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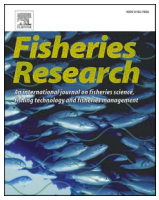

A typology of recreational sea anglers in England and Wales

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ABSTRACT

Understanding diversity among anglers is a key aspect of effective fishery management. Typologies are coherent models best describing heterogeneity in populations and have been used extensively to understand sea angler responses to management and policy. Typologies can also aid the assessment of bias in non-probabilistic sampling, as part of recreational sea angling monitoring, through the inclusion of metrics beyond those based on days fished, location and gear. There is no standard approach to the formation of typologies and, historically, the UK has lacked a suitable description of recreational sea angler diversity to inform both sector monitoring and the development of fishery policy post-Brexit. This study developed and employed a wide-ranging data collection framework to form the first ever typology of recreational sea anglers in England and Wales. The typology is based on principal component and cluster analysis of 472 angler survey questionnaires, follow-up interviews, and was validated using a unique qualitative verification method. Variance was represented by ten components reflecting variable groupings across the data collection framework. Drawing on the components and several independent validating variables, the typology comprised: consumers; trophy anglers; leisure-identity anglers; and social anglers. Value-based and attitudinal metrics performed better than behavioural variables. Domains of angler 'involvement' showed strong performance as markers of variance in the sample. Specialisation variables proved less useful as summary indices that reflected sample variance. Methodological suggestions are provided for integrating the typology in future monitoring assessments in addition to applied examples of how the typology informs the implementation of management measures.

1. Introduction

Marine recreational fisheries (MRF) are socially and economically important but can impact on fish stocks and the environment (Cooke and Cowx, 2005; Lewin et al., 2006, 2019; Hyder et al., 2018; Radford et al., 2018; Arlinghaus et al., 2019; 2020; Kleiven et al., 2019;). Governance of MRF is generally not effective for several reasons including: a lack of recognition in marine policy (Potts et al., 2020); the difficulty in developing a 'one-size-fits-all' fisheries policy (Beardmore et al., 2011); paucity of data both on catches (Hyder et al., 2018; 2020) and human dimensions (Arlinghaus et al., 2008; Johnston et al., 2013; Nguyen et al., 2013); and the difficulty in developing policy to govern behaviours which are influenced by factors that change in different contexts (Beardmore et al., 2011; Brinson and Wallmo, 2013). Exclusion of MRF in fisheries management impacts on the sustainable management of fisheries (Hyder et al., 2014; 2020) and delivery of the social, economic and ecological goals of fisheries policy (Gratti et al., 2025).

MRF are diverse and geographically dispersed, with millions of individuals fishing for different reasons using a variety of gears (Hyder et al., 2018; 2020). Because of this, the management of fisheries is more about managing people than fish as it relies on behavioural responses to implemented management measures (Hilborn et al., 2020). This is especially relevant for recreational fisheries, where the motivations for participation are highly varied among individuals (Fedler and Ditton, 1994; Arlinghaus, 2006a; 2006b; Beardmore et al., 2011). For instance, angler behaviour dictates harvest rates but is influenced by their consumption orientation (e.g. Beardmore et al., 2011) and compliance propensity (Brownscombe et al., 2019; Bova et al., 2019). Understanding how different regulations impact anglers is essential for sustaining the recreational fisheries sector and ensuring social and economic benefits to coastal regions. However, there is no typical angler, as responses to fishing regulations vary across angler populations. The significance of considering angler heterogeneity in the management process for recreational fisheries has highlighted the need to develop social-ecological

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systems that enhance understanding of optimal management strategies (Hunt et al., 2013; Arlinghaus et al., 2016; 2017).

Monitoring of MRF is generally done using separate surveys of effort and catch per unit effort (Pollock et al., 1994), meaning that estimates for off-site data capture must be raised to the general population using characteristics of the angler (e.g. Hyder et al., 2020; 2021). This is usually done using days fished, location, platform, and gear, but there are still differences between offsite and onsite estimates potentially due to characteristics of the respondents that are not captured in the raising process (Hyder et al., 2020; 2021,; Lewin et al., 2021,; Ryan et al., 2024). In addition, there has been an increase in non-probability approaches due to the challenges with response rates to surveys, meaning that approaches to correct biases are needed (e.g. Hyder et al., 2024). As a result, it is important to understand broader characteristics related to motivation, values, attitudes and behaviours to be able to relate samples to the population. Understanding the composition of the UK recreational sea angling community and its impacts are of specific importance since the introduction of the Fisheries Act 2020 and Joint Fisheries Statement, which highlighted intentions to deepen the integration of the sector into the policy framework.

Typologies are the systematic organization of types into a coherent model and should efficiently describe heterogeneity across a given population based on the similarities within identified subgroups (Collier et al., 2012; Stapley et al., 2022). Aside from the benefits afforded to MRF impact assessment and monitoring, they provide policy makers with the most efficient description of key differences among a population and, importantly, topics or themes where these differences feature most strongly (Reed et al., 2009). Typologies can be used by policy makers to inform policy co-development, appropriately frame policy messages, and predict policy outcomes (Brugha and Varvasovszky, 2000; Balane et al., 2020; Hassel and Wegrich, 2022).

Typologies have been used extensively to understand sea angler responses to management and policy (Arlinghaus and Mehner, 2005; Arlinghaus, 2006b; Beardmore et al., 2011; 2013,; Johnston et al., 2013, ; Magee et al., 2018; Matsumura et al., 2019; Arlinghaus et al., 2019; van den Heuvel et al., 2020). There are two types: hierarchical typologies combine dimensions or data from different areas of the experience into a singular continuum (e.g. low-high) along which anglers are positioned; lateral typologies use data to reflect different parts of the angling experience but define groups through the unique performance across (sometimes different) characteristics. Each typology form consists of several theoretical and conceptual models describing differences among angling communities (Table 1).

In hierarchical typologies, the specialist continuum of angler types ranged from beginner to expert (Bryan, 1977). Increased specialism has been correlated with harvest-consumption (Bryan, 1977; Ditton et al., 1992), catch and release (Arlinghaus et al., 2007), and support for management measures such as marine protection zones (Ditton et al., 1992; Salz et al., 2001; Li et al., 2010). The effectiveness of specialisation as a predictive tool has been questioned but remains a staple theory in describing angler heterogeneity (Arlinghaus et. al., 2020). A consistent measurement of specialisation does not exist and as a result proxy measures have been used (Ditton et al., 1992; Salz et al., 2001; Beardmore et al., 2011; 2103). It is accepted that the synthesized conceptualisation of specialisation comprises measures of behavioural commitment reflected as avidity (e.g. see Magee et al., 2018), psychological commitment (Kim et al., 1997) reflected as centrality to life (Beardmore et al., 2011; 2013), and cognate ability measured as a skill rating (Dorow et al., 2010). Also as a hierarchical concept, angler involvement measures the degree of psychological attachment and

Table 1
Framework used to inform data collection showing concepts used in previous heterogeneity studies (variable category codes), source literature and related theory.

Concept (category code)	Literature sources	Theoretical basis
Behavioural commitment (BC)	Oh and Ditton, (2008); Arlinghaus et al., (2008); (2020); Beardmore et al., (2011); 13)	Specialisation
Cognition (C)	Bespoke for this study, based on Arlinghaus et al., (2008); (2020); Beardmore et al., (2013)	
Centrality as psychological commitment (CP)	Kyle et al., (2007)	Specialisation / Involvement
Social bonding (SB)		Involvement
Attraction (A)		
Identity affirmation (IA)		
Identity expression (IE)		
Catch 'something' (CS)	Anderson et al., (2007)	Attitudes to catch
Catch 'Numbers' (CN)		
Catch 'Trophy' (CT)		
Catch: 'Retain' (CR)		
Biocentric (B)	Dunlap et al., (2000); Arlinghaus and Mehner, (2005); Arlinghaus, (2006a); Bruskotter and Fulton, (2007); van den Heuvel et al., (2020)	Behavioural antecedents: cognitive hierarchy theory
Anthropocentric (AN)		
Awareness: environmental consequence (EC)		
Awareness: environmental responsibility (ER)		

personal relevance one holds to a given activity (Kyle et al., 2003; 2004). Studies have shown that higher levels of involvement are correlated with increased environmental concern among anglers (Seimer and Knuth, 2001). Involvement is a multidimensional concept with measurement scales consisted of five dimensions: attraction; centrality; social bonding; identity affirmation; and identity expression (Kyle et al., 2007). Other hierarchical approaches focus on 'catch orientation', albeit with distinct sub-dimensions (Graefe, 1980; Fisher, 1997; Sutton and Ditton, 2001;Arlinghaus and Mehner, 2005; Arlinghaus, 2006b). Few studies have accurately validated the multidimensional catch orientation scale in different settings or fisheries and some only use one dimension as a proxy measure (Aas, Vittersø, 2000). Anderson et al. (2007) has developed the most statistically robust approach, employing a 16-item scale to capture sub-dimensions including general consumptiveness (or 'catching something'), catching numbers of fish, catching large or trophy game fish, and retaining fish (Oh and Sutton, 2019).

Angler motivation is defined as the psychological impulse to partake in an activity based on the expected outcomes (expectancy theory) and has been a central component in most lateral typologies (Manfredo et al., 1996; Parkkila et al., 2010). Motivation can be understood as a two-part concept involving catching fish and pursuit of leisure, with prevalence of non-catch over catch related motivations among anglers often observed (Fedler and Ditton, 1994; Finn and Loomis, 2001; Beardmore et al., 2011). Its antecedental role has been criticized: some claim that it is too changeable in different contexts, can be multiple at singular points in time, and is often outweighed by cultural or local norms (Arlinghaus, 2006b; Beardmore et al., 2011; Cooke et al., 2018). Some still hold that motivation is a key angler profiling tool because of its strong reliability in describing heterogeneity and because it has related well to other key measures such as specialisation (Finn and Loomis, 2001; Beardmore et al., 2011; Magee et al., 2018). Beardmore et al. (2011) compiled a typology of five distinct angler groups drawing on motivation: trophy-seeking anglers; non-trophy, challenge-seeking anglers; meal-sharing anglers; nature-oriented anglers; and social anglers. Magee et al. (2018) conceptualized anglers into five distinct types based on unique combinations of activity specific (catch) and activity general (non-catch) motivations: social anglers (driven by human interactions); trophy anglers (driven by skills and competition); outdoor enthusiasts (driven by escapism); generalist anglers (with an equal mix of motives); and hunter gatherers (driven by eating the fish they caught). The degree of overlap in the angler groups noted here is not uncommon; other studies have also pointed towards similar angler types, including generalists, consumption orientated and trophy anglers (Johnston et al., 2010; 2013). There is, however, a fundamental problem with previous approaches employing motivation to decipher angler heterogeneity: motivation for all anglers straddles the catch and non-catch divide to varying degrees, and most research studies cater for this by collecting multiple response pre-coded (nominal) data for each type of motivation. In reality, anglers are driven by primary motivation, and this is likely masked by the multiple options (and responses) given to anglers in such research studies. There is, therefore, a lack of research that reveals the importance of one motivation type, either catch or non-catch, when the other is taken away.

Although not fully employed in the formation of either hierarchical or lateral typologies, other indicators of diversity have been revealed in recreational angling studies, including: ethnicity (Hunt and Ditton, 2001); fishing location (Arlinghaus and Mehner, 2005); species preference (Ross and Loomis, 2001); and environmental values. The latter has proven particularly useful in predicting angler behaviour (Arlinghaus and Mehner, 2005; Bruskotter and Fulton, 2007; van den Heuvel et al., 2020). Values have been operationalised in angling studies mainly using the New Environmental Paradigm (NEP), which tested biocentric and anthropocentric sentiment (Shindler et al., 1993; Bruskotter and Fulton, 2007). Studies have further explored the importance of difference aspects of environmentalism in explaining angler behaviour via three sub-components: power balance between the natural environment or human world; awareness of impact on the environment; and, feelings of responsibility for fishery management or environmental protection (Schwartz, 1977; Arlinghaus and Mehner, 2005; van den Heuvel et al., 2020).

As demonstrated, there is a rich theoretical foundation to the study of angling communities which can be employed in geographies of choice. In the UK, Sea angling is a popular activity with 568,188 to 753,165 participants from 2016 to 2021 generating important economic and social benefits (Armstrong et al., 2013; Roberts et al., 2017; Hyder et al., 2020; 2024) and impacts on fish stocks (Hyder et al., 2018; Radford et al., 2018). Response rates to monitoring surveys are low, meaning that non-probability offsite methods are employed to generate data with the potential for biases. Current analyses to address biases do not account for angler values, attitudes, or behaviors (Hyder et al., 2024). In addition, enhanced management measures are in place for some fisheries (e.g. sea bass and bluefin tuna): compliance with such management measures is unknown but research has demonstrated the likely positive impacts of different value and attitudinal dimensions of the angler psyche and related normative management approaches in reducing non-compliance (Mackay et al., 2018; 2020; Bova, 2019; van den Heuvel et al., 2020). The psychological dimensions are likely distributed to varying degrees across the angling community, meaning that understanding heterogeneity can aid the development of management measures to stimulate increased angler compliance. However, prior to work presented in this paper, no typology of UK recreational sea anglers existed which impacted on the effectiveness of monitoring data collection, environmental assessment and implementation of management strategies.

This paper presents a validated typology of recreational sea anglers in England and Wales. Results are contextualized through comparison with existing typologies in the research literature. Insights are generated into ways that the typology may be employed in future research to advance monitoring assessments. The paper concludes by considering the benefits afforded by recognition of angler diversity in the development of fishery policy.

2. Methodology

The study focused on recreational sea anglers residing in England and Wales. Target participants were defined as those who used rod and line from ashore or afloat a vessel in marine or estuarine environments to capture fish (not constituting a primary nutrition resource and not sold for financial gain) on at least two occasions in the 12 months prior to involvement in the study. Data collection involved two stages: firstly, an e-survey of anglers (including a pilot phase) aimed at generating a typology; secondly, follow-up telephone interviews with respondents to explore findings of the survey analysis and validate resulting angler clusters.

2.1. Conceptual framework

The multitude of different approaches to assess angler heterogeneity presents difficulty in choosing the most suitable where there is no specific policy focus and a priority to ensure maximum sample size. Too many variables can result in poor response rates and too few may miss key phenomena where diversity manifests. It was therefore key to establish an operationally viable conceptual framework to shape the study from the outset and inform data collection. The framework generated to assess angler heterogeneity drew upon diverse theoretical concepts from the research literature (Table 1). The primary focus of the framework was to identify key areas of the angling experience that had tried and tested variables (questions and statements) which could be used (via summary indices) to describe heterogeneity across the study sample via a simplified set of angler types (displaying maximum in-group homogeneity) suitable for both inclusion in future monitoring

assessments and for use by policy makers. The intention was not to test the relationship between concept and variable (exploratory or confirmatory) as this had already been achieved in the associated literature sources (discussed further in 2.2). No standard data collection exists for typology creation, therefore the framework needed to be wide-ranging, reflecting values, attitudes, and behaviors where previous research showed usefulness in predicting angler behavior and/or had demonstrated strength in describing heterogeneity.

2.2. Typology survey

Accessing representative samples of sea anglers in the UK is challenging as there is no license frame to sample from and response rate to postal and telephone surveys are very low (Hyder et al., 2024). Because there is no census-type data on the UK angling community, there is no way of robustly assessing sample representativeness. This is a recognized issue in angling research (Magee et al., 2018). As a result, it was necessary to use non-probabilistic convenience sampling via online communities and angling clubs and accept associated biases. Such methods give insight into population subgroups and can be used as the first step in prior to research with larger and more representative study samples (Magee et al., 2018). The aim in this context is not to make generalizable claims to the wider population but to set a typology and data collection framework that can inform future probabilistic and/or representative sampling. Still, a representative sample size was calculated to require 384 responses based on estimates of the number of sea anglers in England and Wales (see supplementary information). This was considered the minimum sample size required to increase chances of demographic spread and ensure enough cases for subsequent multivariate analysis based on the large number of variables in the study. The sample frame was compiled using multiple sources: 7000 anglers who are listed on the UK database used for monitoring assessments (Hyder et al., 2021); 7000 anglers in a targeted e-newsletter distributed by UK Sea Angler magazine; and 32,172 anglers via social media, including local and national angling clubs/groups on Facebook. Although it was not possible to determine the degree of overlap between each distribution channel, in theory the sample frame consisted of 46,172 anglers (maximum) across England and Wales.

The questionnaire (see supplementary information) was largely statement-based and designed to cover all concepts and literature in the study framework (Table 1), with several exceptions. Cognition was assessed via a skill judgement based on comparison to angling peers rather than arbitrarily using low-to-high scales. Attitudes to catch were measured using 12 statements from Anderson et al. (2007) with amendments to reflect their application in a UK (marine, open access) context. The survey also included questions related to the wider context for intended use in testing the typology, including: motivation (implemented as a categorical variable covering priority between non-catch and catch-related factors, or parity of both in order to overcome the masking issues identified in previous research discussed in Section 1); catch-release behaviours (proxy for personal stewardship); stewardship norms (Landon et al., 2018); and demographic information. Statement-based questions were measured through 5-point Likert scales: strongly disagree; disagree; neither agree nor disagree; agree; strongly agree.

A pilot phase was conducted with 10 sea anglers resulting in improvements to the narrative of terms not commonly used in non-academic contexts within angling communities (e.g. ecology). The questionnaire took an average of 22 min to complete. The survey link and supporting information was distributed via the gatekeepers and social media administrators of the sample frame sources. The survey yielded a total of 567 responses. Due to the minimal control held over the survey link once distributed via gatekeepers and because the intended analysis is particularly sensitive to skewed case responses (Hair et al., 2014), the sample was reviewed to identify case outliers using Mahalanobis D^2 ($n = 0$). The sample was cleaned to remove cases where: there had been no fishing days spent, spend or travel over the 12 months prior to questionnaire completion (indicators of inactivity); where responses were potentially automated (extreme responses), where the angler only fished in freshwater environments (interpreted from open text responses). A sample consisting of 472 usable cases remained for multivariate analysis. To assess potential bias, comparisons of the characteristics of the respondents were made with a face-to-face UK survey of angling participation and effort that included demographic and fishing related information (Hyder et al., 2021).

The typology was generated using multivariate analysis carried out in stages consistent with data reduction to inform cluster analysis: principle component analysis was firstly used to reduce the data through grouping variables by weighted averages to identify linear representations that accounted for maximum variance in the sample; components were applied in both non-hierarchical and hierarchical cluster analysis to classify anglers into distinct clusters. The analysis partitioned case data to satisfy the balance between enough homogeneity within clusters to enable easy definition but enough heterogeneity between clusters to warrant separation; both data reduction and clustering techniques were subject to scenario testing involving different numbers of components and clusters (Tabachnick and Fidell, 2001; Davies, Hodge, 2007; Tsourgiannis, 2007; Urquhart and Courtney, 2011; Hair et al., 2014; Malekinezhad et al., 2024). The typology clusters were validated through analysis of variance against independent variables drawn from outside the factor framework and through a novel angler validation technique.

It is important here to iterate the aim and methodology of this paper in relation to the conceptual framework. Across angling studies, latent constructs have played an important role, largely because much of the literature has been at the forefront of developing and/or discovering these phenomena (and their subdomains) as part of the angling experience/angler. Research (see Section 1) therefore employed methodologies which focused on testing the presence of (and relationship between) latent constructs and associated measures, incorporating modelling techniques based on (exploratory and confirmatory) factor analysis. This is evident in typology focused studies using motivation and specialization and work focusing on attitudes to catch and involvement, which were highly focused on the specific structural nature of the latent phenomena. The outcome from this spectrum of research is a suite of statistically proven variables and measures for each concept employed in the conceptual framework developed in this paper. Considering this paper's aim to practically inform the current UK policy context, continuing to focus on testing the presence of the latent concepts and their relationships between each other or to loading variables using relevant techniques was less relevant. Of more importance was the ability to use the array of variables in the framework (ordered by their ability to describe variance in the sample) to inform clustering and angler profiling. This was deemed of most use for the UK policy and monitoring context. For this reason, principal component analysis was the preferred data reduction technique. As a numerically based (to a degree unbiased) process for ordering variance based on a regressed line of best fit for grouped variables, it avoided having to re-address discussion on the existence and relationship between latent construct and variables that would naturally arise when using either exploratory or confirmatory factoring. The approach taken in this paper is consistent with standard practice in other fields (see Urquhart and Courtney, 2011; Malekinezhad et al., 2024). This does naturally limit some of the conclusions made in this paper when comparing the outcomes of the data reduction to respective source literature. These limitations are highlighted where necessary in Sections 3 and 4.

2.3. Validation interviews

Once the typology had been created, survey participants were sent invitations to take part in semi-structured telephone interviews regarding their survey responses. These semi-structured interviews

explored experiences of anglers in the context of their own lived world to develop instrumental dialogue on why certain views were held or behaviours demonstrated in the survey responses (Kvale, 2007). The interviewees (n = 24) were also read descriptions of the angler clusters and asked to position themselves in just one (single-fit). Respondents also scored each cluster in terms of how well they felt the definitions reflected them personally using pre-coded responses (ranked-fit): completely; strongly but not completely; partially; and, not at all. The qualitative typology validation approach was a unique and novel method in angling research literature. Interviewee narratives were subject to thematic content analysis (Nowell et al., 2017) and used to support the typology descriptions.

3. Results

3.1. Representativeness of the sample

Comparison of respondent characteristics in the sample with the UK population showed some differences. Compared to the known angling population characteristics in Hyder et al. (2020); (2021), respondents in the study sample were: older (80 % over 55 compared to 54 %); more avid (22.5 % fishing for 35 + days compared to 8.9 %); but spent less on equipment (an average of £365 in the past year compared to £841). The geographical location of the respondents was similar with the majority in the Southeast (22.2 %) and Southwest (23.3 %) of England. The majority were male (99.2 %), had no known disability (59.3 %), and were white British (97.6 %). These trends are not uncommon in UK angling study samples (Armstrong et al., 2013).

3.2. Typology analysis

Based on numerical correlation between variables, principal component is analysis dependent on an adequate degree of multicollinearity. Variables were omitted from the correlation matrix where recommended extremities of multicollinearity were exceeded (Hair et al., 2014): excessive multicollinearity at ± 0.90 and no variable correlation at ± 0.30. No partial correlations were observed in the variable matrix. Overall correlation in the variable set was adequate based on Bartlett's test of sphericity and Keiser-Meyer Measure of Sampling Adequacy (KM MSA = +0.50). Further variables were removed that showed low variable communality (<0.50).

Principal component analysis groups variables in hierarchical order of how well they account for variation in the data (Hair et al., 2014). The satisfactory number of components and loading variables (Table 2) was based on assessment of eigen values (>1), visual analysis of the scree plot, and variable loading cut off (± 0.42). Cross loading variables were removed at point of initial data extraction which required further assessment of multi-collinearity: variable communalities remained at 0.50; the KM-MSA was 0.83; Bartlett test was sufficient at 6450.35 (df=561; $p < 0.001$); all variables showed at least one correlation coefficient at ± 0.30; the lowest individual MSA was 6.74; and there were no partial correlations. Ten components, involving 34 variables, explained 67.6 % of total variance among the sample in this study, providing an adequate degree of data reduction that conformed to minimum tolerance (>60 % sample variance as recommended by Hair et al., 2014).

Nine variables were omitted from the analysis due to breaches in multicollinearity, cross loading and variable communality. Grouped by category these included: BC (n = 2); IA (n = 3); C (n = 1); B (n = 1); AN (n = 1); and, ER (n = 1). Case and score outliers were further assessed prior to cluster analysis, which left 453 respondents in the sample. Pearson's correlation was used to ensure there were no relationships between component scores (Hair et al., 2014).

Hierarchical cluster analysis using a single and average link (between group) stopping rule showed six, four, three and two cluster solution to describe segmentation in the case data. The most effective

Table 2
Principal components resulting from survey analysis with corresponding survey questions or statements and loading scores (negative implies disagreement). Variable category code correlates with Table 1.

Code & label	Description (survey question / statement)	Loading
Component 1: Central to life		
BC_Days	On how many days in the last 12 months have you gone recreational sea angling?	0.708
CP_Organised	"I find that a lot of my life is organized around recreational sea angling"	0.784
CP_Central	"Recreational sea angling occupies a central role in my life"	0.840
CP_Preference	"To change my preference from recreational sea angling to another recreation activity would require major rethinking"	0.727
A_Enjoy	"Recreational sea angling is the most enjoyable thing I can do"	0.711
A_Important	"Recreational sea angling is very important to me"	0.714
A_Satisfying	"Recreational sea angling is one of the most satisfying things I can do"	0.702
Component 2: Keep and consume		
CR_Eat	"I usually eat the fish I catch"	0.889
CR_Keep	"I want to keep the fish I catch"	0.897
CR_Release	"I'm just as happy if I release the fish I catch instead of keeping them"	−0.746
Component 3: Identity		
IE_Seeing	"You can tell a lot about a person by seeing them take part in recreational sea angling"	0.793
IE_Says	"Participating in recreational sea angling says a lot about who I am"	0.784
IE_Want	"When I participate in recreational sea angling people see me the way I want them to see me"	0.750
Component 4: Biocentrism		
B_Rights	"Fish have as much right to exist as humans"	0.726
B_Value	"Fish are valuable in their own right, regardless of people"	0.702
AN_Rule	"Humans were meant to rule over the rest of nature"	−0.716
AN_Managed	"Fish should primarily be managed for human benefit"	−0.666
Component 5: Awareness of environmental consequence		
EC_Interfere	"When humans interfere with nature it often produces disastrous consequences"	0.767
EC_Abusing	"Humans are severely abusing the environment"	0.845
EC_Catastrophe	"If things continue on their present course, we will soon experience an ecological catastrophe"	0.818
Component 6: A 'catch' orientation		
CS_No-fish	"A fishing session can be successful even if no fish are caught"	−0.803
CS_Any-fish	"If I thought I wouldn't catch any fish, I wouldn't go fishing"	0.736
CS_Some-fish	"When I go fishing, I'm not satisfied unless I catch at least something"	0.749
Component 7: Social bonding (friendship)		
SB_Friends	"Most of my friends are in some way connected with recreational sea angling"	0.720
SB_Discuss	"I enjoy discussing recreational sea angling with my friends"	0.784
SB_Opportunity	"Participating in recreational sea angling provides me with an opportunity to be with my friends"	0.824
Component 8: Catch numbers		
CN_More-fish	"The more fish I catch, the happier I am"	0.785
CN_Many-fish	"A successful fishing session is one in which many fish are caught"	0.779
CN_Others	"I'm happiest with a fishing session if I catch more than other anglers around me"	0.673
Component 9: Catch characteristics (trophy)		
CT_Rather	"I would rather catch 1 or 2 big fish than 10 smaller fish"	0.800
CT_Challenge	"I'm happiest with a fishing session if I hook a fish that is challenging to catch"	0.755
CT_Chance	"I like to fish where I know I have a chance to catch a trophy fish"	0.685
Component 10: Environmental responsibility		
ER_Protect	"We anglers do not do enough to protect aquatic ecosystems"	0.786
ER_Ecosystems	We anglers should be willing to change our present angling behaviour to protect aquatic ecosystems"	0.662

Note: negative loading related to reversed statements.

number of clusters to describe the data was identified by combining comparative-visual inspection of component scores and cluster groupings, ANOVA of components, subsequent non-hierarchical clustering comparisons and, importantly, ANOVA of variables outside the data reduction exercise by cluster (the process followed Urquhart, 2009; Urquhart and Courtney, 2011). Analysis supporting the outcomes of these processes, discussed hereafter, is presented in supplementary information. The six-cluster hierarchical solution was omitted due to low level of variation between clusters compared to the four-cluster model; the two-cluster solution omitted for loss of variation and disproportionate clustering. Non-hierarchical clustering was used to confirm the typologies partitioning as it allowed for reallocation of cases until maximum homogeneity was achieved within clusters (Hair et al., 2014). In this context, two methods were used to test the strength of the three and four cluster scenarios: component centroids in a K-means ANOVA followed by predictive validity testing against independent stewardship behaviors drawn from elsewhere in the survey questionnaire that were not used in the principal component analysis. These were interpreted as behaviors to increase likelihood of released-fish survival in line with private stewardship (Landon et al., 2018).

The four-cluster solution showed strongest performance across all metrics and significant variation between clusters for the apparent factors (Fig. 1). Because of the theoretical link between stewardship behaviors and personal norms (Landon et al., 2018), the ability of the four-cluster solution to explain between-group differences regarding normative statements was also tested. All results are shown in Tables 3 and 4. The four-cluster solution showed variation in three of the four (tested) stewardship behaviors: cradling fish; keeping fish in water; and use of barbless hooks. Post-hoc testing (multiple comparisons) showed significant differences (in means) to manifest between clusters 1 and 4 in reference to cradling fish and use of barbless hooks. Significant variation was demonstrated across clusters for all three normative statements tested. Post-hoc tests showed significant differences regarding conservation of fishery resources (between clusters 1 and 2), moral obligation (between clusters 2 and 4), and feelings of guilt (between clusters 1, 2 and 4).

As categorical variables, there was a significant relationship between cluster and motivation (X^2 (6, N = 453) = 13.88, $p < 0.05$), validating the hypothesis that changes in angler type was reflected by changes in reasons for taking part in recreational fishing (catch related, non-catch related or parsimony of both).

Table 3
Predictive validity of a four-cluster solution using catch and release behaviors and personal norms. Behavior sample based on removal of respondents who had not returned fish in past year: N = 443 (cluster sizes: 1 = 105; 2 = 82; 3 = 98; 4 = 158. Frequency: 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always. Norm statements measured using: 1 = strongly disagree, 2 = disagree, 3 = neither disagree or agree, 4 = agree, 5 = strongly agree. Norms N = 453 (clusters:1 = 112; 2 = 82; 3 = 99; 4 = 160. * indicates that homogeneity of variance violated, which was subject to correction using Welch ANOVA, reporting df1 and df2, uncorrected: $F(3, 438) = 0.924$, p = 0.429.

	Cluster	M	*F (df)*	*P*
Behaviour				
Cradled fish in water to ensure they can swim before being released	1	3.78	3.248 (3, 213) *	0.023 *
	2	3.99		
	3	4.09		
	4	4.18		
Kept fish to be released in water while being unhooked	1	2.91	2.667 (3439)	0.047
	2	3.11		
	3	3.35		
	4	3.23		
Used barbless hooks	1	2.61	5.909 (3439)	0.001
	2	2.84		
	3	3.11		
	4	3.28		
Normative statement				
People like me should do whatever they can to conserve fishery resources and aquatic ecosystems	1	4.13	3.941 (3, 449)	0.009
	2	4.44		
	3	4.30		
	4	4.25		
I do not feel morally obliged to try and conserve fishery resources and aquatic ecosystems	1	1.89	3.422 (3, 449)	0.017
	2	1.61		
	3	1.99		
	4	2.01		
I would feel guilty if I didn't do my part to conserve fishery resources and aquatic ecosystems	1	3.91	5.411 (3, 449)	0.001
	2	4.33		
	3	4.11		
	4	4.19		

3.3. Exploring survey finding through angler interviews

The survey analysis identified components that were predominantly self-descriptive by the composition of loading statements. Component 3, however, presented room for interpretation: it was not clear how angling specifically related or influenced angler identity. This provided the basis for discussion during the angler interviews. Eleven anglers

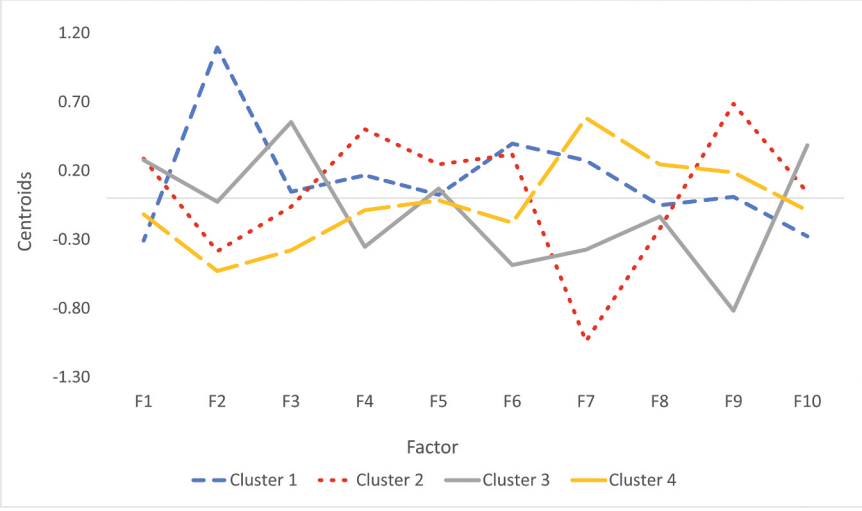

Fig. 1. Component scores (centroids) of angler clusters resulting from non-hierarchical analysis. Corresponding ANOVA. C1 centrality: F(3, N = 453) = 9.89, p < 0.001; C2 keep and consume: F (3, N = 453) = 124.09, p < 0.001; C3 identity: F(3, N = 453) = 22.13, p < 0.001; C4 biocentrism: F(3, N = 453) = 15.12, p < 0.001; C5 environmental impact: F(3, N = 453) = 1.65, p = 0.12; C6 catch orientation: F(3, N = 453) = 22.84, p < 0.001; C7 friendship/social bonding: F(3, N = 453) = 87.30, p < 0.001; C8 numbers: F(3, N = 453) = 5.56, p < 0.001; C9 catch charecteristics: F(3, N = 453) = 53.08, p < 0.001; C10 environmental protection: F(3, N = 453) = 9.48, p < 0.001.

Table 4
Catch and release behaviours and normative statements where analysis demonstrated variation between specific clusters. CI are 95 %. Scheffe analysis was used to account for unequal segment sizes and multiple comparisons.

	Cluster – comparator	Mean difference	Standard error	*P*	*Lower CI*	*Higher CI*
Behaviour						
Cradled fish in water to ensure they can swim before being released	1–4	−0.403	0.125	0.017	−0.05	−0.75
Used barbless hooks	1–4	−0.669	0.168	0.001	−1.14	−0.20
Norm statement						
People like me should do whatever they can to conserve fishery resources and aquatic ecosystems	1–2	−0.305	0.091	0.011	−0.56	−0.05
I do not feel morally obliged to try to conserve fishery resources and aquatic ecosystems	2–4	−0.396	0.131	0.028	−0.76	−0.03
I would feel guilty if I didn't do my part to conserve fishery resources and aquatic ecosystems	1–2	−0.419	0.110	0.003	−0.73	−0.11
	1–4	−0.283	0.093	0.028	−0.55	−0.02

interviewed felt that angling was very important to their identity as a whole. An additional four anglers felt that angling was important to their identity but only in a leisure context. Of these combined 15 anglers, four belonged to cluster 3, which across all components scored highest for Component 3 (Fig. 1). The majority (n = 10) reported that angling allowed them to engage in their enthusiasm for the outdoors and/or nature, helping to both construct and reflect their identity. As one interviewee from cluster 3 stated: *"Putting yourself against the challenges of not just fish but the environment… I'm into the environment anyway, being out there in the environment, lots of watery stuff, surfing and kayaking"*. Evidently, those who associate identity with angling often engage in other sports that act to situate or position themselves with nature or the environment.

3.4. Defining and comparing the typology

Angler clusters were defined and described using component scores, predictive ability tests, and interviews, constituting a typology consisting of consumers; trophy anglers; leisure-identity angler; and, social anglers (Table 5). Descriptive data is also provided in supplementary information showing responses by cluster for each of the highest loading component variables shown in Table 2 (consistent with the summaries below).

Although the geography, context, method and analysis techniques (see Section 2) used in other typology studies differed to that employed in this study, it is important to highlight potential similarities in outcomes regarding angler types (and note caveats). Magee et al. (2018) conceptualized consumer anglers slightly differently to this study: 'hunter gatherers' were defined as having a high degree of consumptive orientation but did not reveal propensity towards social bonding. While this study employed principal component analysis and theirs latent class (factor) analysis, the difference noted here is not on definition composition in terms of dimension, but performance in the definitional and dimensional constructs. It is more difficult to make comparisons to Beardmore et al. (2011) due to their research primarily drawing on numerous (factored) sub-dimensions of motivation not used in the current study. Johnston et al. (2010); (2013) is more comparable, with consumers showing a predisposition to retain fish caught (a directly comparable measure).

Trophy anglers in this study are most comparable to trophy anglers in Magee et al. (2018): both placed higher importance on catching challenging and larger fish. Size was also an important part of the conceptualisation of trophy anglers in Johnston et al. (2013). Beardmore et al. (2011), however, found that centrality and fish consumption played an important part in defining 'trophy' anglers, which is contrary to the defining characteristics in this study: trophy angers did not score highly for these variables and showed increased likelihood of releasing fish as opposed to retaining for the table. Again, the differences noted here, are not on the factor or components (no new or different measures are used to define this particular angler cluster); the definition differs based on the scores or performance in each dimension. This implies that although the analysis method is different between this study and others, the definitional components resulting from such analyses are very similar.

This observation continued to be the case regarding leisure-identity and social anglers. Leisure-Identity anglers were most comparable to the 'outdoor enthusiast' group in Magee et al. (2018), although their definition is primarily based on a more detailed capture of non-catch motivations involving escapism and relaxation. This study and Magee et al. (2018) showed low importance for this group in relation to fish size, numbers and socialisation. Beardmore et al. (2011) conceptualised the equivalent group as 'nature orientated anglers' that placed higher importance on being outdoors. However, this group scored low in terms of centrality and high regarding importance placed on challenge and size of fish caught, meaning that differ slightly compared to leisure-identity anglers identified in this study.

Magee et al. (2018) defined social anglers by the motivation to be with friends, escapism and propensity to release fish; less importance was placed on catching fish (Magee et al., 2018). This resonates with characteristics used in this study to define social anglers. In Beardmore et al. (2011) the social group proved the most difficult to define, although they did share the common characteristic of low retention rates.

Types not identified in this study but apparent in others include generic anglers (Magee et al., 2018; Johnston et al., 2013), non-trophy and challenge seeking anglers (Beardmore et al., 2011).

3.5. Typology validation

In the single fit scenario, 16 of the 24 anglers taking part in the validation exercise positioned themselves in the cluster to which they were assigned in the survey analysis. The number increased to 20 anglers in the ranked scenario when combining those that felt they belonged 'completely' or 'strongly but not completely' to their assigned cluster. At cluster level, based on single fit positioning, the leisure-identity cluster showed the strongest verification with 6 of 7 anglers interviewed positioning themselves in the same grouping as the survey analysis. The consumer cluster also performed well (n = 4 of 5). Of the social cluster, four of the seven anglers interviewed self-allocated to the same group as the survey analysis, but only two of the five trophy anglers followed suite. Trophy anglers that did not align with the survey cluster resonated 'completely' with the leisure-identity group. Those mis-aligned within the social cluster resonated with either the leisure-identity (n = 2) or consumer groups (n = 1).

4. Discussion

The typology developed in this study included angler types that are consistent with other studies. The similarity in typology composition exists regardless of: different fishing environments, including freshwater

Table 5
Typology of recreational sea anglers.

Cluster label	Percentage of sample (N)	Description	Studies with same/ similar groups
Consumer	24.7 (N = 112)	Placed importance on retaining and eating fish (C2, C6, C8). Motivated by the experiences related to catching fish (40 % of cluster – highest proportion across typology) and associated angling with an opportunity to be with friends (C7). They did not view angling as a centrally important part of their life (C1) and were less likely to feel responsibility to protect the environment compared to other clusters (C10). They held lower levels of stewardship norms (specifically compared to trophy anglers) and were less likely (compared to social anglers) to carry out stewardship behaviours (cradling fish and use of barbless hooks).	Beardmore et al., (2011); Johnston et al., (2013); Magee et al., (2018)
Trophy	18.1 (N = 82)	Scored highly on characteristics (size and challenge) of the catch (C9) and expressed biocentric viewpoints (C4). They were less likely to engage in angling for social reasons (e.g. spending time with friends) compared to other clusters. Trophy anglers felt guilt towards not protecting the environment and demonstrated a sense of moral obligation to conservation.	Beardmore et al., (2011); Johnston et al. (2013); Magee et al., (2018)
Leisure-identity	21.9 (N = 99)	Placed lower importance on catching fish and their sized-based characteristics (C6 and C9). This group linked recreational sea angling to their personal identity (C3): the activity reflected how they see themselves and how they want to be viewed by others in a leisure context. Angling facilitates their engagement in the natural environment and fulfils their general desire to be outdoors. Angling played a central role in their life (C1). This cluster did not feature strongly in comparison to other clusters regarding stewardship norms or behaviours.	Beardmore et al., (2011); Magee et al., (2018)
Social	35.3 (N = 160)	Scored highly regarding the opportunity provided by angling to be with friends (C7). Lower importance placed on consuming fish (C2) although some emphasis on catch-related aspects of angling (C8 and C9). The social angler is the most likely cluster in the typology to be motivated by non-catch aspects of angling (38 % of cluster). They showed lesser propensity to associate angling with their identity (C3). They were more likely to engage in stewardship behaviours (use of barbless hooks and cradling fish) in comparison to the consumer cluster.	Beardmore et al., (2011); Magee et al., (2018)

(Johnston et al., 2013), mixed fresh and saltwater (Beardmore et al., 2011; Magee et al., 2018) and solely saltwater (this study); and, analytical methodologies that employed fundamentally different statistical techniques to group variables, including those based on modelling the effects of latent constructs and those, employed in this paper, which were based on numerical linear correlation of variable weighted averages. This, in combination with the fact that there are clearly observed similarities in the outcomes of the principal component analysis (i.e. the components and variable definitions) and outcomes of factor analysis (i.e. latent constructs) elsewhere in the literature suggests that regardless of how angler heterogeneity is researched, one is very likely to encounter the same types. By conducting a slightly alternative approach to the measurement of heterogeneity dimensions compared to other literature, but with similar results, the paper has added to the strength of previous theories on how to best describe differences among anglers albeit with methodological caveats (Section 4.1) and have provided a robust framework relevant to future UK monitoring assessments (Section 4.2).

Evidently, there are other angler types apparent in the literature (see Section 3). However, they are constructed using the same definitional measures/dimensions. This highlights an important macro-observation on angler heterogeneity studies, which is important to consider in future studies employing either component or factor analysis. The typology formation is partly dependent on research design and how researchers interpret and label groupings: for example, at what point do anglers become part of a 'non-trophy' group, and surely all those not in the 'trophy' group are, to an extent, non-trophy orientated by default (Beardmore et al., 2011). Culture and linguistics may also affect the naming and definition of angler clusters, suggesting that more international and comparative typology studies are required.

4.1. The study framework

By theme, it is evident that value-based and attitudinal components of the typology developed in the current study were most useful in describing variance in the sample. Behavior measures were omitted in the analysis process, including spend on fishing equipment in the 12 months prior to completing the questionnaire (communality breach) and travel in one-direction on last fishing trip (correlation breach). The cognition variable ("how would you rate your overall sea angling skills in comparison to other anglers you know?") was also omitted for a communality breach. In the context of this study and its analytical methods, these two key components of specialization therefore did not feature as components that could be included in the description of variance in the sample. Only centrality proved reliable in this regard. It must be highlighted, however, that in this study, the analytical approach

was to highlight the simple ability of variables to capture variance in the sample (component analysis) whereas previous approaches to specialization did not focus on this feature, instead testing the relationship of the concept, subdimensions and variables to one another, or to other features of the angling experience. The outcomes of this study nonetheless question the theoretical structure of specialization considering the inconsistency in the performance of sub-dimensions to capture variance.

The second set of variables omitted in the component analysis included three statements representing IA (as a result of cross loading): "when I participate in recreational sea angling, I can really be myself"; "I identify with the people and image associated with recreational sea angling"; and "when I'm sea angling for recreation I don't have to be concerned about the way I look". Kyle et al. (2007) used IA as a key component of enduring involvement. Again, the analytical techniques employed factoring against the effects of latent constructs so comparisons to this study must be limited; however, the observation can be made that in terms of variance IA does not differ substantially from variables measuring identity expression. There are other observable differences in the components developed in this study and the sub dimensions of involvement theory. The centrality component (C1) incorporated seven variables, including three standard measures alongside three attraction statements. At no stage in the analysis did the seven variables de-group: measures of attraction consistently covaried with standard measures of centrality. In addition, social bonding measures stood independently of centrality. Kyle et al. (2007) highlighted the fluid nature of sub-dimensions within their theory and necessity to change the definitions of constituent factors with plausible-logical reason. In this study and in opposition to Kyle et al. (2007), attraction and centrality are similar if not the same in explaining the largest proportion of variance in the sample. The separation of social bonding from centrality, however, supports Kyle et al. (2007), differing from previous work suggesting their coexistence in the same conceptual space (Mclntyre and Pigram, 1992). Principal component analysis has therefore raised intriguing observations on the nature of angler involvement, demonstrating that it is a strong framework for understanding variance among recreational sea anglers in England and Wales (specifically: centrality; social bonding, and identity expression). It is recommend that future work is carried out to explore the strength of 'involvement' domains in a hierarchical model of UK anglers.

Results also demonstrated that sample variance could be explained by all four dimensions of 'attitudes to catch' (Anderson et al., 2007). In order to reflect the loading statements more accurately, two dimensions were renamed: 'catch something' was renamed to 'a catch orientation' and 'large/trophy' fish was renamed as 'catch characteristics'. Regarding the latter, only one of the three loading statements referred to 'trophy' fish, with the other two focused on 'big' fish and 'challenging' fish. These aspects of a fish are more in-line with their biological characteristics rather than simply indicating their label as a trophy fish. This further demonstrates the effect researcher interpretation can have on the intricacy of describing component of angler attitudes as part of typology formation. Environmental values, as a relatively new domain in exploring angler diversity has also proved useful in describing variance among anglers in the study. However, only two of the three statements for biocentrism (B) and anthropocentrism (AN) respectively survived the analysis. The statements omitted (communality breach) included: "humans are not more important than other parts of nature" and "humans have a right to change the natural world to suit their needs" (AN). One statement reflecting environmental responsibility (ER) was also omitted: "We anglers are well qualified to manage and protect aquatic ecosystems" (low variable correlation).

The small number of noted differences in loading variables in this study compared to previous work (see Table 1) is not unexpected considering the different extraction methods and purposes of principal component analysis (i.e. the correct method for understanding variance in samples). Nevertheless, it may prove beneficial to run a confirmatory factor analysis model on the data employed in study to accurately comment on the composition of latent constructs employed in the previous work. The observation may still be limited considering the sample method adopted in this study. To provide the most robust observations on latent constructs, such frameworks would benefit from being applied among UK recreational sea anglers via probabilistic sampling, which would require further data collection efforts and consideration of the difficulties involved that type of research design.

4.2. *Future heterogeneity studies*

The typology developed in this study was validated by constituent anglers. It may be assumed that the validation exercise verified the existence (and proportion) of the four angler types among the recreational sea angling community across England and Wales. This is partly correct and partly supported by the commonality of the angler groups in the research literature. The method actually verified the strength of the survey analysis to accurately combine questionnaire responses into definable clusters with which its constituents agree. To extent this lessens the importance of the debate thus far regarding extraction methods in principal component and factor analysis: anglers generally agree with the top-level descriptions drawn from these facets of the angling experience regardless of the mathematical mechanics behind their construction. To satisfy the original assumption, however, further research is required to apply the study framework to a representative sample of anglers in England and Wales. Onsite data collection, factoring location type, geography, times and seasons may be the most efficient and accurate sampling method to ensure maximum representativeness. This is a fundamental step in enabling further work to understand the potential bias in UK monitoring assessments and must also include capture of catch and release data (optimally by species) so that future comparison and benchmarking can take place. If presumed that the angler types identified in this study are an accurate representation of all possible types, the question is how to efficiently collect data to profile anglers. This is a pivotal question because of the heavy research burden that already exists on the UK angling community. Efficient data collection techniques are required.

There are several answers. Firstly, the data collection method tested in this study could be utilised in its entirety (suite of 43 variables); this, however, may prove too time consuming. Secondly, proxy variables (statements) could be employed to represent the components identified; further work would therefore be required to test the performance of this approach in segmenting angler samples compared to the use of component scores. Thirdly, and recommended, is that a direct approach is taken in which anglers self-allocate to the appropriate segmentation based on the following question format: Q: When taking part in recreational sea angling, what is most important to you from the options listed below? Please choose one option: to catch fish to eat; to catch 'trophy' fish (based on size or other biological fish characteristics); to express my identity as someone who enjoys being outdoors or in nature; To be with, or make new, friends." Permeations of this question could include the rank scenario where respondents are asked to rate the importance of each statement using an appropriate scale.

The importance of further work testing the typology in a representative sample should not be overlooked. The white, older, male predominancy in the study sample may have implications on results. For example, Schroeder et al. (2006) demonstrated that motivation to eat fish was higher among female anglers compared to males and that men were more likely to release fish. Men were more supportive of sustainability orientated regulations such as limitations on the numbers of fish caught or restrictions on the minimum sizes of endangered species. This implies that changes increasing female representation could potentially change the outcome of the typology. In practice, these changes are not likely to affect the outcome of the principal component analysis but could affect the proportion of the anglers in each cluster, potentially increasing the size of the consumer group. A systematic review of gender

or ethnic differences in relation to the factor themes (biocentrism or centrality) may shed more light on potential ways that the typology outcomes are affected. This increases the importance of applying the typology in future representative samples in a UK context.

5. Conclusion

Heterogeneity among the recreational sea angling community in England and Wales can be effectively described by a typology consisting of four angler types: consumers, trophy anglers, leisure-identity anglers, and social anglers. Their characteristics are defined using a suite of ten principal components which accurately described maximum variance in the sample. Components comprised attitudinal and value-based variables. The differences between angler types transcend, to a degree, with regards to designated stewardship norms and behaviours aiming to decrease mortality of released fish. The typology developed in this study is comparable to those elsewhere in the research literature: the angler types transcend fishing contexts (freshwater/saltwater) and emerge from studies employing diverse approaches. It is therefore recommended that the angler types developed in this study are employed in further sea angling monitoring in the UK. This would specifically support data extrapolation techniques from sample to population levels when considering that, for example catch rates, are not fully explained by demography and avidity profiling (Lewin et al., 2021). The typology can therefore be used to correct for such bias in offsite surveys but must be combined with the probabilistic sampling work recommended in Section 4, which will provide the representative data on angler type and catch behavior for sample comparison to take place. Profiling of anglers in accordance with typology, using an angler-self-allocation method, could easily be included in such surveys and consultations because of its minimal time requirements.

In addition, the UK Fisheries Act 2020 incorporates strategies based on co-design with the recreational sector. Typologies such as that developed in this study can be used to understand and monitor appropriate diversity in stakeholder input and responses to angler consultation (employing the recommended profiling data collection methods). This will ensure that appropriate stakeholders are engaged in relation to the objectives of associated management measures (e.g. it would be ill advised to engage consumers in catch and release campaigns). In a wider sense, typologies should therefore be regarded as key a component of fishery policy stakeholder analysis, helping to identify potential differences in predicted policy outcomes or impacts.

Finally, management measures often relate to increasing release rates (e.g. closed seasons, bag limits, minimum sizes). Understanding the characteristics of sea anglers (as per typology components) that fish for specific species in receipt of enhanced regulatory protection (e.g. sea bass or blue fin tuna) would impact the efficacy of management measures and help with campaign framing. For example, targeting management campaigns to communities consisting of trophy anglers will benefit from messages about environmental protection and conservation. Such message framing may be less effective when aimed at consumers. Misalignment with the angling sector as a whole may result in ineffective policy and regulation.

The typology presented has highlighted the heterogeneous nature of the recreational angling community in England and Wales and demonstrated applied relevance for the future fishery policy in several contexts.

CRediT authorship contribution statement

Fisher Adam: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Urquhart Julie:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis. **Hyder Kieran:** Writing – review & editing, Writing – original draft, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.fishres.2025.107364.

Data availability

Data will be made available on request.

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