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Looking below the surface: The cultural ecosystem service values of UK marine protected areas (MPAs)

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ABSTRACT

Recreational users appreciate the UK marine environment for its cultural ecosystem services (CES) and their use and non-use values. UK Governments are currently establishing a network of marine protected areas (MPAs) informed by ecological data and socio-economic evidence. Evidence on CES values is needed, but only limited data have been available. We present a case study from the UK National Ecosystem Assessment (NEA) follow-on phase that elicited divers' and anglers' willingness to pay (WTP) for potential MPAs. The case study is an innovative combination of a travel-cost based choice experiment and an attribute-based contingent valuation method. Our study design allowed us to understand the marine users' preferences from both a *user* and a *stewardship* perspective. Following the UK NEA's place-based CES framework, we characterised marine CES as environmental spaces that might be protected, with features including the underwater seascape, and iconic and non-iconic species. Our survey highlighted the importance of CES to divers and anglers. A wide variety of marine spaces influenced user-WTP, while stewardship-WTP was most influenced by management restrictions, species protection, and attitudes towards marine conservation. An understanding of key stakeholders' CES values can inform a more holistic and sustainable approach to marine management, especially for decisions involving trade-offs between marine protection and opportunity costs of the blue economy.

1. Introduction

The UK National Ecosystem Assessment (NEA) defined cultural ecosystem services (CES) as environmental settings or spaces that enhance human wellbeing through activities, capacities, identities and experiences (Church et al., 2014, 2011). One of the key aspirations of the ecosystem services (ES) research community is to improve environmental decision making by providing information on the benefits of nature conservation (Chan et al., 2012a; Daily et al., 2009). CES are often omitted from cost–benefit analysis and impact assessments because data on CES benefits are unavailable, and there are considerable methodological challenges to measuring them (Chan et al., 2012a; Church et al., 2011; Ruiz-Frau et al., 2013). Omitting CES from impact assessments underestimates the social and economic value of nature to people (Chan et al., 2012a). In this paper, we present evidence that makes a strong appeal to include CES despite these measurement challenges. We show how conservation features important for a national network of marine protected areas (MPAs) can be translated into CES benefits and be valued using stated preference surveys, thus better accounting for CES in decision-making.

This interdisciplinary research project, which was part of the second phase of the UK NEA,[1] had three objectives: (i) to add to the evidence base on marine CES values, (ii) to improve understanding about marine use and non-use values, and (iii) to provide evidence that can be used in MPA decision-making in the UK. To achieve these objectives, we developed a stated preference valuation method that linked a travel-cost choice experiment (CE) with an attribute-based contingent valuation method (CVM). The CE elicited direct and indirect use values for recreational visits to marine sites. The CVM elicited non-use and option values for protecting marine sites. Attribute-based CVM has been applied in only a few studies (Christie and Azevedo, 2009; Holmes and Boyle, 2004; Moore et al., 2011) and the combination with a travel-cost CE is a novel approach to valuing ES. This paper is also the first to base the monetary valuation of CES on the place-based CES framework developed by the UK NEA (Church et al., 2014). In this

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[1] See URL: http://uknea.unep-wcmc.org and URL: www.lwec.org.uk/sharedvalues.

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paper we report monetary values for divers' and anglers' marine site preferences based on CES. The total value of recreation in and designation of proposed UK MPAs is reported elsewhere (Kenter et al., 2013).

1.1. Threats to marine ecosystem services provision

The marine environment provides many ES including fish, climate regulation, water circulation, habitats, nutrient cycling, resilience and resistance, waste absorption, detoxification of pollutants, primary production, medicinal and biotechnological products, storm protection, a wide variety of marine spaces for recreational activities such as angling, diving and snorkelling, and generates substantial cultural benefits (Austen et al., 2008; Beaumont et al., 2007; UNEP, 2006). Currently, the long-term provision of marine ES is threatened by human activities including industrial fishing, raw material extraction, oil and gas exploration, shipping and terrestrial source pollution (Barbier et al., 2011; Benn et al., 2010). Most marine activities are concentrated around coastlines because of the ease of coastal access and the limitations of accessing deeper parts of the ocean further offshore. The environmental impacts of these activities in shallow water makes them a marine conservation focal point (Halpern et al., 2008). Three important questions for decision makers are: (1) To what extent are marine ES being affected? (2) What are the benefits of protecting marine areas? (3) Could these benefits outweigh the opportunity costs of marine conservation on the marine economy (TEEB, 2012; UK NEA, 2011)?

1.2. Marine policy context

The Convention on Biological Diversity (CBD) signatories agreed to protect at least 10% of marine habitats by 2020 (CBD, 2010; UNEP, 2012). In 2010, only 1.6% of the oceans were protected (UNEP, 2012). Currently, the UK and Scottish, Welsh and Northern Irish devolved governments are designating conservation areas to protect marine biodiversity in response to both CBD targets and the EU Marine Strategy Framework Directive 2020. The UK Marine & Coastal Access Act and the Marine Scotland Act empower governmental bodies to designate an ecologically coherent network of MPAs in UK waters, with the aim of progressing towards "clean, healthy, safe, productive and biologically diverse oceans and seas" (DEFRA, 2002). The MPA network comprises different types of MPAs including Ramsar sites, sites of special scientific interest (SSSIs), special areas of conservation (SACs), special protection areas (SPAs) and two new main types of MPA: Marine Conservation Zones (MCZs) and Scottish MPAs (Fig. 1).

Biological and geological conservation targets and social and economic factors are taken into account when considering potential MCZ and Scottish MPA sites. In England, stakeholders have recommended 127 MCZs, 27 of which were designated in November 2013[2] with some further sites likely to be designated in 2015. In Scotland, 33 MPAs were proposed for designation (The Scottish Government, 2014). Wales and Northern Ireland have yet to decide how they will contribute to the UK MPA network. In 2012, there was a public outcry over the Welsh government's proposal to establish highly protected marine conservation zones. The Welsh government withdrew its plans as a result of the consultation responses, which were "expressing highly divergent and strongly held views" (Welsh Government, 2012). One of the main reasons for the public upset was the exclusion of all extractive, damaging, and disturbing activities in these areas without consideration of the socio-economic implications for local communities and businesses (Kenter et al., 2013; Welsh Government, 2012). The experience clearly illustrates the importance of socio-economic evidence, including CES values, for decision making. While cost data on marine management is relatively easy to obtain, data on the non-market benefits of marine conservation in the UK are scarce (cf. Austen et al., 2011; Beaumont et al., 2006, 2008; McVittie and Moran, 2010; Radford et al., 2009; Rees et al., 2010; Ruiz-Frau et al., 2013). A recent report by Fletcher et al. (2012) specifically identified the ES provided by the UK marine habitats and species of conservation importance and highlighted the lack of information on CES values associated with these marine features.

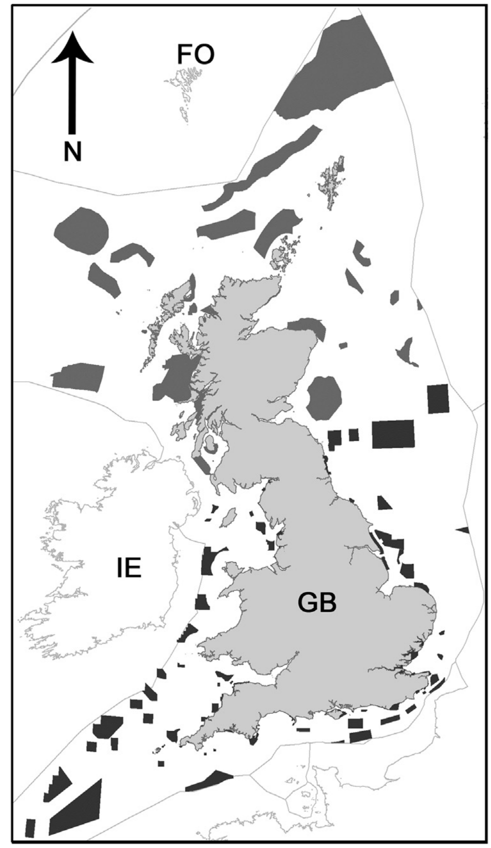

Fig. 1. The British network of recommended MPAs. In black the English recommended marine conservation zones and in grey the Scottish potential MPAs (*status quo* at the time of research in December 2012). Boundaries show the limits of Exclusive Economic Zones (max. 200 nm offshore). GB = Great Britain, FO = Faroe Islands, and IE = Republic of Ireland.

1.3. Valuing cultural ecosystem services

There are many potential marine CES benefits to the general public and specific communities associated with history, heritage and identity in relation to the sea. This paper focuses on the use and non-use benefits to two key recreational user groups of potential future MPAs (i.e. divers and anglers). Most economic valuations of marine CES have been based on market related values of leisure and recreation. For example, leisure and tourism revenues including users' expenditures on access fees, equipment, fuel, accommodation costs, etc. For the UK marine environment, these values amounted to £11.77 billion per annum in 2002 (Beaumont et al., 2006, 2008). Using market related values mixes ES values with infrastructure and human labour values, and fails to take account of the total economic value (TEV; Fig. 2) of the recreational activities (Toivonen et al., 2004). TEV includes both use and non-use values. To recreational users of MPAs, use value includes the actual use value (the value of recreating in an area) and option value (the value of maintaining a site's availability for potential use in the future; Pascual et al., 2010,

[2] See Joint Nature Conservation Committee (JNCC), *Marine Conservation Zones*; URL: http://jncc.defra.gov.uk/page-4525 (last access May 2014).

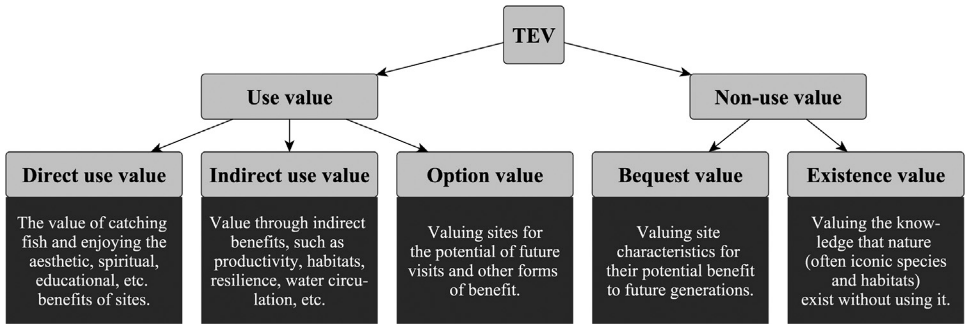

Fig. 2. The total economic value (TEV) of marine sites with examples for divers' and anglers' cultural ecosystem services values.

p. 14). Use values are likely to be underestimated in market studies, because many recreational activities are inexpensive or free yet they provide considerable wellbeing to participants and therefore generate substantial consumer surplus. In addition, marine users (as well as non-users) will have non-use and option values for marine sites. Non-use values include altruistic values (the value of maintaining sites for others), bequest values (for future generations), and existence values (for other species) (Balmford et al., 2008; Pascual et al., 2010). In relation to CES, use and non-use values may be closely intertwined (Church et al., 2014; Kenter et al., 2011), and their separate measurement is not necessarily straightforward. Stated preference methods (chiefly CE and CVM) are particularly relevant in this context, as they can elicit non-use as well as use values.

The Millennium Ecosystem Assessment (MEA) divided CES into the recreational, spiritual, religious, aesthetic, educational, scientific, and existence values (MEA, 2005). The MEA categorisation is problematic, because of the intangibility of the categories and their overlap, e.g. recreation can include aesthetic and spiritual experiences (Fig. 2). The MEA categorisation also leads to bias in assessment because assessment of all categories is rare and other categories of cultural experience can be identified. Thus, the UK NEA and its follow-on phase developed a different CES framework in which environmental settings or spaces themselves were identified as CES, and MEA categories were considered benefits that arise through practices and experiences in these spaces (Church et al., 2014, 2011).[3] The UK NEA framework allows assessment of CES through an assessment of the extent and state of different types of spaces, an assessment of practises (e.g. diving) and of the well-being benefits associated with spaces and practices through capacities (e.g. knowledge and skills), identities (e.g. cultural identities) and experiences (e.g. spiritual and aesthetic experiences).

In the UK NEA framework the valuation of CES can take place at different levels, and through different methods. At the level of the environmental spaces themselves the abundance and integrity of particular natural and cultural features can be assessed using, for example, ecological surveys or participatory mapping. The natural and cultural features may also be associated with existence and bequest values that can be assessed and valued using stated preference methods. At the level of practices participation rates and willingness to pay (WTP) to visit spaces are suitable indicators of value. At the level of benefits, such as experiences and identities, the value of CES can be assessed using subjective well-being and/or qualitative methods such as storytelling. An important advantage of this multi-level conceptualisation is that double counting is avoided, as recreational practices sit at a different level from closely related benefits such as identities and aesthetic experiences. It may be assumed that visit counts and WTP to visit one place or another is tied up with the features of those sites that generate more specific but hard to disentangle well-being benefits. Such a mixed-methods approach was applied in the UK NEA follow-on phase to value CES associated with the marine environment (Kenter et al., 2013; 2014). In this paper, we report on the monetary valuation component used within this CES framework.

Conceptualising CES as marine spaces links their provision to marine biodiversity features and highlights the associated recreational benefits for users. Marine spaces include underwater seascapes, with particular features that would be more or less attractive to their users. For example, mussel beds on a muddy substrate provide a different experience to divers and anglers than a sea grass seascape. While the leisure and recreation industry depends directly on the diversity of sites (e.g. by advertising variety between and within sites, including their biodiversity), generally recreation valuation studies have not addressed this dependency (Rees et al., 2010; Ruiz-Frau et al., 2013). Protection of biodiversity is important for the existence values of marine sites (McVittie and Moran, 2010; Ressurreição et al., 2011) and potentially important for the supply of other CES benefits.

Divers and anglers account for a substantial part of the leisure and recreation component of CES provided by the UK coastal waters. The importance of the two recreational groups is reflected by their numbers, across the UK there are 1.1–2 million anglers and 150,000–250,000 divers (CEFAS, 2013; Drew Associates, 2004; Kenter et al., 2013). In 2012 22.7% (11.1 million people) across the UK participated in water sport activities (in marine areas as well as lakes and rivers), with 2.1% of the population participating in angling and 0.4% in diving activities (Arkenford, 2012). Only spending time at the beach (12.3%), outdoor swimming (7.1%), and boating activities (5.8%) were more important than angling (Arkenford, 2012). For countries in high latitudes, there exists little information on the value of CES and especially information on marine recreational benefits to divers (non-commercial divers including SCUBA divers and snorkellers) and sea anglers (non-commercial fishermen, fishing with angling rods from shore or boat) (Kenter et al., 2013; Ruiz-Frau et al., 2013). Studies from northern countries are more abundant for anglers' than divers' values and the studies for divers almost exclusively consider tropical and subtropical dive destinations and iconic marine habitats such as coral reefs (Ruiz-Frau et al., 2013).

Recreational diving and angling can have environmental impacts. For example, divers can break sea bed organisms and disturb substrate by flipping (Luna et al., 2009), and anglers might extract target fish species, dig for bait or lose fishing gear (Drew Associates, 2004). Here, however, we considered biodiversity conservation objectives and assume recreational activities are not incompatible within MPAs.

2. Methodology

Divers' and anglers' WTP to visit marine dive and angling sites and their WTP to protect these sites against future harm were elicited via an online stated preference survey. The questionnaire

[3] In the UK NEA the term 'environmental settings' was used to frame CES; in the follow-on phase this was replaced by the term 'environmental spaces'.

was developed and distributed in partnership with the British Sub-aqua Club and Angling Trust, the largest diving and angling organisations in the UK. The survey combined two preference elicitation methods, a travel-cost based CE and an attribute-based CVM. This combination of elicitation methods allowed us to explore how site attributes affected recreational trip choices (the travel-cost based CE) and how these same attributes affect the value of protecting sites against future harm (the attribute-based CVM). For both the CE and CVM, we examined whether values were significantly different across divers and anglers or whether values were held in common. This allowed us to highlight potential conflicts between divers and anglers and mutual benefits from conservation scenarios.

2.1. Sample selection and survey distribution

The online survey was conducted over a six-week period between December 2012 and January 2013. Four focus groups (two for each marine recreational group) were held to help design the questionnaire including the marine site descriptions used, the framing of the tasks and to test the cognitive burden of the survey. A pilot survey was conducted with 95 participants to further test the survey instrument (no major conceptual changes to the survey were necessary). The main survey was advertised via the British Sub-aqua Club and Angling Trust member mailing lists with 28,000 divers and at least 3000 anglers. Additionally adverts were posted on internet fora, social media, and in national angler and diver magazines.

2.2. Survey design

Survey participants were given background information about the study's purpose and the policy context (Table 1). The survey questions were split into three sections: 1. Participants' socio-demographic characteristics, 2. stated preference tasks, and 3. visitor counts to proposed MPAs, non-monetary well-being and psychometrics. The non-monetary well-being results are reported in two UK NEA reports, of which this monetary valuation was part (Kenter et al., 2014, 2013). Participants' socio-demographic characteristics were asked at the start of the survey to ensure that all participants were older than 16 years, and had previously dived or angled in UK seas. Participants were then asked to state their level of support for marine protection in general and their level of support for MPA implementation around the UK coastline, specifically.

Following these socio-demographic questions, participants were asked to complete the stated preference questions valuing CES provided by the proposed MPA network (Table 1). In general, stated preference methods ask survey participants either to value or to choose between hypothetical goods or services that are described in the survey (in this case marine dive or angling sites). Further details on CE and CVM methods can be found in Bateman (2002), Hanley and Barbier (2009) and Hensher et al. (2005). In this study, both stated preference methods applied described marine sites in terms of their attribute or features. Key attributes of marine sites were identified from the focus groups and mapped onto the UK MPA selection features to ensure these results were relevant to current decision making processes.

The marine sites were described using eight attributes: marine landscape, underwater objects, sea life, access, other restrictions, vulnerable species protected, size of the protected area, and travel distance (Table 2). The marine landscape attribute had 18 levels including information on substrate type (i.e. muddy, sandy or gravelly, and rocky) and the UK marine habitats of conservation importance (further detail in Kenter et al., 2013, pp. 36-38). We used text, simple pictograms and images to help participants understand the attributes.

We elicited use values for hypothetical marine sites using a travel-cost based CE. The hypothetical marine sites were described by eight attributes (Table 2). A typical CE asks participants to select their preferred alternative from a choice set of two or more alternatives. Following Christie et al. (2007), we asked participants to allocate the next five recreational (dive or angling) opportunities to be taken in the next year between two hypothetical (dive or angling) sites and a 'stay at home' option (Fig. 3 and Table 3). This question format gathers more information per choice task than a standard 'choose one' choice. Furthermore, this question format is more realistic in our context because divers and anglers visit diverse and numerous sites for recreation and it is important to allow for distinctions between highly attractive, far-away sites and less attractive, easy to reach sites. For example, site A is 400 miles away and has unique characteristics but site B is 5 miles away and has less attractive site characteristics. Given a single choice participants might choose to visit site A despite its remoteness. However, given the option to allocate five trips instead of just one, the participant might decide to visit site A once and site B four times due to the travel distances (and therefore cost) involved. Another example of the increased realism of the choice context is a situation where sites A and B both have some value to the respondent but not enough to justify more than one visit per site. In such a case the respondent is able to allocate the remaining trips to the 'stay at home' option. Therefore, the allocation of five trips as opposed to a single choice allows participants to express a limited interest in some of the site alternatives (Christie et al., 2007). By

Table 1
Outline of the online survey.

Survey stage	Explanation
Survey introduction	Background information on the survey including what the survey results were meant for.
Socio-demographics	Questions on socio-demographic characteristics (age, gender, educational level, etc.), including questions on engagement with the environment (how many angling/diving days in 2012, etc.).
Information on MPAs	A short description on the UK MPA proposal.
Support for protection	Questions asking for respondents' support for marine protection.
Monetary valuation	A combination of travel cost based choice experiment (i.e. travel distance to hypothetical recreational sites; 4 choice tasks with 3 alternatives each) and contingent valuation with voluntary donations to support the protection of marine sites (4 choice tasks with 1 alternative and payment ladder).
Follow-up part I	Questions on choice-making strategies and decision-making rules to identify protestors and strategic behaviour.
Site-visitor counts	An interactive map-based exercise asked people to select a maximum of 15 'real' sites from the region they visit most. Also, how often they had visited these sites over the past year.
Non-monetary valuation	Questions on the respondent's subjective well-being (on a Likert scale) derived from benefits associated with the visited sites within their region.
Follow-up part II	Psychometric questions based on values-beliefs-norms (VBN) theory and theory of planned behaviour (TPB).

This paper covers the monetary valuation part of the outlined survey including follow-up part I. Non-monetary valuation and visitor counts can be found in Kenter et al. (2013).

Table 2
Choice attributes used in CE and CVM and their levels.

Attributes	Levels
Marine landscape	Details on the type of substrate and marine habitats that scientists identified as of conservation importance (Kenter et al., 2013, pp. 36-38). The attribute consisted of 18 levels (Table 5).
Underwater objects	Both dummy variables could be present simultaneously: (A1/A0) shipwreck present or absent, (B1/B0) and rock formation such as a vertical wall, gully or archway present or absent.
Sea life	The chances of encountering fish and sea life at the site were presented together but formed two distinct attributes: (A1/A0) large/specimen fish present or absent dummy variable, and four levels of sea life: (B1) grey/common seal, (B2) sea bird colony, (B3) or octopus present. (B0) The base level for sea life was presented as 'no bird colony, octopus, or seal present'.
Vulnerable species protected	Four levels of species protection: 0, 5, 10, 15 out of the 40 marine species identified as endangered or vulnerable and protected by the new marine protected areas. We indicated that chances of encounter/catch at the site were very unlikely.
Access	Four levels of access to the site: (A0) Accessible by shore and boat (base level), (A1) Access by shore only, boat use prohibited, (A2) Access by shore, boat, and pier, (A3) and site out at sea, can only be reached by boat.
Other restrictions	Four levels of activities banned in the area: (A0) No restrictions (base level), (A1) no dredging & trawling, (A2) no dredging & trawling, no potting & gillnetting (A3) or no dredging & trawling, no anchoring & mooring.
Size of protected area	Four levels of the size of the protected site in square kilometres: 1, 10, 100, 1000 km^2
Travel distance	Six levels of one-way travel distances: 5, 20, 50, 100, 200, 400 miles.

including travel distance to a site as an attribute, we were able to estimate a monetary value for a trip to the site using a travel-cost method. Each participant was presented four choice cards, similar to the online survey screen shot in Fig. 3.

We elicited non-use and option values for marine sites using an attribute-based CVM task. We asked respondents how much they were willing to pay to protect a hypothetical site from future harm and degradation. The CVM task used the same choice cards as the CE (Fig. 4) and the CVM question was posed immediately after each allocation of five trips in the CE. One of the two hypothetical sites was selected at random (with the other blanked out) and participants were asked how much they were willing to pay as a one-off donation to protect the site from future harm on a payment scale (Table 3). To explore the sensitivity of respondents' WTP to the task's framing we used two payment scales each with a different range of values, either £0–£20 or £0–£40. In both payment scales, respondents could state a WTP higher than the top of the scale. The payment vehicle in the CVM tasks was a donation to a local management trust whose objective was to maintain the site as described.

The different question framings in the CE and CVM tasks (Table 3) elicited different types of values from respondents. The travel-cost based CE was framed from a user perspective, and the CVM was framed from a stewardship perspective. The values elicited via the CVM might be understood as an insurance value against future decrease of ES benefits. Similar to home or car insurances, those who purchase a policy are unlikely to have precise knowledge of the risks they mitigate against. Nonetheless, they form an expectation and preference and choose a policy to purchase based on their value of the object to be insured.

Based on the attributes and levels presented in Table 1 there are 884,736 possible marine sites. We selected a subset using Ngene 1.1.1 (Choice Metric software) to find a D-efficient design. We reduced the total number of possible sites to 64 choice cards each with two hypothetical sites and a stay at home option. These 64 choice cards were split into 16 blocks of 4 choice cards per participant. We used the same choice cards for both CE and CVM to reduce the cognitive burden to respondents.

Before answering the CE and CVM questions, respondents were given a short briefing about the MPA designation process, and how this research and their responses would inform this process. Respondents were reminded to consider their budget constraints and treat donations and travel distances as if they were real (Table 3) (cf. Bulte et al., 2005; Cummings and Taylor, 1999). Follow-up questions asked participants about their choice-making strategies and decision-making rules. Participants were excluded as 'protestors' from the CE model if they stated that they chose randomly, could not envision the sites, or ignored travel distance (Table 4). For the CVM, 'protestors' were excluded who stated that they chose sites strategically to decrease/increase survey values and those who stated they had made zero-bids, either because they thought that divers and anglers should not be asked to pay, or because they were opposed to the proposed policies (Table 4).

2.3. Analysis

Both the CE and attribute-based CVM responses were analysed based on random utility theory (RUT) (McFadden, 1974). This assumes that participants know the utility of each marine site and are perfectly able to discriminate between the sites, but that the researcher cannot observe all factors that influence respondents' utility. Thus, the utility u that individual i receives from site j is the sum of two components: a systematic, and observable, component, v_{ij}, which is based on site attributes, and an additive random component, ε_{ij}, which is not observable.

In the CE, participants allocate their next five recreation opportunities across two hypothetical sites and staying at home. Following Christie et al. (2007), we assume participants allocate trips to sites based on the relative utility of the available sites. We assume that observable component of this utility is a linear additive function of the site attributes:

$$V_{ij} = \beta_1 + \beta_2 X_{ij2} + \beta_3 X_{ij3} + \cdots + \beta_n X_{ijn} \quad (1)$$

with β indicating the weighting of the site attribute X_{ij}. The random (unobserved) component ε_{ij} represents unmeasured variation in participants' preferences due to unobserved site attributes, inter-individual differences in site utility due to taste heterogeneity, measurement error and/or the functional form specification (Manski, 1977). If ε is assumed to be independently and identically Gumbel-distributed then the probability of choosing alternative j from a choice set of k alternatives can be estimated using a logit model. We analyse the CE data using a frequency based conditional logit (CL) model in Nlogit 4.0 (Econometric Software). Each participant provided four responses; therefore standard errors in the model were calculated using a cluster robust estimator to account for correlation between the multiple observations for the same participant. We test the assumption of independence from irrelevant alternatives (IIA) in the model using the test developed by Hausman and McFadden (1984). Participants' individual-specific characteristics (ISCs) were included in the model as interactions with the alternative-specific constant (ASC) to improve the realism of the models. These interactions indicate how

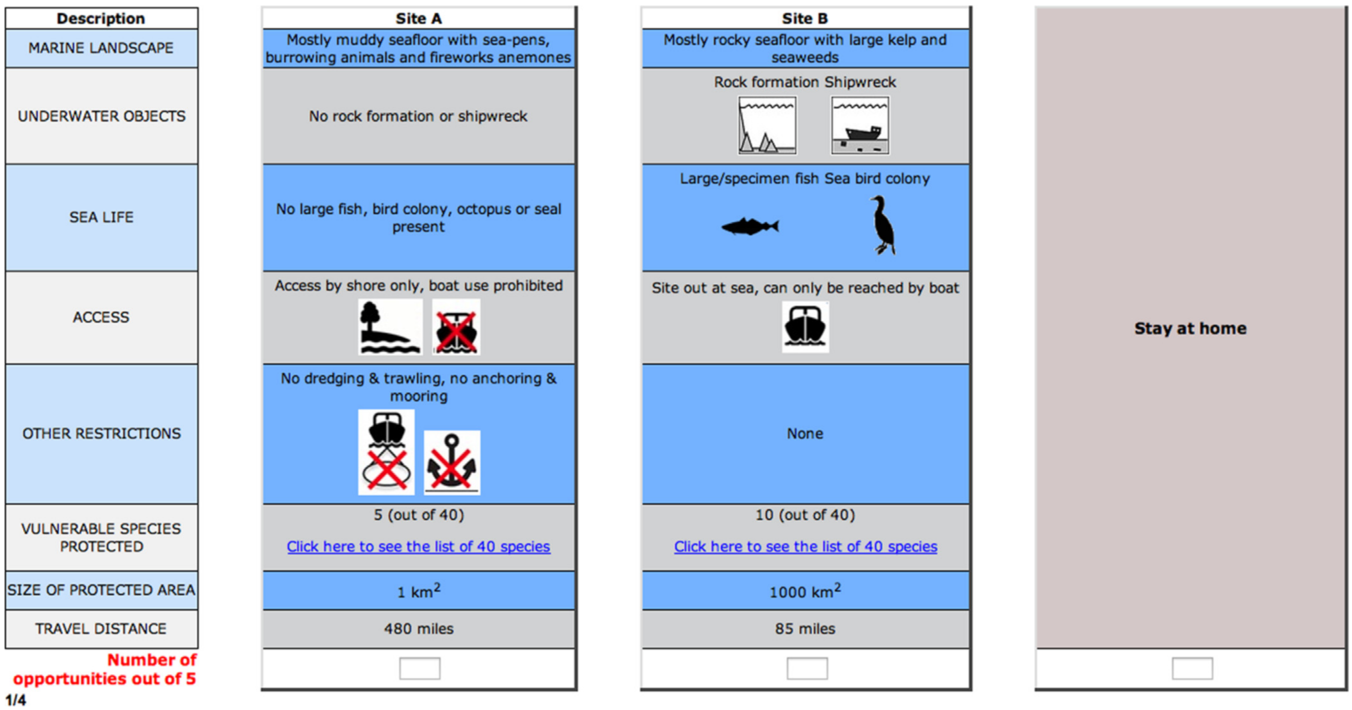

Fig. 3. CE choice card example from the online survey.

Table 3
Framing of the monetary valuation questions.

	Survey instructions
Choice making introduction	"In this section we will ask you to make a number of choices between angling [or dive] sites that we will present to you and which could be protected. Each site is described in terms of its attributes [brief description of the attributes]. We would like you to imagine the sites, and consider whether they would be worth you visiting, and whether they would be worth protecting. The sites may be similar to ones that you would usually visit, or there may be differences. All of the sites we are presenting are hypothetical; they don't exist in reality. The aim of these questions is to get an idea of what things are most important about the marine environment from the perspective of anglers [or divers]."
Choice experiment	"If you had to choose between sites A and B, out of your next five angling [or diving, or snorkelling] opportunities within the next year, how many times would you visit site A, how many times site B, and how many times would you stay at home? Please imagine that these are the only options available to choose from."
Contingent valuation	"If you were asked to make a one-off donation to support protection of site A [or site B] into the future, how much would you be willing to donate? Please carefully consider the attributes of the site. Your donation would be used to set up a local management trust to maintain this site as it is shown below, and protect its natural features against the risk of future harm and degradation."
Reminders	"In this question and questions that follow, it is really important for our analysis that you consider travel distances and financial amounts as if they were real. Thus, you need to consider your household income and expenditures, and what you might need to give up to be able to afford a donation, or the cost of travelling to a site."

ISCs affect the probability of visiting a site. ISCs included as interaction terms were income, education, age, gender, number of years angling or number of dives completed in a lifetime, membership or donation to an environmental organisation, and level of support for MPAs.

From the model results, we calculated participants' marginal rates of substitution between attractive site attributes and travel distance. These marginal rates of substitution represent the maximum distance participants are willing to travel for a marginal improvement in an attribute level. From these distances, we calculated WTP using travel costs and converting distance in miles into pounds using a conversion rate of £0.088/mile, based on Christie et al. (2007) plus 17.49% inflation rate, which corresponded well with market prices for fuel. The value was thereafter adapted to account for car sharing based on the assumption that on holiday trips, on average, two people share one car.[4] The value did not include additional running or purchasing costs of the vehicle and could thus be considered a conservative estimate of the total travel costs. We used return distances to convert travel miles into WTP following Hanley et al. (2002). Participants were informed that the site's distance referred to the travel distance by car from their home to the coast.

The CVM data were analysed using a mixed-effects interval regression (*xtintreg* procedure in Stata/SE 12.0). The WTP values from the CVM data set were transformed for modelling purposes using the natural logarithm:

$$\ln(WTP_{CVM}+1)=\beta_0+\beta_1X_1+\cdots+\beta_nX_n+u_i \quad (2)$$

where β_0 stands for the intercept, β_n the regression weight for X_n an individual characteristic or attribute, and u_i the residual with a mean of zero. We included a number of ISCs: income, being an angler, membership or donation to an environmental organisation, and level of support for MPAs. We used a step-wise general to specific approach to model specification. Initially all ISCs were included, but excluded from the regression model when they showed not to be significant at the 10% level. Differences between the groups were accounted for via contrasts, with divers being the

[4] See Department for Transport Statistical Release: National Travel Survey 2010 (URL: www.gov.uk/government/publications/national-travel-survey-2010) (last access December 2013).

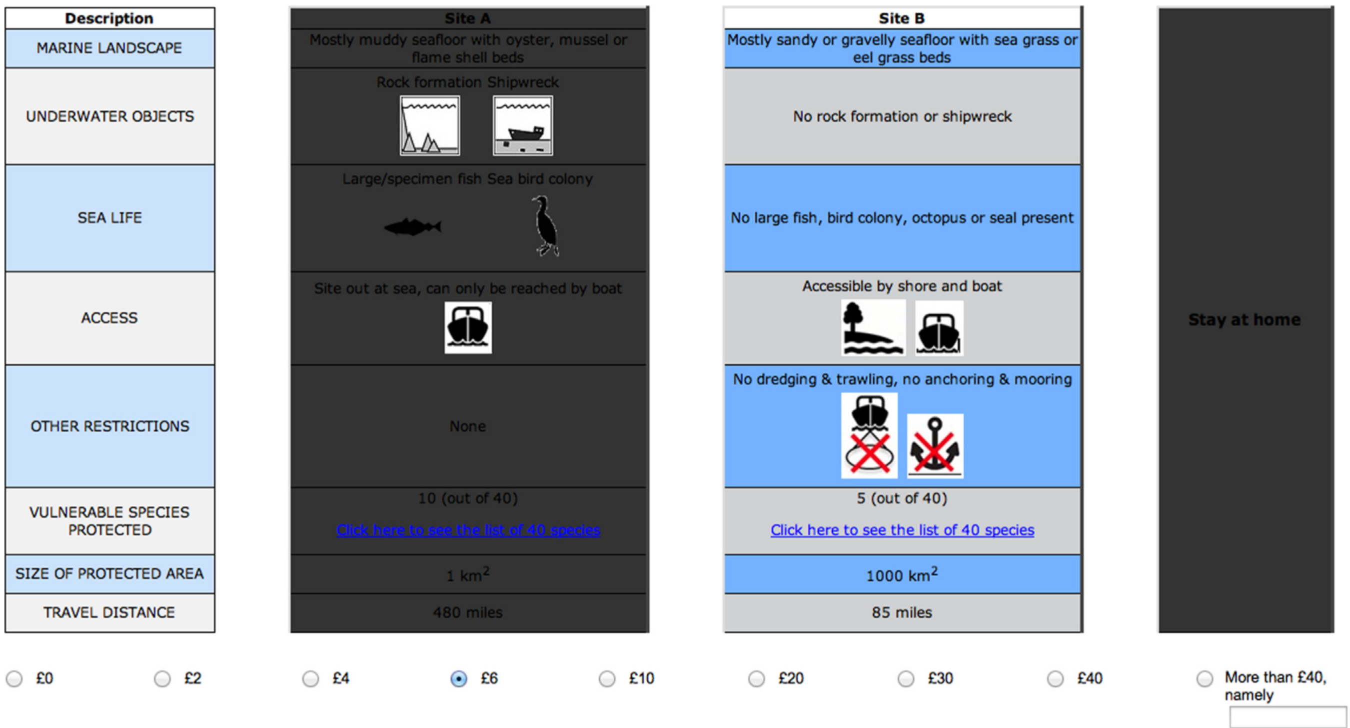

Fig. 4. CVM choice card example from the online survey.

Table 4
Stated preference follow-up questions used to identify 'protestors'. Statements in bold letters led to the participant's exclusion from the choice models.

Statement	Selected (%)[a]
CE question: "Which statements best describe how you picked the sites you preferred?"	
I chose randomly.	**0.6**
I picked the site that reminded me most of my favourite angling sites in reality.	42.4
I usually or always chose the nearest site out of A and B.	18.2
I mostly chose sites that were below a certain maximum distance that I was willing to travel.	20.8
I chose the sites that I liked most relative to the distance.	40.6
I chose the sites that I liked most regardless of the distance.	**18.2**
I picked one or two types of benefits of the site and mostly based my choices on that	30.9
I usually or always chose 'Stay at home' because I could not really imagine any of these sites	**0.6**
Other [text box]	14.1
CVM question: "Which statements best describe how you decided the amounts you were willing to donate?"	
I picked zero or low amounts because I wanted the average that comes out of the survey to go down.	**0.6**
I picked high amounts because I wanted the average that comes out of the survey to go up.	**0.3**
I considered my household budget, and how much I could spare.	27.9
I considered how much I would pay, if I was really asked to donate.	65.8
I thought about what others would donate.	5.3
I picked high amounts because I thought it was the right thing to do.	2.4
I picked zero or low amounts because I thought money needed for managing this site should come from another source, such as taxes.	**17.9**
I picked zero or low amounts because I do not agree with proposed policies around marine protected areas.	**3.1**
I picked an amount depending on what I thought protecting a specific site was worth.	18.5
Other [text box]	12.5

[a] The percentage indicates the relative selection frequency based on a sample of 1332 respondents. Multiple selections were possible.

base level (i.e. mean coefficient) and the coefficient for anglers showing the magnitude and statistical significance of the differences in WTP across the two groups.

For the CVM results, the impact of ISC or site attributes on individual WTP cannot be expressed in monetary terms because the response variable (WTP) is log-transformed (Eq. (2)). Therefore, we estimated the mean WTP per recreational group for the lower and upper bound of the payment cards, as well as the midpoints. A *t*-test was used to test the presence of framing bias related to the different payment scale ranges used. *t*-Tests used the log-transformed lower bound of WTP.

3. Results

3.1. Sample characteristics

One thousand three hundred and thirty-two participants completed the survey, 76% of participants were divers and 24% anglers. In the diver sample, 733 (73%) were male. In the angler sample, all participants were male; female anglers are estimated to account for 3.3% of the UK angler population (Drew Associates, 2004). Anglers were significantly older (52 years) than male divers (48 years), and female divers significantly younger than the male divers (41 years). Consequently, anglers had a higher proportion of pensioners (15% compared to 6% for divers). On average, divers had a higher educational attainment than anglers – undergraduate (34%) and postgraduate degrees (26%) were the most common levels of educational attainment for divers compared to A-Levels (27%) and GCSE (25%) for anglers. Both groups had a mean income of between £35,000–£50,000 per annum. A higher proportion of divers than anglers were in income groups above £50,000. The demographic statistics were reasonably representative of the membership of British Sub-aqua Club (A. Dando, pers. comm.) and Angling Trust (D. Mitchell, pers. comm.).

In 2012 anglers spent more time pursuing their activity than divers – 52% of anglers spent more than 21 days outside compared to 28% of divers. Survey participants were relatively experienced in their activity – 26% of divers had completed 200–500 dives in their lifetime, 42% of divers had completed over 500 dives, and similarly anglers had, on average, 32 years of experience. Almost all divers (97%) were engaged in both shore and boat diving, but only 69% of anglers were boat anglers compared 91% who were shore anglers.

The majority of divers and anglers supported extending the UK MPA network, with stronger support among divers (82% strongly supportive) than anglers (52% strongly supportive). There was also greater support for increased marine protection in general (85% of divers and 70% of anglers strongly supportive). Furthermore, 50% of divers and 38% of anglers had donated money to an environmental organisation over the previous year.

3.2. Choice experiment: eliciting use values

The results of the frequency based conditional logit model of CE responses are reported in Table 5. After excluding protestors ($n=275$; 19%), a total of 1075 participants remained for analysis. Table 5 reports the results separately for divers ($n=802$) and anglers ($n=273$). A likelihood ratio test rejected the null hypothesis that preferences were the same across groups and Hausman–McFadden tests confirmed that the IIA assumption was not violated for the models.

In 40% of the choice tasks participants chose to 'stay at home' at least once out of the five dive or angling trips they were asked to allocate. This choice behaviour indicates that some participants had a limited interest for some of the sites presented on the CE choice cards. Participants were able to express their limited interest through allocating only part of their five trips to the sites and chose 'stay at home' for the remainder. Focus groups had indicated that going angling or diving had priority regardless of site quality, which was also confirmed in the substantial and significant ASC (representing a preference to go diving or angling) (Table 5). The coefficient on travel distance to the sites, as a proxy of cost, was significant and negative (Table 5); as expected participants were less likely to state they would visit a site further away from home.

The WTP in travel cost to go diving (rather than to 'stay at home') regardless of site attributes was £7.52 and WTP to go angling was £20.78. This value was higher for participants who had donated money to an environmental organisation in the last year (WTP increased by £3.93 for anglers and £7.86 for divers). WTP also depended on the number of days spent diving over the past 12 months increasing by £4.70 per 10 dive days or £0.90 per 10 angling days, and dive or angling experience (£1.57 per 100 dives; £4.06 per year of angling experience). Older participants were willing to pay less. Participants with higher incomes were willing to pay more, as were those divers with a university degree. Gender had no significant effect on divers' WTP.

Considering the commonalities and contrasts in values between the two marine user groups (Table 5), we found that both divers and anglers valued marine habitats and 'rocky tide swept channels' were among the most valued habitats ($WTP_{diver}=£23.85$ and $WTP_{angler}=£25.14$). Shipwrecks were valued higher by divers (£18.98) than anglers (£8.87). Protecting species of conservation interest (without potential of catch or encounter) increased WTP by £0.44 (divers) and £0.30 (anglers) per species (with a maximum of 15 species per site out of a total of 40 species of conservation interest). The presence of large/specimen fish was valued by both groups, but anglers had a higher WTP (£23.58) than divers (£7.64). Sites that were only accessible by boat reduced WTP for divers by £−5.54 and anglers by £−20.61. Both groups valued areas that were closed to commercial potting and gillnetting ($WTP_{diver}=£4.28$ and $WTP_{angler}=£4.76$) but trip choice was not affected by an area being close to dredging and trawling activities.

The most prominent differences in values across divers and anglers were for iconic marine animals: seals, bird colonies and octopus (Table 5). Divers valued all three animal groups (£7.02–£15.97), anglers did not value the presence of seals, and bird colonies and octopus reduced a site value by £4.13 and £4.17, respectively. Divers valued spaces with rocky substrate, and rock formations such as archways and pinnacles (£5.05). Anglers did not value these, but valued honeycomb and rossworm colonies (£20.04–£22.79 depending on substrate). Restricting boat access increased the value of a site to anglers (£11.37) and decreased the value of a site to divers (£−6.24). Divers valued accessibility through shore, boat and pier (£6.30), whereas anglers did not value access by pier over the baseline of shore and boat access. The size of the proposed protected area around the dive site did not affect divers' WTP and anglers' WTP decreased slightly for larger protected areas (£−0.79 per 10 times increase in size). Divers valued areas with restrictions on anchoring and mooring (£6.12).

3.3. Contingent valuation: eliciting non-use values

In CVM tasks, we asked participants for their WTP a one-off donation to protect a hypothetical dive/angling site against potential future harm and degradation. Of 1332 participants, 21% were identified as protestors and excluded from further analysis. In 18% of the CVM tasks participants stated zero values for the site they were presented with. Table 6 provides lower and upper bounds, and mid-points of WTP, with confidence intervals. On average, divers were willing to pay significantly more (£8.83) than anglers (£8.29) [lower bounds, t-test: $df=4194$, $t=-6.50$; $p<0.01$]. We found evidence of range bias in the results of the CVM task. Mean WTP was higher for those respondents who completed the payment scale task with the larger range (£0–£40) compared to the smaller range (£0–£20): £9.55 compared to £7.89 (t-test: $df=4194$; $t=-3.16$; $p<0.01$).

The large and significant constant term indicates that participants were generally willing to donate money towards marine protection irrespective of the site attributes. Travel distance to a site reduced WTP and the size of the protected area did not significantly affect WTP. Having previously donated money to an environmental organisation, being a supporter of MPAs, and participants' income all significantly increased WTP for sites in general. The impact of some site attributes on WTP differed between divers and anglers; these differences are stated as contrasts[5] with anglers (Table 7).

Among the most important site attributes for WTP were shipwrecks ($\beta=0.162$), specimen fish ($\beta=0.151$), bird colonies ($\beta=0.105$), and restrictions on commercial fishing (dredging and trawling: $\beta=0.110$). Other restrictions such as on potting and gillnetting were of less importance (dredging, trawling, potting and gillnetting: $\beta=0.135$ compared to no dredging and trawling

[5] Contrasts, in this case, refer to the difference in the mean coefficients (β) between anglers and divers. The mean coefficient of divers served as the base level.

Table 5
Conditional logit travel cost models for anglers and divers.

Parameter	Divers		Anglers	
	β	*WTP*	*β*	*WTP*
ASC (go out)	0.193 (0.115)*	7.52	0.674 (0.206)***	20.78
*Female	NS			
*Angling experience (10 years)			0.132 (0.022)***	4.06
*Number of dives in lifetime (100 dives)	0.040 (0.007)***	1.57		
*Angling/diving days last 12 months (10 days)	0.012 (0.001)***	4.70	0.029 (0.001)***	0.90
*Age (10 years)	−0.063 (0.018)***	−2.47	−0.204 (0.033)***	−3.22
*Income (£1000)	0.003 (0.001)**	0.11	0.006 (0.002)***	0.19
*University degree	0.086 (0.048)*	3.37	NS	
*Donated money to environmental organisation	0.201 (0.045)***	7.86	0.127 (0.072)*	3.93
Vulnerable species protected (1 species)	0.011 (0.002)***	0.44	0.010 (0.004)**	0.30
Size of protected area (Log_{10})	NS		−0.026 (0.009)***	−0.79
Accessible by shore only, boat use prohibited	−0.160 (0.067)**	−6.24	0.368 (0.116)***	11.37
Access by shore, boat and pier	0.162 (0.045)***	6.30	NS	
Site out at sea, can only reached by boat	−0.142 (0.028)***	−5.54	−0.668 (0.055)***	−20.61
No dredging and trawling	NS		NS	
No dredging, trawling, potting and gillnetting	0.110 (0.042)***	4.28	0.154 (0.072)**	4.76
No dredging, trawling, anchoring and mooring	0.157 (0.036)***	6.12	NS	
Large/specimen fish	0.196 (0.023)***	7.64	0.764 (0.047)***	23.58
Bird colony	0.180 (0.033)***	7.02	−0.134 (0.064)**	−4.13
Seals	0.409 (0.052)***	15.97	NS	
Octopus	0.344 (0.053)***	13.42	−0.135 (0.080)*	−4.17
Shipwreck	0.486 (0.023)***	18.98	0.288 (0.043)***	8.87
Rock formation	0.130 (0.025)***	5.05	NS	
Sandy or gravelly seafloor with oyster, mussel or flame shell beds	NS		NS	
Muddy seafloor with oyster, mussel or flame shell beds	NS		NS	
Rocky seafloor with oyster, mussel or flame shell beds	0.195 (0.195)***	7.61	NS	
Rocky seafloor with large kelp and seaweeds	0.173 (0.072)**	6.75	0.458 (0.120)***	14.15
Rocky seafloor with anemones, soft corals, and sponges	0.397 (0.070)***	15.49	0.299 (0.124)**	9.22
Muddy seafloor with sea-pens, burrowing animals and fireworks anemones	0.221 (0.073)***	8.64	0.220 (0.117)*	6.77
Sandy or gravelly seafloor with honeycomb- or rossworm colonies	NS		0.649 (0.128)***	20.04
Rocky seafloor with honeycomb- or rossworm colonies	0.277 (0.079)***	10.81	0.739 (0.142)***	22.79
Sandy or gravelly seafloor with sea grass or eel grass beds	0.182 (0.076)**	7.10	0.250 (0.127)**	7.72
Muddy seafloor with burrowing sea urchins and brittle stars	NS		−0.296 (0.143)**	−9.13
Sandy or gravelly seafloor with scallops and sea urchins	0.198 (0.069)***	7.71	0.639 (0.140)***	19.70
Sandy or gravelly seafloor in tide swept channel	NS		0.254 (0.116)**	7.85
Rocky seafloor in tide swept channel	0.611 (0.076)***	23.85	0.815 (0.129)***	25.14
Rocky seafloor with rocky habitats in estuary	0.193 (0.070)***	7.53	NS	
Muddy seafloor with intertidal boulders	NS		NS	
Travel distance to the site (10 miles)	−0.045 (0.000)***		−0.057 (0.000)***	
Number of respondents	802		273	
Number of observations	3208		1092	
Log-likelihood ratio (χ^2)*	4395***		2035***	
Pseudo-R^2	0.13		0.17	

WTP: Willingness-to-pay in GBP; NS: not significant.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

alone). Restrictions on anchoring and mooring reduced WTP (dredging, trawling, anchoring and mooring: $\beta = 0.085$ compared to no dredging and trawling alone). Whereas divers, on average, did not value the accessibility of a site, anglers valued access by shore with boat use prohibited ($\beta = 0.205$; contrast) and multiple access including shore, boat and pier ($\beta = 0.110$; contrast). The presence of seals increased divers' WTP ($\beta = 0.144$) and slightly decreased anglers' WTP ($\beta = -0.167$; contrast). Rock formations increased divers' WTP ($\beta = 0.070$) and decreased anglers' WTP ($\beta = -0.093$; contrast). Both groups valued the protection of octopus at the site, but divers valued it more than anglers ($\beta = 0.131$ and -0.102; contrast).

Throughout different model specifications, coefficients for habitats were unstable and mostly not significant; suggesting that for the CVM part of the survey participants did not have clear preferences for one underwater landscape over the other in terms of non-use values. However, divers were willing to pay for the protection of sites that featured anemones, soft corals, and sponges ($\beta = 0.192$), described by diver focus group participants as iconic habitats. Donating money for the sake of protecting species for their existence value was of relatively low importance, but nevertheless showed a positive coefficient ($\beta = 0.005$ per additional species protected at the site we presented a maximum of 15 out of 40 species of conservation interest). Species protection as a non-use value was therefore, at least for divers, less important than protecting iconic species such as seals, birds, and octopus.

Table 6
CVM mean stated willingness to pay.

	Lower bound		Mid-point		Upper bound	
	Anglers	Divers	Anglers	Divers	Anglers	Divers
Mean	£8.29	£8.83	£10.28	£11.13	£12.27	£13.44
95% confidence interval	£7.61	£8.53	£9.58	£10.82	£11.52	£13.09
	£8.97	£9.12	£10.98	£11.44	£13.01	£13.77

Lower bound, mid-point, and upper bound of the payment card interval, with 95% confidence intervals.

Table 7
CVM interval regression model for divers and anglers.

Parameter	β
Constant	0.788 (0.170)***
Angler	NS
Income (£1000)	0.003 (0.001)***
Donated money to environmental organisation	0.207 (0.047)***
In favour of MPAs	0.183 (0.034)***
Vulnerable species protected (1 species)	0.005 (0.002)***
Accessible by shore only, boat use prohibited	NS
*Anglers	0.205 (0.083)**
Access by shore, boat and pier	NS
*Anglers	0.110 (0.058)*
Site out at sea, can only reached by boat	NS
*Anglers	NS
No dredging and trawling	0.110 (0.027)***
No dredging, trawling, potting and gillnetting	0.135 (0.026)***
No dredging, trawling, anchoring and mooring	0.085 (0.029)***
Large/specimen fish	0.151 (0.018)***
Seals	0.144 (0.027)***
*Anglers	−0.167 (0.051)***
Bird colony	0.105 (0.026)***
Octopus	0.131 (0.027)***
*Anglers	−0.102 (0.050)**
Rocky habitat with anemones, soft corals, and sponges	0.192 (0.041)***
*Anglers	NS
Shipwreck	0.162 (0.018)***
Rock formation	0.070 (0.020)***
*Anglers	−0.093 (0.042)**
Travel distance to the site (10 miles)	−0.010 (0.001)***
ρ	0.684 (0.012)
Log-likelihood	−6837
Wald χ^2 (26 df)	574.5***
Number of respondents	1049
Number of observations	4196

df: degrees of freedom; NS: not significant. Interactions are stated as contrasts.
*** $p<0.01$.
** $p<0.05$.
* $p<0.10$.

4. Discussion

This study provides empirical evidence that the CES value of marine biodiversity that could be protected by UK MPAs is substantial, both from a user and a stewardship perspective. Our results also indicate potential conflicts between recreational users and other interests, particularly commercial fishing and conservation. Divers and sea anglers attached importance to restrictive measures that affect commercial fishing, and valued their own access to areas, which could be reduced if MPA management resulted in measures that limited recreational access to achieve conservation aims.

4.1. The valuation of cultural ecosystem services

We combined two monetary valuation approaches to elicit divers' and anglers' WTP associated with both the use and non-use values of MPAs. The survey attributes' framing, which described hypothetical marine spaces characterised by a range of features, enabled us to elicit monetary CES values for potential MPAs. In the CE, respondents stated their WTP in terms of travel costs, and a range of marine habitats were valued highly. The 'rocky seafloor in tide swept channels' was most important for both user groups. It may be considered that divers valued aesthetic and scenic benefits from the fauna growing on the rocky substrate and use currents for challenging and exciting drift dives. Anglers may have been interested in the increased productivity and fish abundance associated with strong currents. For other habitats, it is also likely that divers focused on the direct experiential and aesthetic value, and that anglers focussed on (indirect) use values such as provision of fish nurseries, feeding grounds and refuge. We found that divers valued all iconic species, whereas anglers' focused on the presence of large/specimen fish. While other things might be as or more important than catching fish [e.g. Moeller and Engelken (1972) mention water quality, natural beauty and privacy while angling; Kenter et al. (2014) also mention peacefulness, 'getting away from it all', and sharing of knowledge and experience with others], nonetheless the chance to catch a reasonably sized fish appears as a basic condition of the pursuit.

The CE results indicate that both groups were significantly more likely to travel to spaces with more species of conservation importance present, even where there was a minimal chance of encountering these species. One explanation is that a place with more rare or endangered species is perceived as more natural compared to other sites (Kenter et al., 2013). Increased environmental awareness has led to more people searching for naturalness in their wildlife experience (Cronon, 1996; Smith, 2012).

The marine environment is an open access resource and its users have competing interests when pursuing benefits from the resource. Divers and anglers can be adversely affected by others, such as commercial fishermen and private boat users. Our CE results confirm that boating activities adversely affect divers, and small-scale fishing such as potting and gillnetting affected both groups. Anchoring and mooring of boats at dive sites was perceived as a potential safety hazard to divers. Large-scale commercial fishing (i.e. trawling and dredging) was not perceived as having an adverse effect on a site's use value in the CE. However, restrictions on commercial trawling became the most important attribute to affect values in the CVM study. This supports the expectation that users would change perspective from users to stewards of the marine environment when switching from the CE to the CVM questions, with the latter able to elicit non-use values. Further evidence of this interpretation is the non-significant access attribute for divers, showing that despite being important in the CE model of divers' use values it was not important in their donations. Conversely, anglers showed stronger support for sites that could only be reached by shore, similar to the CE results, with two potential explanations: the option value of shore anglers to visit this site in the future, or the perception that these sites had less risk to be degraded by other activities due to the closure for boats.

In the CVM, respondents were WTP similar amounts mostly irrespective of the habitat present at a site. This might have been due to an inability to judge whether habitats were more or less important from a conservation perspective, or the result of a conclusion that species diversity was a clearer measure of a sites' conservation value. However, the importance of 'anemones, soft corals, and sponges' to divers as a particularly iconic habitat, and large fish to both divers and anglers indicated that option values were also a substantial component of WTP in the CVM.

Both stated preference approaches confirm that respondents cared more for sites closer to home than those in remote areas. Taking economic data into account in the decision-making for marine protected areas might favour sites of intermediate ecological quality that are close to large population centres and likely to attract larger visitor numbers, as well as high quality sites in remote areas with low visitor numbers that are worthy of protection on the basis of ecological grounds alone, such as the North West of Scotland.

The relatively large constant in the angler CE model compared to the diver CE model (Table 5) suggests that the CE attributes captured a higher proportion of divers' utility for going out than anglers. While both groups take other factors into account when selecting sites, such as weather conditions, water currents, tides, site recommendations by others, facilities nearby etc., the results non-surprisingly indicate that above-water characteristics and sense-of-place might be more important to anglers than divers. We did not include these attributes because here we were interested in the benefits of MPAs, and the other potential site selection factors are independent of marine management. For both groups, follow-up question results (Kenter et al., 2013) suggested that respondents 'translated' site descriptions into specific sites they knew with unique characteristics (i.e. place-based values). Many participants of this survey indicated they thought of sites in 'real life' that were similar to the hypothetical sites they were presented with when making choices, so some of the 'real' site values will have been captured by the constants.

Overall, the framing of CES as environmental spaces allowed us to conduct a comprehensive valuation of the benefits of potential MPAs and marine conservation to users. The place-based approach allowed us to assess the value of benefits regardless of whether they were aesthetic, spiritual, therapeutic, recreational or other benefits. The framework we have applied is one particular way of thinking about how humans gain cultural benefit from the environment, and may not completely account for the multi-faceted way in which ecosystems are important to people culturally. We also acknowledge that monetary valuation will never be able to fully account for all the benefits of ES. This is particularly true for CES, and complex cultural experiences such as the shaping of peoples' personal and communal identities that cannot be reduced to economic categories, and are not always amenable to the utilitarian and individualistic assumptions underlying economic assessments (Church et al., 2014, 2011; Daniel et al., 2012; Kenter et al., 2011, 2014; Tengberg et al., 2012). Thus, the wider research package that this paper is associated with as part of the second phase of the UK NEA (see Acknowledgements) also included an extensive, complementary non-monetary assessment of CES subjective wellbeing (Kenter et al., 2013) and a series of deliberative workshops with divers and anglers (Kenter et al., 2014), but these were beyond the scope of this paper.

4.2. Validity and limitations of the study

Currently, stated preference methods are the only way to estimate a comprehensive monetary value of the environment that includes non-use value (Carson, 2012; Hanley and Barbier, 2009). Both methods applied in this paper, CVM and CE, have been used extensively in policy context (Hanley and Barbier, 2009; UK NEA, 2011). To be useful to decision makers, stated preference results must be valid and reliable (Ressurreição et al., 2012). First, in the models, all attributes showed the *a priori* expected signs and diver/angler characteristics such as income, having donated money to an environmental organisation, support for MPAs, and dive/angling experience as well as travel distance were significant determinants of visiting a site or donating money to a site. These indicate the internal validity of our results (Arrow et al., 1993; Chambers et al., 1998). Second, while participants were not sensitive to the scope of the good in terms of the size of protected areas, they were sensitive to the scope of the features and species present in the area. Focus group participants made it clear that area size would not matter, in principle, but that they preferred a diversity in different sites over sites with little variation in species and habitats. Third, from the very low drop-out rates during the online survey we inferred that participants felt capable of answering the questions and choice tasks they were confronted with.

Some limitations to the validity of this study exist. First, support for marine protection among respondents was strong and a self-selection bias cannot be ruled out. Therefore some participants might have been better informed about the MPA designation process than the average sample population. However, Brown (2012) showed that environmental concern is widespread among anglers and that they are generally well informed about marine issues including commercial overfishing and habitat destruction.

Second, the close succession of CE and CVM in the survey might have caused a form of anchoring effect. It is likely that participants were in a user mindset after answering the CE questions and this could have influenced their WTP in the CVM. Given that eliciting the option value of potential future use of marine sites was one reason for conducting the CVM, this anchoring effect might have benefited the approach. In this case the survey structure let participants think about the use of the sites first and then about their WTP to insure this potential use against future harm. However, it is possible that the non-use value of the sites was underestimated as a result of this survey structure.

Third, the use of voluntary payments as a CVM payment vehicle may have led respondents to understate their true WTP, because the non-excludability of public goods, such as open recreation sites, encourages free-riding behaviour (Bergstrom et al., 1986; Bush et al., 2012; Hanley and Barbier, 2009). However, access fees are uncommon in the UK, and a voluntary payment was the most realistic payment vehicle to value non-use values of anglers and divers. Respondents who strategically over- or understated their donations were removed as protestors through the control follow-up questions (cf. Table 4).

Fourth, distinguishing 'warm glow' (i.e. respondents moral satisfaction from charitable giving; cf. Nunes and Schokkaert, 2003) from existence value in CVM is not trivial. The fact that some site characteristics were valued higher than others in this attribute-based CVM, as well as scope sensitivity for protected species numbers, might be taken as an indication for donations being directed towards an existence value rather than as part of a 'warm glow'. Nevertheless, 'warm glow' could have contributed to the respondents' stated WTP, which arguably might imply that WTP does not fully reflect real individual welfare gains if a site were protected.

Fifth, the survey was based on hypothetical sites and therefore the added value of particular local features and benefits might not have been covered. This issue is common in benefits transfer where the valuation context is often ignored for the sake of transferring values from one site to another (Spash and Vatn, 2006). In our survey this issue was mitigated to some degree, because respondents indicated they compared hypothetical sites with sites familiar to them when responding to questions. Ultimately there is a balance to strike between describing sites in a generalised way, so that values can be more readily transferred to a range of sites, and describing specific attributes of a particular site and its benefits, where values might be more context specific and therefore less transferable.

Sixth, information on the uniqueness of marine habitats was not made available to respondents, even though this information might have influenced option and non-use values. Therefore, it is possible that some respondents unknowingly over- or understated those values based on inaccurate beliefs on how scarce or unique a particular habitat was. However, it might be noted that this limitation also operates in real markets, where consumers are rarely if ever fully informed, which economic theory nonetheless assumes.

Seventh, the travel-cost model did not account for potential costs of accommodation, vehicle purchase and maintenance costs, equipment costs, or travel cost for boat access to offshore sites. Site access by boat is considerably more expensive and increases further when boats are chartered (Pendleton and Rooke, 2007). Opportunity cost associated with travel time was also not included. Therefore, outcomes of the model are likely to be a conservative estimate.

Comparing our results with other angling or diving studies is not straightforward, as most studies have focused on tourists rather than those recreating in their own country, and there are few stated preference studies for temperate waters (Carr and Mendelsohn, 2003). Exemplary case studies for international divers elicited WTP between $7 and $63 per diver per year for dive access to MPAs (Asafu-Adjaye and Tapsuwan, 2008; Dixon et al., 1995; Park et al., 2002; Seenprachawong, 2003). A Scandinavian survey elicited non-use values ranging from $56 (Sweden) to $140 (Iceland) per angler per year (Toivonen et al., 2004).

4.3. Unfamiliarity and uncertainty in valuing MPAs

Compared to terrestrial environments, marine environments are less well understood, both by scientists and the public. Stated preference methods require that participants understand the good described. Participants' unfamiliarity with attributes can hinder the use of stated preference methods especially when participants are uncertain about their preferences for the good being valued. Experience with the non-marketed goods under valuation decreases preference uncertainty (Czajkowski et al., 2012). A general lack of experience with the marine environment makes it more challenging for survey participants to value certain benefits of marine protection (Christie et al., 2007; Czajkowski et al., 2012). Study participants were experienced divers or anglers and therefore familiar with marine features. One advantage of our experienced sample was that the number of attributes in the tasks and the detail in their descriptions could be higher than would be possible with an unfamiliar sample, or for a marine environment people are unfamiliar with, such as the deep-sea (Jobstvogt et al., 2014). Potentially, divers were more familiar than anglers with underwater habitats and other non-fish related survey attributes (Austen et al., 2011), however in focus groups anglers clearly understood the services and benefits provided by particular marine habitats, such as fish nursery sites and food sources. In our CE, anglers valued tide-swept channels – a habitat with regular supply of food that supports a rich community of marine life including fish. Conducting a similarly detailed survey with the general public is likely to be infeasible because of the cognitive challenge posed to the average respondent by processing the detailed information that our 'expert' users understood, as a result of their experience with the marine environment.

The effect of experience on the WTP of anglers and divers has been shown in the past. Moeller and Engelken (1972) found that anglers who put higher importance on the size of fish were, on average, younger, less experienced and less willing to pay for fishing than their counterparts. In a Scottish case study, respondents' dive experience and exposure to the marine environment increased their WTP for MPAs in deep waters and the non-use benefits of marine conservation (Jobstvogt et al., 2014).

In this study, we provided background information on current uncertainties about management restrictions and for the magnitude of protection (cf. Roberts et al., 2008; Wang and Rolfe, 2009). There is still substantial uncertainty around the designation outcomes for the UK MPA network in terms of the number of protected sites, when protection will start, how protected sites will be managed, how restrictions on marine activities will affect recreational users and whether marine users will comply with the restrictions (Kenter et al., 2013). There is also uncertainty about the scientific evidence base, including the ecological benefits of the MPA network. Thus, survey participants faced substantial uncertainty about the CES delivered in the future by MPAs. In the CE and CVM studies, elicited WTP is likely to be affected by how participants process and interpret current uncertainties and the risk of irreversible degradation if there is no protection (Wang and Rolfe, 2009). Possible interpretations of uncertainty and risk of site degradation might have been: (i) there is a high risk of degrading sites by not insuring sites against future harm; (ii) sites will probably be safe without protection; (iii) protection may not be effective and there is risk of paying whilst harm still befalls the sites. Such perceptions will have almost certainly influenced how participants evaluated the hypothetical scenarios, just as this would have been the case if participants were asked to pay for conservation measures for a non-hypothetical site. As a consequence of (ii) and (iii), stated WTP in the CVM may again have led to understating the value of CES of these marine sites.

5. Conclusions

Including CES values into marine ES assessment is challenging, but not impossible, and is substantially facilitated through the application of a place-based approach, and innovative combinations of multiple valuation tools. Clearly, the marine environment delivers substantial CES use and non-use values, and it is crucial that decision-making takes account of this. This study provided new evidence for impact assessment reviews by UK Governments. Providing evidence for decision-making is often an aspiration in ES research, but studies are seldom directly useful to decision making (Chan et al., 2012b). The marginal values that we estimated for hypothetical dive and angling sites under different management scenarios take *ex ante* management uncertainties into account, allowing policy makers to adapt the survey results to their needs (Kenter et al., 2013; McVittie and Moran, 2010). CES values of marine sites in combination with ecological conservation evidence is likely to be a stronger argument for protection than conserving biodiversity alone. Further research will be necessary to include other recreational beneficiaries of MPAs, such as surfers and yachters, and other threats to marine habitats and species, to better understand values and trade-offs with commercial fishing and other sectors of the 'blue economy'.

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