survey Rank*), quantile value rankings are 1 = low; 2 = medium, 3 = high. (b) is the cumulative percent distance between this rank and survey rank.

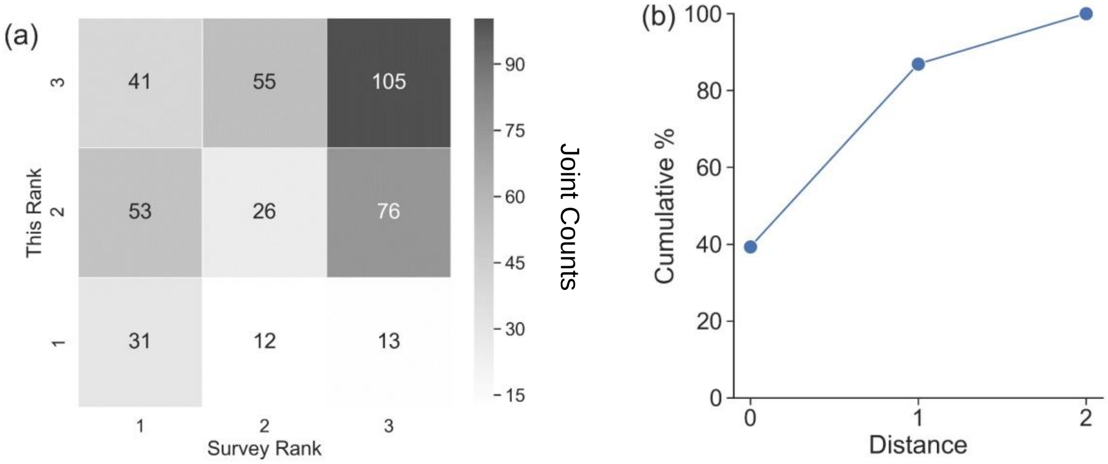


Table 38. Cumulative percent difference by IFCA for species validation.

IFCA	Cumulative % Distance		
	≤ 0	≤ 1	≤ 2
Cornwall	15.4	92.3	100
Devon & Severn	32.8	96.6	100
Eastern	51.0	85.7	100
Isles of Scilly	33.3	93.3	100
Kent & Essex	35.1	78.4	100
North East	36.7	73.5	100
North West	66.7	100	100
Northumberland	35.1	86.2	100
Southern	-	-	-
Sussex	70.6	100	100

3.1.1.3 Post-Validation

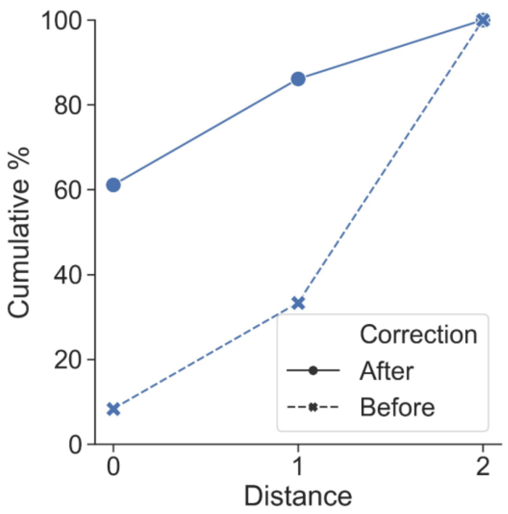
Two sites on the Isles of Scilly were flagged by the respondent as invalid. Falmouth Docks was also flagged as possibly invalid because of access restrictions to the docks but the extent included the publicly accessible harbour area and surrounds. On examination of the two invalid Isles of Scilly sites, it was found that duplicate regionally-close gazetteer names were the main contributory factor and additional controls were put in place to reduce this misassignment, as outlined in Methods 2.7.2.1. Exceptions for the North West were also examined, but no additional issues were identified beyond those adjusted for in Methods section 2.7.2.1.

Examining several discrepancies between high ranked sites graded as low by respondents showed that the use of unique species mentions could inflate value rankings where reports of activity under several scenarios were made, for example multiple anglers or species hunt trips. The metric was changed for overall activity. The methods of 2.7.1 and all outputs incorporate this change.

It was not possible to compare pre-validation results against all outputs produced after the enhancements described above. This was because post-validation outputs were aggregated by MPLA, rather than by IFCA, following changes to the project parameters which were adjusted to be used to support marine planning. Tertile ranks were calculated by IFCA or MPLA, hence changing the spatial extent of the region will affect all rankings. However, it can be seen how the adjustments affected outputs using the Isle of Scilly sites as a case study, by manually matching the count of value ranks with the old tertile boundaries.

Post-validation adjustments were made based on the results of the site and species validation. The Isle of Scilly sample had six sites; Church Quay Sands and Green Bay, Great Bay, Appletree Bay, Crow Point, Old Town Bay and Peninnis Head (Annex G). The respondent reported that Appletree Bay and Crow Point were invalid (but didn't indicate why as both are accessible). Nevertheless, after applying adjustments Appletree Bay had no detected activity for both summer and winter. Crow point still had activity tertiles ranging between 0 and 2, and the ranks were all decreased or remained the same. Applying corrections lead to an improvement in agreement with the rankings made by the Isles of Scilly respondent with agreement distance of 0 (i.e. exact matches) increasing by 53%, and 86% of rankings being within a ranking distance ≤ 1.

Figure 33. Cumulative percent distance between This rank and survey ranks for the Isles of Scilly IFCA region. *Before*, rankings as provided for validation; *After*, rankings after remedial actions arising from examination of stakeholder validation and feedback.



Further examination of individual records showed that it was likely that records for Crow Point were still being wrongly assigned from a South West location with the same name however, even under manual review of the OTSs the location of Crow Point could not be determined with certainty.

When examining the relative levels within the Isles of Scilly IFCA (subsumed into the South West Inshore MPLA), then only one intertidal polygon exceeded the medium rank, and this polygon covered a large length of coastline.

3.2. Charter Boats

3.2.1 Summary Statistics

In total, 364 vessels were identified as operating from 91 ports and launch facilities across England. This figure will be subject to some error because it was impractical to validate the status of each vessel by direct contact. However, it compares closely to the 399 vessels identified for the Sea Angling 2012 research (Hargreaves et al., 2013). Details on trip numbers—used to describe ground and species preferences—were derived from data mining. The OTRs from 38 different FK sources were mined, with a total of 49,424 separate OTSs contributing to this data set.

Estimated maximum angler trip days per annum were 733,766 ±12,034 (Annex D), with the South Inshore MPLA having the numerical maximum number of charter boat operators (170, 47%). The majority of boats were licensed to operate at 60 nautical miles (nm) and to carry a maximum of 12 passengers (Table 39). The spatial layer *cb_pivot_dst_pts* (listed, Annex I; example, Annex R) shows a by-port breakdown of maximum angler trip days per annum.

Table 40. Number and percentage counts of charter boat operating distance licenses (nm, nautical miles) and maximum passenger number by MPLA. Angler trip days per annum is calculated based on maximum passenger numbers and survey data from Substance, with median imputation used to complete empty values for individual charter boats. †Two charter boats were licensed to carry 20 passengers. The remainder were licensed for 12 passengers.

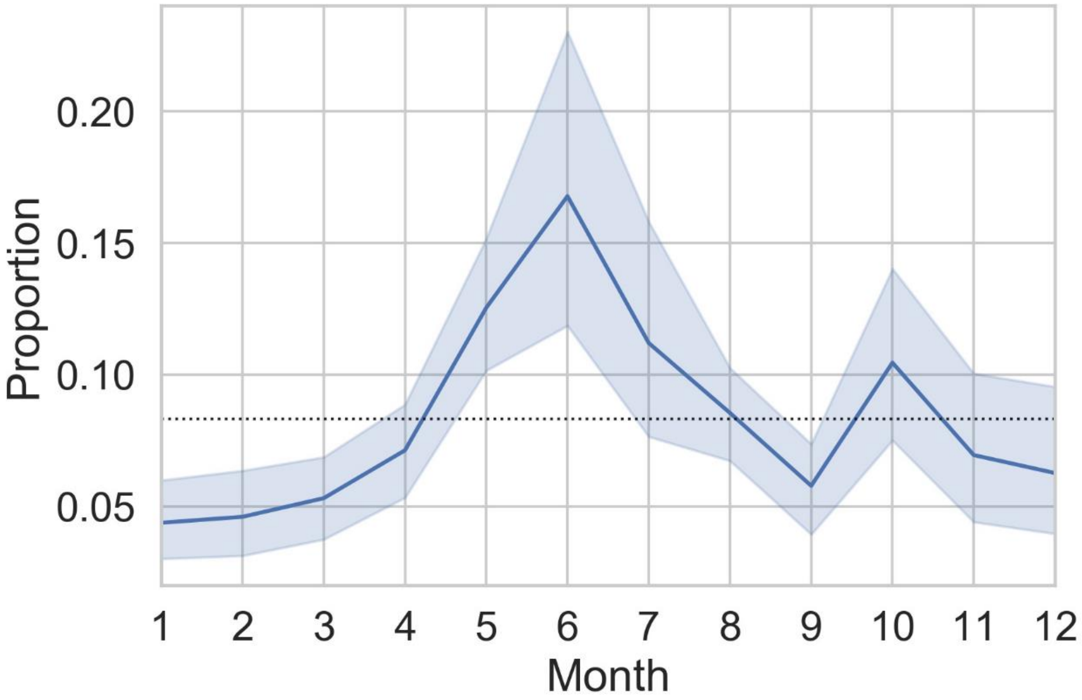
MPLA Inshore	**Operating Distance (nm)**					**Maximum Passengers**				**Maximum angler trips per Annum**
	3	**20**	**60**	**150**	**Sum**	**<6**	**6-8**	**9-11**	**12,20†**	
East		9 (2%)	14 (4%)		23 (6%)		3 (1%)	5 (1%)	15 (4%)	50,691 ±10,441
North East	1 (0%)	11 (3%)	39 (11%)		51 (14%)		4 (1%)	12 (3%)	35 (10%)	63,396 ±5,259
North West			13 (4%)		13 (4%)		2 (1%)	5 (1%)	6 (2%)	24,993 ±10,198
South	3 (1%)	25 (7%)	142 (39%)		170 (47%)	4 (1%)	16 (4%)	45 (12%)	105 (29%)	394,123 ±16,571
South East		5 (1%)	46 (13%)	1 (<1%)	52 (14%)	1 (0%)	8 (2%)	23 (6%)	20 (5%)	71,007 ±4,001
South West	1 (0%)	4 (1%)	50 (14%)		55 (15%)		3 (1%)	16 (4%)	36 (10%)	129,556 ±8,834

3.2.2 Grounds, Activity and Species

Results are produced for overall trips by season, trips by grounds, grounds by season and trips by species.

In terms of overall number of trips, these are at a maximum in summer and a minimum in winter (summer, 61%; winter, 39%). Figure 34 shows the proportional activity by month (mean; December, 0.063 ±0.068; January, 0.044 ±0.037; February, 0.046 ±0.039). There is an increase in activity through spring to a peak in June (0.17 ±0.13). This pattern supports anecdotal evidence from charter skippers in research conducted by Substance for MMO in 2012 (Hargreaves et al., 2013) in which skippers frequently reported that they will stop operations during late winter and early spring to perform maintenance work.

Figure 35. Relative by-month angling activity for charter boats, with 95% confidence interval as indicated by species frequencies extracted from open text. The dotted line is the mean expected activity level (y = 1⁄12). The month range is January to December. Confidence intervals are estimated across factor levels of year, displayed as the blue shaded area around the charter boat frequency line (blue thick line).



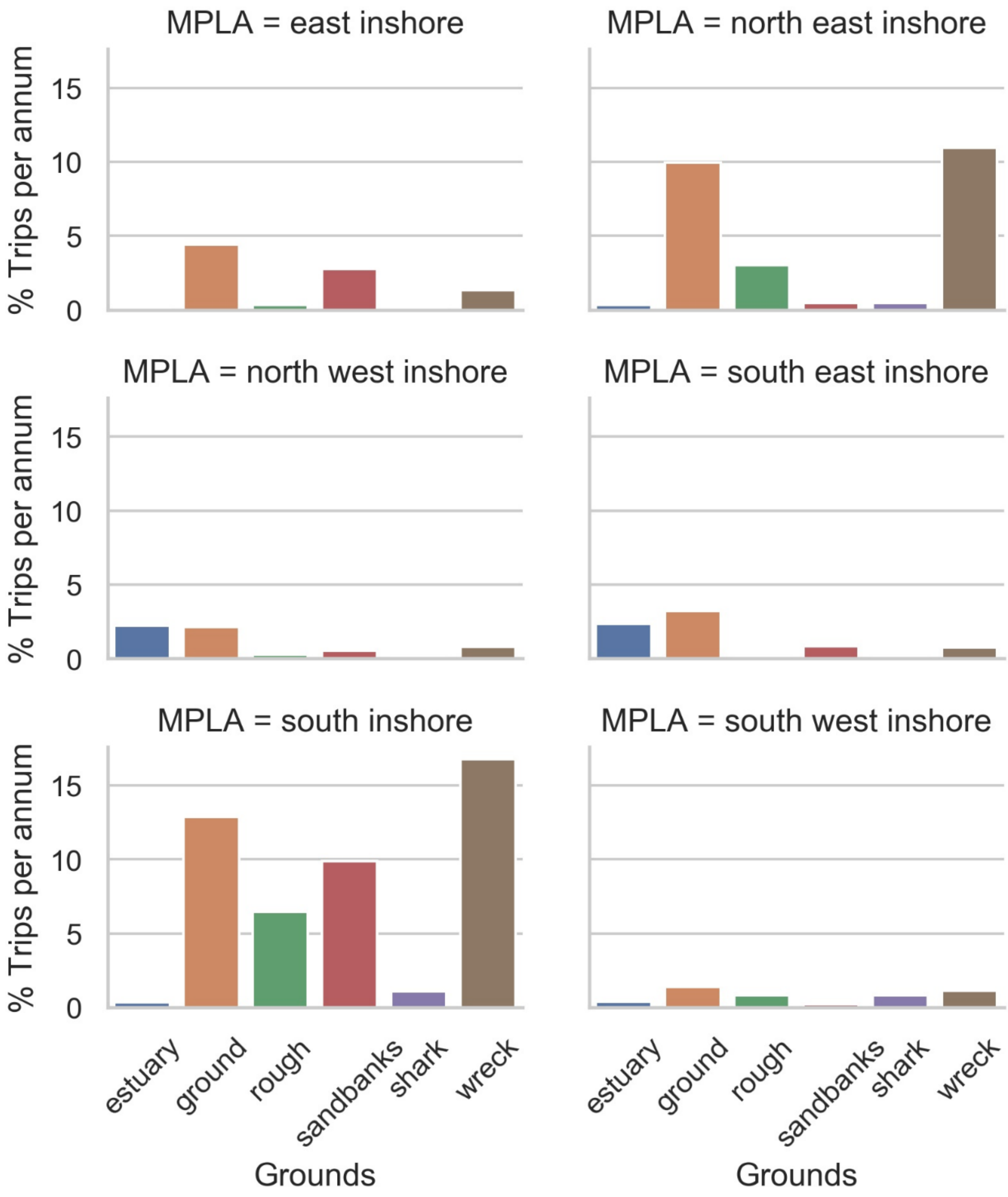
In terms of the types of fishing undertaken, general ground fishing was the most popular fishing ground type across England, with 1,841 (34%) of maximum trip days per annum (trips yr^{-1}). This was followed by angling over wrecks 1721 ±374. Fishing in deep open water (for example for large pelagic sharks) was the least often reported “grounds”, with 144 ±23 trips yr^{-1} (Table 41).

Table 42. Mean actual trip days per annum (*M*) by ground type extracted from fisher knowledge.

Ground	Trip Days per Annum	Percent
Estuary	*M* = 309 ±57 *n* = 6	6%
General ground	*M* = 1841 ±253 *n* = 6	34%
Rough	*M* = 604 ±135 *n* = 6	11%
Sandbanks	*M* = 798 ±204 *n* = 6	15%
Open water (Pelagic sharks)	*M* = 144 ±23 *n* = 6	3%
Wreck	*M* = 1721 ±374 *n* = 6	32%

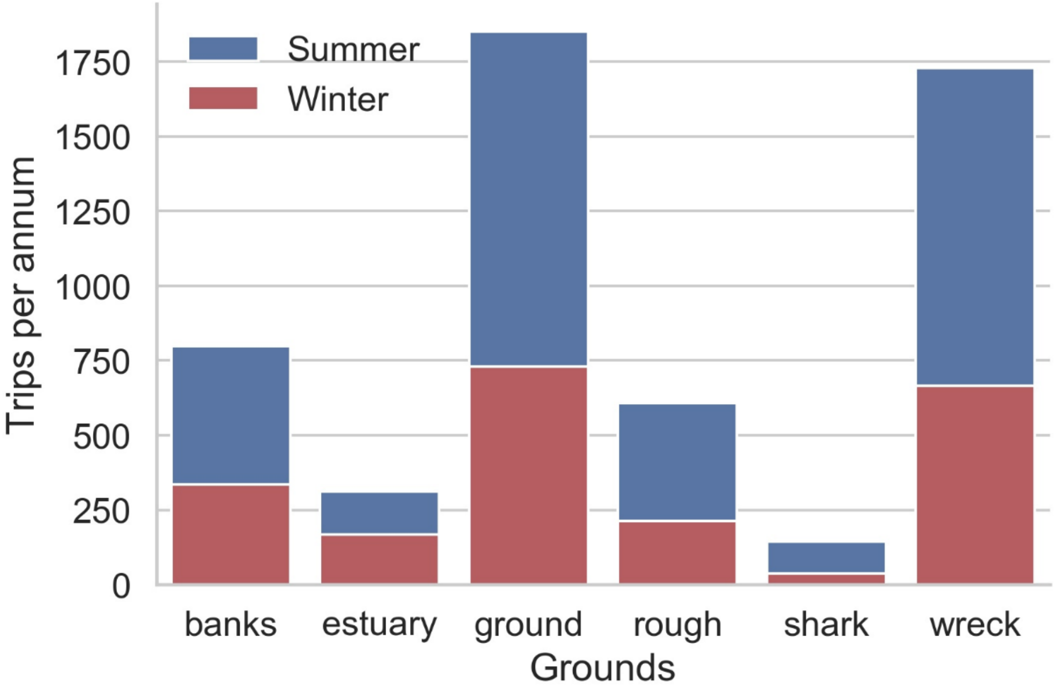
It should be noted that these estimates are not intended as an estimation of the total number of charter boat trips for the fleet but are used to show the proportionality of different kinds of trip. The greatest number of trips were estimated to occur over wrecks in the South Inshore MPLA (*n* = 909), followed by general ground fishing in the same MPLA (*n* = 698), and then wreck fishing in the North East MPLA (*n* = 594). The least popular ground type within each MPLA was open water (large pelagic sharks) for East (n = 1), North West (*n* = 6) and South East (*n* = 5), and sandbanks (*n* = 11), estuary (*n* = 20) and estuary (*n* = 18) for South West, South and North East respectively (Figure 36).

Figure 37. Percentage charter boat trips per annum by ground type and MPLA. A single trip can involve angling over multiple ground types. NB. These are not estimates of total trip numbers and should only be interpreted comparatively. Shark



In terms of the distribution of trips by grounds across the year, (Figure 38) it is evident that there is no significant interaction between season and favoured grounds. Comparative proportions remain approximately constant between the 2-bin summer and winter seasons. The only exception was trips within estuaries which were higher in number in winter (summer, 46%; winter, 54%). The spatial layer *cb_grounds* (listed, Annex I; map example, Annex S) gives a spatial view of the by-port percentage values of grounds across the charter boat fleet in England.

Figure 39. Actual trips per annum over grounds by 2-bin season. Values aggregated across all MPLAs. Grounds: *Banks* are sandbanks. *Sharks* are blue (open water). *Summer*; April, May, June, July, August, September; *Winter*, October, November, December, January, February, March. A single trip can involve angling over multiple ground types. Note that this is not an estimate of the total number of charter boat trips per annum and should be interpreted comparatively.



In terms of species, the top three ranked species across all MPLAs for charter boats were cod, skates and rays, and whiting (Figure 40; mean ±SD; cod, 20.3% ±13.9; skates & rays, 16.2% ±7.9; whiting, 7.0% ±4.8). Cod and skates and rays featured in the top five valued species for every inshore MPLA, with plaice also featuring in three MPLAs (Figure 41, plaice, 6.1% ±5.2). A detailed breakdown of fluctuations in species value by MPLA and 4-bin season is given in Annex T and Annex U. These data show the high value of cod as a recreational species throughout the year in the North East and, to a lesser extent, the East MPLAs. Rays are consistently evident through the year across all MPLAs, but most notably in spring, with the exception of the North East (skates and rays 1.8%; cod 13%). Also, of note is the relatively high importance of breams (dominated by black bream) in the South, with the value for the South MPLA being 360% higher than the mean for all MPLAs (probably due to it being a key species for charter boats in the area). Surprisingly, plaice was a highly ranked target species in the North West MPLA throughout the year, being 248% higher than the mean. This high ranking for plaice in charter boat catch reports for the region was checked manually and found to be representative. Sea bass featured prominently in the South East MPLA where they are important in spring and summer. An example spatial output is provided in Annex V.

Figure 42. Top five species by angler value for charter boats. Data extracted from fisher knowledge for charter boats. MPLA is determined by the charter boat home port and not known angling grounds.

3.2.3 StakMap

The StakMap activity data had 94 individual contributors who provided 2,415 separate spatial areas (including some point data) in which they were active. The majority of areas by number were provided within the southerly MPLAs, with 94% of activity polygons occurring in the South East, South and South West MPLAs (Table 43). Additionally, the spatial resolution - where provided - was comparatively good for the East Inshore, South East Inshore, South Inshore, South Offshore, South West Inshore areas, but tended to be poorer for the offshore MPLAs. Resolution and coverage were particularly poor for East Offshore, North East Offshore, North West Inshore, North West Offshore and South Offshore, as indicated by the distribution of polygon areas (Table 44).

Table 45. Breakdown of respondent number and polygon coverage by MPLA for StakMap. Raw, before processing, i.e. the areas of polygons provided in the original dataset; Processed, after processing as detailed in the methodology. Area in km^2.

MPLA	Respondent Nr.[8]	Polygon Nr.	Raw Area Quartiles	Processed Area Quartiles
East Inshore	16 (12%)	84 (3%)	2.47, 6.01, 30	0.10, 0.90, 4.30
East Offshore	10 (7%)	27 (1%)	190, 926, 1390	2.98, 18, 135
North East Inshore	8 (6%)	10 (<0.5%)	3.83, 7.93, 108	0.02, 0.08, 0.40
North East Offshore	3 (2%)	7 (<0.5%)	1105, 1603, 11510	40, 72, 186
North West Inshore	1 (1%)	3 (<0.5%)	79, 95, 284	263, 263, 263
North West Offshore	1 (1%)	2 (<0.5%)	347, 432, 516	0.06, 0.40, 2.00
South East Inshore	17 (12%)	168 (7%)	4.99, 16, 92	0.01, 0.10, 0.70
South Inshore	37 (27%)	941 (39%)	1.94, 11, 47	4.38, 11, 38
South Offshore	23 (17%)	243 (10%)	0.30, 260, 2207	0.01, 0.30, 1.99
South West Inshore	19 (14%)	891 (37%)	0.20, 1.34, 5.10	2.76, 5.04, 7.23
South West Offshore	4 (3%)	39 (2%)	5.10, 7.37, 574	0.10, 0.90, 4.30

Aggregating within-MPLA polygon quartiles indicated that activity was at a minimum during winter, with 45% of the 1st quartile ranks occurring in winter against 15% of 1st quartile ranks occurring in summer. Summer activity was elevated above the other seasons, with 33% of 4-bin ranked polygons relating to summer activity (Figure 43). Due to the highly unbalanced distribution of polygons and respondents across MPLAs any analysis of the data between MPLAs is inappropriate. The layer *stakmap_cb* (Annex I) contains the processed StakMap data, and reports the count of intersecting boat numbers standardised by area and aggregated by 4-bin season. An example map is provided in Annex W.

Figure 44. Frequency distribution of quartile ranked activity within MPLAs by 4-bin season derived from StakMap survey of charter boat operators.

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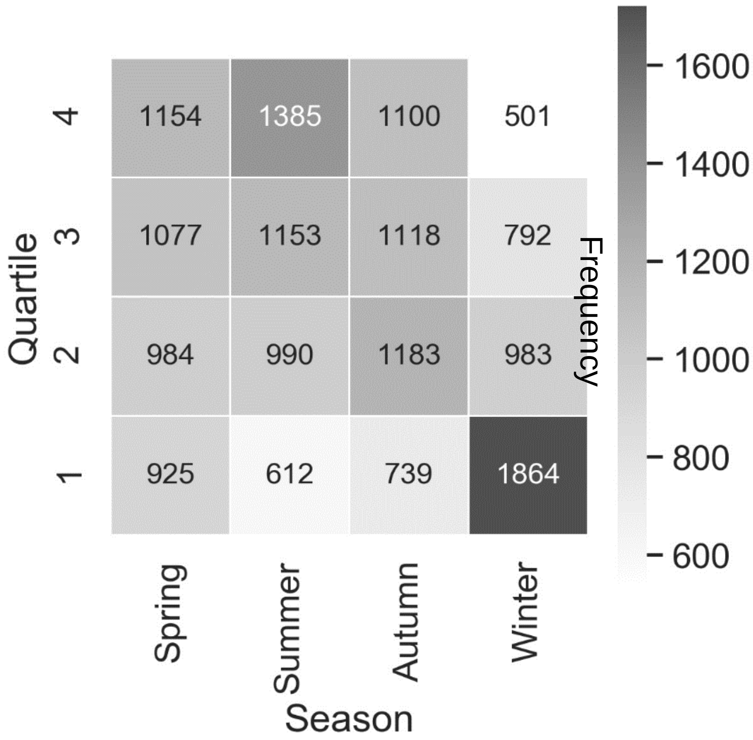
[8] Percentages may not sum to 100 due to rounding.



3.3 Afloat Platforms

In contrast to charter boats, FK sources were particularly data-poor for private boat and kayak afloat platforms. Of all OTSs for which a spatiotemporal and species value designation could be made, only 154 (0.2%) were assigned as from a kayak and 905 (1.4%) from afloat platforms (predominantly private boat).

The afloat gazetteer used to georeference OTSs contained 2% (4,859) of the records used in georeferencing OTSs for shore mapping. The vector polygons used to aggregate georeferenced OTSs (i.e. UKHO named sea features) also tended to cover larger areas than the intertidal layer used for the same purpose for the shore process. The southerly MPLAs are better represented in the UKHO gazetteer, with South Inshore, South East Inshore and South West Inshore intersecting 71% of the gazetteer polygons (Table 46). An example map output is provided in Annex X.

Table 47. Summary of the polygon areas used in georeferencing afloat value from open text data by MPLAs. Polygons are derived from the UKHO Seacover layer. Angling value (species number km^{-2}) is presented. *N*, number of polygon areas intersecting the MPLA; *Quartiles*, first quartile, median and third quartile; *Range*, minimum and maximum area; *Intensity*, area standardised (km^2) species value.

MPLA	*N*	Area (km^2) Quartiles	Intensity ±SD	Area Range (km^2)
East Inshore	35 (11%)	1.33, 3.22, 11.2	6.74 ±9.92	0.13 – 89
East Offshore	5 (2%)	1.40, 2.93, 7.34	32 ±46	0.78 – 262
North East Inshore	19 (6%)	0.094, 1.34, 5.98	68 ±135	0.028 – 17.1
North East Offshore	1 (0.3%)	179	0.03	179
North West Inshore	29 (9%)	0.66, 5.25, 37.2	109 ±219	0.13 – 280
North West Offshore	0	-----	-----	-----
South East Inshore	62 (20%)	0.42, 1.51, 6.65	216 ±713	0.0048 – 129
South Inshore	109 (35%)	0.22, 0.80, 2.43	403 ±1,265	0.005 – 709
South Offshore	1 (0.3%)	24.3	0.6	24.3
South West Inshore	50 (16%)	0.12, 0.37, 2.00	242 ±792	0.004 – 123
South West Offshore	0	-----	-----	-----

3.3.1 IFCA and MMO Sightings

The IFCA and MMO sightings data is included in the charter boat and afloat spatial layers. No adjustments have been made for patrol effort and the considerable difference in sighting proportions across MPLAs indicates that the sighting data were incomplete (Table 48). It is notable that the general trend of increased activity in summer (mean ±SD; 43.8% ±9.8), spring (22.2% ±7.1) and autumn (18.7% ±9.2) when compared to winter (15.2% ±8.4) is reflected in this sightings data.

Table 49. Summary of fisheries patrol sightings by MPLA. Note that Afloat are vessels where the underlying data did not differentiate between charter boat (*CB*) and private boat (*PB*) platforms. Percentages are calculated across rows, within platform or season. Percentages for total (*tot.*) are calculated across the Tot. column.

MPLA	Platform			Season				Tot.
	Afloat	CB	PB	Spr.	Sum.	Aut.	Win.	
East Inshore	22 (56%)	7 (18%)	10 (26%)	10 (26%)	17 (44%)	0 (0%)	12 (31%)	39 (1%)
East Offshore	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)	0 (0%)	1 (0%)
North East Inshore	368 (99%)	4 (1%)	0 (0%)	71 (19%)	176 (47%)	70 (19%)	55 (15%)	372 (9%)
North West Inshore	76 (15%)	16 (3%)	429 (82%)	82 (16%)	282 (54%)	109 (21%)	48 (9%)	521 (12%)
South East Inshore	64 (44%)	45 (31%)	37 (25%)	41 (28%)	67 (46%)	23 (16%)	15 (10%)	146 (3%)
South Inshore	2,305 (97%)	20 (1%)	52 (2%)	817 (34%)	819 (34%)	518 (22%)	223 (9%)	2,377 (56%)
South Offshore	16 (100%)	0 (0%)	0 (0%)	4 (25%)	4 (25%)	4 (25%)	4 (25%)	16 (0%)
South West Inshore	477 (61%)	42 (5%)	264 (34%)	115 (15%)	362 (46%)	250 (32%)	56 (7%)	783 (18%)
South West Offshore	13 (100%)	0 (0%)	0 (0%)	2 (15%)	7 (54%)	2 (15%)	2 (15%)	13 (0%)

3.3.2 The StakMap Survey

The StakMap recreational angling afloat data that contained the filtered activity data had 252 individual contributors who provided 23,707 separate spatial areas (including some point data) in which they were active. The majority of areas (by number) were provided within the southerly MPLAs, with 97% of activity polygons occurring in the South East, South and South West MPLAs (Table 50).

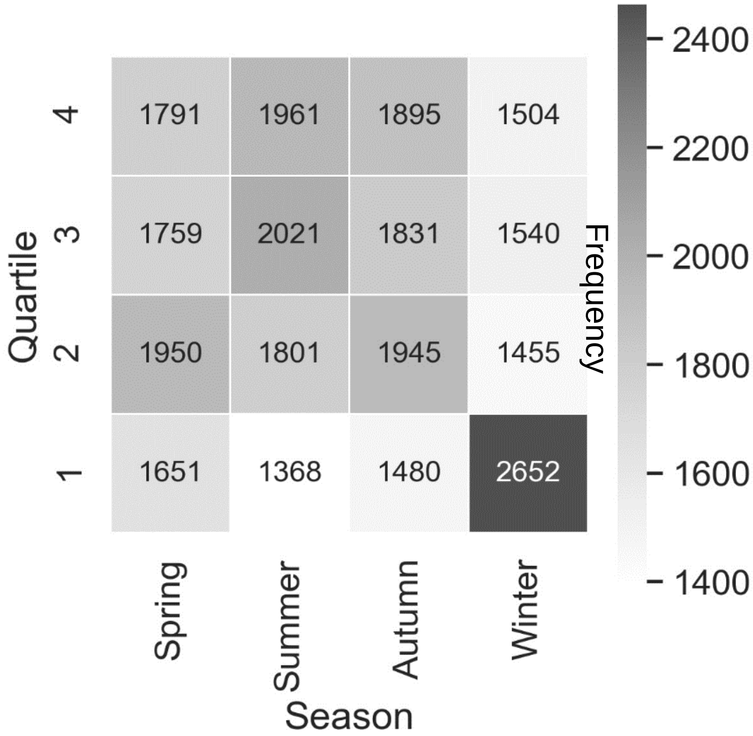
The spatial resolution results correspond closely to that of the StakMap charter boat data. Spatial resolution was comparatively good for the East Inshore, South East Inshore, South Inshore, South Offshore, South West Inshore areas and was generally poor for the offshore MPLAs. Resolution and coverage were particularly poor for East Offshore, North East Inshore and North East Offshore areas as indicated by the distribution of polygon areas (Table 51).

Table 52. Breakdown of respondent number and polygon coverage by MPLA for StakMap. *Raw*, before processing; *Processed*, after processing. Area in km. This layer contains records from anglers fishing aboard charter boats, private boats and kayaks. Quartiles; quartile 1, median and quartile 3.

MPLA	Respondent Nr.	Polygon Nr.	Raw Area km^2 Quartiles	Processed Area km^2 IQR
East Inshore	32 (13%)	498 (2%)	2.45, 7.44, 52	0.01, 0.20, 1.33
East Offshore	13 (5%)	127 (1%)	2.73, 281, 940	2.55, 2.73, 137
North East Inshore	19 (8%)	107 (0%)	43, 98, 286	0.02, 0.20, 1.33
North East Offshore	13 (5%)	239 (1%)	555, 1135, 1510	137, 172, 306
North West Inshore	20 (8%)	168 (1%)	8.15, 21, 58	0.06, 0.50, 2.55
North West Offshore	7 (3%)	40 (<½%)	0.20, 18, 48	17, 31, 42
South East Inshore	23 (9%)	284 (1%)	0.80, 6.99, 43	0.06, 0.50, 2.67
South Inshore	56 (22%)	9,446 (40%)	0.20, 0.40, 5.33	0.010, 0.06, 0.30
South Offshore	12 (5%)	5,015 (21%)	0.20, 0.3, 0.40	0.03, 0.08, 0.20
South West Inshore	49 (19%)	5,624 (24%)	0.10, 0.3, 3.53	0.007, 0.05, 0.30
South West Offshore	8 (3%)	2,159 (9%)	0.20, 0.30, 0.30	0.06, 0.20, 0.30

Aggregating within-MPLA polygon quartile ranks indicated that activity was at a minimum during winter, with 37% of the 1st quartile ranks occurring in winter against 19% of 1st quartile ranks occurring in summer. Across the other ranks, the percentage division of ranks across season showed a relatively equal distribution (Figure 45). Due to the highly unbalanced distribution of polygons and respondents across MPLAs, any analysis of the data between MPLAs is inappropriate. The layer *stakmap_afloat* (Annex I) contains the processed StakMap data, and reports the count of intersecting boat numbers standardised by area by 4-bin season. An example map output is provided in Annex X.

Figure 46. Frequency distribution of quartile ranked activity within MPLAs by 4-bin season. Data derived from StakMap survey data of recreational angling and includes survey data provided by anglers who reported engaged in angling aboard charter boats or private boats.



3.3.3 The Potential Marine Protected Areas Survey

The original source data is described in 2.9.4 (Kenter et al., 2013). A total of 100 of the pMPA from 2012 intersected with the MPLAs and the survey recorded 60,506 visits by anglers. Table 53 summarises the areas of the pMPAs, MPLAs. Offshore MPLAs are seen to be dominated by larger pMPAs. The North East Inshore, South Inshore and South West Inshore areas do have some small area pMPA designations in which an intensity is recorded and the South Inshore MPLA intersects 28% of the pMPAs and 53% (31,585) of all visits submitted to the original survey.

Table 54. Summary of the sizes and angling intensity within the marine protected areas (pMPA) proposed in 2012. Original data from Kenter et al. (2013).

Data aggregated by MPLA. *N*, number of pMPAs intersecting the MPLA; *Quartiles*, first quartile, median and third quartile; *Area Range*, minimum and maximum area; *Intensity*, survey recorded visits per year per km^2. No pMPAs with survey data intersected the North West Offshore MPLA.

MPLA	n	Area (km^2) Quartiles	Area (km^2) Range	Intensity visits yr^{-1} km^{-2} ±SD	Visits year^{-1}
East Inshore	9 (9%)	83, 180, 320	11.4 – 1,176	*M* = 4.30 ±5.07	4,357 (7%)
East Offshore	2 (2%)	176, 184, 192	168 – 200	0	0 (0%)
North East Inshore	4 (4%)	1.77, 35, 100	0.39 – 198	*M* = 278 ±409	2,027 (3%)
North East Offshore	5 (5%)	551, 945, 2439	492 – 4,745	*M* = 0.05 ±0.11	225 (0%)
North West Inshore	10 (10%)	16, 42, 88	4.39 – 388	*M* = 12.7 ±15.2	2,566 (4%)
North West Offshore		–	–	–	–
South East Inshore	7 (7%)	56, 64, 194	10.4 – 285	*M* = 32.2 ±61.1	6,518 (11%)
South Inshore	28 (28%)	3.91, 20, 57	0.034 – 594	*M* = 1,725 ±7,128	31,585 (53%)
South Offshore	2 (2%)	286, 478, 669	94 – 861	*M* = 1.69 ±0.66	1,261 (2%)
South West Inshore	23 (23%)	7.24, 25, 117	1.32 – 474	*M* = 57 ±95	9,800 (17%)

3.3.4 Launch and Storage Facilities

3.3.4.1 Slipways

Slipways in England can be under public ownership by the local authority or other governmental organisation or privately owned. During the summer months local authorities will frequently collect fees from people wishing to launch boats, however, such facilities are also used by kayak anglers who can usually use these at no charge. Private facilities may be associated with holiday accommodation (e.g. caravan sites), clubs and other private landowners. Access to these slipways will usually be associated with a fee. Assisted launching/recovery services may also be provided, particularly where slipway access does not extend to the low water mark or is not constructed of a hard building core.

Across England 528 slipways were identified and these are provided as a point feature class (listed, Annex I; map, Annex P). The greatest densities are seen in the

South and South West Inshore MPLAs and lowest density in the North East Inshore MPLA. Slipway counts by MPLA are given in Table 55.

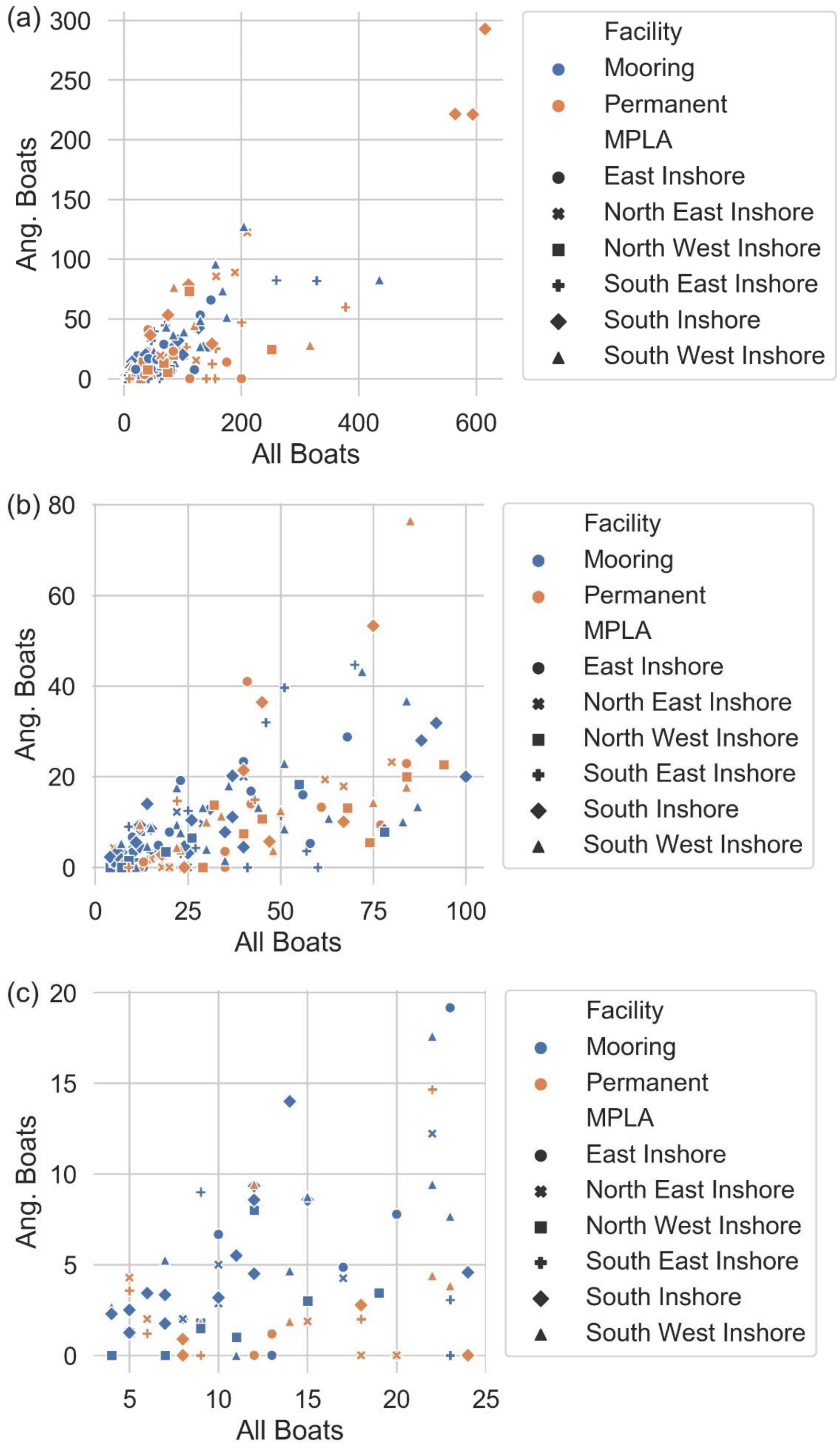
Table 56. Number and percentage of slipways—derived from fisher knowledge—by MPLA.

MPLA	Nr. (%)
East Inshore	90 (17%)
North East Inshore	30 (6%)
North West Inshore	49 (9%)
South East Inshore	97 (18%)
South Inshore	160 (30%)
South West Inshore	102 (19%)

3.3.4.2 On-Water Boat Storage Facilities

A total of 550 on-water facilities were identified, with a point-in-time total estimate of boats that could be used for sea angling (95% CIs) of 12,946 [10,543, 15,349]. Viewing sampled facilities shows that 88% of sampled facilities had 50 or fewer RSA-centric boats. The southerly MPLAs hosted the largest facilities (Figure 47).

Figure 48. Distribution of *sampled* facilities by MPLA and on-water facility type; *Permanent*, permanent facility e.g. harbours or pontoons; *Moorings*, buoyed moorings. Angling boats (Ang. Boats) is the number of angling-centric boats estimated at the facility by the manual classification of boat type using images in Google Street View. All Boats is the count of all boats observed in satellite imagery. Graph (b) shows all boats limited to 0-100 with the respective number of angling boats and (c) shows all boats limited to 5-25.



Of the 550 facilities, 236 (43%) were in permanent structures (e.g. harbours and pontoons) and 314 (57%) were buoyed moorings. The South West MPLA had the highest number of recorded facilities (175, 32%), and East Inshore had the fewest (41, 7%). However, the South MPLA had the highest estimated boat numbers with 45% of the total sum across all MPLAs (Table 57, Figure 49). An example of the facilities spatial layer, *facilities* (Annex I) is provided in Annex AA.

Table 58. Point-in-time estimates of the number of boats that could be used for angling at on-water boat storage facilities by MPLA and facility type. Facility type is a 2-bin classification of buoyed moorings or permanent structures (e.g. harbours and pontoons). Columns are: N, facility count; *Mean*, mean boat number per facility with the population standard deviation; *Boat Nr.* estimated number of boats; Total, estimate of total number of boats across all facilities. Confidence intervals (CIs) estimated with a finite population correction[9].

MPLA	**N**	**Permanent**		**Buoyed Moorings**		**Total [95% CIs]**
		Mean ±SD	**Boat Nr. [95% CIs]**	**Mean ±SD**	**Boat Nr. [95% CIs]**	
East Inshore	41 (7%)	*M* = 22 ±17 *n* = 18	389 [299 – 479]	*M* = 18 ±14 *n* = 23	422 [361 – 482]	810 (6%) [661 – 961]
North East Inshore	45 (8%)	*M* = 19 ±25 *n* = 30	579 [454 – 704]	*M* = 6 ±4 *n* = 15	90 [77 – 103]	670 (5%) [532 – 807]
North West Inshore	36 (7%)	*M* = 23 ±18 *n* = 10	227 [174 – 280]	*M* = 8 ±9 *n* = 26	207 [177 – 236]	434 (3%) [351 – 516]
South East Inshore	81 (15%)	*M* = 33 ±27 *n* = 40	1,313 [1,012 – 1,614]	*M* = 19 ±21 *n* = 41	765 [655 – 876]	2,078 (16%) [1,667 – 2,489]
South Inshore	172 (31%)	*M* = 41 ±51 *n* = 80	3,252 [2,533 – 3,971]	*M* = 28 ±63 *n* = 92	2,566 [2,204 – 2,928]	5,818 (45%) [4,737 – 6,899]
South West Inshore	175 (32%)	*M* = 20 ±27 *n* = 58	1,161 [901 – 1,420]	*M* = 17 ±18 *n* = 117	1,975 [1,694 – 2,256]	3,135 (24%) [2595 – 3,676]

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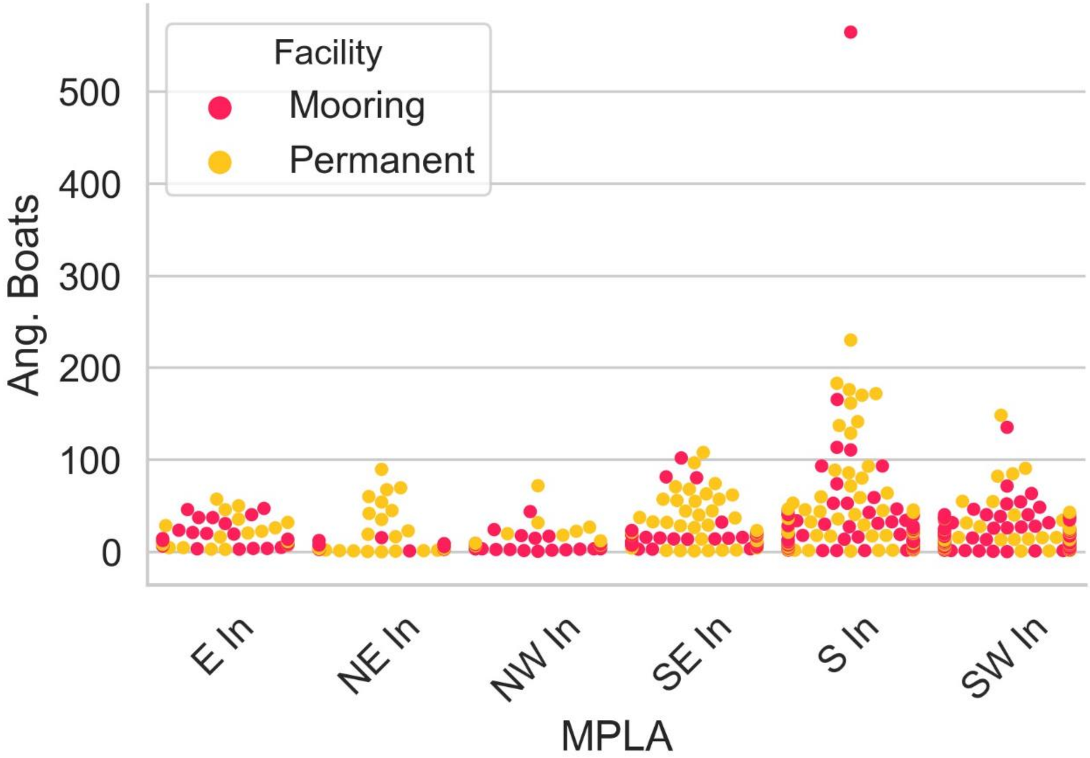
[9] CIs have been summed, considering permanent and buoyed moorings as independent samples which may tend to overestimate the confidence intervals.

Figure 50. Estimates of boats that could be used for angling for all mapped facilities by facility type and MPLA. All MPLAs are inshore (In) and are; E, East; NE, North East; SE, South East; NW, North West; SW, South West; S, South. Facility types are buoyed moorings (mooring) and permanent structures including quays, harbours, marinas, docks and pontoons (permanent).



4. Discussion

4.1. Overview

The spatial extent of shore angling was successfully mapped at high—but variable—resolution. Yields of data from open text were sufficient to provide strong indicators of value when data were disaggregated by season and species. Approximately 51% ±7.4 of all intertidal areas were assigned some activity (and species) angling value. The Sea Angling 2012 site survey recorded species, spatial and temporal variables for 4,703 species catches (Armstrong and Hyder, 2013). In contrast, this methodology extracted 503,681 activity records (afloat and shore), but the two approaches have different limitations. The onsite survey of Sea Angling 2012 in which species and activity were recorded with spatial data is costly, but statistically sound whereas data mining can collect many more records per unit cost but are subject to unknowable biases.

Across the shore dataset, the volume of data allows us to have reasonable confidence in the by-monthly fluctuations in activity (Figure 51). The confidence intervals suggest a high degree of variation at individual sites, as anglers switch between species, venues, fishing gears and strategies to meet changes in species availability throughout the year. This seasonal change is clear in the heat map outputs for shore (Annex N, Annex O) and charter boats (Annex T, Annex U) with the most obvious pattern being the increase in sea bass value in the summer months, a switch from cod in the winter. These outputs also capture that this effect is not uniform across the country, with sea bass value maintaining a higher base level in the winter for the more southerly MPLAs. These patterns match expectation from our personal knowledge; from research on seasonal changes in the distribution and migration of mature sea bass (Pawson and Pickett, 1987; Pickett et al., 2004; Pawson et al., 2007a, 2007b), and stock estimates (Pawson et al., 2007c).

When reviewing the heat maps at high resolution, as the shore outputs allows, inter-seasonal changes are captured. For example, examination of the Merseyside area (layer species in Annex I, Annex P, Annex Q) shows an expected increased angler association of cod at Mersey Estuary venues in the autumn and winter months, with a general decrease in activity in the Spring and Summer (personal observation), despite increased catches of flounder and eel. This level of detail is vital for further understanding the analysis and to use this information in management. Similarly, generic frameworks of implementing such data for management have previously been reviewed in other European regions (Stelzenmüller et al., 2013) and more specifically the same method has been applied within Wales, UK (Monkman et al., 2015b).

When viewing and interpreting the mined data it is critical to appreciate that value measures have not been adjusted or raised to the sea angler population. 'Raising to a population' is a generally recognised term in surveys, meaning an estimation is multiplied by a known population number to get a total estimate for the population. All outputs are only suitable in making comparisons of relative value. There was no sampling frame from which samples were drawn. The broad assumption made is that the population of anglers who publish open text to the source lists (of which we have effectively made a census) report values of sites in the same way that the general population of anglers would do for those areas.

It is also assumed that within sample, the temporal distribution of reporting by ordered value rank was the same as the true value in the general angler population. Rephrasing, we are asserting that the population of anglers who contribute open text data is representative of the total angler population with no significant biases across the factors and factor levels reported. These assumptions are reasonable, but difficult to verify within the scope of this project. For instance, it may be the case that there are biases of avidity and experience within those who report, but this was not verifiable within the scope and approach of this project. As such, a qualitative ground truthing validation was undertaken.

Looking at species, it is apparent that biases in species reporting were present. Prestige biases are particularly relevant to the data mining methods used (Campbell et al., 2001), which can result in the over reporting of prestige, sport and rare species, and under reporting of mundane trips where only common species, non-trophy specimens or no captures are certain to have occurred. This is most clearly seen in the comparatively high value of sea bass, cod and ray species, and to a lesser extent bream, plaice and smooth-hound species in the heat map outputs (Annex N, Annex O, Annex T, Annex U). This contrasts with the Sea Angling 2012 (Armstrong and Hyder, 2013) on-site survey results where whiting, mackerel and dab were the top three captured species (rays were 16th) and in the North Wales Pilot Surveys (Goudge et al., 2009, 2010) where the ranking was whiting, mackerel and wrasses (mean shore catch percent; cod, rays, bass= 0.2%). However, there is agreement with survey assessment of what anglers report as their target species, where combined data from four sources ranked sea bass (1), cod (2) and rays (4) in the top four targeted species (review, Monkman et al., 2015). In addition, sea bass, cod and mackerel were ranked as the top three targets among both shore and private boat anglers in Sea Angling 2012 (Armstrong et al., 2013a).

Marine planning seeks to ensure that the right uses of the marine environment occur in the right place and at the right time, and that sustainable development underlies any decisions on what can or cannot take place. This includes consideration of social, environmental and economic factors in decision-making. Marine plans guide management of the marine environment and help inform an understanding of the interaction between commercial and recreational fishing in the marine planning context. This includes the benefits of marine planning in terms of promoting sustainable marine recreational activities, including sea angling, which is known to be an important economic sector in England, supporting coastal communities and facilities.

The outputs from this research will also be used to inform decision-makers. For example, maps showing areas of high-intensity recreational angling will be of use when looking at development applications, to see if there would be any associated impacts on anglers; either on the fish resources, the access of recreational anglers to their typical fishing grounds, or businesses related to supporting angling, such as charter boats.

In assessing ecosystems services, an unambiguous measure of effort and catch (by appropriate variables, such as angling method) is ideally required and should accompany assessments of impact by those variables. However, when making judgements about the relative importance of factors such as social, physical and mental wellbeing and environmental benefits, value is a more meaningful measure. In addition, the value outputs provided have been shown to correlate highly with angling effort measures (Monkman, 2013; Monkman et al., 2015a, 2018a, 2018b).

It is an inescapable limitation of the method that we cannot, with absolute certainty, say a given location has no value to RSA. When considering the spatial distribution of shore angling, absence of evidence is not evidence of absence. We can, however, have a degree of confidence that an area ranked “non-detected” is not highly valued where value is defined as the aggregated count of visits in the proximity of the location. Conversely, the validation exercise showed that there is a high degree of confidence that highly ranked sites are accurately predicted. There is, however, another fundamental limitation in this measure of value. As presented, our reported value cannot be assumed to be the same as some notional, all-encompassing value measure. For example, some areas may be highly valued but not rank highly because the site is under-reported. A highly pertinent example would be the pursuit of comparatively rare species (e.g. sting ray) at certain venues or during certain time of the year. Further evaluation would be required to determine if these methods could detect such activity patterns.

Originally it was intended that stakeholder consultation would be undertaken via four webinars with stakeholders from different regions ‘attending’ to comment on data produced. However, an alternative approach was taken. This was partly as a result of initial consultation and stakeholder preference and availability, but more importantly because the maps and data being produced were very specific to locations. As such, a group session would not have been productive (some attendees may have been familiar with some areas and others not). Time constraints also meant that a more efficient method was required.

The validation proved to be invaluable in revealing exceptions in the output results. This shows the importance of utilising local knowledge when handling large volumes of fisheries data. The misidentification of sea bass as a target species in Isles of Scilly can be attributed to the comparatively low number of anglers within the Isles of Scilly IFCA. When the distribution of frequencies of value records is narrow for the area considered, then there can be less confidence that the predicted value rankings are an accurate representation the real-world value. The Isles of Scilly IFCA is a special situation, as the majority of value records were low. Where value record counts are low within the given spatial area in which we group the quantile ranking, then output ranks are more sensitive to errors which arise from the data mining process. Small biases which increase the count of a particular species are more likely to impact quantile rankings – i.e. with fewer anglers contributing data, individual contributions carry more weight, so may influence changes in the results to a greater extent . It was shown that the additional controls which were developed significantly reduced this error (section 2.7.2.1). It should be noted that the final outputs included the Isles of Scilly IFCA in the South West Inshore MPLA for reporting reasons, which increases the frequency spread of value rank counts. This also highlights methodological limitations in the reliability of accurate activity level for sites and species where there are few sources of open text.

Alternate approaches that could have been adopted to validate such data include recruiting a higher number of stakeholders, creating a more purposeful approach with definitions for the subjective rankings, or making the entirety of the data open source, with the ability to retrieve feedback online. Subjectivity, however, will always remain an issue in validation exercises, regardless of the approach type. Therefore, getting a large enough sample of sea anglers that are representative of the sea angler population is preferable to validate results.

Data embedded in fisher knowledge reveals the preferences of participants without the biases which arise when soliciting a response directly. It is reasonable to assume that recall bias will be reduced in comparison to some survey instruments as posts will generally be made soon after the trip occurred. However, social media data are non-independent in space and time and the same users in a community will tend to provide repeated contributions (Lerman, 2007; van Mierlo, 2014; Nielsen, 2017). Clearly the locations frequented by participants in their recreational activity will not be randomly chosen. Social media posts are likely to influence others in the social network (Centola, 2010; Bond et al., 2012), will increase contributions and may stimulate recreational activity in other users.

The data mining method used is repeatable with some caveats. Repeatability in acquisition, classification georeferencing and reporting is intrinsic to the process as it uses entirely deterministic code. Given the same starting data, we end up with the same outputs. In fact, the process could be repeated at any time, and data compared as the time series continues to increase. Provided the code does not change, direct comparisons can be made between time points, assuming biases remain the same between years.

Certain elements of the whole process were non-deterministic. Choices were made on which sources were used to produce the gazetteers and the lexicon, and it is a truism that some OTSs will become unavailable and new ones will arise. Evidence does suggest there is a decline in the use of angling blogs and forums (Monkman, 2013) as the popularly of the large social networking sites (e.g. Facebook) continues to increase (Statista, 2018).

4.2. Afloat and Charter

The afloat and charter outputs are discussed together because the extent of spatiotemporal data for both groups across England was poor. As detailed in the methods, both afloat and charter datasets included data-mined data, and the previous discussion points equally apply.

Determining the angling locations of private boat anglers and charter boats was problematic. Data coverage from survey sources was patchy and although OTS were relatively numerous, named locations were very rarely used in open text (possibly to protect knowledge of fishing grounds which can be commercially advantageous) and the afloat gazetteer contained just 2% of the records contained in the shore gazetteer by count. This is despite the area available to afloat RSAs being at least three orders of magnitude greater. All available sources of data had spatial coverages which were incomplete, with large areas with no recorded value. Where a value was assigned, the area polygon frequently covered an area over $10km^2$ (Table 59, Table 60, Table 61).

The StakMap project was successful in mapping high resolution spatial data for both afloat and charter platforms, particularly towards the south of the country. However, coverage was extremely poor in the offshore MPLAs and in the more northerly MPLAs. The StakMap project was also a non-randomised self-selecting survey sample. In addition, the lineage of the data is largely unknown as no detailed methodology or formal report could be found. The dataset also included point data which had been subsequently buffered to 300 meters. When standardising value by an area measure, these buffered areas will have a high value. This is an accepted limitation.

The estimated number of charter boats is similar to that in some previous studies (there were an estimated 399 in Sea Angling 2012 (Hargreaves et al., 2013)) although the estimated number of charter angler day trips (733,766) is much higher than in other studies: the ONS survey in Sea Angling 2012 estimated 370,825 angler days; and the charter boat survey in the same study was even lower at 105,871. It should be noted that the estimate of days in this research is a maximum value for both boat numbers and possible days and this does not take account of days lost to weather (not known) and there are no adjustments made for charters doing mixed trips. Poor data quality, survey methods and other factors may also account for differences.

Some of the data sources used are several years old and as such may be out of date, which has been fully disclosed in the caveats section. In addition it is a reasonable assumption that the same species retain their popularity through recent times. Species preferences demonstrate anglers' value size, fighting prowess and palatability and these will remain largely invariant except where availability is reduced through significant reductions in catchability (e.g. angel shark and common skate). The popularity of venues can also reasonably be assumed to not change markedly over time - except where venues become unavailable (e.g. piers) - because important predictors of site popularity will be accessibility, proximity to population centres and infrastructure, fish catchability and social influence (Carlin et al., 2012; Dabrowksa et al., 2017; Hunt et al., 2019). It is important to note that all methods which use data mining include contemporary sources.

The interpretation of the spatial charter and afloat values provided in the spatial layer may best be considered as proportional to the chance of finding a boat within a fixed sampling area of the approximate scale of a single boat.

4.3. Facilities

Improvements in the resolution of satellite imagery has made it easier to identify the extent of boat facilities and to count boat numbers. The resolution is of high quality to identify individual mooring buoys which can be counted to produce estimates of total capacity for a given mooring. The mapping exercise captured all on-water storage facilities in England's marine plan inshore areas.

The location of these facilities is highly correlated with the distribution of afloat effort. Angling boat numbers were estimated using a randomised and sound statistical approach, but estimates can only be interpreted as a single point–in-time estimate of the relative distribution of boats potentially used for RSA across the sample extent. Only relative comparisons can be made and the reported boat numbers must not be interpreted as an estimate of total private angling boat numbers for any given spatial area.

Although RSA boats are relatively easy to identify, not all boats identified as used for RSA may be used for sea angling. Cruisers, ribs and powerboats may also be involved in angling activity, though undoubtedly at a reduced average activity level, but these were assigned into the 'other' category. The identification of RSA boats is open to observer interpretation although a single observer was used to make all estimates of RSA boat numbers. In addition, this was a point-in-time estimate, and that point-in-time was different across England as not all satellite imagery was captured at the same time. Variations in the time of day, month and year may bias the results however; dates and times were reviewed and satellite images were captured during spring and summer and during daylight hours and repeat studies could follow this approach to facilitate comparability. Each of these influences may serve to increase or decrease the estimates and it would be inappropriate to take the figures as a proxy quantitative indicator of the magnitude of RSA-centric vessels likely to be operating from the respective facilities.

4.4. Recommendations

Survey costs directly proportional to sampling effort. The extent of the areas involved on the shore and at sea make it completely impractical to conduct a comprehensive site survey of the spatial extent of activity. This is particularly true of the afloat sector which covers a much larger area than shore and in addition private boat users are comparatively rare in the national population, making traditional low-cost survey methods ineffective.

In addressing environmental stewardship in marine spatial planning, it is important to undertake work to better understand the potential impacts of RSA on the ecosystems and associated habitats of high vulnerability or otherwise at risk. These habitats can then be prioritised to provide assessment of the potential impact of RSA. If significant impacts are possible, an appropriate spatial resolution needs to be determined to match predetermined risk levels of angling effort with the habitat in question. A suitable survey approach can then be decided to deliver outputs at the required resolution.

Other approaches to the validation could be undertaken to increase the input of stakeholders and individual sea anglers. This could include:

- a much more extensive survey involving angling clubs and IFCAs in each area, but this could have significant resource implications and require preparation of 'packs' for a wide range of sites for people to comment on.

- a more purposeful approach to ask stakeholders to select the sites they know about and then validate what we have at those sites with them (an approach ultimately adopted in this project).
- making the full dataset available and have an open, ‘crowd sourced’ online feedback mechanism for people to identify the sites and whether they agree with the grading of them. This could be accompanied by questions to assess respondent knowledge of the sites, to inform use of this input.

However, issues with accuracy and subjectivity will remain whatever approach is taken and developing a better understanding of the distribution of species will involve a more extensive catch survey. Although the Sea Angling Diary project records the activity and catches of 1,750 people in the UK, this is to produce annual estimates and does not produce data at the resolution required for this research. More extensive catch surveying might enable this.

Replication of the methods to estimate boat numbers should be repeated at the same time of year to ensure comparability. An alternative approach might be to commission satellite imagery within particular time windows to assess seasonal changes. Additional on-site surveys of anglers and facility managers could further help refine population estimators of boat numbers.

Other potential approaches could include adding to and expanding the data collected in the StakMap survey, for instance utilising online methods and existing angler databases; and targeted work in some areas to address poor data, such as the afloat data in the Northern MPLAs.

4.5. Caveats

Table 62. Summary caveats for each section

Afloat Mined Data
Summary of Caveats
The area is restricted by the named locations in the UKHO sea_cover layer. The use of named locations from anglers who fish on afloat platforms is also very sparse. The UKHO_sea_cover features are also comparatively large and the distribution of afloat angling activity within these areas is likely to be highly heterogeneous.
Comparisons should only be made quantitatively between areas. In addition, absence of recorded activity cannot be taken as evidence of no activity.
There are serious limitations from sampling issues and framing, open text data was processed from all identified sources, however, it is impossible to match this to any strict knowable sampling frame.

Afloat StakMap and Afloat Charter Boats
Summary of Caveats
StakMap data were collected between 2012-2013. The methodology was a self-selecting survey and should be considered as qualitative only. It should not be used to estimate population numbers or effort.
Part of the original data buffered points to 300 meters, these areas will tend to show a high intensity value because of the standardisation by area. They do represent highly spatially specific data on locations of known activity but may exaggerate the intensity within these areas when compared against polygons which were originally hand drawn by respondents.
Absence of activity in these data does not constitute evidence of no activity at any given location.
The lineage of the original StakMap data is not documented. Nor can any formal report be found that provides full details of the methods used to collect the data and any limitations.
Data coverage is very patchy. More northerly regions are very poorly represented.
There are serious limitations from sampling issues and framing, it is impossible to match this to any sampling frame.

Afloat The Value of […], Proposed MPLA Survey, from Kenter et al., 2013
Summary of Caveats
There are limitations from sampling issues and framing. There was uncertainty about the real number of sea anglers in the UK and their geographical distribution. Also, the sample size for sea anglers in particular is limited by the accuracy of visitor estimates and in some cases visitor estimates could not be made. Sea angler visits to sites and angler recreational values need to be read as relative trends, allowing us to distinguish popular from less popular sites, but with considerable uncertainty about exact numbers.
There is considerable uncertainty as to whether results are under- or overestimates as a result of uncertainty around the implications of the sample size for visit numbers to individual sites (although the latter affects aggregate recreational use values only, as only these depend on visit counts).
The study was restricted to the MCZ proposals around 2012/2013. Activity outside of these areas is entirely absent. Hence comparisons can only be made qualitatively between the polygons in the layer and no inference about the comparative activity outside of the MCZ proposals can be made.
The MCZ areas are comparatively large and the distribution of activity within an MCZ area will be highly heterogeneous.
There are serious limitations from sampling issues and framing, it is impossible to match this to any strict knowable sampling frame.

Charter Boats Grounds, Activity and Species
Summary of Caveats
Imputation was used to complete missing values for maximum passenger capacity, operating distance and annual total operating days. Hence individual records may be inaccurate where imputation was used, and confidence limits will be large where harbours have few boats.
Resource restrictions meant that details were validated from online information only - as opposed to telephone interview - including whether or not any individual charter boat was still operating.
The charter boat sector has a high turnover. The list of operating boats and their operating location is subject to rapid change. However, it is reasonable to assume that changes in ground preferences will not be affected by charter boat turnover, unless there are major ecosystem changes which alter the distribution of targeted species.
These data do not map the distribution of different grounds within the extent of the spatial location but merely indicate the grounds favoured by charter boats as expressed in public open text data.
Although the identification of operating charters and their home ports represents a high proportion of the total number of charter boats, data on the reported operating ground and species preferences were derived from open text data, and will be subject to frame sampling errors and other statistical problems. Hence these data should be considered qualitative only.
There are limitations with sample framing, it is impossible to match this to any sampling frame.

Afloat Facilities
Summary of Caveats
Imputation was used to complete missing values for angling boat numbers (approximately 75% by facility number), hence individual records may be inaccurate where imputation was used, and confidence limits will be large where facilities have few boats.
These data represent a snapshot in time, the estimated numbers will be highly dependent on the time of day and year when the satellite imagery was captured hence data cannot be used to make any population inferences of boat numbers, but should just be considered comparatively within sample.
In counting boats and classifying boats as having a primary function of angling there is likely to be some unavoidable subjectivity. Again, data cannot be used to make any inferences of total boat numbers, but should just be considered comparatively within the sample.
These data do not describe the physical grounds over which RSAs are active. These data may be suitable to direct further survey and assessment work or other similar assessments.

Afloat Slips
Summary of Caveats
Slipway facilities are being closed because of budgetary restrictions on local authorities. It is likely that some of the facilities listed will no longer be available for launch.
These data do not describe the physical grounds over which RSA are active. These data may be suitable to direct further survey and assessment work.

Shore Mined Data
Summary of Caveats
The extents of the intertidal polygons were originally created by buffering a mean high-water line, but the intertidal area may extend beyond this buffer.
The intertidal polygons were manually mapped and further edited as part of this work. The lengths of coastline vary considerably because the extents have been drawn to coincide with coastline features such as the extent of a beach. This should be considered when comparing the ranks assigned to the intertidal polygons.
These data do not describe the physical grounds over which RSA are active. These data may be suitable to direct further survey and assessment work.
There are limitations with sample framing; open text data was processed from all identified sources, however, it is impossible to match this to any sampling frame.
Comparisons should only be made quantitatively between areas. In addition, absence of recorded value cannot be taken as evidence of no value.
Predictions of medium and high activity value are more reliable (>80% from validation) than predictions of low value.
Species value is skewed to prestige species.
Although site value strongly correlates (93%) with what we term effort or activity, the value presented in this report should not be considered as an precise proxy for effort or activity.

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6. Annexes

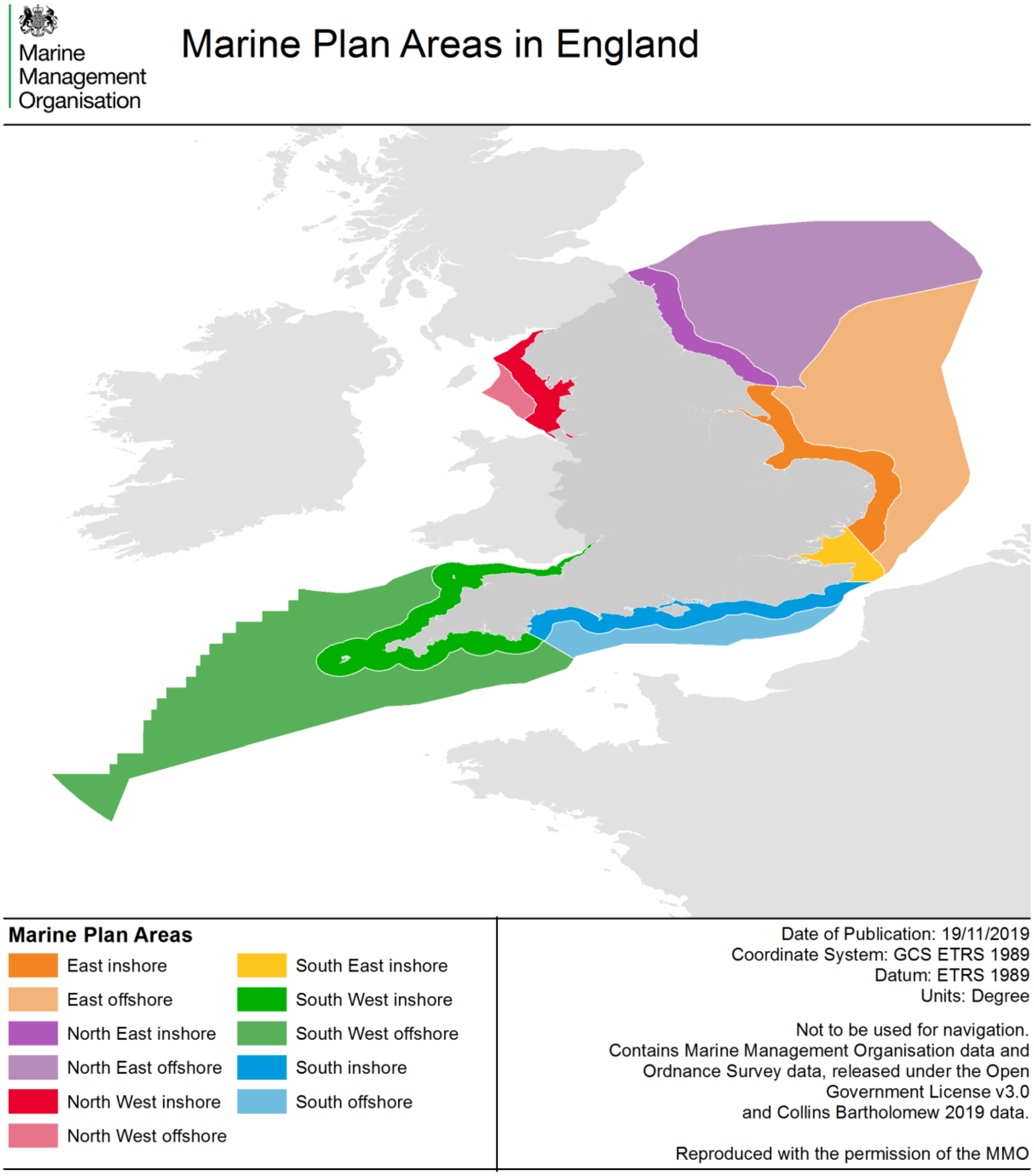
Annex A. Source Summary for All Platforms

Summary of sources reviewed for suitability for this project for all platforms. Columns under *Reason Unused* are: *Dup.,* Duplicate source; *Extent*, spatial extent did not cover England; *Protected*, Source could not be accessed because of security protection or possible data protection conflicts. *Sparse*, source contained no or very little relevant information; *Defunct*, source was no longer available. Under *Use*, *Map* indicated that the source was used to map spatial value and *Gaz* indicates the source was used to contribute to the gazetteer. Bolded lines are the classification with totals. *Print* refers to magazines and books. Also see Supplementary Materials A for the full list of all sources reviewed. Other abbreviations: SNS, Social Networking Sites; App, Application.

Classification	**Reason Unused**					**Use**	
	Dup.	**Extent**	**Protected**	**Sparse**	**Defunct**	**Map**	**Gaz.**
Expert Knowledge				4		1	
Other				1		1	
Web Site (App)				2			
Web Site (Static)				1			
Expert Observation				5		3	
Other				3		3	
Report				1			
Survey Data				1			
Fisher Catch Records			2	3			
Academic				1			
Diary				2			
Logbook			1				
Other			1				
Fisher Knowledge	2	2	14	259	126	15	59
Diary				1			
Other	1					1	
Print	1			47	6		23
Web Site (App)						1	1
Web Site (Forum)			14	17	11	13	15
Web Site (SNS)				5			1
Web Site (Static)		2		189	109		19
Imaging				2			
Web Site (App)				2			

Classification	Reason Unused					Use	
	Dup.	Extent	Protected	Sparse	Defunct	Map	Gaz.
Other				4			
Report				1			
Web Site (Static)				3			
Review				6			
Other				1			
Report				5			
Survey (Mixed)				3			
Report				2			
Survey Data				1			
Survey (Non-Random)					1	2	
Report						1	
Survey Data					1	1	
Survey (Random)		1		8			1
Other		1					
Report				3			
Survey Data				5			1
Survey (Self-Selecting)				8			
Academic				2			
Report				3			
Survey Data				3			
Total	2	3	16	302	127	21	60

Annex B. Marine Plan Areas for England



Date of Publication: 19/11/2019
Coordinate System: GCS ETRS 1989
Datum: ETRS 1989
Units: Degree

Not to be used for navigation.
Contains Marine Management Organisation data and Ordnance Survey data, released under the Open Government License v3.0 and Collins Bartholomew 2019 data.

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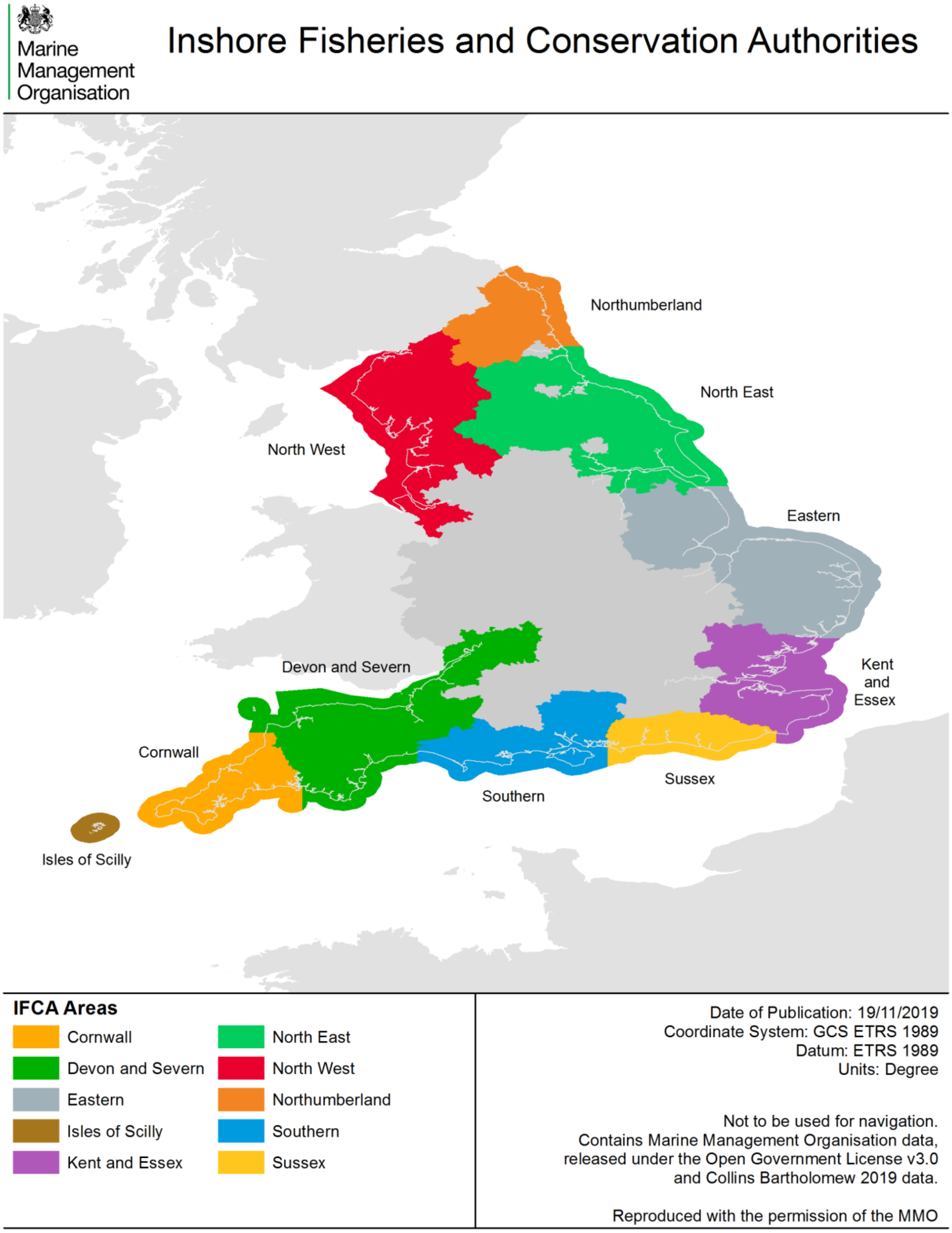
Annex C. Inshore Fisheries and Conservation Areas



Date of Publication: 19/11/2019
Coordinate System: GCS ETRS 1989
Datum: ETRS 1989
Units: Degree

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Annex D. Open-Text Source–Region Groupings

Spatial coverage by IFCA region assigned to open text sources. IFCAs as follows; Co. Cornwall; DS, Devon and Severn; Ea, Eastern; Sc, Isles of Scilly; KE, Kent and Essex; NE, North East; NW, North West; Nb, Northumberland; S, Southern; Sx, Sussex. Plt refers to the platform; Sh, Shore; PB, Private Boat; CB, Charter Boat; Ky, Kayak.

Source	Board	Co.	DS	Ea	Sc	KE	NE	NW	Nb	S	Sx	Plt.
www.solent-fishing-forums.co.uk	beach talk	X	X							X		Sh
www.southwestseafishing.co.uk	Cornwall fishing	X										Sh
www.southwestseafishing.co.uk	Devon fishing		X									Sh
www.southwestseafishing.co.uk	Dorset fishing									X		Sh
www.sea-fishing.org	east coast			X			X		X			Sh
worldseafishing.com/forum	east coast catch reports			X		X						Sh
anglingaddicts.co.uk	east-coast-sea-fishing-reports			X		X						Sh
wirralseafishing.co.uk/forum	easy access venues/directions for all areas							X				Sh
wirralseafishing.co.uk/forum	fishing session reports							X				Sh
www.sea-fishing.org	Humber estuary			X			X					Sh
www.sea-fishing.org	Isle of Wight									X		Sh
wirralseafishing.co.uk/forum	Merseyside/Fylde coast/Cumbria venues/directions							X				Sh
worldseafishing.com/forum	north east catch reports						X		X			Sh
www.sea-fishing.org	north east coast						X		X			Sh
worldseafishing.com/forum	north west & the Isle of Man catch reports							X				Sh
www.sea-fishing.org	north west coast							X				Sh
anglingaddicts.co.uk	north east sea fishing reports						X		X			Sh
anglingaddicts.co.uk	north west fishing reports							X				Sh
www.anglersnet.co.uk	sea fishing	X	X	X	X	X	X	X	X	X	X	Sh

Source	Board	Co.	DS	Ea	Sc	KE	NE	NW	Nb	S	Sx	Plt.
wirralseafishing.co.uk/forum	sea fishing and venue questions							X				Sh
www.nesa.co.uk	shore fishing						X		X			Sh
www.southwestseafishing.co.uk	Somerset fishing		X									Sh
www.sea-fishing.org	south coast									X	X	Sh
worldseafishing.com/forum	south coast & Channel Islands catch reports									X	X	Sh
worldseafishing.com/forum	south east catch reports					X						Sh
www.sea-fishing.org	south east coast			X		X					X	Sh
worldseafishing.com/forum	south west catch reports	X	X		X					X	X	Sh
www.sea-fishing.org	south west coast	X	X		X							Sh
anglingaddicts.co.uk	south-coast-sea-fishing-reports									X	X	Sh
anglingaddicts.co.uk	south-east-sea-fishing-reports			X							X	Sh
anglingaddicts.co.uk	south-west-sea-fishing-reports	X	X		X							Sh
www.sea-fishing.org	Thames estuary			X		X						Sh
www.total-fishing.com/forums	sea fishing	X	X	X	X	X	X	X	X	X	X	Sh
www.sea-fishing.org	west coast	X	X									Sh
anglingaddicts.co.uk	where-to-sea-fish	X	X	X	X	X	X	X	X	X	X	Sh
worldseafishing.com/forum	Whitby, Holderness & the Humber catch reports			X			X					Sh
worldseafishing.com/forum	boat angling / angling afloat	X	X	X	X	X	X	X	X	X	X	CB,PB
worldseafishing.com/forum	kayak angling forum	X	X	X	X	X	X	X	X	X	X	Ky
anglingaddicts.co.uk	kayak-fishing-reports						X	X	X			Ky
anglingaddicts.co.uk	boat-fishing-reports						X	X	X			CB,PB
www.solent-fishing-forums.co.uk	boat talk	X	X							X		PB
www.southwestseafishing.co.uk	general boat fishing talk	X	X							X		PB

Source	Board	Co.	DS	Ea	Sc	KE	NE	NW	Nb	S	Sx	Plt.
www.southwestseafishing.co.uk	fishing kayaks	X	X							X		Ky
www.anglersnet.co.uk	kayak fishing	X	X	X	X	X	X	X	X	X	X	Ky
www.sea-fishing.org	kayak	X	X	X	X	X	X	X	X	X	X	Ky
www.sea-fishing.org	boat owners forum	X	X	X	X	X	X	X	X	X	X	PB
www.nesa.co.uk	shore catch reports						X		X			Sh
www.nesa.co.uk	boat catch reports						X		X			CB,PB
www.nesa.co.uk	lure fishing						X		X			Sh
www.nesa.co.uk	lure catch reports						X		X			Sh
www.nesa.co.uk	boat fishing						X		X			CB,PB
www.nesa.co.uk	shore fishing missed						X		X			Sh
https://www.charterboats-uk.co.uk/fishingreports	latest fishing reports England	X	X	X	X	X	X	X	X	X	X	CB

Annex E. Stakeholder Interview

The following lists the questions which were asked during telephone interview. These interviews were conducted during the initial stakeholder engagement and recruitment phase.

- Please explain your involvement in sea angling
- Please describe in general terms the range of sea angling in your area/region:
    - Boat and shore angling? Charter boat fleet?
    - Seasonality
    - Species
- What are the main sites/locations/marks where sea angling takes place?
- Do you have any specific detail?
- If there is a lot of information, please could you send us, or refer us to a resource that specifies particular marks?
- Do you know of detail on catches? (e.g. club or competition records, or local studies that have been done)
- Do you know of any other data sources that might be useful or organisations that might hold that data?
- Do you have any other comments about mapping sea angling in your area/region?
- Once the initial analysis of data has been done, we will be asking people with particular local knowledge to review and validate what has been produced to help make it more accurate. Would you be willing to help us with that?

Annex F. Validation Questionnaire[1] Sample with Response Examples

Region	North West[2]				
Sample location	Eastham Jetty Area[2]				
1. Is this a valid location?	[✓ Yes]	No	Don't Know		
Our overall activity rank	High[2]				
2. Is the overall activity correct	Yes	[✓ No]	Don't Know		
3. If 'No', what should it be?	High	Medium	[✓ Low]	Don't Know	
Value by season and species					
Species most associated or targeted Summer/Autumn			Bream[2]	Sea Bass[2]	Mackerel[2]
4. Please rank H/M/L compared to rest of your region			Low	High	Medium
Species most associated or targeted Winter/Spring			Cod[2]	Sea Bass[2]	Mackerel[2]
5. Please rank H/M/L compared to rest of your region			Low	High	Medium

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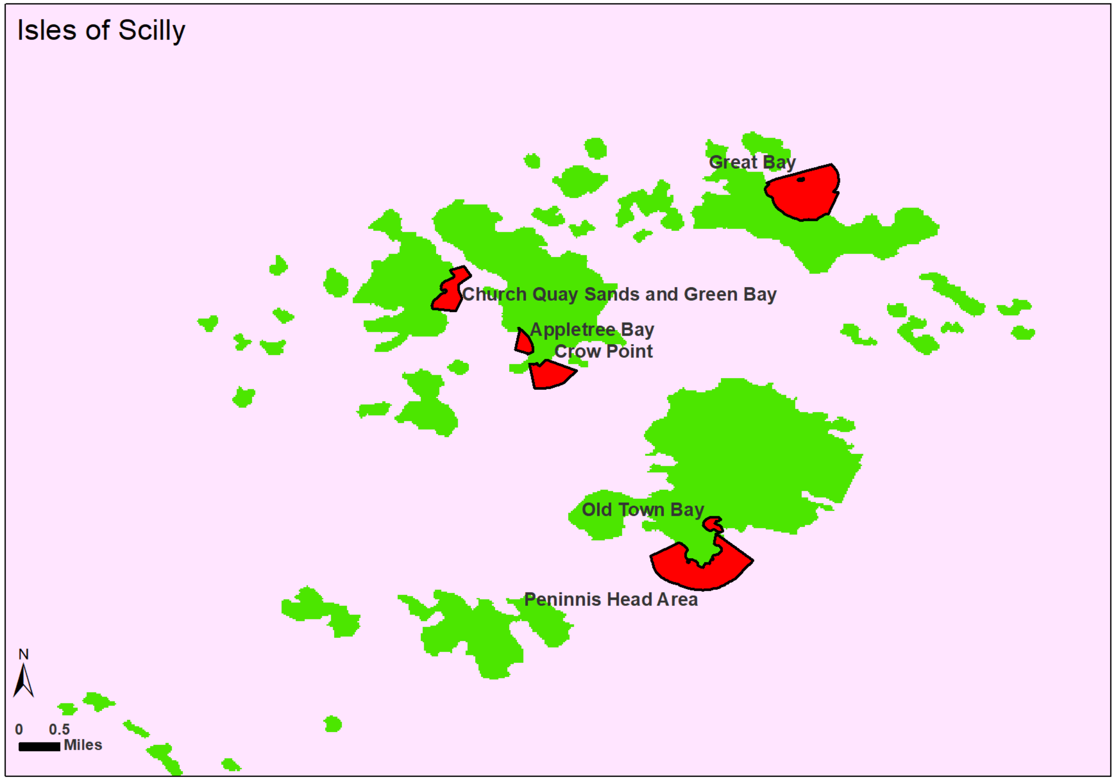
[1] Example of a single site, each questionnaire would have had this repeated for each of the six sample sites. The visual representation of the questionnaire layout may have differed from this, visual representation has been amended for clarity.

[2] Example data, prefilled by Substance prior to submission to the respondent.

Annex G. Validation Questionnaire Map Example (Isles of Scilly)



Above, overview of the six randomly selected intertidal areas chosen for the validation process. Right, detailed views over the extent of the six areas, as demarcated by the outlined polygon. Named areas are Church Quay Sands and Green Bay, Great Bay, Appletree Bay, Crow Point, Old Town Bay and Peninnis Head.

Annex H. Validation Survey Stakeholder[12] Cover Letter

Dear Stakeholder,

What we are asking you to do

We are now at the stage in this research where we are asking a selection of sea angling stakeholders with local knowledge to help validate a small sample of findings for each region.

Information we would like you to comment on includes:

- A sample of locations of sea angling and whether these are valid or not.
- The relative intensity of 'popularity' of these sites for sea angling compared to elsewhere in your region.
- The relative importance of a selection of species that are associated with or targeted at each site at different times of the year.

We are only asking you to comment on **six sites** in your region, to minimise the impact on your time.

We are providing you with:

- A **map of your region** with the sample of sites identified.
- A more **detailed map of each site**. Individual site maps show a hard boundary for the area. We have drawn areas delimited by common natural features (e.g. sandy beach with scars). Beaches for example may be naturally bounded by broken rocks or steep cliffs, which offer very different angling opportunities, hence just consider the beach and not the bordering features.
- A pre-loaded **table on a spreadsheet** for you to feedback to us on each site.

What to do

1. Open the mapping document (entitled '(name of region) _sites') to see the sample that have been selected for you to comment on.
2. Open the spreadsheet within the folder entitled 'Validation comments sheet_(Region)', as well as the 'sites' document.
3. Work through each site individually. For each site there will be a corresponding map (in the 'sites' document) and row within the spreadsheet.
4. Look at the **name and map of each site** and say whether they are valid or not – i.e. does sea angling take place here at all, or not?
5. Look at the **ranking of intensity of activity** each site – this will be shown as High, Medium or Low. The ranking relates to whether our data shows the level of activity within your region.
6. Use the drop-down cells to say whether this ranking is, in your view and experience, **correct or not** by selecting 'Yes', 'No', or 'Don't know'.

---

[12] IFCA contacts received a similar communication.

7. If you select **‘No’** use the next column to select whether you think it should be High, Medium, or Low.
8. Next, look at a list of three species associated with the site. There is one column for summer/autumn and one for winter/spring. For each species in each season, we would like you to say whether you think the ‘association’ or targeting of species there is ‘High’, ‘Medium’, or ‘Low.

Once you have done this, please look at the list of features where we think sea angling may take place. Simply place a cross next to any that you know sea angling is prohibited from. For instance, we might have a pier listed. If you know that, in fact, this pier is closed, place a cross next to it.

Your help is really important for helping to validate this research with local knowledge. Many thanks for your participation, and please do not hesitate to get in touch with any questions you may have.

Annex I. List of Spatial Outputs

Originator	Platform[13]	Feature Class	Type	Public	Description
MMO & IFCAs	Charter and private boat	ifca_sighting	Vector point	No	Fisheries enforcement fisheries patrols have recorded boat sightings. The dataset was prefiltered for boats recorded as engaging in angling activity. Angling is defined as recreational fishing with rod and line.
Natural England	CB, PB	stakmap_afloat	Vector polygon	Yes	Area standardised sum by-season of afloat marine anglers (including charters) derived from the StakMap surveys (2012). Source data from the marine recreational activity mapping project StakMap (2012). The StakMap data was published in 2013, it should be taken as indicative data only now. Natural England requested the data should only be used in this project.
Natural England	CB, PB	stakmap_cb	Vector polygon	Yes	Area standardised sum by-season of charter boats who indicated they operated in the given area. Source data from the marine recreational activity mapping project StakMap (2012). The StakMap data was published in 2013, it should be taken as indicative data only now. Natural England requested the data should only be used in this project.
Kenter et al.	CB, PB	survey_mpa_value	Vector polygon	Yes	Area standardised visitor numbers to recommended marine protected areas. Data extracted from the report Kenter et al. (2013). *The value of potential marine protected areas in the UK to divers and sea anglers*. UNEP-WCMC, Cambridge, UK.
This Project	CB, PB, K	raw	Table	Yes	Deaggregated data of each species co-occurrence with named spatial location and a temporal indicator occurring in public fisher knowledge sources (predominantly trip reports). In addition, the text indicates that the content concerns activity on an afloat platform, i.e. kayak, private boat or charter boat.
This project	CB, PB, K	ugc_afloat	Vector polygon	Yes	Data from public fisher knowledge sources. Intensity is the seasonal sum of (probable) recreational angling trips reported in public data sources contributed by anglers, divided by the polygon area in square kilometres. Reported in a 5-bin quantile. Spatially aggregated by the UKHO Seacover layer.
This project	CB	cb_grounds	Vector polygon	Yes	Proxy indicator of the grounds favoured by charter boats derived from public fisher knowledge sources. Grounds are classified as rough (including reefs and rock pinnacles), wrecks, estuary, ground, sand banks and shark (large pelagic sharks). The sum of reported trips for each charter boat is assigned to the

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[13] CB, Charter boat; PB, Private boat; K, Kayak; Sh, Shore

Originator	Platform[13]	Feature Class	Type	Public	Description
					reported departure point or harbour. All trips are aggregated at operating harbour by grounds classification and then expressed as a percentage of all reported trips across all MPLAs.
This project	CB	cb_spp_pvt_sans_dist_pts	Vector point	Yes	Proxy indicator of species captured by charter boats derived from public fisher knowledge sources. Species list is restricted to cod, sea bass, skates/rays, flatfish, breams and sport sharks (spurdog, bull huss, tope, smooth hound). Sums species terms co-occurring with a named charter boat in reported trips and aggregates these per-boat sums at harbours and departure points.
This project	CB	cb_reports_all	Table	Yes	Raw data, reporting all occurrences in public knowledge sources where species keywords co-occurred with charter boat names and a temporal and spatial indicator of when the activity occurred. These data were aggregated to derive the other layers in the charter geodatabase.
This project	CB	cb	Table	Yes	Register of charter boats, derived from Survey by Substance, charterboats.co.uk and other online resources.
This project	CB	cb_pivot_dst_pts	Vector point	Yes	Total angler trip days per year for charter boats stratified by the operating distance license. Charter boats were identified from public sources and operating distance and maximum passengers were extracted. Substance surveyed charter boat skippers to derive estimates of trip days per week and operating months per year to derive annual estimates of trip days per year. Where boats were not surveyed, values were imputed using means stratified by operating distance.
This project	PB	facilities	Vector polygon	Yes	A temporal snapshot of estimated angling boat numbers on moorings, harbours and marinas across England. Angling boat numbers were estimated using Google Earth and Google Street View.
This project	PB, K	slips	Vector point	Yes	Slipways across England, derived from public knowledge sources and the now defunct site, boatlaunch.co.uk. Locations have been manually verified using Google Earth.
This project	Sh	intertidal	Vector polygon		This layer was derived from Intertidal Substrate: England and Scotland at https://data.gov.uk/dataset/6efcebae-874e-4691-bf46-53057bdebda1/intertidal-substrate-foreshore-england-and-scotland. Features were cut at IFCA boundaries and MPLA boundaries and edits were made so that polygons more closely aligned with homogenous features such as sandy beach extents and rocky headlands. This layer provides spatial context to the next listed data tables in via the key intertidalfid.

Originator	Platform[13]	Feature Class	Type	Public	Description
This project	Sh	overall	Table		Proxy indicator of relative shore marine angling activity expressed as a 3-bin quantile rank. The rank was calculated from the co-occurrence of named spatial locations with words indicative of an angling trip and the month or season in which the activity occurred in. The co-occurrence sum approximates to trip count. Data were aggregated to the nearest-neighbour intertidal polygon.
This project	Sh	raw	Table		Disaggregated data of all records of fish species names found to co-occur in open-text public fisher-knowledge sources where the species name co-occurred with named spatial location(s) and a temporal reference.
This project	Sh	seasonal	Table		Proxy indicator of relative shore marine angling activity expressed as a 3-bin quantile rank, aggregated by a 4-bin season. The rank was calculated from the co-occurrence of named spatial locations with words indicative of an angling trip and the month or season in which the activity occurred in. The co-occurrence sum approximates to trip count. Data were aggregated to the nearest-neighbour intertidal polygon.
This project	Sh	species	Table		Proxy indicator of relative shore marine angling activity expressed as a 3-bin quantile rank, aggregated by species and a 2-bin season (Winter: October to March; Summer: April to September). The rank was calculated from the co-occurrence of named spatial locations with words indicative of an angling trip and the month or season in which the activity occurred in. The co-occurrence sum approximates to trip count. Data were aggregated to the nearest-neighbour intertidal polygon.
This project	Sh	species_full_join	Table		Same as the feature class species but includes all possible stratification (factor level) combinations.

Annex J. Species Lexicon

List of species in the lexicon, with common and scientific names derived from the British Sea Fishing (www.britishseafishing.co.uk). Alias is the count of colloquial or alternative names for the species. *Tot.* is the total count of words for a given species in the lexicon, including pluralisation and spelling errors generated from Levenshtein distance, - indicates the species was excluded. Note, apostrophes were excluded from names to simplify processing.

Common name	Scientific name	Type	Alias	Tot.
Scale-rayed Wrasse	*Acantholabrus palloni*	Wrasse	2	124
Sturgeon (Unspecified)	*Acipenseridae*	Rare & Unusual Species	1	-
Pogge	*Agonus cataphractus*	Other fish species	6	116
Thresher Shark	*Alopias vulpinus*	Dogfish & Shark Species	3	37
Allis Shad	*Alosa alosa*	Rare & Unusual Species	1	-
Twaite Shad	*Alosa fallax*	Rare & Unusual Species	1	-
Shad (Unspecified)	*Alosinae*	Rare & Unusual Species	1	-
Ray (Starry)	*Amblyraja radiata*	Skates & Rays	3	64
Sand eel (Lesser)	*Ammodytes tobianus*	Bait Species	1	-
Atlantic Wolffish	*Anarhichas lupus*	Rare & Unusual Species	1	-
Silver Eel (European)	*Anguilla anguilla*	Other fish species	9	39
Mediterranean Scaldfish	*Arnoglossus laterna*	Rare & Unusual Species	1	-
Gurnard (Red)	*Aspitrigla cuculus*	Common Roundfish Catches	2	76
Sand Smelt (Silversides)	*Atherina presbyter*	Other fish species	6	32
Triggerfish	*Balistes capriscus*	Common Roundfish Catches	5	74
Garfish (Garpike)	*Belone belone*	Common Roundfish Catches	21	55
Blenny (Unspecified)	*Blennidae*	Other fish species	1	20
Bogue	*Boops boops*	Rare & Unusual Species	1	-
Rays Bream	*Brama brama*	Seabreams & Mullets	9	31
Tusk	*Brosme brosme*	Rare & Unusual Species	1	-
Solenette	*Buglossidium luteum*	Uncommon Species	6	121
Dragonet	*Callionymidae*	Other fish species	4	114
Boar Fish	*Capros aper*	Rare & Unusual Species	1	-
Blue Runner	*Caranx crysos*	Rare & Unusual Species	1	-
Rock cook Wrasse	*Centrolabrus exoletus*	Wrasse	5	56
Rudderfish	*Centrolophus niger*	Rare & Unusual Species	1	-
Red Bandfish	*Cepola macrophthalma*	Uncommon Species	12	222
Thick Lipped Grey Mullet	*Chelon labrosus*	Seabreams & Mullets	6	404
Five-bearded Rockling	*Ciliata mustela*	Other fish species	7	138
Herring	*Clupea harengus*	Common Roundfish Catches	2	23
Conger Eel	*Conger conger*	Other fish species	2	53

Corkwing Wrasse	*Crenilabrus melops*	Wrasse	2	60
Goldsinny Wrasse	*Ctenolabrus rupestris*	Wrasse	9	309
Lumpsucker	*Cyclopteridae*	Rare & Unusual Species	1	-
Common Stingray	*Dasyatis pastinaca*	Skates & Rays	3	57
Sea Bass	*Dicentrarchus labrax*	Common Roundfish Catches	14	32
White Sea Bream	*Diplodus sargus*	Seabreams & Mullets	3	149
Weeverfish (Lesser)	*Echiichthys vipera*	Other fish species	2	84
Skate/Ray (Unspecified)	*Elasmobranchii*	Skates & Rays	6	63
Skate (Common)	*Elasmobranchii*	Skates & Rays	1	41
Sharks (Great)	*Elasmobranchii*	Dogfish & Shark Species	1	14
Four-bearded Rockling	*Enchelyopus cimbrius*	Other fish species	7	138
Anchovy	*Engraulis encrasicolus*	Bait Species	1	-
Gurnard (Grey)	*Eutrigla gurnardu*	Common Roundfish Catches	2	84
Rockling (Unspecified)	*Gadidae*	Other fish species	2	31
Cod	*Gadus morhua*	Common Roundfish Catches	11	62
Shore Rockling	*Gaidropsarus mediterraneus*	Other fish species	1	53
Three-bearded Rockling	*Gaidropsarus vulgaris*	Other fish species	7	138
Tope	*Galeorhinus galeus*	Dogfish & Shark Species	4	47
Blackmouth Dogfish	*Galeus melastomus*	Rare & Unusual Species	1	-
Witch	*Glyptocephalus cynoglossus*	Flatfish	2	43
Clingfish	*Gobiesocidae*	Rare & Unusual Species	1	-
Goby (Unspecified)	*Gobiidae*	Other fish species	1	14
Sand Goby	*Gobius*	Other fish species	1	36
Giant Goby	*Gobius cobitis*	Other fish species	1	40
Couchs Goby	*Gobius couchi*	Other fish species	3	82
Black Goby	*Gobius niger*	Other fish species	1	40
Rock Goby	*Gobius paganellus*	Other fish species	1	36
Flatfish (Unspecified)	*Heterosomata*	Flatfish	4	58
Six-gilled Shark	*Hexanchus griseus*	Dogfish & Shark Species	8	69
Long Rough Dab	*Hippoglossoides platessoides*	Flatfish	13	265
Sand eel (Greater)	*Hyperoplus lanceolatus*	Bait Species	1	-
Marlin	*Makaira nigricans*	Rare & Unusual Species	1	-
Mako Shark (shortfin)	*Isurus oxyrinchus*	Dogfish & Shark Species	2	51
Wrasse (Unspecified)	*Labridae*	Wrasse	2	22
Ballan Wrasse	*Labrus bergylta*	Wrasse	4	92

Cuckoo Wrasse	*Labrus mixtus*	Wrasse	3	90
Porbeagle Shark	*Lamna nasus*	Dogfish & Shark Species	6	208
Opah	*Lampris guttatus*	Rare & Unusual Species	1	-
Megrim	*Lepidorhombus whiffiagonis*	Flatfish	3	86
Ray (Sandy)	*Leucoraja circularis*	Skates & Rays	2	60
Ray (Shagreen)	*Leucoraja fullonica*	Skates & Rays	2	66
Ray (Cuckoo)	*Leucoraja naevus*	Skates & Rays	2	60
Dab	*Limanda limanda*	Flatfish	1	5
Shanny	*Lipophrys pholis*	Other fish species	5	56
Golden-Grey Mullet	*Liza aurata*	Seabreams & Mullets	3	169
Thin Lipped Grey Mullet	*Liza ramada*	Seabreams & Mullets	6	47
Squid (European)	*Loligo vulgaris*	Squids	1	-
Squid (Northern)	*Loligo forbesi*	Squids	1	-
Norway Haddock	*Sebastes norvegicus*	Rare & Unusual Species	1	-
Haddock	*Melanogrammus aeglefinus*	Common Roundfish Catches	4	37
Whiting	*Merlangius merlangus*	Common Roundfish Catches	9	54
Hake	*Merluccius merluccius*	Rare & Unusual Species	1	-
Blue Whiting	*Micromesistius poutassou*	Rare & Unusual Species	1	-
Sunfish	*Mola mola*	Rare & Unusual Species	1	-
Ling	*Molva molva*	Common Roundfish Catches	3	29
Mullet (Unspecified)	*Mullidae*	Seabreams & Mullets	2	39
Red Mullet	*Mullus surmuletus*	Seabreams & Mullets	4	33
Smooth Hound	*Mustelus asterias*	Dogfish & Shark Species	16	104
Ray (Eagle)	*Myliobatis aquila*	Skates & Rays	5	33
Sea Scorpion (Unspecified)	*Myoxocephalus*	Other fish species	20	83
Sea Scorpion (Short-spined)	*Myoxocephalus scorpius*	Other fish species	4	352
Hagfish	*Myxine glutinosa*	Rare & Unusual Species	1	-
Pandora Sea Bream	*Pagellus erythrinus*	Seabreams & Mullets	4	173
Couch’s Seabream	*Pagrus pagrus*	Seabreams & Mullets	15	311
Tompot Blenny	*Parablennius gattorugine*	Other fish species	2	69
Lemon Sole	*Microstomus kitt*	Flatfish	1	37
Sand Sole	*Pegusa lascaris*	Flatfish	1	33
Butterfish	*Pholis gunnellus*	Other fish species	6	41
Greater Forkbeard	*Phycis blennoides*	Rare & Unusual Species	1	-
Flounder	*Platichthys flesus*	Flatfish	4	60
Plaice	*Pleuronectes platessa*	Flatfish	3	35

Pollack	*Pollachius pollachius*	Common Roundfish Catches	5	25
Saithe (Coley, Coalfish)	*Pollachius virens*	Common Roundfish Catches	10	34
Common Goby	*Pomatoschistus Microps*	Other fish species	1	40
Blue Shark	*Prionace glauca*	Dogfish & Shark Species	1	37
Turbot	*Psetta maxima*	Flatfish	2	34
Ray (Blonde)	*Raja brachyura*	Skates & Rays	3	89
Ray (Thornback)	*Raja clavata*	Skates & Rays	8	26
Ray (Small Eyed)	*Raja microocellata*	Skates & Rays	4	45
Ray (Spotted)	*Raja montagui*	Skates & Rays	4	130
Ray (Undulate)	*Raja undulata*	Skates & Rays	2	74
Tadpole Fish	*Raniceps raninus*	Other fish species	9	67
Skate (White)	*Rostroraja alba*	Skates & Rays	7	108
Salmon	*Salmo salar*	Rare & Unusual Species	1	-
Sea Trout (Sewin)	*Salmo trutta*	Common Roundfish Catches	9	37
Pilchard	*Sardina pilchardus*	Bait Species	1	-
Bonito	*Sardini*	Rare & Unusual Species	1	-
Cornish Blackfish	*Schedophilus medusophagus*	Rare & Unusual Species	1	-
Spanish Mackerel	*Scomber colias*	Rare & Unusual Species	1	-
Mackerel	*Scomber scombrus*	Common Roundfish Catches	11	206
Brill	*Scophthalmus rhombus*	Flatfish	1	11
Black Scorpion Fish	*Scorpaena porcus*	Rare & Unusual Species	1	-
Red Scorpion Fish	*Scorpaena scrofa*	Rare & Unusual Species	1	-
Dogfish (Lesser)	*Scyliorhinus canicula*	Dogfish & Shark Species	19	55
Bull Huss	*Scyliorhinus stellaris*	Dogfish & Shark Species	19	92
Comber	*Serranus cabrilla*	Rare & Unusual Species	1	-
Dover Sole	*Solea solea*	Flatfish	4	72
Sole (Unspecified)	*Soleidae*	Flatfish	1	9
Greenland Shark	*Somniosus microcephalus*	Rare & Unusual Species	1	-
Red Sea Bream	*Sparidae*	Seabreams & Mullets	3	125
Bream (Unspecified)	*Sparidae*	Seabreams & Mullets	4	9
Gilthead Sea Bream	*Sparus aurata*	Seabreams & Mullets	8	216
Black Bream	*Spondyliosoma cantharus*	Seabreams & Mullets	5	80
Sprat	*Sprattus sprattus*	Bait Species	1	-
Spurdog (Spiny Dogfish)	*Squalus acanthias*	Dogfish & Shark Species	9	50
Angel Shark	*Squatina*	Dogfish & Shark Species	4	78
Baillons Wrasse	*Symphodus bailloni*	Wrasse	3	92

Pipefish (Greater)	*Syngnathus acus*	Other fish species	1	30
Sea Scorpion (Long Spined)	*Taurulus bubalis*	Other fish species	8	71
Squid (Unspecified)	*Teuthida*	Squids	1	-
Leopard-spotted Goby	*Thorogobius ephippiatus*	Other fish species	7	324
Yellowfin Tuna	*Thunnus albacares*	Tunas	4	78
Bluefin Tuna	*Thunnus thynnus*	Tunas	5	72
Ray (Marbled-Electric)	*Torpedo marmorata*	Skates & Rays	5	252
Ray (Electric)	*Torpedo nobiliana*	Skates & Rays	8	74
Weeverfish (Unspecified)	*Trachinidae*	Other fish species	2	38
Weeverfish (Greater)	*Trachinus draco*	Other fish species	2	100
Scad (Horse Mackerel)	*Trachurus trachurus*	Common Roundfish Catches	12	537
Gurnard (Tub)	*Trigla lucerna*	Common Roundfish Catches	5	94
Gurnard (Unspecified)	*Triglidae*	Common Roundfish Catches	2	19
Norway Pout	*Trisopterus esmarkii*	Rare & Unusual Species	1	-
Pouting (Bib, Pout)	*Trisopterus luscus*	Common Roundfish Catches	9	21
Poor Cod	*Trisopterus minutus*	Common Roundfish Catches	3	48
John Dory	*Zeus faber*	Other fish species	21	127
Sand eel (Unspecified)	*Ammodytes marinus*	Bait Species	1	-
Vivaporous Blenny	*Zoarces viviparus*	Other fish species	3	54
Topknot	*Zeugopterus punctatus*	Flatfish	2	52
Pipefish (Unspecified)		Other fish species	1	14
Wreckfish	*Polyprion americanus*	Rare & Unusual Species	1	-
Eel (Unspecified)		Other fish species	1	5

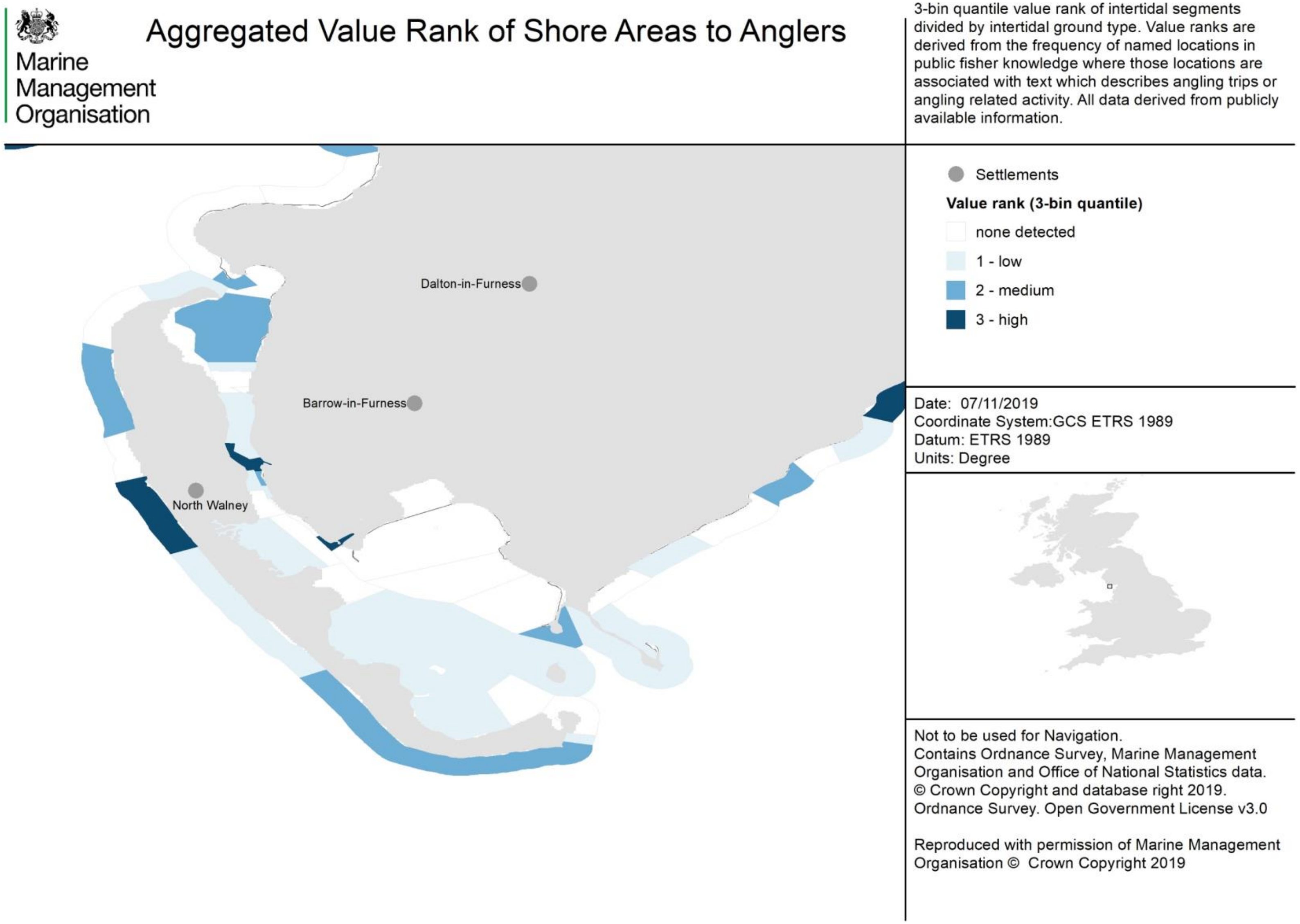
Annex K. Finite Population Estimation Code

Finite population code estimate, with Python’s NumPy and SciPy packages. A is the vector of sample values.

```
import numpy as _np
    import scipy.stats as _stats

def finite_population_stats(A, N, alpha=0.05, two_tailed=True):
  '''(iter, int, float, bool) -> tuple
  return finite population stats estimates

  A: iterable, np.array(A) compatible
  N: The population sample size
  Alpha: alpha value
  two_tailed: bool indicating 1 or 2-tailed test

  Returns finite population adjusted estimates of:
  mean, SE, Absolute Confidence, CI Lower, CI Upper

  '''
  B = _np.array(A)
  SE = (_np.std(B) / _np.sqrt(B.size)) * _np.sqrt((N - B.size)/(N - 1))
  CIAbs = _stats.t.ppf((1 - (alpha / 2)) if two_tailed else (1 - (alpha)), B.size) * SE
  CILower = _np.mean(B) - CIAbs
  CIUpper = _np.mean(B) + CIAbs
  return _np.mean(B), SE, CIAbs, CILower, CIUpper
```

Annex L. Shore Site Value Example Map

Where maps are shown in the Appendices, they are for illustrative purposes for readers of this report, to show the form of outputs that can be generated from the map spatial layers produced and will be available from data.gov.uk and https://www.gov.uk/guidance/explore-marine-plans. ‘Value’ as used here is defined in the Definitions of Terms and methods section and is a proxy for activity and value.



Marine Management Organisation

Aggregated Value Rank of Shore Areas to Anglers

3-bin quantile value rank of intertidal segments divided by intertidal ground type. Value ranks are derived from the frequency of named locations in public fisher knowledge where those locations are associated with text which describes angling trips or angling related activity. All data derived from publicly available information.

● Settlements

Value rank (3-bin quantile)

- ☐ none detected
- ▨ 1 - low
- ▨ 2 - medium
- ■ 3 - high

Date: 07/11/2019
Coordinate System:GCS ETRS 1989
Datum: ETRS 1989
Units: Degree

Not to be used for Navigation.
Contains Ordnance Survey, Marine Management Organisation and Office of National Statistics data.
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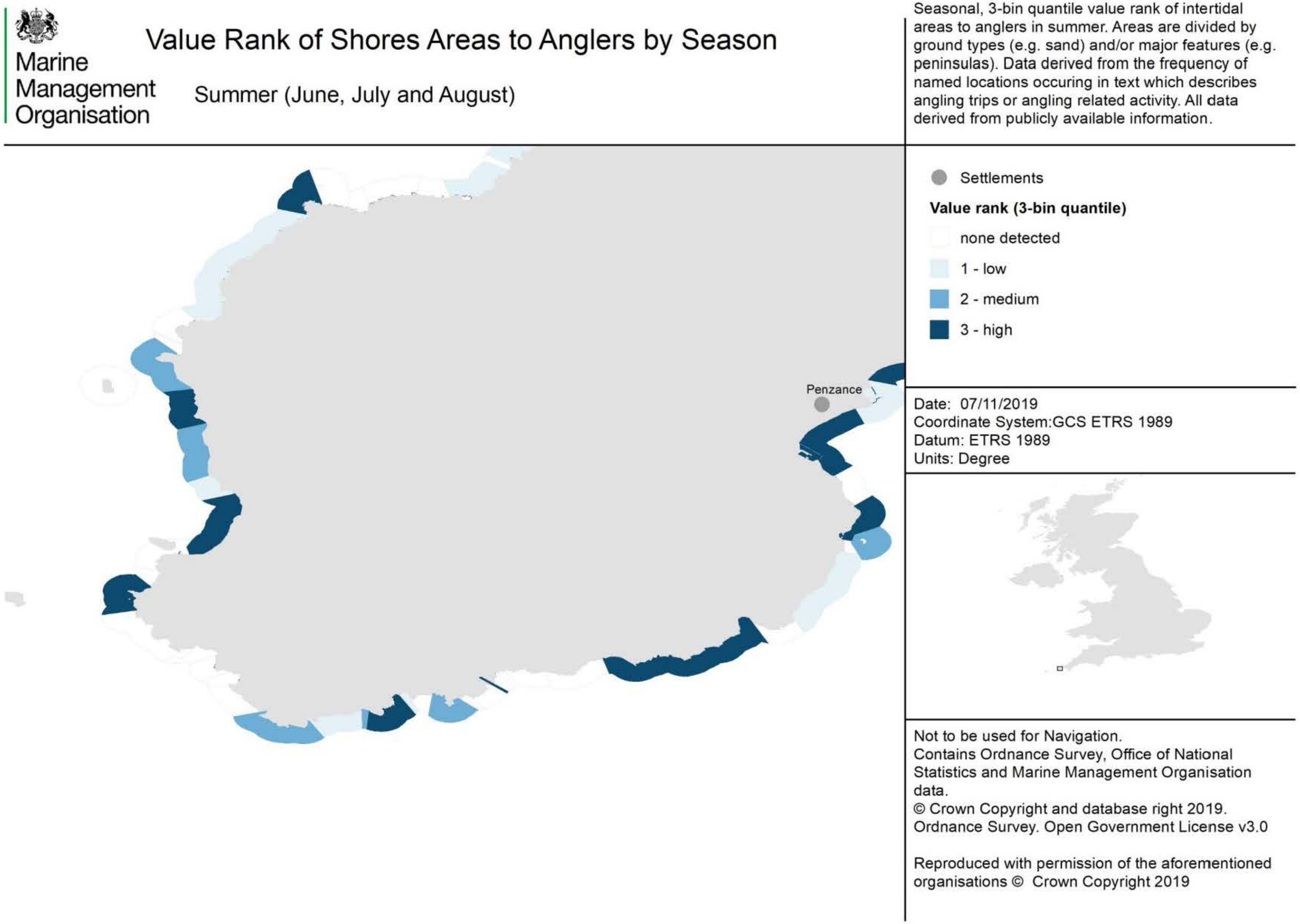
Annex M. Shore Site Value for Summer Example Map



Marine Management Organisation

Value Rank of Shores Areas to Anglers by Season

Summer (June, July and August)

Seasonal, 3-bin quantile value rank of intertidal areas to anglers in summer. Areas are divided by ground types (e.g. sand) and/or major features (e.g. peninsulas). Data derived from the frequency of named locations occuring in text which describes angling trips or angling related activity. All data derived from publicly available information.

● Settlements

Value rank (3-bin quantile)

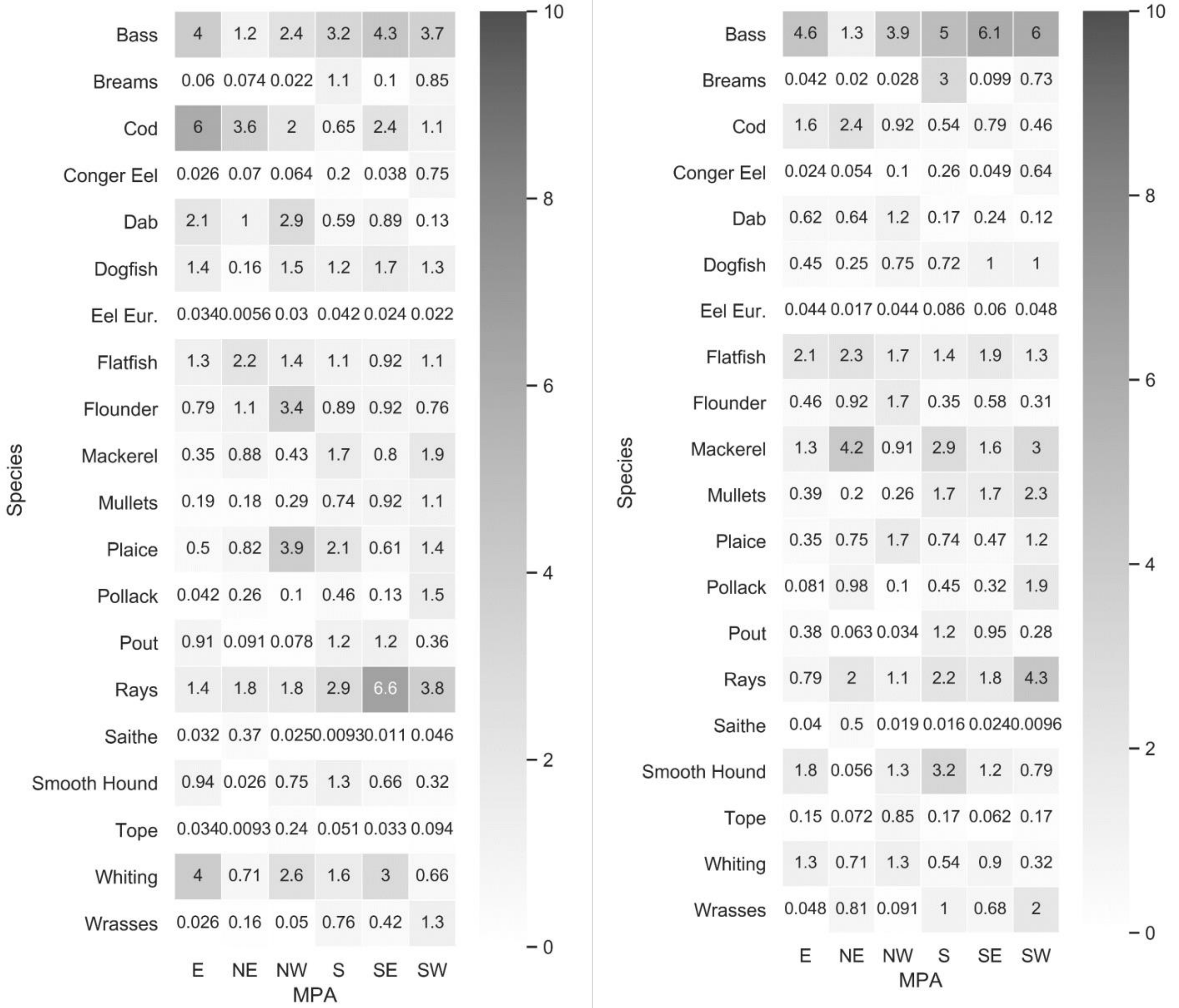
- none detected
- 1 - low
- 2 - medium
- 3 - high

Date: 07/11/2019
Coordinate System:GCS ETRS 1989
Datum: ETRS 1989
Units: Degree

Not to be used for Navigation.
Contains Ordnance Survey, Office of National Statistics and Marine Management Organisation data.

Annex N. Shore Species Value by Season for Spring (left), Summer (right)

Percent frequency of species extracted from fisher knowledge.Values are standardised within a MPLA by total number of species within a given MPLA. MPLA abbreviations are E, East Inshore; NE, North East Inshore; NW, North West Inshore; S, South Inshore; SE, South East Inshore; SW, South West Inshore (map, Annex B). Spring, March, April, May; Summer, June, July, August. Eel Eur., European eel (*Anguila anguila*).

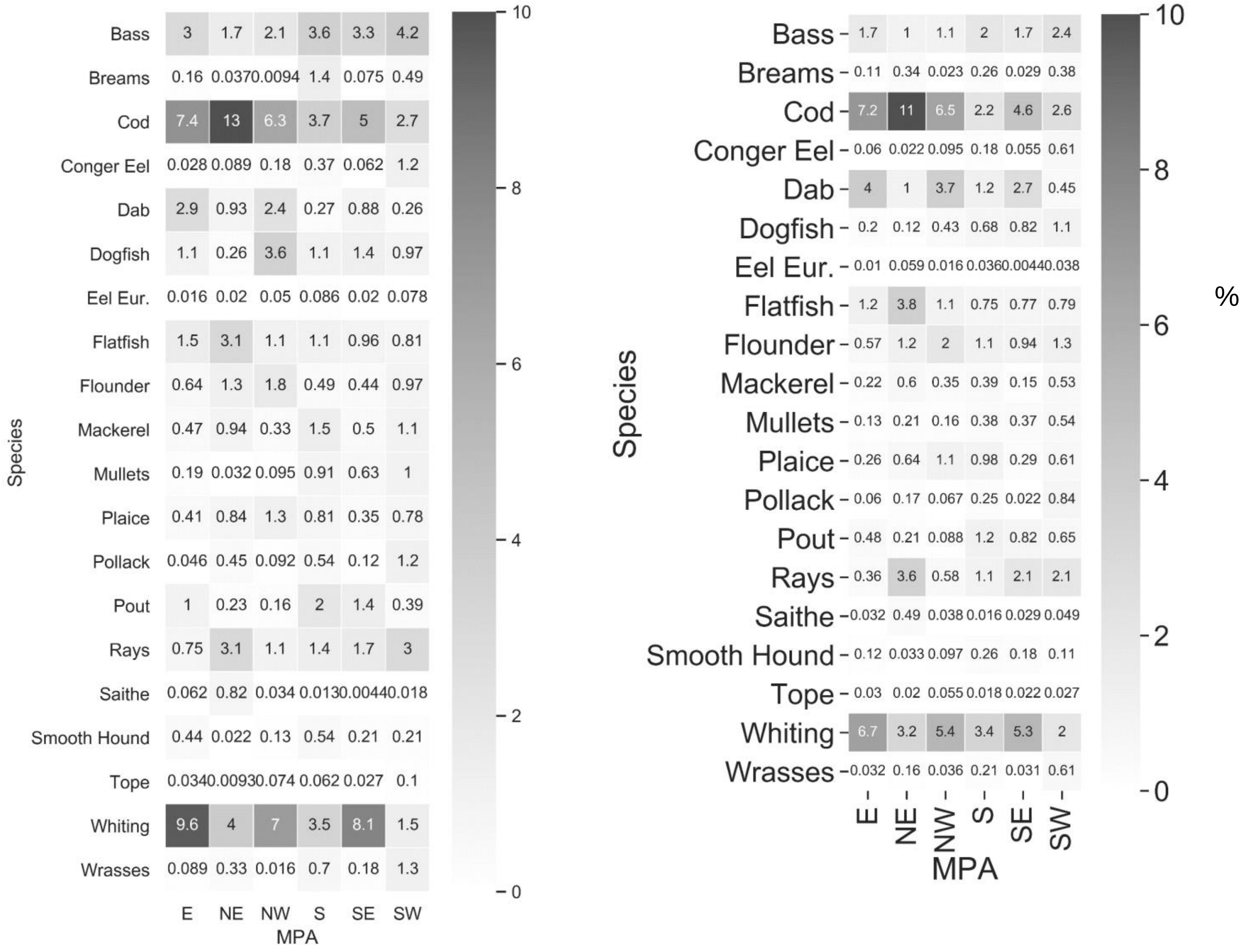


Species	E	NE	NW	S	SE	SW
Bass	4	1.2	2.4	3.2	4.3	3.7
Breams	0.06	0.074	0.022	1.1	0.1	0.85
Cod	6	3.6	2	0.65	2.4	1.1
Conger Eel	0.026	0.07	0.064	0.2	0.038	0.75
Dab	2.1	1	2.9	0.59	0.89	0.13
Dogfish	1.4	0.16	1.5	1.2	1.7	1.3
Eel Eur.	0.034	0.0056	0.03	0.042	0.024	0.022
Flatfish	1.3	2.2	1.4	1.1	0.92	1.1
Flounder	0.79	1.1	3.4	0.89	0.92	0.76
Mackerel	0.35	0.88	0.43	1.7	0.8	1.9
Mullets	0.19	0.18	0.29	0.74	0.92	1.1
Plaice	0.5	0.82	3.9	2.1	0.61	1.4
Pollack	0.042	0.26	0.1	0.46	0.13	1.5
Pout	0.91	0.091	0.078	1.2	1.2	0.36
Rays	1.4	1.8	1.8	2.9	6.6	3.8
Saithe	0.032	0.37	0.025	0.0093	0.011	0.046
Smooth Hound	0.94	0.026	0.75	1.3	0.66	0.32
Tope	0.034	0.0093	0.24	0.051	0.033	0.094
Whiting	4	0.71	2.6	1.6	3	0.66
Wrasses	0.026	0.16	0.05	0.76	0.42	1.3

Species	E	NE	NW	S	SE	SW
Bass	4.6	1.3	3.9	5	6.1	6
Breams	0.042	0.02	0.028	3	0.099	0.73
Cod	1.6	2.4	0.92	0.54	0.79	0.46
Conger Eel	0.024	0.054	0.1	0.26	0.049	0.64
Dab	0.62	0.64	1.2	0.17	0.24	0.12
Dogfish	0.45	0.25	0.75	0.72	1	1
Eel Eur.	0.044	0.017	0.044	0.086	0.06	0.048
Flatfish	2.1	2.3	1.7	1.4	1.9	1.3
Flounder	0.46	0.92	1.7	0.35	0.58	0.31
Mackerel	1.3	4.2	0.91	2.9	1.6	3
Mullets	0.39	0.2	0.26	1.7	1.7	2.3
Plaice	0.35	0.75	1.7	0.74	0.47	1.2
Pollack	0.081	0.98	0.1	0.45	0.32	1.9
Pout	0.38	0.063	0.034	1.2	0.95	0.28
Rays	0.79	2	1.1	2.2	1.8	4.3
Saithe	0.04	0.5	0.019	0.016	0.024	0.0096
Smooth Hound	1.8	0.056	1.3	3.2	1.2	0.79
Tope	0.15	0.072	0.85	0.17	0.062	0.17
Whiting	1.3	0.71	1.3	0.54	0.9	0.32
Wrasses	0.048	0.81	0.091	1	0.68	2

Annex O. Shore Species Value by Season for Autumn (left), Winter (right)

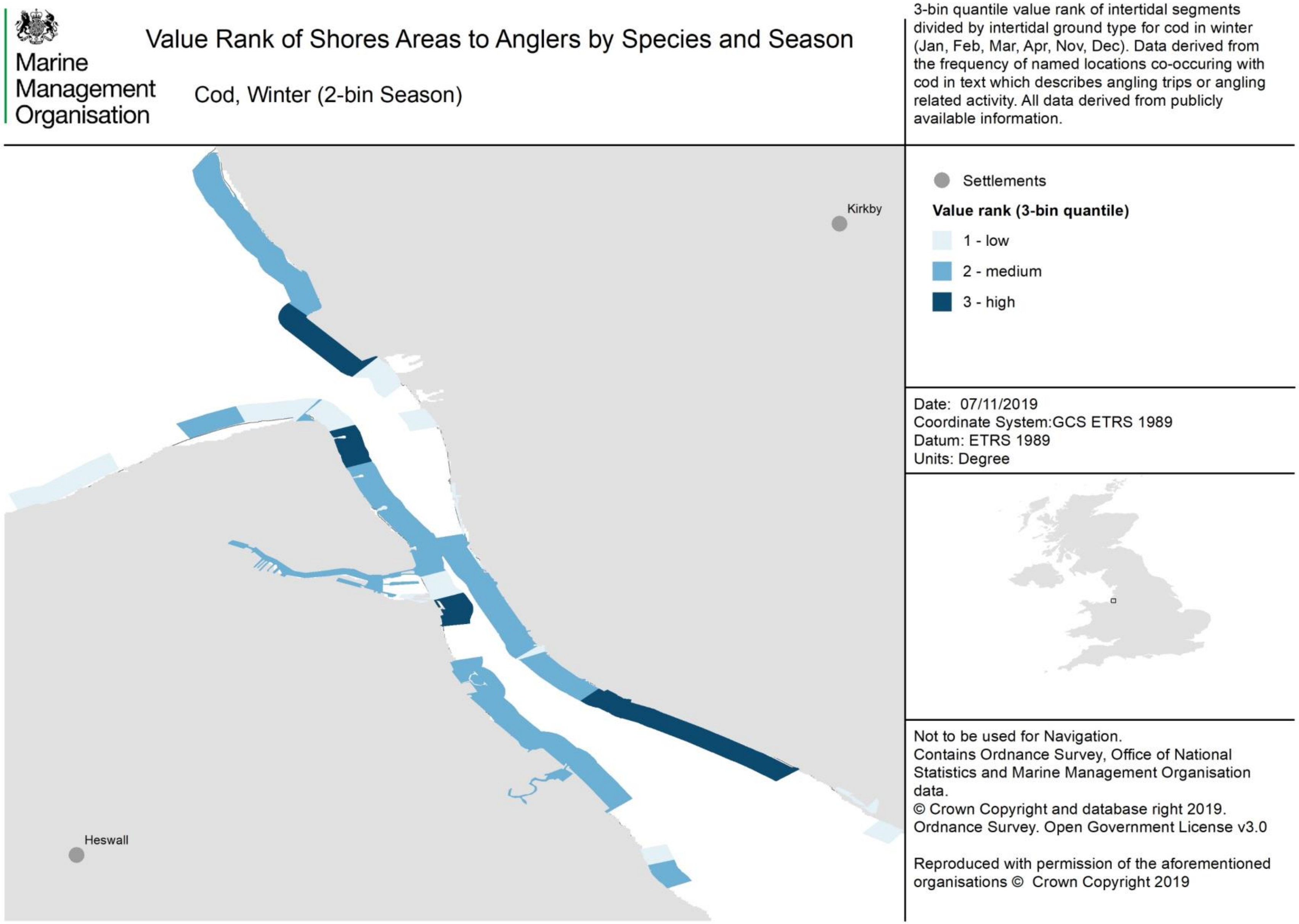
Percent frequency of species extracted from fisher knowledge. Values are standardised within a MPLA by total numer of species within a given MPLA. MPLA abbreviations are E, East Inshore; NE, North East Inshore; NW, North West Inshore; S, South Inshore; SE, South East Inshore; SW, South West Inshore (map, Annex B). Autumn, September, October, November; Winter, December, January, February. Eel Eur., European eel (*Anguila anguila*).



Species	E	NE	NW	S	SE	SW
Bass	3	1.7	2.1	3.6	3.3	4.2
Breams	0.16	0.037	0.0094	1.4	0.075	0.49
Cod	7.4	13	6.3	3.7	5	2.7
Conger Eel	0.028	0.089	0.18	0.37	0.062	1.2
Dab	2.9	0.93	2.4	0.27	0.88	0.26
Dogfish	1.1	0.26	3.6	1.1	1.4	0.97
Eel Eur.	0.016	0.02	0.05	0.086	0.02	0.078
Flatfish	1.5	3.1	1.1	1.1	0.96	0.81
Flounder	0.64	1.3	1.8	0.49	0.44	0.97
Mackerel	0.47	0.94	0.33	1.5	0.5	1.1
Mullets	0.19	0.032	0.095	0.91	0.63	1
Plaice	0.41	0.84	1.3	0.81	0.35	0.78
Pollack	0.046	0.45	0.092	0.54	0.12	1.2
Pout	1	0.23	0.16	2	1.4	0.39
Rays	0.75	3.1	1.1	1.4	1.7	3
Saithe	0.062	0.82	0.034	0.013	0.0044	0.018
Smooth Hound	0.44	0.022	0.13	0.54	0.21	0.21
Tope	0.034	0.0093	0.074	0.062	0.027	0.1
Whiting	9.6	4	7	3.5	8.1	1.5
Wrasses	0.089	0.33	0.016	0.7	0.18	1.3

Species	E	NE	NW	S	SE	SW
Bass	1.7	1	1.1	2	1.7	2.4
Breams	0.11	0.34	0.023	0.26	0.029	0.38
Cod	7.2	11	6.5	2.2	4.6	2.6
Conger Eel	0.06	0.022	0.095	0.18	0.055	0.61
Dab	4	1	3.7	1.2	2.7	0.45
Dogfish	0.2	0.12	0.43	0.68	0.82	1.1
Eel Eur.	0.01	0.059	0.016	0.036	0.0044	0.038
Flatfish	1.2	3.8	1.1	0.75	0.77	0.79
Flounder	0.57	1.2	2	1.1	0.94	1.3
Mackerel	0.22	0.6	0.35	0.39	0.15	0.53
Mullets	0.13	0.21	0.16	0.38	0.37	0.54
Plaice	0.26	0.64	1.1	0.98	0.29	0.61
Pollack	0.06	0.17	0.067	0.25	0.022	0.84
Pout	0.48	0.21	0.088	1.2	0.82	0.65
Rays	0.36	3.6	0.58	1.1	2.1	2.1
Saithe	0.032	0.49	0.038	0.016	0.029	0.049
Smooth Hound	0.12	0.033	0.097	0.26	0.18	0.11
Tope	0.03	0.02	0.055	0.018	0.022	0.027
Whiting	6.7	3.2	5.4	3.4	5.3	2
Wrasses	0.032	0.16	0.036	0.21	0.031	0.61

Annex P. Shore Species Value Cod, Winter Example Map



Value Rank of Shores Areas to Anglers by Species and Season

Cod, Winter (2-bin Season)

3-bin quantile value rank of intertidal segments divided by intertidal ground type for cod in winter (Jan, Feb, Mar, Apr, Nov, Dec). Data derived from the frequency of named locations co-occuring with cod in text which describes angling trips or angling related activity. All data derived from publicly available information.

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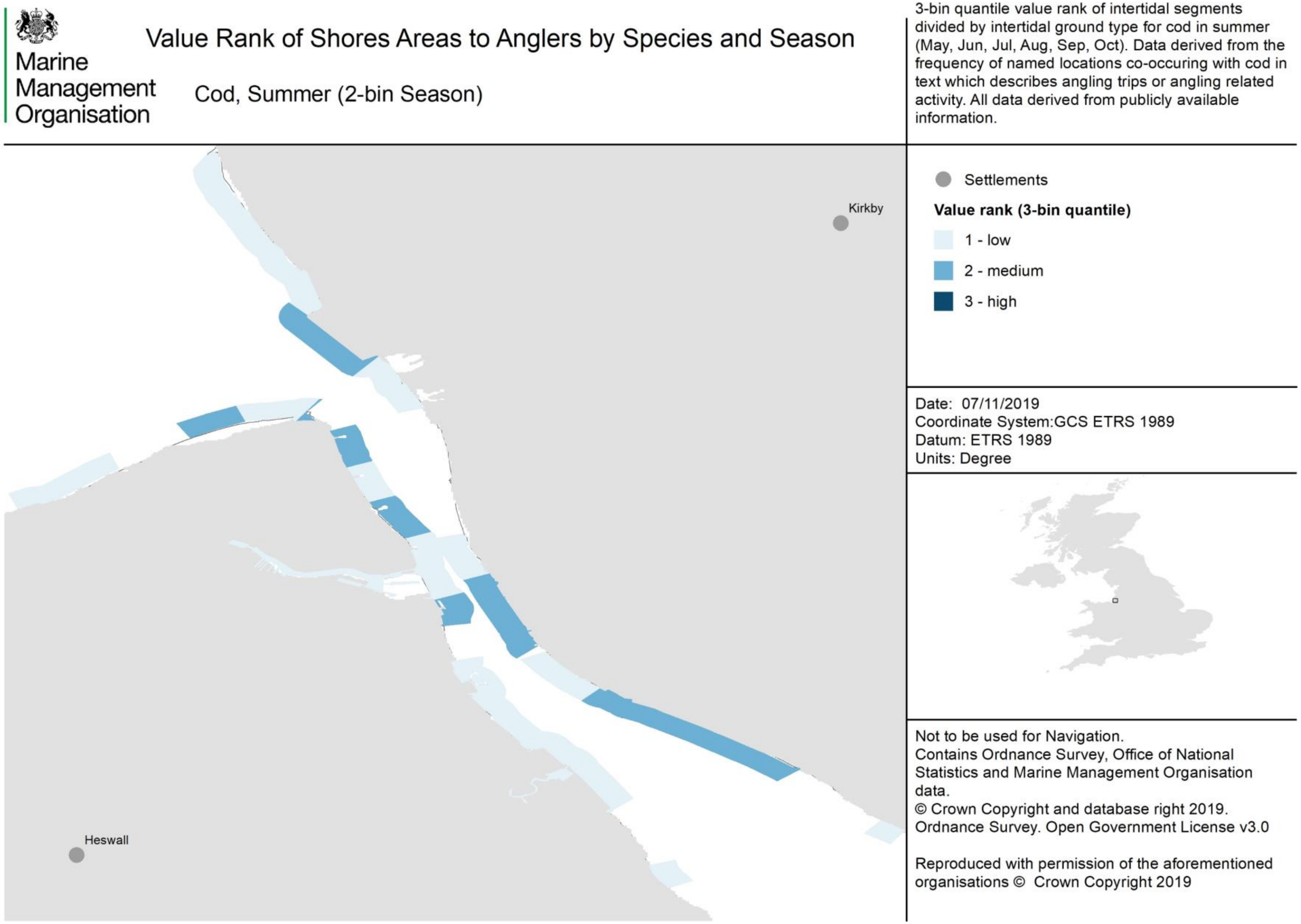
Annex Q. Shore Species Value Pollock, Summer Example Map



Marine Management Organisation

Value Rank of Shores Areas to Anglers by Species and Season

Cod, Summer (2-bin Season)

3-bin quantile value rank of intertidal segments divided by intertidal ground type for cod in summer (May, Jun, Jul, Aug, Sep, Oct). Data derived from the frequency of named locations co-occuring with cod in text which describes angling trips or angling related activity. All data derived from publicly available information.

● Settlements

Value rank (3-bin quantile)

▢ 1 - low
▨ 2 - medium
■ 3 - high

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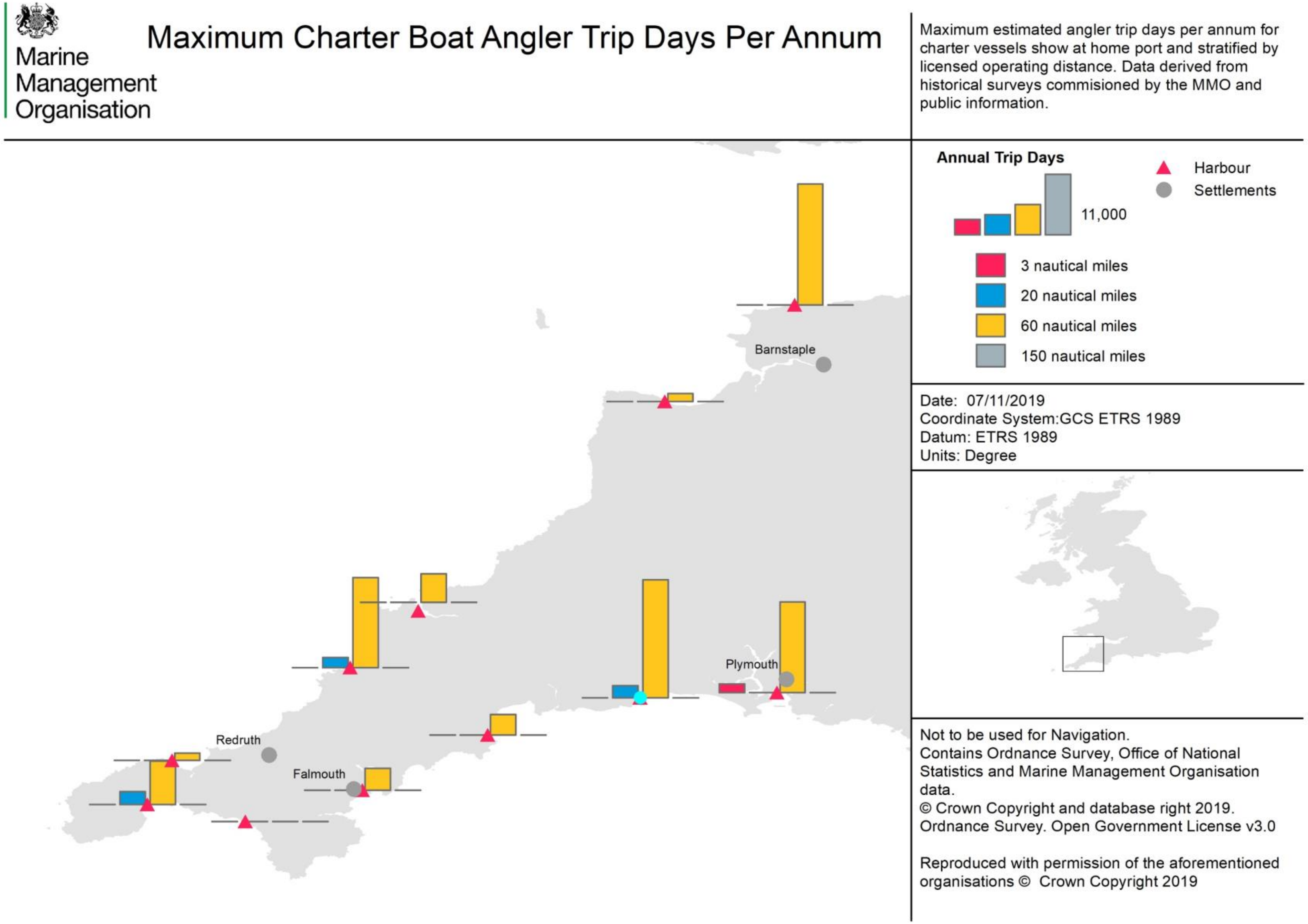
Annex R. Charter Boats Trips and Operating Distance Example Map



Maximum Charter Boat Angler Trip Days Per Annum

Maximum estimated angler trip days per annum for charter vessels show at home port and stratified by licensed operating distance. Data derived from historical surveys commisioned by the MMO and public information.

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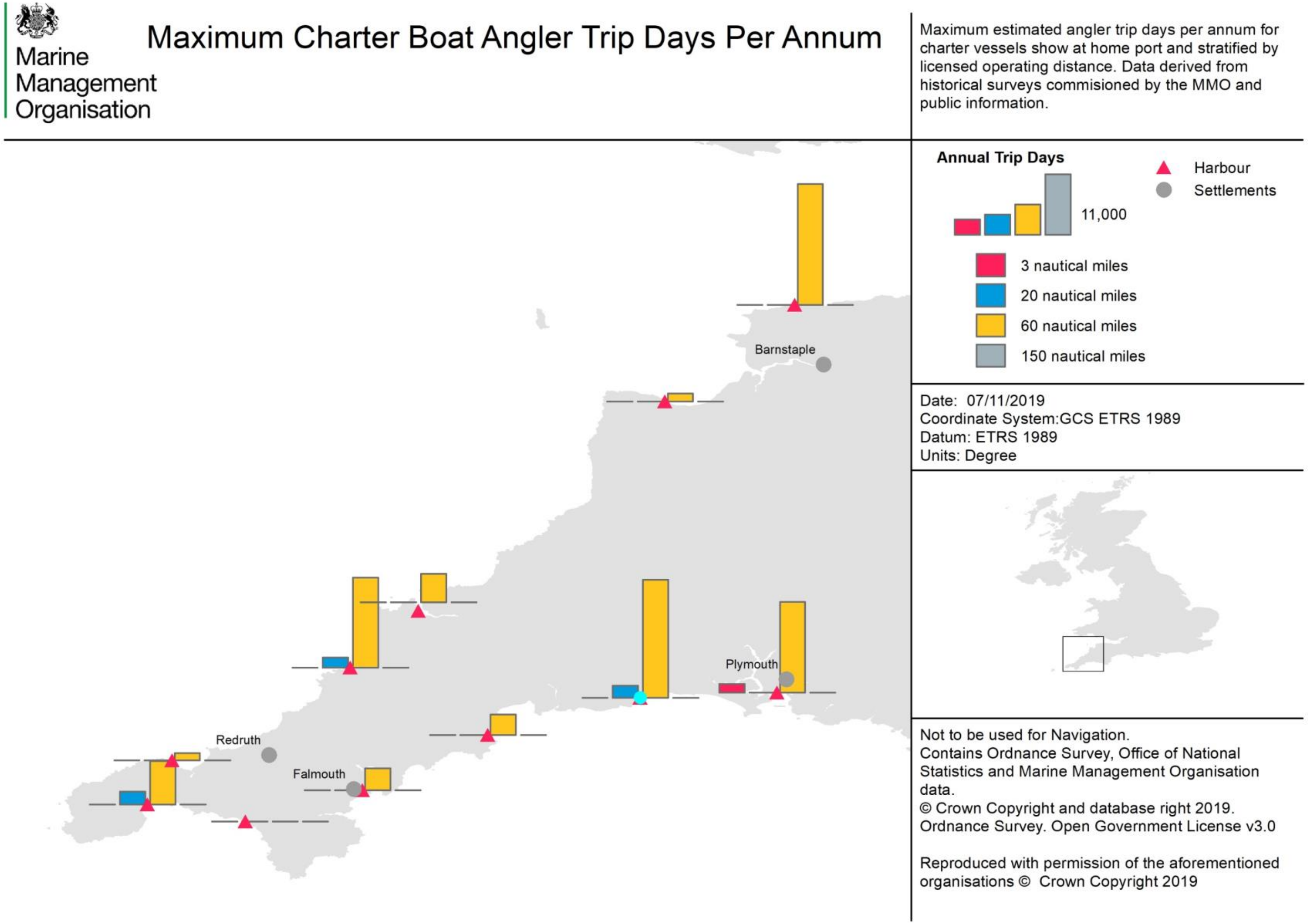
Annex S. Charter Boat Value of Grounds Example Map



Maximum Charter Boat Angler Trip Days Per Annum

Maximum estimated angler trip days per annum for charter vessels show at home port and stratified by licensed operating distance. Data derived from historical surveys commisioned by the MMO and public information.

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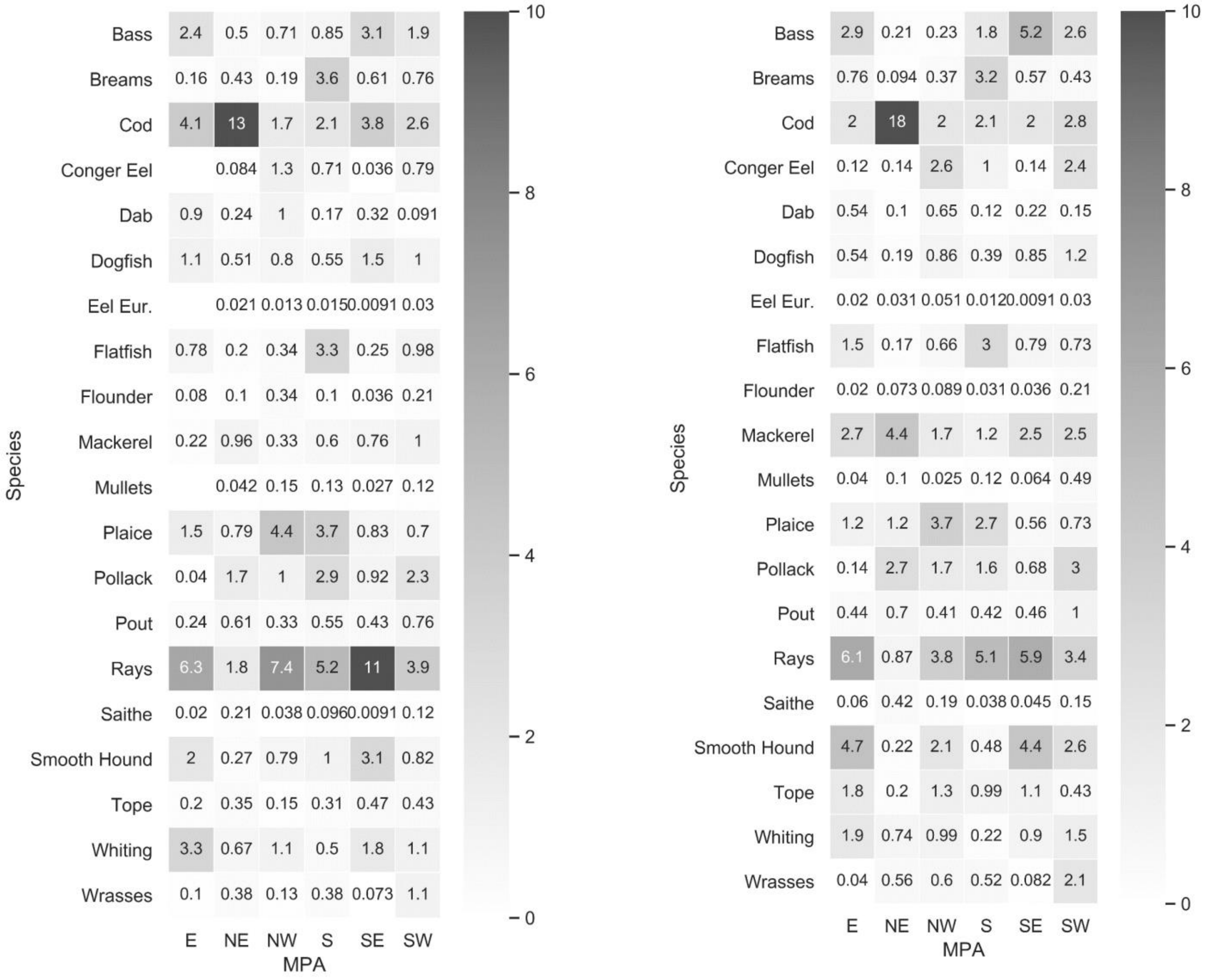
Annex T. Charter Boat Species Value by Season for Spring (left) and Summer (right)

Percent frequency of species extracted from fisher knowledge for charter boats (CB). Spatial distribution is assigned by the CB home port as opposed to known fising grounds. Values are standardised within a MPLA by total number of species within a given MPLA. MPLA abbreviations are E, East Inshore; NE, North East Inshore; NW, North West Inshore; S, South Inshore; SE, South East Inshore; SW, South West Inshore. Spring, March, April, May; Summer, June, July, August. Eel Eur., European eel (*Anguila anguila*).

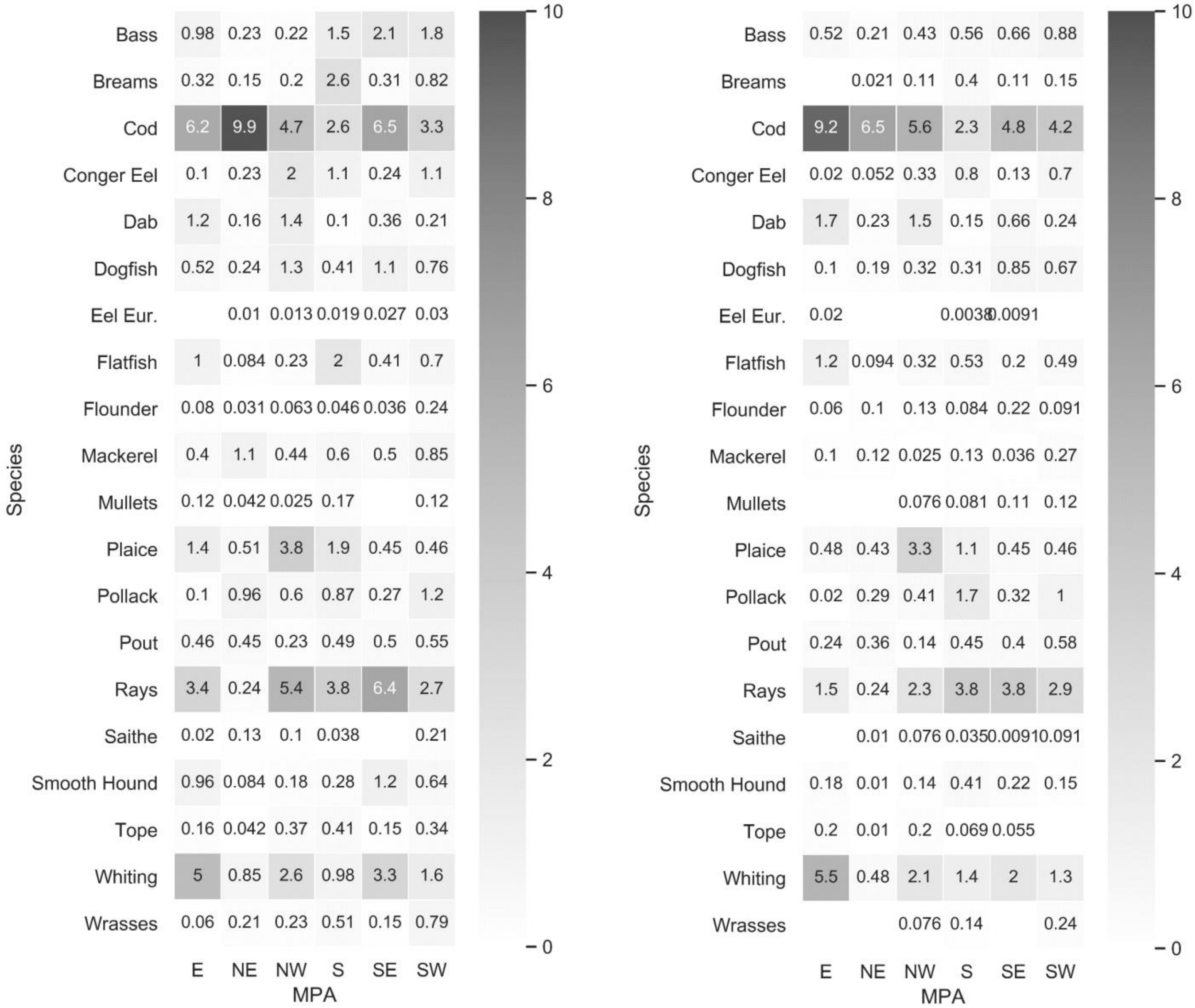


Species	E	NE	NW	S	SE	SW
Bass	2.4	0.5	0.71	0.85	3.1	1.9
Breams	0.16	0.43	0.19	3.6	0.61	0.76
Cod	4.1	13	1.7	2.1	3.8	2.6
Conger Eel		0.084	1.3	0.71	0.036	0.79
Dab	0.9	0.24	1	0.17	0.32	0.091
Dogfish	1.1	0.51	0.8	0.55	1.5	1
Eel Eur.		0.021	0.013	0.015	0.0091	0.03
Flatfish	0.78	0.2	0.34	3.3	0.25	0.98
Flounder	0.08	0.1	0.34	0.1	0.036	0.21
Mackerel	0.22	0.96	0.33	0.6	0.76	1
Mullets		0.042	0.15	0.13	0.027	0.12
Plaice	1.5	0.79	4.4	3.7	0.83	0.7
Pollack	0.04	1.7	1	2.9	0.92	2.3
Pout	0.24	0.61	0.33	0.55	0.43	0.76
Rays	6.3	1.8	7.4	5.2	11	3.9
Saithe	0.02	0.21	0.038	0.096	0.0091	0.12
Smooth Hound	2	0.27	0.79	1	3.1	0.82
Tope	0.2	0.35	0.15	0.31	0.47	0.43
Whiting	3.3	0.67	1.1	0.5	1.8	1.1
Wrasses	0.1	0.38	0.13	0.38	0.073	1.1

Species	E	NE	NW	S	SE	SW
Bass	2.9	0.21	0.23	1.8	5.2	2.6
Breams	0.76	0.094	0.37	3.2	0.57	0.43
Cod	2	18	2	2.1	2	2.8
Conger Eel	0.12	0.14	2.6	1	0.14	2.4
Dab	0.54	0.1	0.65	0.12	0.22	0.15
Dogfish	0.54	0.19	0.86	0.39	0.85	1.2
Eel Eur.	0.02	0.031	0.051	0.012	0.0091	0.03
Flatfish	1.5	0.17	0.66	3	0.79	0.73
Flounder	0.02	0.073	0.089	0.031	0.036	0.21
Mackerel	2.7	4.4	1.7	1.2	2.5	2.5
Mullets	0.04	0.1	0.025	0.12	0.064	0.49
Plaice	1.2	1.2	3.7	2.7	0.56	0.73
Pollack	0.14	2.7	1.7	1.6	0.68	3
Pout	0.44	0.7	0.41	0.42	0.46	1
Rays	6.1	0.87	3.8	5.1	5.9	3.4
Saithe	0.06	0.42	0.19	0.038	0.045	0.15
Smooth Hound	4.7	0.22	2.1	0.48	4.4	2.6
Tope	1.8	0.2	1.3	0.99	1.1	0.43
Whiting	1.9	0.74	0.99	0.22	0.9	1.5
Wrasses	0.04	0.56	0.6	0.52	0.082	2.1

Annex U. Charter Boat Species Value by Season for Autumn (left), Winter (right)

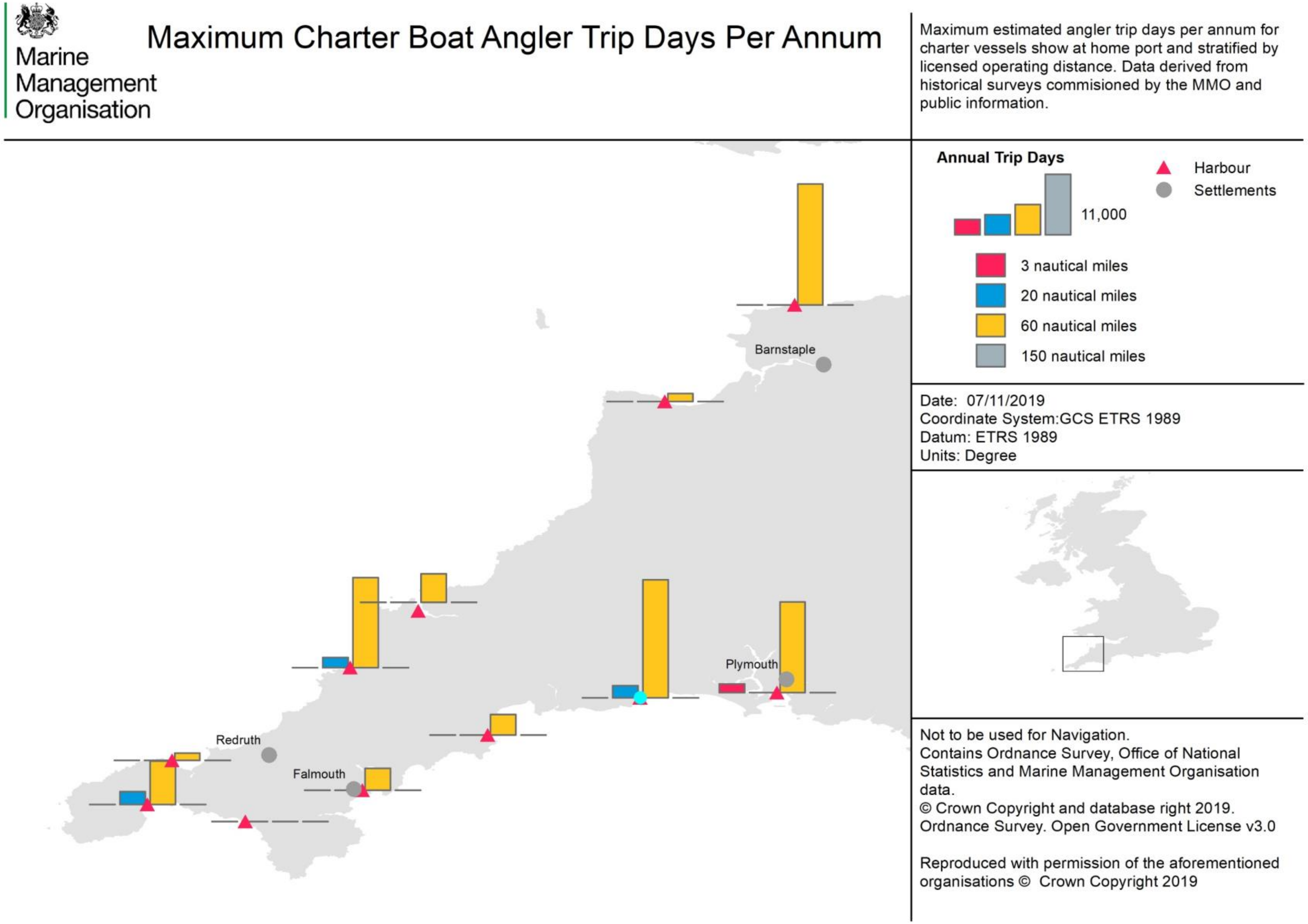
Percent frequency of species extracted from fisher knowledge for charter boats (CB). Spatial distribution is assigned by the CB home port as opposed to known fising grounds. Values are standardised within a MPLA by total numer of species within a given MPLA. MPLA abbreviations are E, East Inshore; NE, North East Inshore; NW, North West Inshore; S, South Inshore; SE, South East Inshore; SW, South West Inshore (map, Annex B). Autumn, September, October, November; Winter, December, January, February. Eel Eur., European eel (*Anguila anguila*).



	E	NE	NW	S	SE	SW
Bass	0.98	0.23	0.22	1.5	2.1	1.8
Breams	0.32	0.15	0.2	2.6	0.31	0.82
Cod	6.2	9.9	4.7	2.6	6.5	3.3
Conger Eel	0.1	0.23	2	1.1	0.24	1.1
Dab	1.2	0.16	1.4	0.1	0.36	0.21
Dogfish	0.52	0.24	1.3	0.41	1.1	0.76
Eel Eur.		0.01	0.013	0.019	0.027	0.03
Flatfish	1	0.084	0.23	2	0.41	0.7
Flounder	0.08	0.031	0.063	0.046	0.036	0.24
Mackerel	0.4	1.1	0.44	0.6	0.5	0.85
Mullets	0.12	0.042	0.025	0.17		0.12
Plaice	1.4	0.51	3.8	1.9	0.45	0.46
Pollack	0.1	0.96	0.6	0.87	0.27	1.2
Pout	0.46	0.45	0.23	0.49	0.5	0.55
Rays	3.4	0.24	5.4	3.8	6.4	2.7
Saithe	0.02	0.13	0.1	0.038		0.21
Smooth Hound	0.96	0.084	0.18	0.28	1.2	0.64
Tope	0.16	0.042	0.37	0.41	0.15	0.34
Whiting	5	0.85	2.6	0.98	3.3	1.6
Wrasses	0.06	0.21	0.23	0.51	0.15	0.79

	E	NE	NW	S	SE	SW
Bass	0.52	0.21	0.43	0.56	0.66	0.88
Breams		0.021	0.11	0.4	0.11	0.15
Cod	9.2	6.5	5.6	2.3	4.8	4.2
Conger Eel	0.02	0.052	0.33	0.8	0.13	0.7
Dab	1.7	0.23	1.5	0.15	0.66	0.24
Dogfish	0.1	0.19	0.32	0.31	0.85	0.67
Eel Eur.	0.02			0.0038	0.0091	
Flatfish	1.2	0.094	0.32	0.53	0.2	0.49
Flounder	0.06	0.1	0.13	0.084	0.22	0.091
Mackerel	0.1	0.12	0.025	0.13	0.036	0.27
Mullets			0.076	0.081	0.11	0.12
Plaice	0.48	0.43	3.3	1.1	0.45	0.46
Pollack	0.02	0.29	0.41	1.7	0.32	1
Pout	0.24	0.36	0.14	0.45	0.4	0.58
Rays	1.5	0.24	2.3	3.8	3.8	2.9
Saithe		0.01	0.076	0.035	0.0091	0.091
Smooth Hound	0.18	0.01	0.14	0.41	0.22	0.15
Tope	0.2	0.01	0.2	0.069	0.055	
Whiting	5.5	0.48	2.1	1.4	2	1.3
Wrasses			0.076	0.14		0.24

Annex V. Charter Boat Species Value by Home Port Example Map



Maximum estimated angler trip days per annum for charter vessels show at home port and stratified by licensed operating distance. Data derived from historical surveys commisioned by the MMO and public information.

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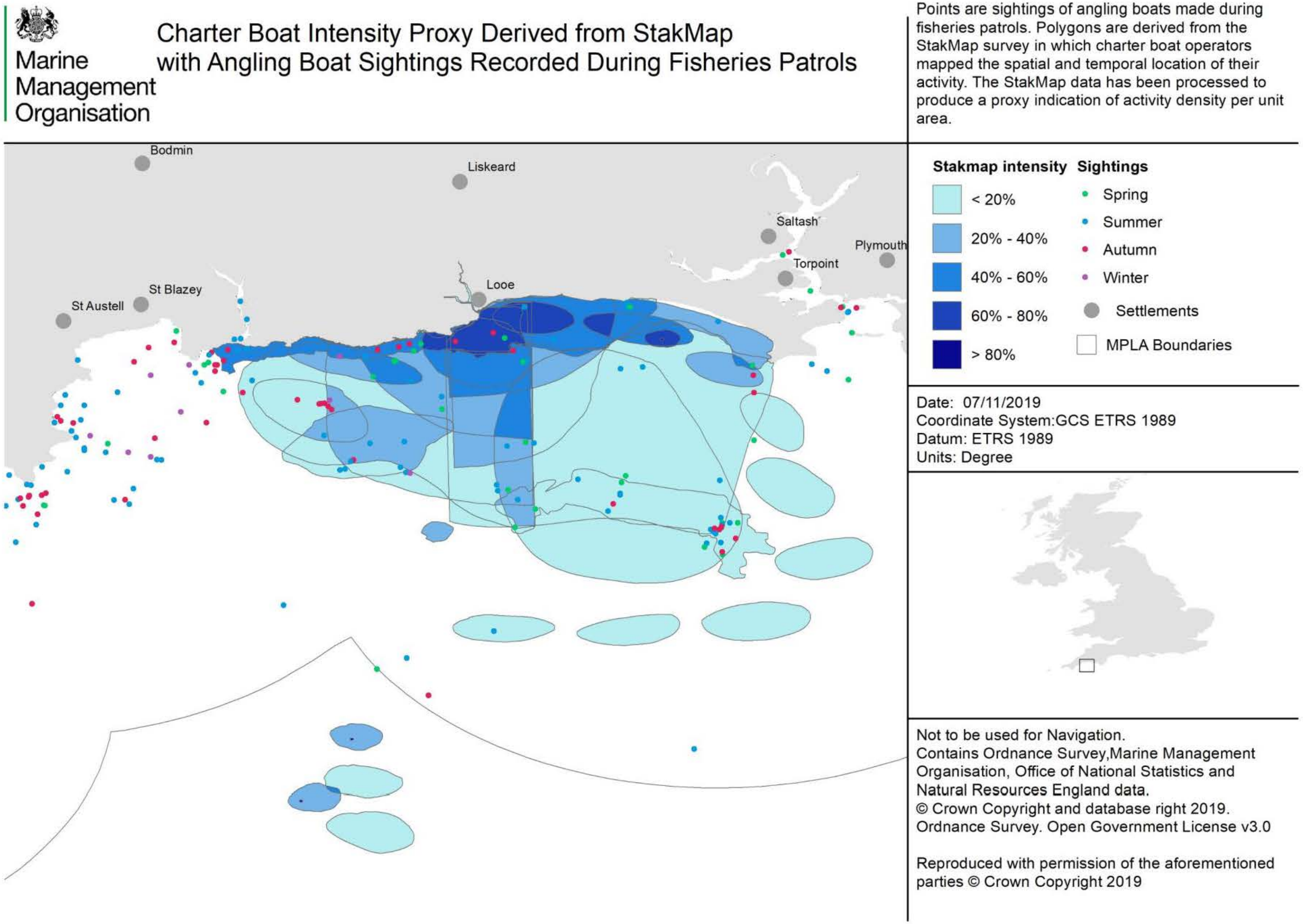
Annex W. StakMap, Charter Boat Intensity Map Example



Marine Management Organisation

Charter Boat Intensity Proxy Derived from StakMap with Angling Boat Sightings Recorded During Fisheries Patrols

Points are sightings of angling boats made during fisheries patrols. Polygons are derived from the StakMap survey in which charter boat operators mapped the spatial and temporal location of their activity. The StakMap data has been processed to produce a proxy indication of activity density per unit area.

Stakmap intensity

- < 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- > 80%

Sightings

- ● Spring
- ● Summer
- ● Autumn
- ● Winter
- ● Settlements
- ☐ MPLA Boundaries

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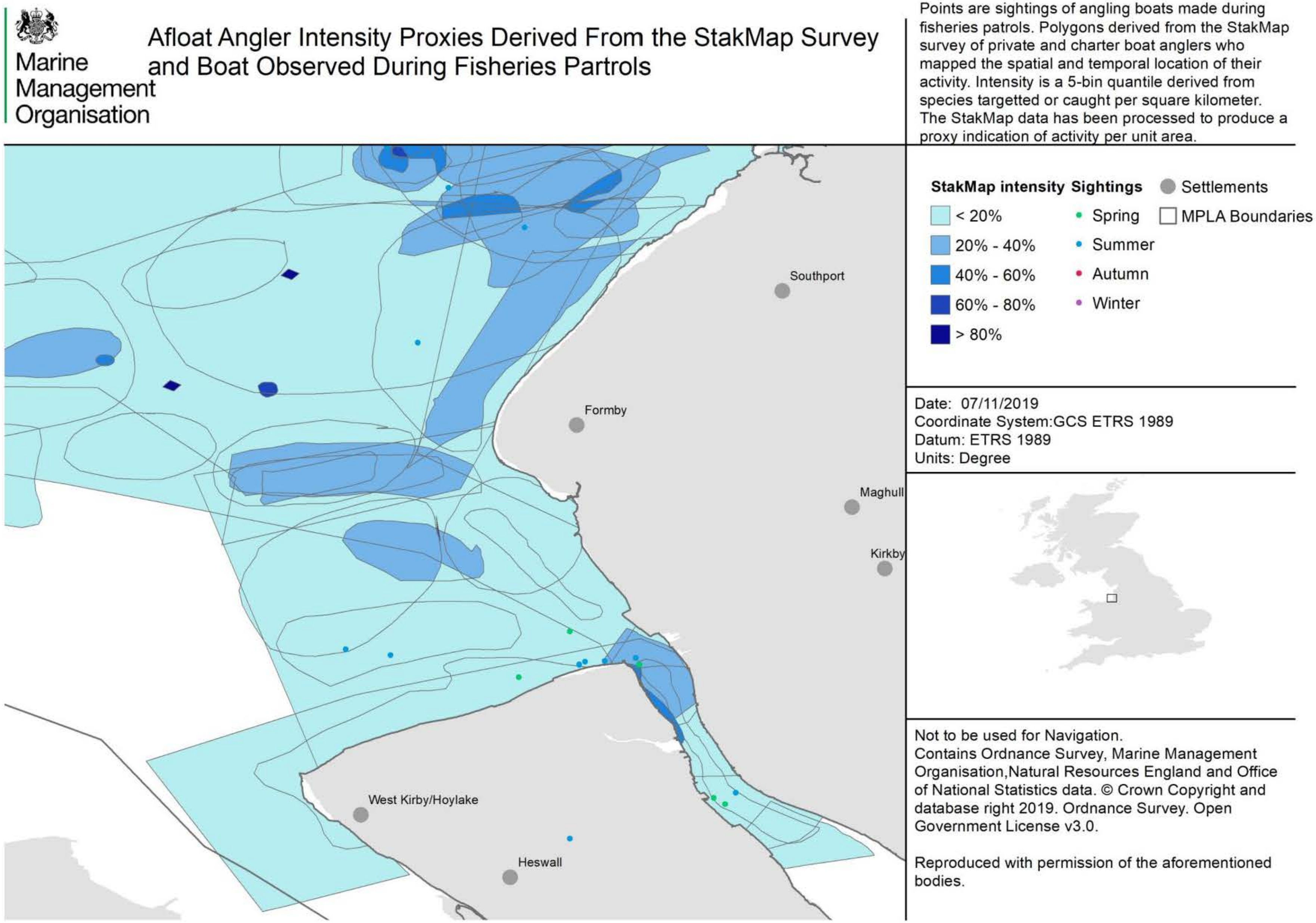
Annex X. StakMap, Afloat Angler Intensity Map Example



Afloat Angler Intensity Proxies Derived From the StakMap Survey and Boat Observed During Fisheries Partrols

Points are sightings of angling boats made during fisheries patrols. Polygons derived from the StakMap survey of private and charter boat anglers who mapped the spatial and temporal location of their activity. Intensity is a 5-bin quantile derived from species targetted or caught per square kilometer. The StakMap data has been processed to produce a proxy indication of activity per unit area.

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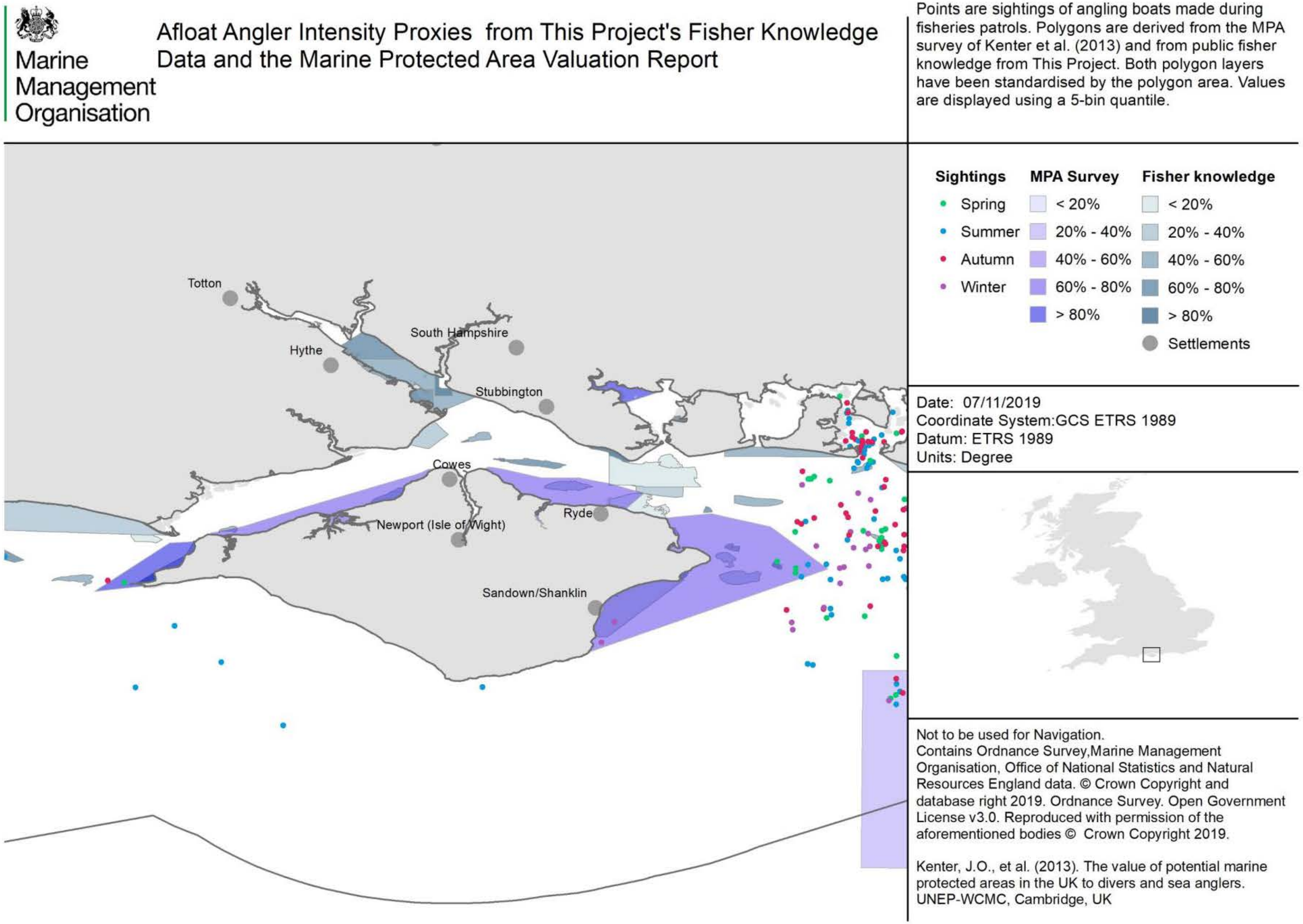
Annex Y. Kenter et al. (2013), Afloat Intensity Map Example



Points are sightings of angling boats made during fisheries patrols. Polygons are derived from the MPA survey of Kenter et al. (2013) and from public fisher knowledge from This Project. Both polygon layers have been standardised by the polygon area. Values are displayed using a 5-bin quantile.

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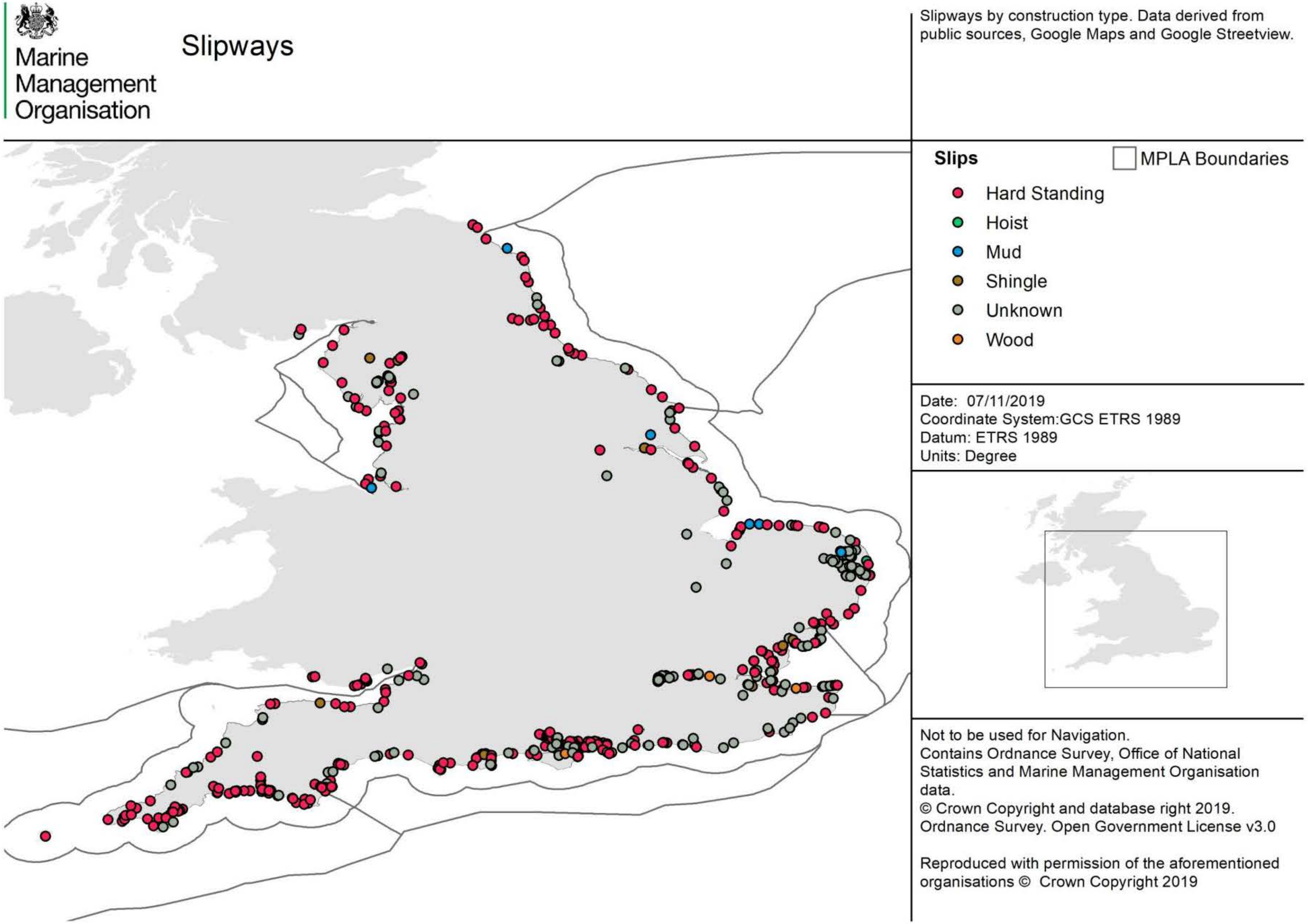
Kenter, J.O., et al. (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge, UK

Annex Z. Slipways



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Slipways

Slipways by construction type. Data derived from public sources, Google Maps and Google Streetview.

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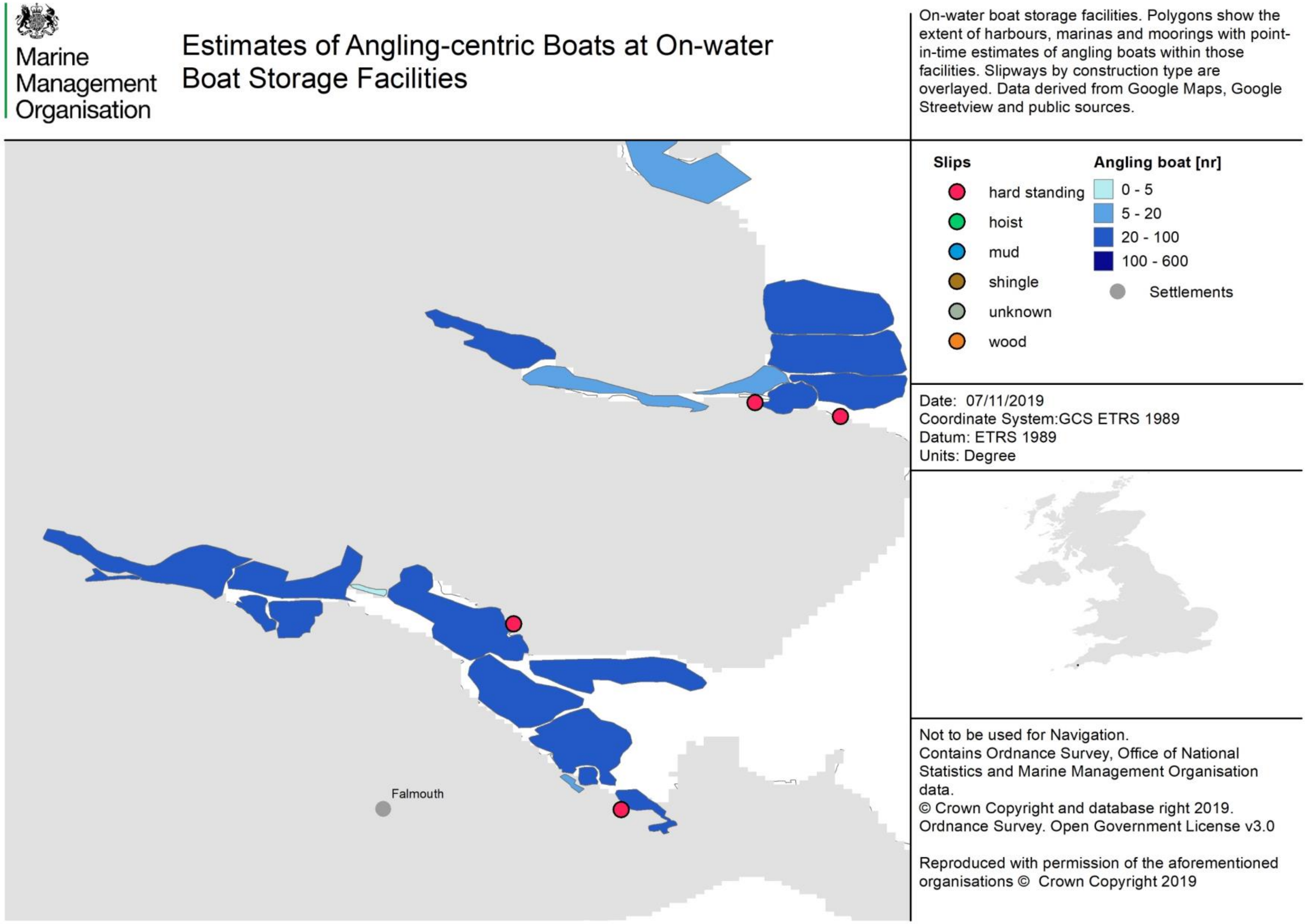
Annex AA. Facilities Map



Marine Management Organisation

Estimates of Angling-centric Boats at On-water Boat Storage Facilities

On-water boat storage facilities. Polygons show the extent of harbours, marinas and moorings with point-in-time estimates of angling boats within those facilities. Slipways by construction type are overlayed. Data derived from Google Maps, Google Streetview and public sources.

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