Ecosystem Services: A bridge or barrier for UK marine stakeholders?

Abstract

Ecosystem services conceptualises the multiple interactions between ecosystems and the people and communities benefitting from their direct or indirect use, aiming to provide stakeholders and scientists with a common language. While some users appear to have adopted this language and terminology, there are concerns that the complexities associated with the concept make it inaccessible and, rather than providing stakeholders with a tool to explain complex relationships, the language and terminology itself may disengage. Through surveying UK-based coastal and marine stakeholders (*n*=158), this study examines stakeholders' perceptions of the concept of ecosystem services and its role and usefulness within the marine and coastal science-policy-practice interface. Overall, stakeholders provided favourable opinions, with findings similar across respondents with the exception of industry; which used it less, was less confident with it and believed it to be less important. The results provide an evidenced argument for the benefits of the ecosystem services approach, including communication, supporting management and linking environment to humans. The analysis also details the required advancements to ensure effective future use, including improved terminology, pluralistic valuation and shared learning. Finally, the paper highlights challenges and benefits relating to the term, creating links to ongoing discussions about effective scientific communication for marine and coastal management.

Keywords: environment, policy, governance, management, practitioners, coastal

1. Introduction

The Ecosystem Services (ES) concept has been in use since the 1970's (Westman 1977, Costanza et al., 1997, Daily 1997) but was formally defined and classified in 2005 by the Millennium Ecosystem Assessment (MA 2005) as "the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth". Since the publication of the MA (2005), interest in the ecosystem service concept has grown substantially and there are now a multitude of definitions and classifications, for example: The Economics of Ecosystems and Biodiversity classification (TEEB, de Groot et al., 2010b); the United Kingdom's National Ecosystem Assessment classification (NEA 2011). Further classifications have been developed by the Crown Estate (Saunders et al., 2010), Fisher et al., (2009), Atkins et al., (2011), Cognetti and Maltagliati (2010), Beaumont et al., (2007), Balmford et al., (2011), as well as more recent contributions from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Diaz et al., 2018) (also see Gomez-Baggethun et al., 2010 for a historical summary). Accompanying this has been an explosion of ES focused research across all areas of environmental, and more recently economic and social, sciences (e.g. Beery et al., 2016; Willcock et al., 2016; Costanza et al., 2014; Braat and de Groot, 2012).

The ES concept aims to provide a common language through which diverse audiences and users can communicate about the natural world (Tallis et al., 2008; Steger et al, 2018). Over time, it has evolved to reframe the human-nature relationship (Costanza et al, 2014), and has become acknowledged as an effective management and policy tool (Beery et al., 2016; Willcock et al., 2016; Dempsey and Robertson, 2012; De Groot et al, 2010; Norgaard, 2010; Tallis et al., 2008, Beaumont et al., 2018), and as a concept through which the environment and societal wellbeing can be better connected (Armsworth et al., 2007). Advantages of the application of the ecosystem service concept have been found to include improved understanding of environmental benefits, improved

transparency of potential trade-offs under different management scenarios, and the enabling of discussion and shared learning between stakeholders and with the wider academic community, resulting in improved long-term relationships between these groups (Beaumont et al., 2018).

However, despite the perceived benefits of applying the ES concept within environmental management, concerns have been raised. In fact, within the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the framework was perceived as so political by some countries that a new shared terminology was introduced (Borie and Hulme 2015, Diaz et al., 2018), sparking intense debate (see for example responses by Braat 2018 and Kenter 2018). To tackle some of these challenges, there have been some recent Special Issues focusing on the ecosystem services debate. Examples include a Special Issue of Ecosystem Services presents a series of papers working towards the successful operationalisation of the ES concept (Van Dijk et al., 2018), as well as a further Special Issue of the International Journal of Biodiversity Science, Ecosystem Services & Management focused on the operationalisation of marine and coastal ecosystem services (Rodrigues et al., 2018). A common theme throughout these publications is the recognition that, although ES is a recognised concept within global environmental policy, challenges remain in its application (Jax et al., 2018). First, although valuation is an optional rather than inherent aspect of the ecosystem service concept, many recent interpretations have favoured economic valuation, with a resultant key criticism that it instigates a migration towards market-led, economically driven environmental policy (Kallis et al., 2013; Dempsey and Robertson, 2012). This is accompanied by a growing body of research, which argues against the commodification of nature and the feasibility of assigning a price or value to ecosystems (Kallis et al., 2013; Dempsey and Robertson, 2012, Pendleton et al., 2016). A second concern arises from the deliberation as to a correct and shared definition and classification of ES and a fundamental confusion arising from the vast array of complex terminology (Beery et al., 2016; Thompson et al., 2016; Schroter et al., 2014; Dempsey and Robertson, 2012; Braat and de Groot, 2012; de Groot et al., 2010; Norgaard, 2010, Metz et al., 2010). A third and final concern is that the concept is overly simplistic and anthropocentric focused, conflicting with global conservation and biodiversity goals, and lacking in necessary detail to deliver benefit for both society and the environment (Schroter et al., 2014).

With a backdrop of a continually developing conversation around the contribution of nature to society (Diaz et al., 2018), and owing to their often peripheral nature, coastal and marine environments are particularly in need of careful management and a common language between stakeholders. In addition, marine and coastal ecosystems are experiencing a growing level of pressure on resources, and an accompanying unprecedented deterioration in ecosystem health, biodiversity and functionality (Nursery-Bray et al., 2013; Barbier et al., 2011; UNEP, 2006; UNEP/GPA, 2006; Worm et al., 2006; GESAMP, 2001; Turner, 2000). In response to this, marine and coastal governance has shifted towards the ecosystem approach, which aims for integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (Granek et al., 2010; CBD 2000; Turner, 2000). However, although there is a great deal of marine and coastal science being undertaken, gaps remain between the science and its inclusion in policy (Rivero and Villisante, 2016; Nursery-Bray et al., 2013). In principle, the ES concept should provide support to bridge these gaps, but within the marine and coastal realm, similar concerns as those posed above are being raised about the widespread acceptance and application of the ES concept (Beaumont et al., 2018). Further to this, from a societal perspective, numerous scholars have examined public understanding of ES in the context of a range of environments and situations (e.g. Metz and Weigel, 2010), with others examining the link between ecosystem services and successful delivery of policy (e.g. the EU's Blue Growth policies – see, for example, Lillebo et al., 2017) . For the most part, these studies have highlighted gaps in public understanding of ES, and

indeed, a feeling that the use of terms deemed to be scientific jargon can prove challenging for science communication (Beery et al., 2016; Thompson et al., 2016). While the majority of these studies have focused on public perceptions of ES, recent studies suggest that a lack of understanding and a feeling of redundancy associated with the term may exist within the environmental science and practitioner community (Beery et al., 2016). Accompanying the adoption of the ecosystem service concept as a bridge between academic disciplines and environmental management and policy making, there has also been a growth in the number of barriers. Whether the concept is sustainable will only be observed over time; decided by its ease of use and accompanying benefits, but also whether it is seen as morally and ethically appropriate. As the world of marine and coastal natural resource management negotiates its way between a myriad of management and valuation approaches (e.g. ES, natural capital, natural accounting, marine spatial planning, marine protected areas), this paper presents a timely interrogation of the views of marine and coastal stakeholders in the United Kingdom, on the concept of ES. In a bid to obtain responses from marine and coastal stakeholders from across the UK, an online questionnaire framed around four key themes was used to undertake this task: i. Current use and experiences; ii. Factors that influence use and experience; iii. Strengths and obstacles to use; and iv. Ways of improvement. Through analysis of these themes using both quantitative and qualitative questions, the study provides a novel and unique insight into stakeholders' use and experience of the ecosystem services concept, whether the concept is seen to be beneficial, and if it succeeds in acting as a bridging and common language between the science-policy-practice interface of marine and coastal management or if it is actually an unintended barrier.

2. Methodology

2.1. Questionnaire Respondents

To access UK marine and coastal stakeholders, the Communications and Management for Sustainability (CMS) network was used. CMS boasts a membership of over 6000 individuals, representing a range of marine and coastal stakeholders working within a number of different disciplines and sectors. This includes academic researchers (within education & consultancy), industry representatives (ports, fishing, shipping, defence, aquaculture, tourism to name just a few), Government departments and organisations (e.g. Department for Food and Rural Affairs, the Marine Management Organisation, Marine Scotland, the Environment Agency, Natural Resources Wales), and Environmental Non-Government Organisations and charities (NGOs – e.g. World Wildlife Foundation, Marine Conservation Society, Royal Society for the Protection of Birds). The network was chosen as it would give the authors access to a representative group of marine and coastal stakeholders within the UK with a view to comparing results between sector groups, research disciplines, career stage, as well as country (Scotland, Wales, England and Northern Ireland). The questionnaire was sent out to individuals registered with the CMS network on four occasions in 2017. The survey was opened 345 times, with 181 respondents completing the entire survey (52.5% completion rate). The inclusion criteria were that respondents were over the age of 18 and identified themselves as practitioners, researchers and/or decision makers who work across marine and coastal disciplines and sectors within the UK. Consequently, 23 non-UK respondents were omitted, resulting in a final sample of 158. As shown in Table 1, roughly half of the sample was male, the majority were aged between 25 and 54, were based in England, and had a postgraduate qualification or above. The majority of respondents were in full-time employment, had been working in this field for over 10 years, and self-identified themselves as working within one of six sectors: education / academic research, consultancy research, working within government & policy, and to a lesser extent, non-government organisations (NGOs), industry and other (e.g. self-employment, journalism, and in temporary work; see Table 1).

Demographics	N	%	Work Related	N	%
Gender			Employability Status		
Male	76	48.1	Employed full time	113	71.5
Female	75	47.5	Employed part time	23	14.6
Prefer not to say	7	4.4	Retired	4	2.5
Age Group			Volunteer	1	.6
18-24	10	6.3	Student	9	5.7
25-34	34	21.5	Other	7	4.4
35-44	50	31.6	Sector		
45-54	34	21.5	Education/Academic Research	42	26.6
55-64	18	11.4	Consultancy Research	26	16.5
65 or over	12	7.6	Govt & policy	41	25.9
Current residency			NGO	20	12.7
Scotland	27	17.1	Industry (mixed)	15	9.5
England	113	71.5	Other	14	8.9
Wales	16	10.1	Duration in field		
Northern Ireland	2	1.3	Under 1 Year	11	7.0
Education			Between 1 and 5 years	22	13.9
GCSE/ O Level or equivalent	1	0.6	Between 5 and 10 years	29	18.4
A Levels or equivalent	1	0.6	Between 10 and 20 years	50	31.6
Undergraduate degree	28	17.7	Over 20 years	44	27.8
Postgraduate Masters Qualification	63	39.9			
Postgraduate Doctoral Qualification	54	34.2			
Professional Qualification	11	7.0			

Table 1. The demographic and work profile of the final sample (*n* = 158)

2.2 Procedure & Measures –

The questionnaire was piloted on an expert group with significant experience working in the field of marine and coastal ecosystem services research and management (*n* = 11), with minor changes to the wording of questions made where necessary before undertaking the full study. CMS members were invited to participate by following a link to an online questionnaire survey (using Qualtrics software) between the months of June and September 2017.

Following a short introduction to the study, respondents completed a mix of open and closed questions focusing on: (i) their understanding of the concept of ES, (ii) their use of the term within marine and coastal management, (iii) their evaluation of ES, and (iv) socio-demographic information.

(i) Understanding of ecosystem services – To assess current understanding and perceptions about the overall concept, an open-ended question was used to allow respondents to spontaneously "describe the term 'ecosystem services'" in their own words. Quantitative items were also used where respondents rated how informed they felt about the term (from not at all informed [1] to having a high expertise [5]) and their level of agreement to numerous statements (e.g. "overall I like the terminology used in the ecosystem services approach" and "Ecosystem services are difficult to understand" [negatively coded]. To increase the sensitivity and variance within responses, a 7 point

scale was used (strongly disagree [1] to strongly agree [7]) and a "don't know" response was included to reduce ambiguity for the neutral response option "neither agree nor disagree [4]"

(ii) Use of ecosystem services – To explore the frequency and application of ES in their work, respondents were asked how often they apply the concept in their job and a qualitative item asked how ES are used within their work. They were also asked to rate their level of agreement to a range of statements that looked at their confidence in using the concept (e.g. "I feel confident about using ecosystem services within my role / activities"), the importance of the concept in their line of work (e.g. "The ecosystem service approach is important within my role / activities"), perceived opportunities to apply it (e.g. "There are opportunities for using the Ecosystem Service Approach within my role / activities"), and social support in using it (e.g. "Everyone I work with understands what is meant by ecosystem services"). All statements were rated on the scale from strongly disagree [1] to strongly agree [7] or don't know.

(iii) Evaluation of ecosystem services – When reflecting on their experience of the ecosystem service concept in their work, open questions were used to give respondents the opportunity to qualitatively express their views on it. These questions focused on three key elements; notably, what they saw as the "advantages of using ecosystem services", "what barriers/challenges, if any, are associated with the use of ecosystem services", and "what improvements, if any, [they] could think could be made to the use of the ecosystem services in [their] field".

(iv) Socio-demographic information – The questionnaire concluded with a set of closed personal questions to gather further information on this sample, such as gender, age group, country of origin, and education and employment level.

2.3 Data Analysis

Quantitative Data Analysis

For the quantitative questions, the overall trends are reported (means and standard deviations). To test respondents' agreement with statements, one-sample t-tests examined if the responses statistically differed from the mid-point (i.e. neither agree nor disagree). Further analyses looked at whether responses differed according to individual differences (e.g. demographics and work experience) and how the different measures related to one another. For the individual differences, if data was normally distributed, multiple analyses of variances (ANOVAs) were run, if the data did not fulfil the criteria for parametric tests, non-parametric alternatives were used (i.e. Kruskal-Wallis). To look at how the different responses related to one another, a Principal Components Analysis (PCA) was applied to the responses from the sections '*Understanding of ES*' and *'Use of ES'* of the questionnaire. PCAs emphasise variation and bring out strong patterns in a dataset. The scores for the 1st and 2nd components from each PCA were plotted in a biplot for further interpretation. PCAs were performed using the package *vegan* (Oksanen et al., 2016) in R (R Development Core Team, 2017).

Qualitative Data Analysis

For all of the open response questions, a manual coding process to interrogate the data was used. Thematic analysis was undertaken in a variety of ways. For the majority of these questions, a bottom-up inductive coding was used where the qualitative data was reviewed to identify prominent emergent categories in each question through a data reduction and thematic coding process, these were then developed and revised after numerous reviews of the data to identify the dominant

themes and sub-themes (Braun and Clarke, 2006). Additional content analysis was applied to quantify the prominence of particular themes and sub-themes in our sample's responses, whereby the number of mentions or quotes that aligned with each theme were collated. For one of the qualitative questions, a top-down a-priori coding process was also applied. One of the initial questions asked respondents to provide a definition of the term 'ecosystem services', of which we were interested in what respondents spontaneously said and how this compared with existing definitions. Respondents' answers were consequently compared to an a-prior framework. This involved comparing their answers to a list of published ecosystem service definitions derived from both marine research and practical applications in aquatic management (See Table 1 in Supplementary Material). Key words from those ES definitions were identified, and then these key words were searched for within the respondents' responses (see Table 2).

ES Categories	Contributories	Beneficiaries	Outcome
Regulating	Environment	Human	Benefits
Supporting	Environmental	People	Processes
Provisioning	Ecosystem	Society	Services
Cultural	Nature	Population	Goods
	Natural Resources	Humankind	Wellbeing
			Health
			Value

Table 2: Search protocol developed through review of key ecosystem services definitions.

The qualitative data analysis provided additional insights into how respondents currently apply the concept of ES within the context of marine and coastal management in the UK, and their views on the challenges, benefits and opportunities for improving the use of the concept might be. These key themes are discussed in parallel to findings of the quantitative analysis, with quotes presented in italics to support the discussion where appropriate. Although analysis of qualitative data is inherently subjective, to check for inter-rater reliability two of the authors independently coded 20% of the data. Cohen's kappa found satisfactory agreement between coders across the three qualitative data questions at an average of 67% (Landis and Koch, 1977).

3. Results

3.*1 Understanding of ecosystem services*

The definitions provided by respondents varied in the level of detail. Some were very brief and concise "*Flows of benefits from natural systems*" whereas some definitions included very specific information, presumably connected to the individual respondents' experience, for example "*Recognising the benefits (and 'true' economic values) of natural environmental systems such as land, water, flora and fauna. Ecosystem services benefits are often ignored in traditional economic evaluations. An example would be the scrub/ buffer/ hedgerows around agricultural field that are the home to pollinating insects that are an essential part in maximising yields of grain and food stuffs. If you ploughed all the land that supports the pollinating insects, you might expect an increase in the amount of food produced, but if you destroy the habitat where the pollinators live then the yields will often dramatically decrease. Ecosystem services recognise the true benefits and economic values of the pollinators and their habitat is much greater than the extra land that would be released for agriculture. Similar benefits could be achieved for reduction in rainfall runoff and reduced risk by leaving buffer strips around fields that slow down water entering streams and rivers, thus reducing flooding downstream. These buffer strips act as an ecosystem service to people and property at risk of flooding further downstream a catchment"*.

Using the search protocol from Table 2, 95% of respondents used at least one of the key words in their definition (see Figure 1) – on average, the number of key terms used in respondent definitions was 3, although this varied from none to five. For the four groupings of search terms (see Table 2), 4.5% of responses noted at least one of the ES categories, 34% emphasised contributories, 20% noted beneficiaries, with analysis showing the highest level of emphasis (41.5%) on outcome related terms. The terms most commonly used by respondents were 'benefits', 'ecosystem', 'services', 'human' and 'environment' (Figure 1.). Other words commonly used to define ES included 'natural capital', 'economic value' and 'function' – the inclusion of economic valuation language in respondents' definitions, and the implications of this for the ongoing use of ES concept within marine and coastal management is addressed in later sections. Furthermore, it is interesting to note the dominance of 'benefits' as a key word within definitions, compared with the other ES terms of services and processes.

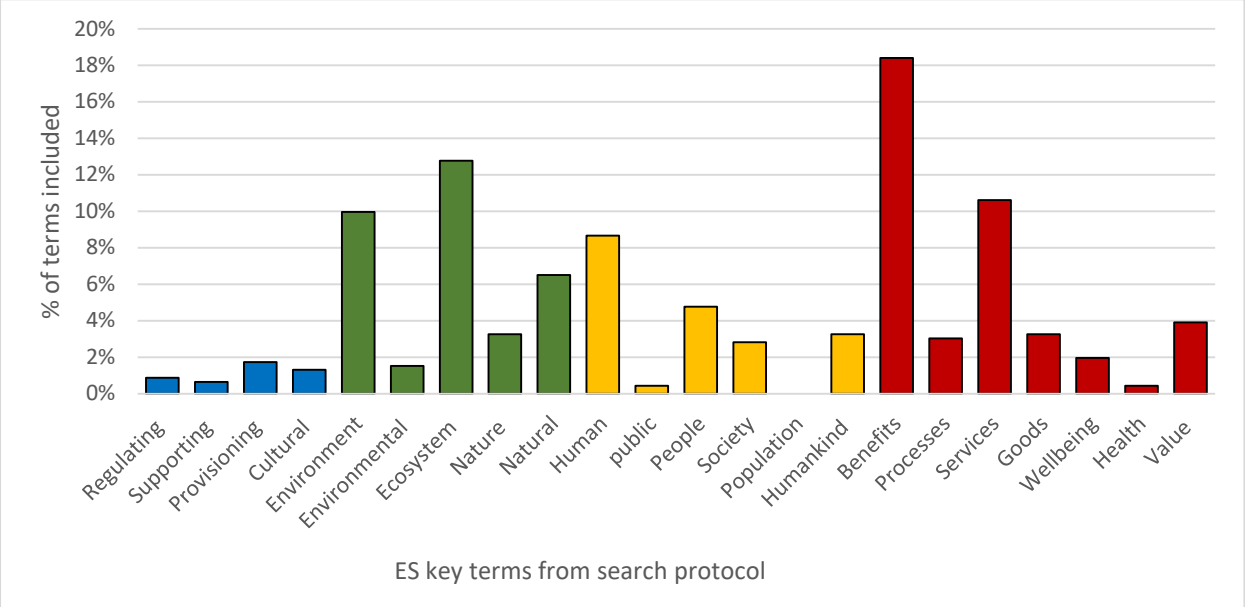

Figure 1: Inclusion of ES terms in respondent definitions of 'ecosystem services'.

Note. Bars in blue refer to the terms associated with 'ES Categories', green is 'contributories', yellow 'beneficiaries' and red 'outcome'.

With regards to the level of understanding of ES, when asked to rate how informed they perceived themselves to be, respondents felt 'moderately' to 'very informed' about ES, on average (M = 3.39, SD = 0.88).

Overall, the sample statistically varied from the mid-point with regard to liking the term, and strongly agreed that it is a useful management tool and helps to assign meaningful value to marine resources. They also agreed that it aids communication, supports management plans, and generally like the terminology (see Table 3). The responses to the question "Ecosystem Services are difficult to understand" and "Ecosystem Services cover all aspects…." remained closer to the mid-point but had greater standard deviation indicating greater variation in the responses.

Statement	Mean	Standard Deviation
How informed do you feel about the term "ecosystem services"? [i]	3.39	0.88
a) Using ecosystem services makes communication easier and more effective. [ii]	4.64***	1.47
b) Ecosystem services are difficult to understand (-ive) [ii]	4.05	1.70
c) The ecosystem services approach is a useful management tool. [ii]	5.46***	1.33
d) Ecosystem services allow us to assign a meaningful value to marine and coastal resources [ii]	5.17***	1.52
e) The ecosystem services approach supports integrated management and plans of our coasts and seas. [ii]	4.64***	1.47
f) Ecosystem services cover all aspects of marine and coastal environments. [ii]	4.32	2.00
g) Overall, I do not like the concept of ecosystem services (-ive) [ii]	2.77***	1.68
h) Overall, I like the terminology used in the ecosystem services approach [ii]	4.46***	1.53

Note. Scale [i] ranged from not at all informed [1] to high expertise [5]; scale [ii] strongly disagree [1] to strongly agree [7]. "Don't know" responses are not included in this analysis. (-ive) denotes negative wording of statement. N varies as some respondents said "don't know" to individual items, thus are not included in the analysis. *** denotes statistically different to the mid-point (4) to a $p < 0.001$

Table 3. The average rating (and standard deviation) for each statement looking at perceptions towards ecosystem services (*n* = 149-158).

PCA analysis found that the first axis of the PCA for respondents' understanding of ES explained 45% of the variance and was clearly an axis of 'ES appeal', as shown by the loadings of 'overall I like the terminology' responses (overall dislikes in opposite direction, see Figure 2). The fact that ES supports integrated management, is a useful management tool, allows to assign meaningful values and makes communication easier also loaded PC1, and were strongly correlated to how much respondents liked the ES framework. In contrast, the fact that the ES framework is difficult to understand and that it covers many aspects did not influence the axis of 'ES appeal' (PC1) as much.

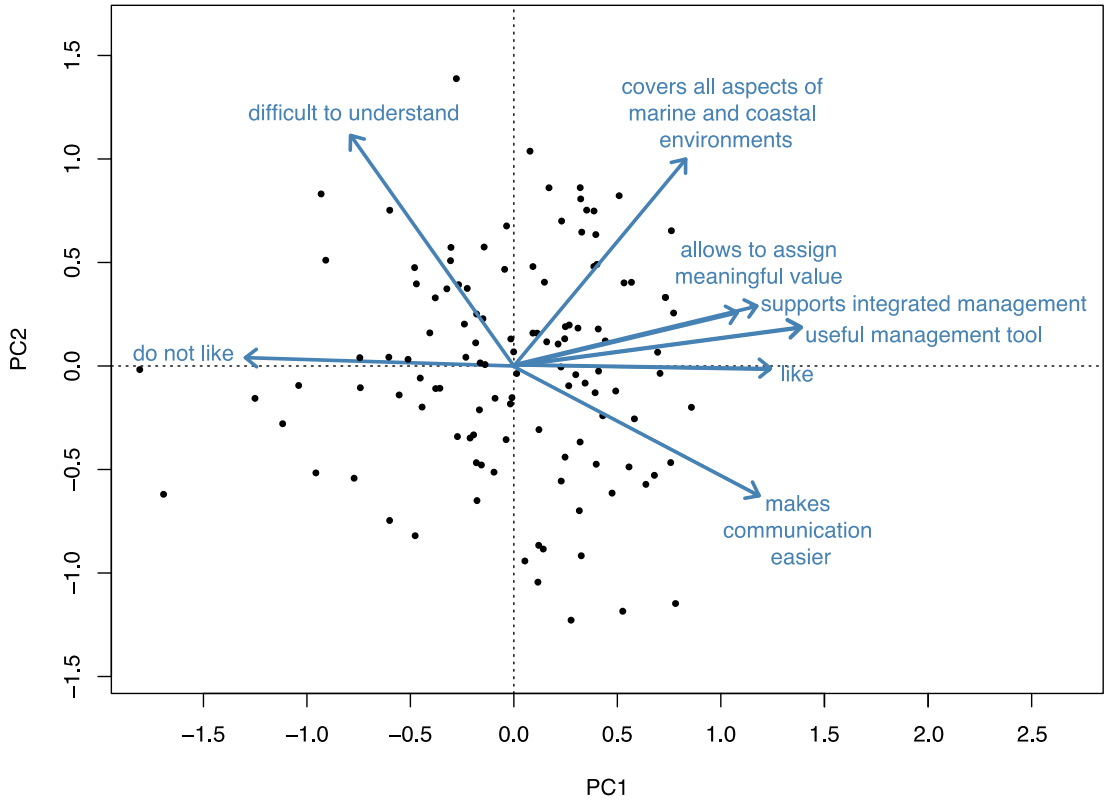

Figure 2. PCA biplot showing the scores of each respondent (black points) and the loadings of each variable (blue arrows) on the 1st and 2nd principal components, in response to 'views about ES'.

Note: The angles between arrows approximate to their correlations (smaller angles imply high correlations between variables, and perpendicular arrows imply zero correlation). Points close together correspond to observations that have similar scores on the PCA components.

As shown in Figure 2, respondents who liked the ES concept (those on the right of the central line in Figure 2) also thought it was useful as a management tool, that it allowed to assign a meaningful value and that supported integrated management. Conversely, respondents on the left side of the graph did not like the concept, did not think it was a useful management tool, did not find it allowed to assign a meaningful value, and did not think it supported integrated management.

3.2 Use of ecosystem services

The majority of respondents (84.8%) have used this concept in their work, with 43.0% using it occasionally, 33.5% using it frequently, and 8.2% of the sample using it on a daily basis. When exploring respondents' experiences in using the concept in their work (see Table 4), they do not believe that everyone understands ES. Overall, respondents agreed that there are opportunities to use ES in their work, it is important within their role, and they understand how it can be used in management plans. They also agree (but to a lesser extent) that they are confident in using ES and communicating about ES, and that it helps to collaborate with other sectors. Demonstrating a greater variability in responses, respondents did not necessarily agree that "My organisation / line manager encourages me to use ecosystem services".

Statement	**Mean**	**(Standard**

		Deviation)
a) I feel confident about using ecosystem services within my role / activities	5.15***	(1.60)
b) The ecosystem service approach is important within my role / activities	5.22***	(1.55)
c) There are opportunities for using the Ecosystem Service Approach within my role / activities	5.56***	(1.52)
d) I feel confident communicating about ecosystem services to colleagues and stakeholders	5.18***	(1.44)
e) I understand how ecosystem services can be used in management plans.	5.10***	(1.53)
f) Everyone I work with understands what is meant by ecosystem services	2.83***	(1.63)
g) My organisation / line manager encourages me to use ecosystem services	4.17	(1.97)
h) The concept of ecosystem services makes it easier to collaborate with different sectors.	4.64***	(1.58)

Table 4. The average rating (and standard deviation) for each statement looking at respondents' use of ecosystem services in their work (*n* = 145-157).

Note. Scale ranged from strongly disagree [1] to strongly agree [7]. N varies as some respondents said "don't know" to individual items, thus are not included in the analysis. *** denotes statistically different to the mid-point (4) to a $p < .001$.

Further analysis on this set of questions was conducted to examine the relationship between the ratings that individuals gave to the various questions. The first axis of the PCA for 'Use of ES' explained 48% of the variance and was an axis of 'ES perceived usefulness'. PC1 was loaded with responses to how confident respondents felt when using ES, how important this framework was within their role, the opportunity of using ES, how encouraged they were to use this concept, or whether the concept made it easier to collaborate with different sectors (Fig. 3). In contrast, whether others understood the concept did not influence the 'perceived usefulness' of the ES concept. Respondents on the right side of the Fig. 3 tended not to use the concept, didn't feel confident communicating it, or felt that it wasn't an important concept within their role. In contrast, respondents on the left side of the graph used the concept and were confident using it, among other responses.

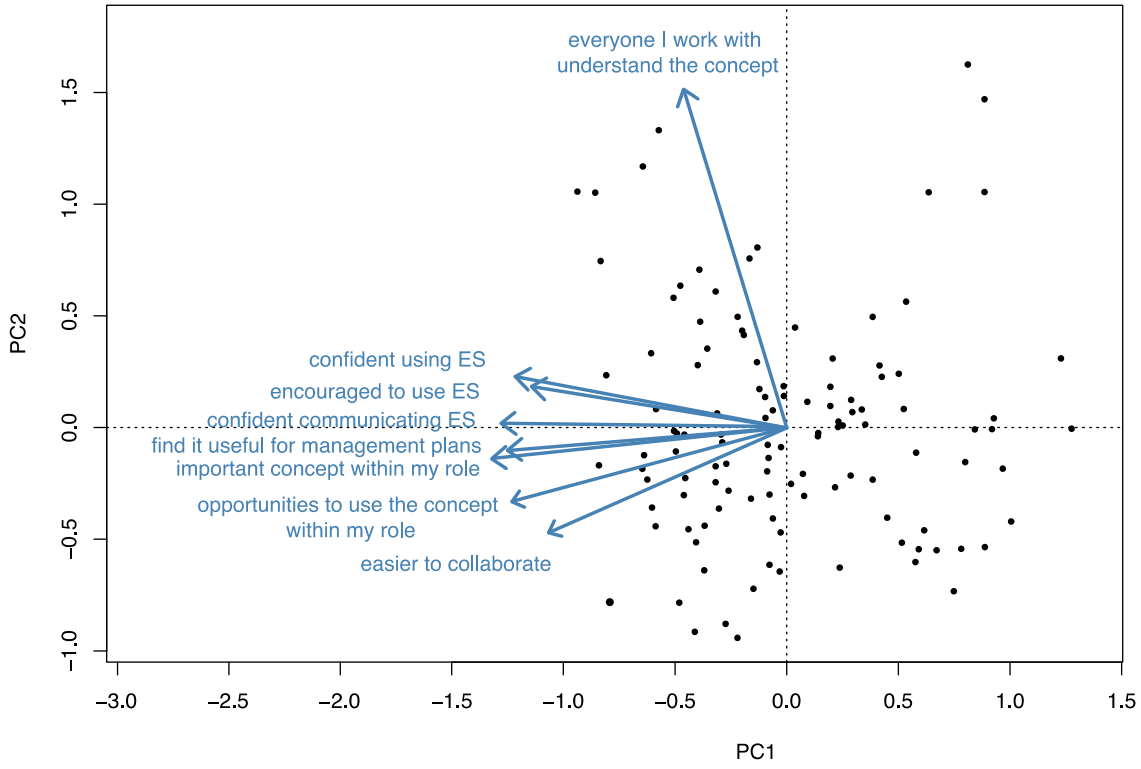

Fig. 3. PCA biplot showing the scores of each respondent (black points) and the loadings of each variable (blue arrows) on the 1st and 2nd principal components, in response to 'using ES'.

Note: The angles between arrows approximate to their correlations (smaller angles imply high correlations between variables, and perpendicular arrows imply zero correlation). Points close together correspond to observations that have similar scores on the PCA components.

Relating to this, respondents were asked to qualitatively describe how they currently use the concept of ES. Analysis of the data found there to be a myriad of ways in which UK marine and coastal practitioners use the concept of ES, with the majority of respondents indicating that they have current or previous experience in using the concept. Using a thematic analysis approach, a number of themes relating to use were identified including: supporting sustainable management and decision making, understanding and communicating the connections between different aspects of the seas and coasts (including cultural and heritage components), education and research, assessment of ES and natural resources, communication between stakeholders, improving understanding of the benefits and importance associated with the marine and coastal environment, and understanding and assigning value (both monetary and non-monetary) to resources, including the application of natural capital/ accounting approaches to decision making. The multiple uses of the ES concept were also neatly summarised by one respondent who stated that they had used the concept in numerous ways – *"1) education - providing lectures on the subject to both undergrad and postgrad students; 2) with stakeholders as a method to stimulate discussion surrounding management of MPAs [Marine Protected Areas]; 3) with MPA site managers by developing a matrix approach; 3) as the basis of ecological valuation; 4) as the basis for economic valuation; 5) as the basis for social valuation; 6) as the basis of peer-reviewed publications for the academic community"*.

Comments on the application and use of the ES concept within marine and coastal management highlighted its complexity, and potentially its limitations, as a concept with one respondent stating that "*ecosystem services give the appearance of quantifying importance but there are too many possible future scenarios for us to be able to prioritise what is/will be the most important things to*

manage/protect)". Another respondent highlighted ongoing work to improve the accessibility of the approach – "*I am working on projects that aim to make the ecosystem services approach applicable and useful for marine management, planning and conservation."*

It is worth noting that although the respondents were all individuals working within marine and coastal management in some way, 13% of respondents indicated that they have never/ currently do not use the concept of ES – one even stated that they are *"an ecological consultant and I cannot recall an occasion when I have used the concept of Ecosystem Services".* Furthermore, one respondent commented that they had used the ES concept in the past, but this was before "*the term natural capital was in common usage*", perhaps indicating a natural evolution in terminology.

3.3 Differences in perceptions towards the ES framework

Secondary analyses were conducted to explore the relationship between respondents' 'understanding of the ES framework' and 'use of ES' and respondents' demographic and work profile. When looking at individual differences, the most significant effects were sector and experience of using ES in their work. Respondents across the six sector groups responded similarly regarding their general perceptions of ES (see Table 5). However, there were significant differences regarding how informed individuals felt about the concept ($p = 0.04$, see Table 5). Whilst respondents from the industry sector self-categorised their knowledge as between 'understanding of the basics' and 'feeling moderately informed', post-hoc analysis found that this was statistically lower than those from other sectors, namely education/academic research ($p = 0.04$) and NGOs ($p = 0.02$). More statistical differences were found when further examining respondents' use of the concept (Table 5), with respondents from industry tending to give lower ratings. The largest effect was found for the statement "My organisation / line manager encourages me to use ecosystem services": unlike the other sectors, respondents from industry overall disagreed with this statement, giving it a statistically significantly lower rating to respondents from all other sectors (ps < 0.03). For the other statements, there was a general agreement, with respondents within the industrial sector feeling less confident in using the concept within their work (compared to education/academic research and consultancy research, ps = .04); did not see it as important within their work compared to others (education/academic research, consultancy research, government & policy, and NGOs, ps < 0.04), and perceived fewer opportunities to use the ecosystem service concept (e.g. than those within consultancy research, NGOs, and government & policy, ps < 0.01).

In agreement with the results from the PCAs (Fig. 3), there were also linear main effects of how often ES are used and how informed respondents felt about the concept on their ratings. With the exception of the statement "Everyone I work with understands what is meant by ecosystem services", respondents who use ES in their work more regularly and felt more informed about the concept gave more positive ratings and were more confident in using it (ps < 0.02). Using this analytical approach, no demographic main effects were identified (e.g. gender, age, and education level were not seen to have an overall main effect on respondents' ratings, ps > 0.06).

Statement	Education/ Research (n = 37-42)	Consultancy Research (n = 21-26)	Govt & Policy (n = 38-41)	NGO (n = 19-20)	Industry (n = 13-15)	Other (n = 13-14)	Statistical difference
Perceptions of Ecosystem Services							
How informed do you feel about the term "ecosystem services"? [i]	3.50 (0.83)	3.50 (0.91)	3.34 (0.91)	3.65 (0.75)	2.73 (0.80)	3.36 (0.93)	F (5,152) = 2.36, p = .04, η^2 = .07
a) Using ecosystem services makes communication easier and more effective. [ii]	4.67 (1.51)	4.76 (1.56)	4.58 (1.41)	4.90 (1.52)	4.50 (1.29)	4.29 (1.59)	n.s.
b) Ecosystem services are difficult to understand (-ive) [ii]	3.81 (1.89)	3.88 (1.66)	4.39 (1.56)	4.40 (1.79)	4.29 (1.38)	3.36 (1.60)	n.s.
c) The ecosystem services approach is a useful management tool. [ii]	5.68 (1.21)	5.38 (1.79)	5.15 (1.31)	5.60 (0.82)	5.57 (0.94)	5.57 (1.60)	n.s.
d) Ecosystem services allow us to assign a meaningful value to marine and coastal resources [ii]	5.24 (1.51)	5.38 (1.65)	5.02 (1.39)	4.90 (1.29)	5.71 (1.38)	4.86 (2.11)	n.s.
e) The ecosystem services approach supports integrated management and plans of our coasts and seas. [ii]	4.67 (1.51)	4.76 (1.56)	4.58 (1.41)	4.90 (1.52)	4.50 (1.29)	4.29 (1.59)	n.s.
f) Ecosystem services cover all aspects of marine and coastal environments. [ii]	4.32 (2.16)	4.72 (2.01)	3.95 (1.80)	4.26 (1.97)	4.92 (1.66)	4.15 (2.41)	n.s.
g) Overall, I do not like the concept of ecosystem services (-ive) [ii]	2.70 (1.56)	2.69 (1.95)	2.80 (1.50)	2.60 (1.85)	2.79 (1.19)	3.21 (2.26)	n.s.
h) Overall, I like the terminology used in the ecosystem services approach [ii]	4.59 (1.50)	4.38 (1.84)	4.48 (1.48)	4.30 (1.49)	4.21 (1.31)	4.64 (1.65)	n.s.
Use of Ecosystem Services							
a) I feel confident about using ecosystem services within my role / activities	5.46 (1.47)	5.46 (1.24)	5.17 (1.72)	5.40 (1.31)	3.80 (1.78)	4.71 (1.77)	X^2 = 12.89, df = 5, p = .02
b) The ecosystem service approach is important within my role / activities	5.07 (1.49)	5.23 (1.77)	5.63 (1.43)	5.80 (1.01)	3.73 (1.28)	5.15 (1.72)	X^2 = 21.49, df = 5, p = .001
c) There are opportunities for using the Ecosystem Service Approach within my role / activities	5.40 (1.55)	5.96 (1.22)	5.85 (1.42)	5.95 (0.89)	4.00 (1.65)	5.50 (1.83)	X^2 = 20.76, df = 5, p = .001
d) I feel confident communicating about ecosystem services to colleagues and stakeholders	5.18 (1.39)	5.42 (1.42)	5.29 (1.57)	5.40 (0.75)	4.07 (1.49)	5.29 (1.64)	n.s.
e) I understand how ecosystem services can be used in management plans.	5.23 (1.40)	5.35 (1.65)	5.00 (1.70)	5.40 (1.27)	4.33 (1.45)	4.93 (1.49)	n.s.
f) Everyone I work with understands what is meant by ecosystem services	2.92 (1.64)	3.22 (1.57)	2.71 (1.69)	3.25 (1.74)	2.14 (1.10)	2.43 (1.65)	n.s.
g) My organisation / line manager encourages me to use ecosystem services	4.14 (1.78)	4.43 (1.86)	4.10 (1.96)	5.37 (1.64)	2.14 (1.41)	4.50 (2.18)	X^2 = 22.55, df = 5, p < .001
h) The concept of ecosystem services makes it easier to collaborate with different sectors.	4.54 (1.33)	4.22 (2.00)	5.10 (1.45)	4.75 (1.55)	4.13 (1.85)	4.71 (1.49)	n.s.

Note. Scale [i] ranged from not at all informed [1] to high expertise [5]; scale [ii] strongly disagree [1] to strongly agree [7]. "Don't know" responses are not included in this analysis. (-ive) denotes negative wording of statement. N varies as some respondents said "don't know" to individual items, thus are not included in the analysis.

Table 5. Comparing respondents according to their self-identified sectors on their average rating (and standard deviation) for each statement looking at perceptions and use of ecosystem services.

3.4 Evaluation of ecosystem services

In addition to identifying trends in understanding and use related to ES, three open questions were posed to further evaluate the stakeholders' views, focusing on the perceived advantages, challenges and potential opportunities for improvement. Open questions were used in this section to capture as broad an input as possible, and because it was not possible to predetermine what these responses might be.

3.4.1. Advantages

A vast majority of respondents shared positive experiences, with 92% providing a response to this question. As explained above, thematic coding highlighted a range of advantages identified by survey respondents (summarised in Table 2 in Supplementary Material). While these advantages were described in varying ways, a dominant theme of communication and improving understanding was identified as a key advantage of the concept of ES services. A total of 25% of responses (under complementary thematic categories of common language and improved dialogue and communication) emphasised that the ES concept acts as a way of supporting effective communication and increasing understanding of the various components of marine and coastal environments, providing a more integrated and holistic way of viewing *and* valuing a diverse set of ecosystems, resources and user groups. There was a feeling that the ES concept provides "*common ground*" and therefore a useful lens through which these complex socio-ecological interactions can be simplified, engendering an increased level of understanding across diverse audiences.

In addition to providing a "*common language*" that supports communication, 10% of responses indicated that the ES concept can be used to improve stakeholder and public understanding of the value of these resources to society. Further to supporting communication between different sectors and user groups, respondents indicated that the ES concept has been a useful tool through which the various values (both monetary and non-monetary) associated with the marine environment can be articulated in an accessible way. Monetary valuations were seen as being particularly useful in the context of linking wider society, the economy and the environment. This aspect of ES valuation was seen as having particular relevance for management and decision making was also identified, with one respondent indicating that "*it can be useful for management plans that consider the economic value of nature*". This was supported by another respondent who stated that *"People realise that the monetary value [associated with the ES concept] provides a common currency for discussion. If issues are not valued then they are excluded and not taken into account event though they are very important".* There was a feeling from some that this quantification of marine and coastal systems would be an ongoing trend within management and governance, with one respondent suggesting that "*At the planning level, in [Environmental Impact Assessments], ecosystem services will increasingly be quantified, and contribute to decisions to approve, and/or attach planning conditions relating to ecosystem services".*

Finally, under the theme of communication, a further benefit of using the concept as a communication tool leading to improved reputation of certain sectors and activities was suggested. An example of this was given by one respondent who stated that "*using this term to describe the more environmentally favourable forms of aquaculture helps with winning hearts and minds*".

3.4.2. Barriers and Challenges

While respondents highlighted a significant number of positive connotations associated with the concept of ES, it was evident that there are a number of challenges facing the effective use of

concept within UK coastal and marine management, with 93% of respondents providing responses to this question. The most commonly noted challenges and/or barriers were linked to the complexity of the term (10%), the use of jargon/ inaccessible language associated with it (10%), and a lack of both stakeholder and public understanding both around the concept and the science related to it (19%).

Although the overarching view was that ES as a concept supports communication and dialogue between different users, there was a recognition that challenges remain. One respondent summed this up, by stating that the common language it provides is beneficial "*if we could all agree…*" alluding to the ongoing debate surrounding the concept. There was an overarching view amongst respondents that the concept remains complicated, complex, "*poorly understood*" and too full of "*jargon*". As shown in Table 3 in Supplementary Materials, respondents characterised the concept as "*narrow*", with a need for improved integration of heritage aspects within the language of ES identified by one respondent, while another highlighted the challenges associated with the "*variety of issues, and the varying approaches that [need to] be applied*". Further comments were made by 4% of responses stressing not only the complexity of the concept, but also that of the marine and coastal environment it is being applied to. There was a feeling that numerous gaps in knowledge and understanding remain, posing a significant challenge to effectively embedding the ES concept within marine and coastal management.

Given the ongoing conversation around the validity of attributing economic values to natural resources, the theme of monetary valuation was examined through the analysis. Although, concerns about monetary valuation have become part of the ES dialogue, this theme was only identified as a concern and an ongoing challenge in 11% of responses, with one individual stating, *"There is often a desire to reduce it down to a financial figure which I am not sure is possible or appropriate*". This concern was supported by another response who commented that they *"worry that if there's an important ecosystem that needs protecting for its intrinsic environmental value but it doesn't have a very strong economical case that these important sites will be overlooked*". Within the broader theme of monetary values, respondents highlighted the challenge of assigning monetary value to the entire marine and coastal system, recognising that many ES and benefits are not marketable and that monetary valuation is just one method of valuing nature and may not always be the most appropriate method. With this in mind, there was a suggestion that the concept of ES *"must be used as one tool in an arsenal rather than solo"* within marine and coastal management.

One respondent questioned the appropriateness of grounding policy development in the ecosystem service concept, recognising gaps in current levels of knowledge and understanding of marine and coastal ES, and directly questioning "*whether it is appropriate, helpful or meaningful to have marine planning policies relating specifically to ecosystem services".* There was a feeling derived from a small group of responses (2%) that, perhaps, the ES concept should be better aligned with other initiatives and policy drivers, for example *"[the] well-being of local communities; protecting MPA networks and biodiversity; protecting/improving water quality etc. are more 'implementable', and should support the provision of ecosystem services."*

While interdisciplinarity and taking an integrated view of marine and coastal systems was seen as a strength of the ES concept, concerns that this bringing together of these diverse sectors and disciplines also posed a significant challenge to successfully applying the concept within marine and coastal management in the UK were evident in 5% of responses. One respondent articulated a concern that *"there are also still very strong sectoral barriers to working across disciplines in a*

practical sense - these barriers can be financial (e.g. funding for particular work coming from one area and therefore that being the focus of the work rather than a broader approach). The barriers can also be political (government, regional and local) and at an individual level where people don't want to engage. I also think that a focus on ecosystem services can be seen to (and can actually) prevent progress in specific work areas, e.g. biodiversity protection".

A further barrier identified within 19% of responses is that the concept remains complex and difficult for different audiences to connect with, particularly the wider public. There were concerns expressed that the intricacies of socio-ecological interactions between society and the UK seas and coasts required more than an academic concept to improve public understanding, but that the additional resources and time would be difficult to obtain, with one interviewee commenting that "*Sometimes, 'the bigger picture' is too big and there is simply no way to tackle an issue on an ecosystem wide level without significant additional resources. Furthermore, the term ecosystem* services does not engender much enthusiasm amongst the general public".

3.4.3. Opportunities for Improvement

Recognising the dominance of ES as a fundamental concept within marine and coastal management, this work sought to identify ways in which its application and use could be improved. Analysis of the data found that 81% of respondents felt some form of improvement could be made to how the ES concept is currently being used within UK marine and coastal management, with the dominant themes discussed in the following sections (summarised in Table 6). Those with more than 10 mentions have been included in bold font; it is worth noting that the theme 'Improved stakeholder and public understanding of the science and the application of the concept - including more research and improved communication' has significantly higher counts than any other thematic category. Other themes frequently mentioned by respondents included: the need for improved knowledge of marine and coastal ecosystems; the need for standardisation across the ES concept; the need to reduce jargon and improve communication supporting a common, user-friendly language; a desire for improved guidance and provision of evidence of success through case studies; and, finally, a need to consider a range of values, not just focusing on economic value and the Natural Capital approach.

1

Theme	Number of mentions	Evidence (quotes from respondent responses)
Improved stakeholder and public understanding of the science and the application of the concept - including more research and improved communication	**47**	*"Educate, educate, educate policy makers, politicians, local communities"* *"Lay person briefing sheets summarising the key ecosystem services would be of great value"* *"Better definition of ecosystem services for marine areas"* *"Further research to identify components of ecosystems which provide mental health and wellbeing benefits"* *"Great understanding and awareness of services that are apparent at a local scale"*
User Friendly language and better communication	**20**	*"Change the term for something more widely understandable - even the term ecosystem is a barrier to many…"* *"More/better communication of successes in integrating ecosystem services into decisions onto coastal management."* *"Use of accessible and appropriate language according to the field."*
Develop integrated valuation – taking all values into consideration, but including links to the Natural Capital approach.	**14**	*"A shift away from numerical values to a traffic light system: Green meaning things are better, Red meaning things are worse"*
Standardisation and development of common methods and tools	**13**	"*Standardisation of metrics, including valuation, and methods of assessment"*
Improved guidance for better application	**12**	"*More clarity on how knowledge of ecosystem services could be used in everyday management issues and casework. E.g. practical examples of how they've been used to implement a change in management."*
Improved knowledge of marine and coastal ES	**11**	*"For the marine environment in particular, we are still a long way from understanding how the different components of the ecosystem inter-relate, making evaluation difficult. So more basic research to support the concept is needed in order to avoid trade-offs that lead to long-term environmental deterioration"* *"Better stakeholder understanding of the marine ecosystem."*
Evidence of Success	**11**	*"Use of ecosystem services/the natural capital approach is still at a relatively early stage so although there is a lot of talk about it there still isn't much evidence of it influencing decision making at either a management or a policy level. Hopefully this may start to change with the Defra 25 year environment plan and the Pioneer areas which have been established to trial this approach"* *"Good applied case studies moving to real application"*
Use of best available and innovative science, data and methods.	6	*"Use the most up to date equipment to measure ecosystem effects…However crucially need to then use data and incorporate it into the data protocols system"*
Improved policy landscape to better support the ES concept	6	*"Introduce legal obligation to take ES into account in decision-making"* *"It is important to recognize the services provided by the environment when developing a policy framework for planning and development, this can then set the direction of travel down the line at the plan or project level to influence ecosystem service goals"*

Theme	Number of mentions	Evidence (quotes from respondent responses)
Improve inclusion to and understanding of culture and heritage.	5	*"Further delineation and refinement of the Cultural Ecosystem Services concept."*
Better recognition of the assumptions that underpin ES	5	*[Need for] more intellectual input and genuine thought about network behaviour rather than tabulating well known connections and arguing about words and their meaning genuine efforts to understand how non-linear interconnections and networks behave, including human behaviour and economics"*
Need for funding	3	*"More financial resources would allow me to utilise ecosystem services on a wider scale and perhaps start to tackle some of the bigger issues. There needs to be more investment in government conservation bodies to lead this change, so that all conservation can be based around what's best for the ecosystem (and in turn the services we depend on) rather than a single site or species."*
Recognition that the ES concept is part of a suite of management tools	3	*"To recognise that this is not the complete answer, it is just a tool which can help to make some comparative values clearer - there is a danger that the concept becomes the important thing and not the place"*

Table 6: Summary of suggested improvements for future application of the ES concept within UK marine and coastal management.

4. Discussion

This paper provides insight into marine and coastal stakeholder perceptions and attitudes towards ecosystem services (ES) and its role within UK marine and coastal management. Despite becoming increasingly embedded within environmental decision-making and management, this study found that while stakeholders indicated positive views towards the ES concept, questions, concerns and scepticism remain. Indeed, respondents found a lot of room for improvement as shown by both the volume and diversity of responses identified through the open questions. Many of these were linked to the need for standard procedures to evaluate ES in marine and coastal settings, for clear (e.g. simplified) terminology and classifications, pluralistic valuations, and the need for examples of success stories using the concept within a marine and coastal context. While some of these are already being addressed by both academia and practitioners (see e.g. Pascual et al., 2017), more research in these areas is clearly required.

Views and attitudes towards ES as a concept

Analysis of the results from this study found that most respondents felt informed about ES, liked the terminology, and found it a useful management tool, with some specifically welcoming it as a mechanism through which values (both monetary and non-monetary) can be assigned to marine and coastal ecosystems. We found that the more respondents used the concept, the more they liked it (or vice versa), and the more they liked it, the more confident in using the concept they felt. Across sectors, respondents from the industry sector felt less informed and encouraged to use the ES framework. When asked to define ES, most respondents linked the concept with words such as 'environment', 'ecosystem', 'nature/natural', 'human' and 'benefits/services', terms found in the most commonly accepted definitions and frameworks of ES (MA, 2005, de Groot 2010b, NEA 2016). This highlights that, overall, this particular sample of stakeholders had a very accurate idea of the

concept, liked the terminology and found it useful as a management tool, across the diverse backgrounds of respondents.

With this in mind, it is possible that the ES concept and its application within marine and coastal management should be reviewed, and definitions and approaches to assessment should evolve if necessary, (as discussed by Fisher et al., 2009) to ensure applicability to a complex environmental and governance landscape. As expected, respondents identified both advantages and challenges associated with the use of the ES concept within marine and coastal management in the UK. Synthesising all responses given throughout the questionnaire we propose that the main advantages of the ES approach can be summarised in 5 key themes:

1) Supports the understanding of the multiple (plural) values of the environment;
2) Reduces complexity and provides a holistic view of the environment;
3) Provides a common language that improves communication between sectors, and increases public understanding;
4) Links society to the environment; and
5) Supports management.

While numerous advantages were identified through this study, it remains clear that there are a variety of challenges tied up with the application of the ES concept within contemporary marine and coastal management. Bringing together the key findings from this study, we propose that these challenges can be grouped into 5 main categories:

1) Problems of understanding and lack of specificity (unknowns);
2) Terminological problems (vagueness, openness);
3) Concerns linked to the commodification of nature and the dominance of economic valuation;
4) Difficult application to a real-world context; and
5) Illustration of the need for increased support from the political landscape.

The benefits and challenges identified by respondents in this study are not necessarily unexpected, and similar observations have been made by other authors, serving to highlight the complexity and challenge associated with the ongoing ES debate. Indeed, it could be said that this itself illustrates the complexity of societal interactions with the environmental world. Despite the range of challenges and potential pit falls identified by respondents, the unique contribution of this work remains in its assessment of the opportunities for future improvements.

Opportunities and Recommendations for Improvement

Although other studies have examined perceptions towards the ES concept (Thompson et al., 2016), this paper presents an evaluation not only of current views, thereby identifying trends in perceptions whilst giving an insight as to why those views are held, but also of the challenges and potential opportunities for improvement in the future. Analysis of the stakeholder responses generated 5 key areas for improvement with regards to the application of the ES concept within marine and coastal management:

- Need for standardisation and more guidance than currently available,
- Need for improved and clear terminology, including a simplification of classifications that does not disengage the general public,
- Need for multilevel/multi-metric/pluralistic valuations, allowing greater connection to culture and heritage,

- Need for a collection of success stories to be used as case studies,
- Improvements beyond ES (e.g. increased funding, increased scientific education for politicians and policy makers).

Language, in a number of guises, was seen to be a key theme throughout the various aspects of this research, both on the positive and negative side of the conversation. This discussion is one that has been ongoing for some time, with numerous authors presenting different views and definitions associated with the concept (see Fisher et al., 2009 for examples). A fundamental concern expressed by stakeholders about the application of ES within marine and coastal management was a feeling that the ES language and terminology is complex, inaccessible and hard for people to connect with. Recent research has examined the influence that language and terminology can have on how a concept is accepted or used (Raymond et al., 2013). Concerns about the semantic implications of ecosystems providing services to people's wellbeing stem from the presentation of people and nature as separate entities, with directional flows just from nature to people (Raymond 2017, Kenter 2018). Respondents referred to these issues, with the ES concept seen to 'disengage the general public'. Concerns about the level of uncertainty and knowledge gaps relating to ES, and how the concept can be applied, are not new (Wallace, 2007; Metz and Weigel, 2010; Dempsey and Robertson, 2012; Schroter et al., 2014; Thompson et al., 2016; Potschin-Young et al., 2018), and, evidently, this remains the case for marine and coastal management in the UK. Previous studies argue that the dominance of the ES concept, and the economic valuation often associated with it, can result in a diminished relationship between society and nature, rather than supporting strong connections (Peterson et al., 2009; Schroter et al., 2014, Raymond et al., 2013; Diaz et al., 2018). However, and interestingly, in many instances respondents found the same topic as both advantageous and a disadvantage: e.g. vagueness-openness of the term, topics linked to making communication easier between disciplines, offering a common ground, linking society to the environment and providing a holistic view of the environment.

The areas for improvement detailed above are already being tackled by many groups, although this is lacking a collective approach with moves towards improvement being steered by specific sub-disciplines or sectors. For example, the Blue Carbon Initiative produced a manual (Howard et al., 2014) 'with the goal of standardizing protocols for sampling methods, laboratory measurements, and analysis of blue carbon stocks and fluxes'. The manual provides scientists and coastal managers with 'a practical tool to produce robust blue carbon data'. This manual has turned into the current gold standard for evaluation of global carbon stocks in marine ecosystems. Adopting a similar approach to standardisation and the production of real-world examples to support implementation for all ES and benefits, including those associated with culture and heritage, would make the ES concept even more used and applicable to the real world. Another example of a trial to improve the concept has been the recent presentation by the IPBES of the notion of 'Nature's Contributions to People' (NCP) (Diaz et al., 2018). While the aim of developing this 'new' term was to come up with a simpler more inclusive terminology that was accepted among different world views and disciplines (Borie and Hulme 2015), the heated debate that has prompted (e.g. de Braat 2018), does not envisage a resolution to this pending improvement. However, what has been praised from the IPBES framework is the pluralistic valuation approach (one of the opportunities for improvement identified in this study), which should be able to accommodate different world views by taking into account not only economic values, but also social, ecological, cultural and indigenous and local knowledge ones (See Pascual et al., 2015 for IPBES, but also Chan et al., 2012a, b). If the ES concept is to realise its potential as a common tool that can be used by the multitude of actors involved in marine and coastal management, more work is required to sufficiently embed these plural values within the ongoing ES conversation and application.

5. Concluding Comments and Recommendations

Regardless of ongoing efforts to further embed the ES concept within marine and coastal management, and despite the ever-growing literature base aimed at further developing the concept and its application, the fact remains that there continue to be concerns as to how, and if, the ES can be appropriately applied to the intricate and complex systems of the global seas and coasts. As shown in this study, despite an overwhelmingly and, indeed, unexpectedly positive response from UK marine and coastal stakeholders towards the ES concept, the perceived opportunities for improvement are vast. With this in mind, the following sets out a series of recommendations:

- While support for the ES concept within the governance sphere is evident through its inclusion in recent policy (e.g. UK's 25 Year Environment Plan (Defra, 2018)), there remains a call for greater political support. We therefore recommend increased explicit consideration of ES provided from specific marine and coastal environments within high level national legislation and key policy drivers in the UK, as has been recently highlighted for Wales (McKinley et al., 2018).
- For the ES concept to be successful, it must be recognised that there will be no 'one size fits all' definition or approach that can be applied to all marine and coastal contexts across the UK. However, for the benefits associated with culture and heritage to be appropriately recognised within wider ES dialogue, a revised definition and perhaps, an interdisciplinary suite of approaches and methodologies with the capacity to take account of pluralistic values and uses, is recommended.
- Alongside a revised definition, it is suggested that users of the ES concept carefully consider the audience and adopt appropriate language when communicating or discussing the ES concept and how it might impact their use of the UK coast and sea. By taking account of the heterogeneity of public audiences, and tailoring language fittingly should reduce the concerns raised regarding complexity, jargon and technical language commonly associated with the ES concept.
- While we found high levels of favourable attitudes towards the ES concept in a UK context, we propose that such rates of stakeholder acceptance and use will not be achieved in other countries of the world (Pagès and McKinley 2018) due to among other things, the influence of differing world views across communities and user groups (Pascual et al., 2018, Borie and Hulme 2015), as well as concerns about the application of monetary valuation to marine and coastal management (Raymond et al., 2013). It is therefore recommended that the work presented in this paper is reapplied internationally to explore this in more detail, with a view to supporting global marine and coastal governance endeavours to develop, agree on, and implement consistent approaches for marine and coastal management on a global scale.
- With a view to improving uptake, understanding and application of the ES concept within marine and coastal management in the UK, the generation of success stories and best practice examples of a multi-use/ value application of ES in an appropriate context is recommended. Stakeholders could use these as evidence and support tools when developing Ecosystem based management approaches.
- Crucially, we recommend that, as the conversation around societal interactions and relationships with the natural environment continues to evolve (see, for example, the emphasis on natural capital in the UK's recent 25 Year Environment Plan (REF)), the ES concept should be considered one tool within a wider suite of options for marine and coastal management.

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