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Analysis

The Effects of Aquaculture and Marine Conservation on Cultural Ecosystem Services: An Integrated Hedonic – Eudaemonic Approach

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ARTICLE INFO

ABSTRACT

Understanding the cultural contributions of ecosystems is essential for recognising how environmental policy impacts on human well-being. We developed an integrated cultural ecosystem services (CES) valuation approach involving non-monetary valuation through a eudaemonic well-being questionnaire and monetary valuation through hedonic pricing. This approach was applied to assess CES values on the west coast of Scotland. The impact of scenic area and marine protected area (MPA) designations on CES values and potential trade-offs with aquaculture, an increasingly important provisioning ecosystem service in the region, were investigated. Results confirmed a eudaemonic well-being value structure of seven factors: *engagement and interaction with nature*, *place identity*, *therapeutic value*, *spiritual value*, *social bonds*, *memory/transformative value*, and *challenge and skill*. Visibility of, but not proximity to aquaculture negatively influenced housing prices. In contrast, proximity to MPAs and visibility of scenic areas increased property values. All eudaemonic well-being value factors were positively and significantly associated with scenic areas and a subset of these with MPAs. The integration of the two methods can provide decision-makers with a more comprehensive picture of CES values, their relation to conservation policies and interactions and trade-offs with other activities and services.

1. Introduction

Cultural ecosystem services (CES) are increasingly central in understanding individual and community connections to ecosystems. CES encompass a broad experiential and symbolic realm of human interactions and understandings of the natural environment (Chan et al., 2011; Fish et al., 2016; Kenter, 2016a). They are an important vector for understanding how environmental management impacts well-being (Satterfield et al., 2013); they provide avenues for building public support for ecosystem conservation (Daniel et al., 2012), but also cause conflict and contestation when they are poorly managed or undervalued in policy (Edwards et al., 2016; Irvine et al., 2016; Kenter et al., 2016c).

While CES have been defined and classified in diverse ways, there is increasing recognition that values associated with CES are intimately tied to concepts of place. Church et al. (2011, p. 674) defined CES as a "series of environmental settings". They later developed the concept of settings as spaces where people carry out cultural practices whilst interacting with nature and one another, deriving CES benefits in terms of identities, experiences and capabilities (Church et al., 2014; Fish et al., 2016).

CES are generally recognised as more difficult to monetise than other ecosystem services, which puts them at risk of being undervalued and disregarded in trade-offs and in the resolution of conflicts (Barbier et al., 2011; Carpenter et al., 2009; de Groot et al., 2005; Haines-Young and Potschin, 2010; Hirons et al., 2016; Liu, 2007; Milcu et al., 2013; Rodríguez et al., 2006), (Liu et al., 2010; Seppelt et al., 2011). CES have material, symbolic and experiential aspects, which are difficult to reconcile in any single value indicator, e.g. monetary value (Fish et al., 2016; Hirons et al., 2016; Raymond et al., 2014). These challenges have generated calls for substantial methodological innovation (Bullock et al., 2018; Daniel et al., 2012; Raymond et al., 2014; UK NEA, 2011).

In answer to this call, this paper introduces a novel integration of two methods for assessing the diverse dimensions of CES benefits and values. These are: a psychometric survey instrument, measuring multiple dimensions of eudaemonic well-being value associated with

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experiences, identities, and capabilities linked to CES, and a hedonic pricing model, measuring monetary values associated with CES through revealed preferences. Such an integration provides: 1) a more comprehensive estimate of the value of CES than stand-alone, monetary or non-monetary approaches; 2) the opportunity to investigate the convergence or divergence between monetary values and non-monetary well-being values; and 3) opportunities to quantitatively assess conflicts, trade-offs and synergies between CES and other ecosystem services, and the tangible and intangible human activities that aid in delivering them. This study considers the potential conflicts and trade-offs between CES and the provisioning service of seafood, delivered via a tangible marine industrial activity (aquaculture), and the potential synergy between CES and biodiversity conservation via the designation of marine protected areas (MPAs), an intangible activity. Due to CES being place-based, the environmental quality of an area is important in the delivery of CES (Church et al., 2014). For this reason, aquaculture, an industry perceived to worsen environmental quality whilst being valued for the provision of food and income to an area, may engender conflict with the provision of CES. In contrast, MPAs typically aim to protect biodiversity and particular habitats and species, conserving aspects of the environment which potentially enhance CES.

Section 2 introduces the CES framework that this study builds upon and provides a justification for the integration of psychometric survey and hedonic approaches. Section 3 presents the study area, the hedonic and psychometric survey methods, and the novel approach used to investigate interrelations between well-being value factor scores and the respondents' environment. The results of these methods are then presented and discussed along with the limitations of this study and policy implications.

2. Background

This study builds on the place-based CES framework that was developed as part of the follow-on phase for the UK NEA (Church et al., 2014) by Fish et al. (2016). Fig. 1 presents the UK NEA Follow-On phase conceptual framework for the linkages between cultural ecosystem

Fig. 1. Conceptual framework for the linkages between cultural ecosystem services, values and benefits.
Source: Church et al. (2014); Fish et al. (2016).
A diagram describing the conceptual framework for the linkages between cultural ecosystem services, values and benefits.

services, values and benefits in terms of identities, experiences and capabilities. This framework defines CES as benefits arising from the interactions between environmental spaces (e.g. coastal landscapes) and practices (e.g. fishing, dog walking, art, education). CES are dynamically influenced by ecosystems and in turn influence ecosystems and shared cultural values. These interactions give rise to cultural goods, including concrete marketable products, and to a broader set of benefits to human well-being. The benefits are split in to three categories: experiences (e.g. inspiration), identities (e.g. place identity), and capabilities (e.g. health, knowledge).

As another part of the UK NEA follow-on, Bryce et al. (2016) developed a psychometric instrument consisting of a set of key indicators for assessing these multiple dimensions of cultural well-being. These indicators are further developed in this paper.

Both 'green' and 'blue' spaces contribute to individual and community well-being in a variety of ways, for example through opportunities to exercise (Tzoulas and James, 2010), reduction of stress (Frumkin, 2001; Kaplan, 1995) other physical and mental health benefits (Bryce et al., 2016; Butler and Oluoch-Kosura, 2006; Hartig et al., 1991), opportunities to form social bonds and interact with one another and with nature (Bryce et al., 2016; Niemelä et al., 2010), and by contributing to an individual's sense of freedom (Bryce et al., 2016; Church et al., 2014; MEA, 2005). Once the material minimum necessary for living is secured, human well-being is largely experiential (Butler and Oluoch-Kosura, 2006). This underlines the importance of considering CES (in particular the experiential and identity aspects) when aiming to increase well-being.

It is generally attested that the contributions to well-being made by CES are difficult to capture through the use of monetary indicators (Daniel et al., 2012). Neoclassical economics conceives of well-being as utility, ultimately reflected in an agent's willingness to pay for goods (Dolan et al., 2008; Keat, 1997). This an incomplete conception of human well-being: it compresses a plurality of potentially incommensurable dimensions of the value of the environment into a single monetary metric (Kenter et al., 2015). In contrast, indicators like those used by Bryce et al. (2016) specifically investigate the nature of multiple subjective dimensions of well-being value linked to environmental benefits, to not only quantify the contribution of the environment to well-being itself through metrics which can then be compared across studies, but also to understand the way in which the contributions of the environment to well-being are structured. Self-reported well-being measures can be roughly divided in two camps: hedonic approaches, which focus on life satisfaction and affect, and eudaemonic approaches which focus on positive psychological functioning, meaning and self-realisation (Dodge et al., 2012; Ryan and Deci, 2001). Following Bryce et al. (2016), we adapt a eudaemonic well-being approach. Eudaemonic well-being values are increasingly emphasised in relation to valuing ecosystem services, including recent efforts to conceptualise relational values of nature and nature's contributions to people (Chan et al., 2018; Díaz et al., 2018). While quantitative self-reported well-being value indicator approaches do not provide the same richness as qualitative (e.g. ethnographic) approaches do, they are a cost-effective and rapid method for assessing CES and their values in a more pluralistic manner than through monetary valuation alone and they can be used at both local and larger scales (Kenter et al., 2016b). In addition, these approaches provide an opportunity to quantify the relative importance of sources of well-being in the environment itself (e.g. bio- and geodiversity and presence of charismatic species, see Bryce et al. (2016)), or the impact of tangible and intangible human activities, as is assessed here.

The integration of monetary and non-monetary measures for CES also provides an avenue to investigate the consistency between monetary valuations and non-monetary values. There are a small number of studies where stated monetary valuations were combined with the use of psychometric well-being value indicators. Dallimer et al. (2014) found broad convergence between monetary and psychometric
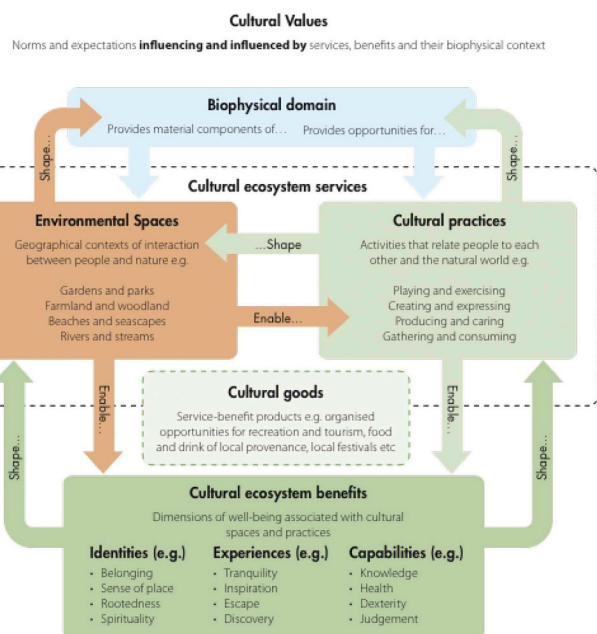
measures, concluding that the two types of measures were broadly congruent. In contrast, Kenter et al. (2016) did not find convergence at the individual level and only found congruence following extensive group deliberation, which explicitly focused on broader well-being value dimensions.

As far as the researchers are aware, only a handful of studies (see e.g. Czembrowski et al., 2016) investigated congruence between psychological well-being measures and revealed preferences for environmental goods. These studies used techniques such as SoftGIS and none of them were directly related to marine social sciences. In this study, hedonic pricing is used to estimate the influence that proximity to and visibility of MPAs, scenic areas, and aquaculture sites exercise over the market price of residential real estate assets in Argyll and Bute, Scotland. Hedonic pricing is a well-established methodology for estimating the influence of environmental amenities (such as urban green spaces) and disamenities on residential prices (Bolitzer and Netusil, 2000; Diao and Ferreira, 2010; Gibbons et al., 2014; Matthews, 2006; Morancho, 2003; Tyrväinen and Miettinen, 2000). When purchasing a property – an endeavour requiring a large financial investment – choices are influenced by many factors, not least of which are the location of the property and the quality of the surrounding environment (Bolitzer and Netusil, 2000). The revealed preferences measured through hedonic pricing are influenced by various housing characteristics, including environmental characteristics. Revealed preferences approaches, such as hedonic pricing, are generally considered less susceptible to biases than stated preference approaches such as contingent valuation (Frey and Stutzer, 2005; Liu, 2007; Matthews, 2006; MEA, 2005; Morancho, 2003).

Marine CES have been particularly under-researched but have been gaining more attention in recent years (Baulcomb et al., 2015; Bryce et al., 2016; Bullock et al., 2018; Fletcher et al., 2014; Jobstvogt et al., 2014b; Kenter et al., 2016b; Nunes and Gowdy, 2015). In this work, house prices and well-being associated with CES are considered in relation to marine and coastal environments.

3. Methodology

This section is organized as follows: firstly, the case study region and our hypotheses are introduced. This is followed by a presentation of the two methods: the well-being value questionnaire and the hedonic model. Finally, the approach used to integrate these two methods is described.

3.1. Study Area, Marine Activities and Hypotheses

The focus of this study is on the region of Argyll and Bute, Scotland's second largest local authority by area which is located on the west coast of Scotland. It is a scenic region with a spectacular coastline, rocky cliff faces, occasional pebble and sand beaches, and mountainous islands. Argyll and Bute presents the third lowest population density among the 32 Scottish local authorities, with 0.13 persons per hectare.[1] Additionally, 45% of the population of the region lives in areas classified as 'remote rural'[2] and 7% in areas classified as 'accessible rural'[3] (Scottish Government, 2014). Almost 80% of the population of Argyll and Bute lives within 1 km of the sea and almost 97% of the population lives within 10 km of the sea (Scottish Coastal Forum, 2002).

Because of its pristine waters, and as part of a wider devolved strategy to boost the local economy, Argyll and Bute has a growing concentration of fish farms. In the region, most of the farms produce

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[1] The average population density in Scotland is 0.65 persons per hectare.

[2] A population of less than 3000 and a drive time of 30 min or more from a settlement of 10,000 or more.

[3] A population of less than 3000 and a drive time of less than 30 min from a settlement of 10,000 or more.

either Atlantic salmon and rainbow trout, or Pacific Oysters (Munro and Wallace, 2018a, 2018b). Aquaculture is a marine industry that has grown rapidly in Scotland and has brought significant economic benefits to Argyll and Bute (Alexander et al., 2014). However, aquaculture may have a variety of externalities affecting CES. These may be indirect externalities such as a negative effect on water quality which reduces the appeal of the marine environment for recreational and other cultural uses (Primavera, 2006; Whitmarsh and Wattage, 2006), or direct externalities such as visual impacts or the creation of spatial conflicts. The Scottish public are to some degree aware of the negative environmental impacts of aquaculture on the marine environment, as shown by their willingness to pay a premium for farmed salmon produced in an environmentally-friendly way (Whitmarsh and Wattage, 2006). The location of marine aquaculture units across Argyll and Bute is presented in image b) of Fig. 2.

Argyll and Bute also harbours a variety of different types of protected area designations, summarised in Table 9 in the Online Supplementary Material (OSM Part A) and visualised in image a) of Fig. 2. The term 'marine protected area' (MPA) can be understood broadly but can also refer to a specific legal designation in Scotland, which covers both Historic MPAs and Nature Conservation MPAs. Other types of MPA designations in the study area include Marine Special Areas of Conservation (SACs), Marine Special Protection Areas (SPAs), and Ramsar and OSPAR (OSlo-PARis convention) sites. Table 12 in OSM Part E presents a full list of the MPAs, Historic MPAs, SACs, and SPAs used in this study. National Scenic Areas are primarily a terrestrial designation but are included in the present analysis as they include island landscapes and coastlines.

The presence of both aquaculture and protected area designations in Argyll and Bute is a wicked problem for marine spatial planning: these activities compete in their use of the marine environment, one making use of the marine environment and the other aiming to conserve current environmental quality (Halik et al., 2018; Kenchington et al., 2003). Although "traditional" aquaculture has been argued to potentially provide economic stability to areas with MPAs restricting fisheries, industrial aquaculture such as that found in Argyll and Bute is considered to cause coastal and marine pollution and habitat degradation (Le Gouvello et al., 2017).

3.2. Qualitative Well-Being Questionnaire

3.2.1. Survey Design

The well-being value questionnaire used in this study was built on an instrument developed by a large-scale prior study investigating the value of potential MPAs across the UK to recreational marine users (as part of the UK NEA (2014)), discussed in detail by Bryce et al. (2016) and Kenter et al. (2013, 2014, 2016a). The instrument comprised 15 well-being value indicators associated with a priori well-being dimensions. The indicators selected by these authors were drawn from: a range of literature sources related to research into green spaces and well-being (Dallimer et al., 2012; Fuller et al., 2007; Irvine et al., 2010), standardised items from the Monitor of Engagement with the Natural Environment (MENE; a large-scale longitudinal questionnaire in the UK; Natural England, 2012), and UK NEA research on CES benefits that contribute to well-being (Church et al., 2011, 2014) which in turn built upon the Human Scale Development Matrix (Max-Neef, 1992). As discussed by Bryce et al. (2016), exploratory factor analysis established three dimensions of well-being influenced by CES: *place identity*, *therapeutic value*, and *engagement and interaction with nature*, with three, three, and five associated indicators respectively. Three further dimensions were taken forward as single-indicator items (*social bonding*, *memory/transformative value*, and *spiritual value*), for a total of six dimensions of well-being intimately tied to CES. In this study, a revised version of the questionnaire was developed which included multiple new indicators based on the same research as the version of the questionnaire from Bryce et al. (2016). These new indicators were included
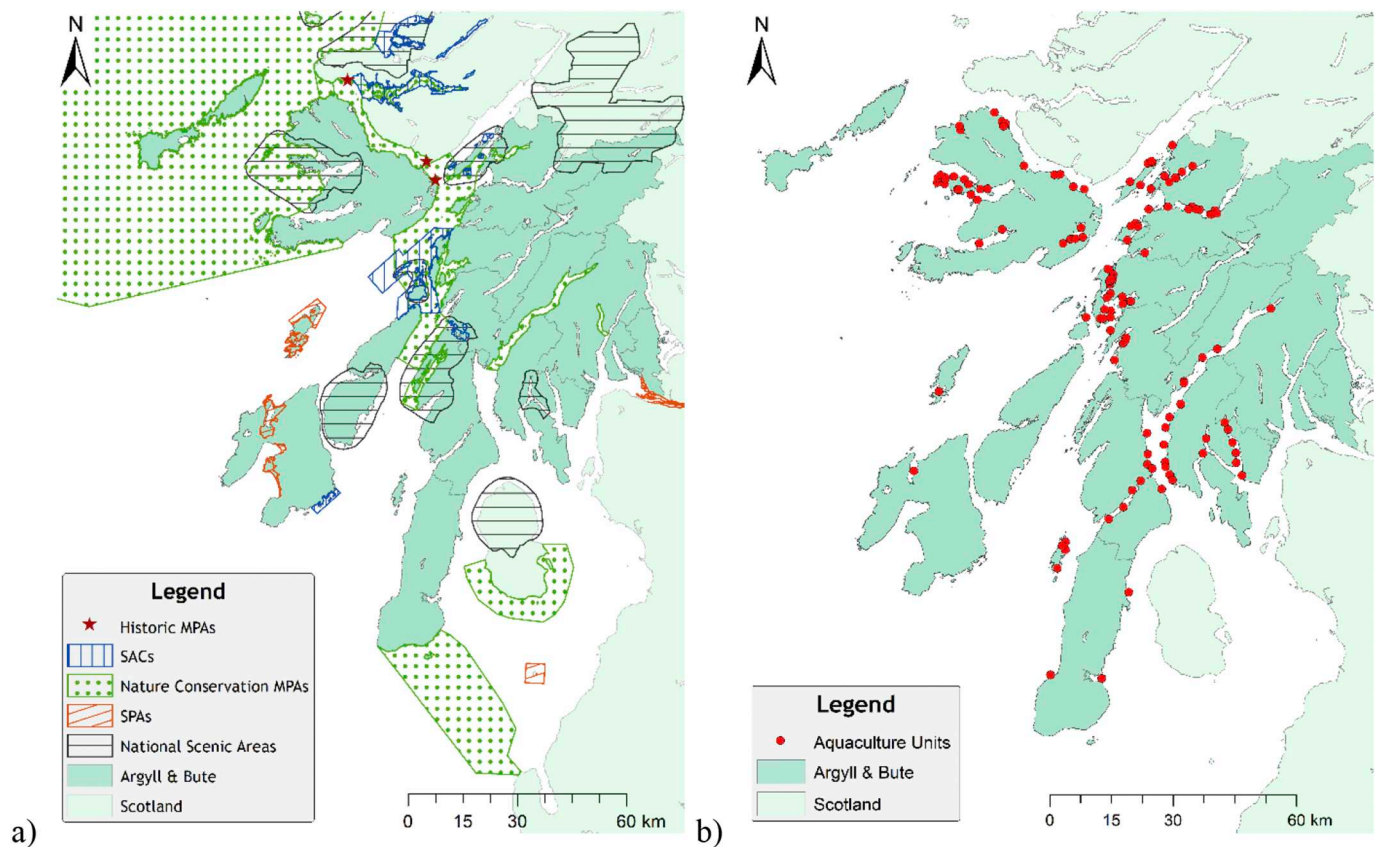
Fig. 2. Marine conservation designations and aquaculture sites of Argyll and Bute.
Two maps showing the marine conservation designations and the aquaculture sites present in the region of Argyll and Bute.

to: balance out the number of indicators for each of the six well-being dimensions, to enrich the concepts of well-being tied to each dimension, and to improve the model given the limited sample size (MacCallum et al., 1999). A seventh a priori factor related to *challenge and skill* was added to express an additional dimension of well-being on the basis of qualitative work by Kenter et al. (2016b).[4] In the design used in this study, all factors are associated with three indicators, except for *engagement and interaction with nature*, which inherited five indicators from Bryce et al.'s version of the survey (2016). All five indicators were included to allow the strongest indicators to be selected in future applications of the instrument based on results from more than one study. Table 1 presents the factors and their indicators.

The instrument was implemented through an online questionnaire, where respondents were asked to assign a value to each indicator on a 7-point Likert scale representing their level of agreement with the indicator statement (1 – Strongly disagree, 4 – Neither agree nor disagree, 7 – Strongly agree). The survey (presented in OSM Part D) also included questions on age, gender, education, employment status, and employment sector.

3.2.2. Data Collection and Analysis

Multiple approaches were used to solicit survey responses and a total of 137 survey responses were collected throughout July 2015. The initial approach was a mail out of postcards with a link to the online survey to all residents in Argyll and Bute who had bought a house between January 2014 and March 2015. A total of 1500 postcards were sent out and 30 responses were received. As the response was unsatisfactory, the sample size was increased through face-to-face

surveying of residents in Oban (the largest town in Argyll and Bute) and propagation of the survey link through social media, adding 107 responses.

Confirmatory factor analysis (CFA) was used to analyse the survey data. CFA is commonly used in the analysis of psychological questionnaires (Bryant et al., 1999), particularly in the domain of well-being (Keyes, 2006; Schimmack et al., 2002; Steel et al., 2008). CFA was used because the instrument was designed with the indicators relating to a priori well-being factors based in the literature (this is not the case in exploratory factor analysis where no a priori factors are defined). The aim of factor analysis here was to investigate whether the indicators indeed related to the well-being factors as hypothesised.

Model selection took place on the basis of chi-square modification indices (MIs). For the initial specification (*Model E1*: all 23 indicators set to load onto their corresponding 7 a priori factors as in Table 1), MIs suggested that model fit would improve by allowing "*skill3*" to load onto multiple factors. This qualified the indicator as ambiguous and the indicator was removed in a second model (*Model E2*). Correlations between all a priori factors were substantial (> 0.5), leading to an alternative, single factor model (*Model E3*: all indicators loading onto one factor). This single-factor allowed for a comparative investigation into goodness of fit to verify whether the well-being linked to CES – as measured through the questionnaire indicators – was indeed multidimensional. All three models were estimated on the basis of maximum likelihood.

Model E1, Model E2, and *Model E3* were iteratively ameliorated by allowing covariance between the error terms of various indicators based on the value of MIs. The final models were created by adding the error covariance with the highest MI to the model at each iteration until there were no MIs > 10. Model fit was evaluated for the final three models through multiple well-established indicators of goodness of fit: comparative fit index (CFI), Tucker-Lewis index (TLI), root mean

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[4] For a further discussion on the cultural dimensions of human well-being, see Church et al., 2014, p. 19.

Table 1
Indicators and a priori factors used in the well-being instrument.

Indicator code	Indicator question	A priori factors
Eng1	The natural places near my home make me feel more connected to the environment.	Engagement and interaction with nature (Eng)
Eng2	Visiting the natural places near my home has made me learn more about the environment.	
Eng3	I feel I can contribute to the care of the natural places near my home.	
Eng4	I have felt touched by the beauty of the natural places near my home.	
Eng5	The natural places near my home inspire me.	
PlId1	The natural places near my home feel almost like a part of me.	Place identity (Plid)
PlId2	I feel a sense of belonging to the natural places near my home.	
PlId3	I miss the natural places near my home when I am away for a long time.	
ThVal1	Visiting the natural places near my home clears my head.	Therapeutic value (Thval)
ThVal2	Visiting the natural places near my home makes me feel healthier.	
ThVal3	Visiting the natural places near my home gives me a sense of freedom.	
SpVal1	At the natural places near my home I feel a part of something greater than myself.	Spiritual value (Spval)
* SpVal2	The natural places near my home provide meaning to my life.	
* SpVal3	The natural places near my home help me experience my life more deeply.	
Soc1	I have made or strengthened bonds at the natural places near my home.	Social bonds (Soc)
* Soc2	Visiting the natural places near my home helps me to connect with other people.	
* Soc3	Visiting the natural places near my home helps support my sense of community.	
Mem1	I have had a lot of memorable experiences at the natural places near my home.	Memory/Transformative value (Mem)
* Mem2	Visiting the natural places near my home has changed me.	
* Mem3	I fondly remember spending time at the natural places near my home.	
* Skill1	The natural places near my home give me the opportunity to challenge myself.	* Challenge and skill (Skill)
* Skill2	The natural places near my home allow me to test my skills and abilities.	
* Skill3	The natural places near my home allow me to enjoy myself while being active.	

Indicators and factors marked with an asterisk (*) were developed for this study, other indicators and factors were adapted from Bryce et al. (2016).
The statements used as indicators in the qualitative well-being questionnaire and the a priori factors to which they were associated.

squared error of approximation (RMSEA) and standardised root mean squared residual (SRMR). Cronbach's alpha was also estimated to assess the internal reliability of the well-being dimension scales.

3.3. Hedonic Pricing Model

To understand the influence exercised by natural amenities and marine economic activities on people's choices, multiple hedonic pricing OLS regressions were employed. Model design is parsimoniously described in the following equation:

$$P = \alpha + \beta_1 E + \beta_2 S + \varepsilon$$

Where:

- P: Sold price of property.
- α: Intercept.
- E: A vector of spatial-environmental attributes, here visibility of and distance to MPAs, aquaculture sites and national scenic areas.
- S: A vector of structural characteristics, here the number of bedrooms, bathrooms, and reception areas.
- ε: The error term.

The dependent variable P is the property price standardised by a housing price index (HPI) (Acadata, 2015). All monetary values are expressed in January 2013 Pound Sterling.

The independent variables of the model were selected to examine the effects of the presence of aquaculture, MPAs, and scenic areas on the prices of properties sold in Argyll and Bute between January 2014 and March 2015. Distance to and visibility of features of interest from properties are important factors in the effect of the features on property prices and are often used as variables in hedonic models (Liu, 2007; Morgan and Hamilton, 2010). These variables included the distance to and visibility of the aquaculture sites,[5] MPAs, and scenic areas from the observed properties. The inclusion of the distance and visibility variables allow for the investigation of whether environmental protection

(MPAs), environmental beauty (scenic areas), and marine industry (aquaculture) influence revealed preferences in the housing market (and well-being, as described in Section 3.4 (Angulo-Valdés and Hatcher, 2010; Pendleton et al., 2007).

The monetary values obtained through the hedonic model (which represent the positive or negative effect of marine designations and aquaculture on property prices) may be interpreted in part as a monetary valuation of the CES gained or lost as a result of these activities. These values are useful in a management context (Muir et al., 1999; Tisdell, 1999). In combining revealed and stated preferences, as well as the analysis of conservation alongside a Blue Economy use of the water space, this work seeks to improve on the existing literature (e.g. Evans et al., 2017; Fleischer, 2012; Latinopoulos, 2018).

3.3.1. Hypotheses

Prior to analysis, a series of hypotheses regarding the effects of aquaculture and conservation designations were formulated. These hypotheses, described here, are summarised in Table 11, OSM Part C. Proximity to aquaculture activity may negatively affect the quality of CES supporting human life and well-being (be this effect through pollution, habitat degradation, etc.), though for workers in aquaculture, proximity to their place of work would be advantageous. As such, it is difficult to predict whether the effect of proximity will be positive or negative. Visibility of aquaculture sites is hypothesised to negatively affect house prices, through negatively affecting the visual amenity offered by the natural environment surrounding the purchased property. MPAs and scenic areas are central to the protection of the marine environment and its components (Agardy, 1994; Allison et al., 1998; Ranger et al., 2016). Through the protection of marine ecosystems, species, and intermediate ecosystem services such as nutrient cycling and water quality regulation, these designations can also enhance benefits of marine CES including visual amenity, place identity, opportunities to study, learn, and explore, and existence values (Bryce et al., 2016; Jobstvogt et al., 2014b; Kenter et al., 2016c). While in certain cases MPAs may also restrict access or place limits on activities such as sea angling and boating which could negatively affect CES benefits, MPAs in Argyll and Bute do not significantly restrict recreational users. It is thus safe to assume that since MPAs are typically designated to protect remarkable and diverse marine ecosystems, they

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[5] An aquaculture site refers to a production aquaculture facility or farm, i.e. the marine infrastructure, which may contain multiple aquaculture pens or cages.

can only enhance human well-being through the provisioning of CES. It is hypothesised that higher visibility and proximity of MPAs lead to increased house values. While past research has found evidence of ocean views positively affecting property prices (e.g. Benson et al., 1998), but no investigation has been made into whether protected area designations raise property values.

3.3.2. Data Collection and Model Specification

A total of 1460 property sale prices were manually collected from Zoopla (Zoopla.co.uk, 2018) for the period between January 2014 and March 2015 (inclusive). When available, the street address, town, council, date sold, price paid, property type, and number of bedrooms, bathrooms, and reception areas was recorded for all sold properties in the 24 towns and islands of Argyll and Bute. Data collection took place between the 28th and 31st of May 2015. Records of sales that did not provide the number of rooms were removed, as well as the records of properties sold multiple times in the same quarter (the most recent sale was retained).

Using the spatial analysis tools in ArcMap (Environmental Systems Research Institute, 2015) and a Digital Elevation Model of Argyll and Bute, the property dataset was completed with distances to and visibilities of aquaculture sites, MPAs, and scenic areas (these three are hereafter referred to as features of interest) from the properties in question. Table 10 (OSM Part B) presents the shapefiles used to create the map, their source, and their role in the spatial analysis conducted. Table 2 presents a summary of the independent variables used in the OLS hedonic model and their summary statistics.

The hedonic OLS model *Model H1* included all MPA types aggregated into one group, allowing the effects of any form of ecological preservation to be identified. One exploratory model was enriched with information on property location, specifically whether or not a property is situated within an urban area (settlement of 3000 people or more, as defined by the Scottish Government Urban Rural Classification (Scottish Government, 2014)). Another included each MPA type separately as independent variables. Other exploratory models tested nonlinear relationships (squared and logged) between property price and the distance to the features of interest considered. Two models (*Model H1 Lower* and *Model H1 Upper*) were run using the lower and upper halves of the property price dataset to investigate whether the effect of distance to and visibility of features of interest differed based on the price bracket of the property. Of these exploratory models, solely *Model H1 Lower* and *Model H1 Upper* provided any additional insight or improved model fit over *Model H1* and only these are discussed below.

3.4. Interrelations between Well-Being Scores and Features of Interest

A total of 53 well-being value questionnaire responses could be associated with properties in the hedonic modelling dataset using the postcodes provided with the questionnaire responses. An OLS model (*Model F1*) was designed to investigate the effect of features of interest on participant valuation of CES benefits. The dependant variable for *Model F1* was the factor score for each dimension of well-being (the model was run seven times, once for Eng, Plid, Thval, Spval, Mem, Soc, and Skill). The independent variables were distance to the nearest aquaculture site, MPA of any type, scenic area, and the sea, visibility of aquaculture sites, MPAs of any type, scenic areas, and the sea, as well as location of the property within a "small town" or "large urban area" as defined by the Scottish Government Urban Rural Classification (The Scottish Government, 2014, p. 4).

The marginal effect of the presence of features of interest on participant well-being was determined through the effect of proximity to and visibility of features of interest on factor scores. One limitation of this method was that properties could not all be linked to a specific set of questionnaire responses and certain postcodes in Argyll and Bute cover a large area. However, of the 46 distinct postcodes provided by questionnaire respondents, only 4 were over 11 km². Most properties sharing a postcode were determined to have similar distances to and visibilities of the features of interest. In cases where postcodes provided in the questionnaire responses were associated with multiple properties in the hedonic dataset, the averages of distance to and visibility of features of interest were used (i.e. if one of three properties in the hedonic dataset sharing the same postcode could see the feature of interest, 0.33 was used as the "visibility" measure).

4. Results

4.1. Well-Being Value Questionnaire

4.1.1. Sample Representativeness

Females and younger age groups were overrepresented in the survey sample when compared to the overall population of Argyll and Bute, which is not uncommon when conducting an online survey. Although the sample is not perfectly representative of the population of Argyll and Bute, the distribution is similar (albeit people older than 75 are proportionally fewer in the sample (Fig. 3)). See Table 3 and Fig. 3 for the age and gender comparisons between the population of Argyll and Bute and the survey sample.

Table 2
Summary Statistics of variables used in the hedonic models.

Variable	Description	Mean	Std. Dev.	Min	Max
Property price	Property price standardised by the HPI.	147,892.90	105,485.80	9443	930,123
Quarter t	Dummy variables informing on whether the property was sold in quarters 2–5 (0; property not sold, 1: property sold).	N/A	N/A	0	1
Distance to the nearest aquaculture site	Distance from a property to the nearest aquaculture site.	11.30	8.70	0.34	40.80
Visibility of aquaculture sites	0: no aquaculture sites visible and 1: at least one site visible.	0.12	0.32	0	1
Distance to the nearest MPA of any type	Distance from the property to the nearest MPA of any type (does not include scenic areas).	7.10	6.70	0.01	25.10
Visibility of MPAs of any type	0: no MPAs of any type visible and 1: at least MPA of any type visible.	0.21	0.41	0	1
Distance to the nearest scenic area	Distance from the property to the nearest scenic area.	15.10	9.00	0	33.90
Visibility of scenic areas	0: no scenic areas visible and 1: at least one scenic area visible.	0.04	0.19	0	1
Distance to the sea	Distance from the property to the sea.	0.67	1.60	7	13.50
Visibility of the sea	0: sea not visible and 1: sea visible.	0.34	0.47	0	1
House elevation	Elevation of the property (in metres).	23.91	22.68	0	225.19
Number of bathrooms	Number of bathrooms in the property.	1.54	0.88	1	11
Number of bedrooms	Number of bedrooms in the property.	2.93	1.20	0	11
Number of reception areas	Number of reception areas in the property.	1.43	0.93	0	11

Table notes: All distances are in kilometres.
The variables used in the hedonic model.

Age groups (% of Total Population)
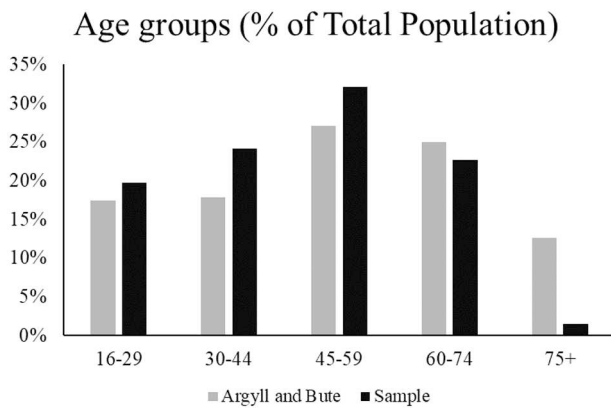
Fig. 3. Age comparison between the population of Argyll and Bute and the survey sample.

A bar graph showing the age-group distribution of the population of Argyll and Bute and of the survey sample.

Table 3
Gender composition of the population of Argyll and Bute and the survey sample.

Gender Group	Female	Male
Argyll and Bute	50.54%	49.46%
Sample	64.23%	35.77%

Table notes: Source for the Argyll and Bute population: National Records of Scotland, 2016.

The gender composition of the population of Argyll and Bute and of the survey sanple.

4.1.2. Model Testing and Results

Table 4 records the results of the goodness of fit tests for the three final models which indicate that *Model E1* and *Model E2* had good fit across all indicators except for the RMSEA (*Model E2* having best fit). These results suggest that the multifactor models of well-being were superior to the unidimensional model. Table 5 presents the Cronbach's alpha scores for the well-being value factors. All scores exceeded 0.8, indicating a high level of scale reliability for each of the factors (Acock, 2013).

Fig. 4 shows the structure of the best-fitting model (*Model E2*) after the iterative amelioration process. All indicator loadings were above 0.6, showing a strong relationship between the indicators and their corresponding factors (Acock, 2013). There was significant covariance between factors, with correlations ranging between 0.69 and 0.96; this is likely a result of the consistent positive skew across indicators (as discussed in Section 5.4.2.). Model fit was improved by allowing covariance between error terms on eight counts (as shown in Fig. 4) which can also be explained by similar patterns of skewedness between indicators. Allowing covariance, while improving model fit, led to

Table 4
Goodness of fit indicator results for the final three models.

Model	CFI	TLI	RMSEA	SRMR	χ^2	df
Thresholds	> 0.90	> 0.90	< 0.08	< 0.08	= 0	≠ 0
Model E1	0.925	0.904	0.097	0.056	457.00	198
Model E2	0.927	0.905	0.098	0.053	417.88	179
Model E3	0.904	0.885	0.107	0.067	542.13	211

Table notes: "Thresholds" are thresholds for good fit as signalled by the goodness of fit indicators (Acock, 2013). (CFI: Comparative fit index, TLI: Tucker-Lewis index, RMSEA: Root mean squared error of approximation, SRMR: Standardised root mean squared residual, χ^2: Chi-squared, df: Degrees of freedom.)

Goodness of fit indicators for the final three models.

Table 5
Cronbach's alpha scores for the well-being factors, or dimensions of well-being.

Dimension of well-being	alpha
Engagement and interaction with nature	0.92
Place identity	0.89
Therapeutic value	0.93
Spiritual value	0.89
Social bonds	0.85
Memory/Transformative values	0.84
Achievement and skills	0.91

Chronbach's alpha scores for the well-being factors.

minimal changes in factor loadings.

The final factor scores were calculated from the estimations produced by *Model E2*. Factor score averages and standard deviations are presented in Table 6 and depicted in Fig. 5. The mean of every factor was well above the mid-point of the 7-point scale (with the lowest scoring factor, social bonding, averaging at 4.8 points). This indicates that the dimensions of well-being value provided by and linked to CES were all positively experienced by the inhabitants of Argyll and Bute on average.

Standardised parameters are depicted. For the list of indicators and factors used, see Table 1.

4.2. Hedonic Pricing Model

Table 7 records the coefficient estimates for *Model H1*, *Model H1 Lower*, and *Model H1 Upper*. The two latter models are respectively the lower 50th percentile of the dataset in price, and the upper 50th percentile. This separation was made to account for differences among buyers and asset types.

Distance to aquaculture sites had no statistically significant effect on property values in any of the models, but visibility of aquaculture sites from a property had a negative effect on the property price for *Model H1*: the visibility of one or more aquaculture sites from the property lowered the property value by £20,032 (± £11,101). In *Model H1*, proximity to any type of MPA positively influenced housing prices by £1948 (± £578) per kilometre. In the price-split models, solely the values of lower-priced properties were significantly affected by proximity to and visibility of the features of interest. For the lower-priced properties, proximity to an MPA had a positive effect of £1544 per kilometre (± £205). In *Model H1*, visibility of a scenic area positively impacted property prices by £63,623 (± £27,742). In *Model H1 Lower*, proximity to the sea lowered property values by £1225 (± £664) per kilometre. Proximity to and visibility of the sea did not have a significant effect on property prices in any of the other models and visibility of MPAs did not significantly impact property values in *Model H1*. In *Model H1 Lower*, there was a positive effect of MPA visibility on property values, to the tune of £8772.678 (± £5309.6023). House elevation impacted property prices in *Model H1* by £251 (± £152).

4.3. Interrelations between Well-Being Scores and Features of Interest

The seven iterations of *Model F1* investigated the marginal benefits of distance to and visibility of features of interest on well-being (though the effect of distance and visibility on factor scores) and results are presented in Table 8. Proximity to aquaculture sites positively affected the *therapeutic value* factor by 0.020 (± 0.010) points per kilometre, the *memory* factor by 0.025 (± 0.013) points per kilometre, and the *challenge and skill* factor by 0.028 (± 0.010) points per kilometre. Visibility of aquaculture sites negatively affected all factor scores, with values between −0.928 (± 0.386) and −1.290 (± 0.644) points per additional visible aquaculture site. Proximity to MPAs of any type positively affected the *spiritual value* and *social bonding* factors by 0.046
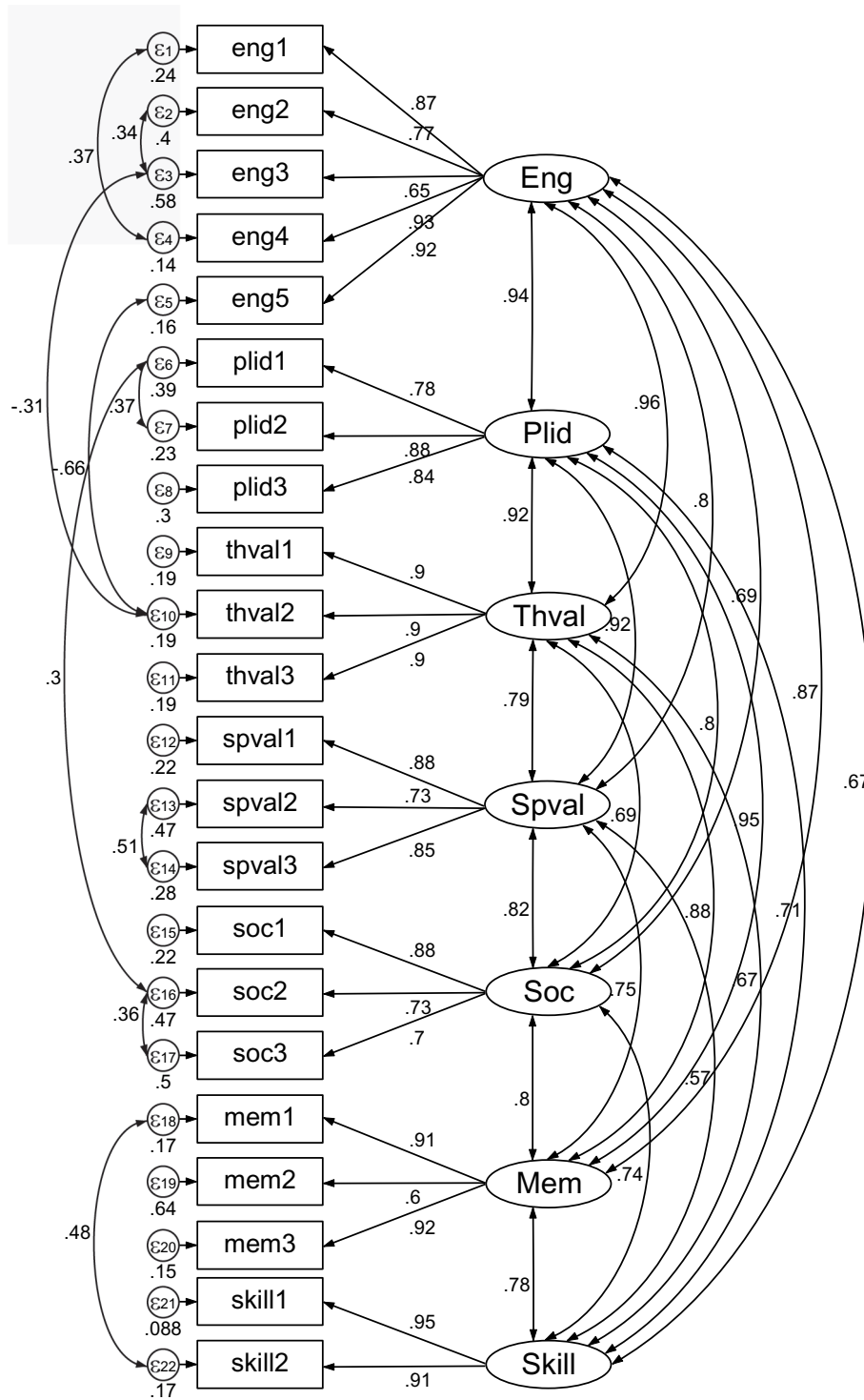
Fig. 4. Structure of the final iteration of *Model E2*.
Figure notes: The Y axis is scaled 4–7. Error bars depict standard deviations.
A diagram showing the structure of the final iteration of Model E2.

Table 6
Overall factor scores and standard deviations of each component.

	Eng	Plid	Thval	Spval	Soc	Mem	Skill
Overall factor score	5.87	5.69	6.00	5.20	4.86	5.40	5.14
Standard deviation	0.36	0.10	0.05	0.22	0.18	0.57	0.13

The factor scores and standard deviations of each component.

(± 0.023) and 0.051 (± 0.026) points per kilometre respectively and visibility of MPAs of any type negatively affected the *engagement* factor by 0.52 (± 0.31) points per visible MPA. Proximity to and visibility of scenic areas positively affected all factor scores, with proximity having effects between 0.054 (± 0.024) and 0.068 (± 0.025) points per kilometre and visibility having strong positive effects between 1.102 (± 0.588) and 1.430 (± 0.432) points per visible scenic area. The effects of living in a small town or a large urban area on factor scores,
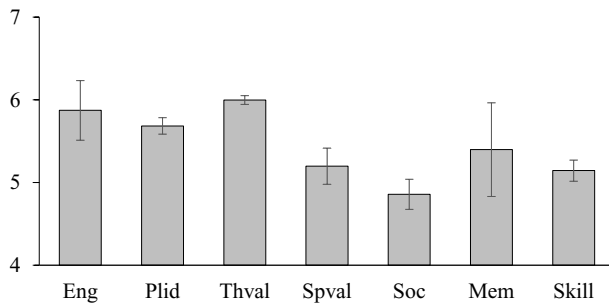
Fig. 5. Overall factor scores and standard deviations of each component. A bar graph showing the factor scores and standard deviations of each component.

Table 7
Results of *Model H1*, *Model H1 Lower price percentile* and *Model H1 Upper* price percentile.

Models Variables	Model H1	Model H1 Lower	Model H1 Upper
Distance to the nearest aquaculture site	62.61 (326.62)	146.29 (−158.78)	56.87 (−510.63)
Visibility of aquaculture sites	−20,031.93* (11,100.56)	7871.89 (−5688.34)	−14,301.73 (−14,969.29)
Distance to the nearest MPA of any type	−1948.30*** (578.84)	−1544.33*** (−205.22)	694.58 (−1169.94)
Visibility of MPAs of any type	−6181.40 (11,768.38)	8772.68* (−5309.60)	9875.43 (−17,025.68)
Distance to the nearest scenic area	−65.56 (366.45)	−490.39*** (−173.47)	168.73 (−602.01)
Visibility of scenic areas	63,622.47** (27,741.70)	801.89 (−7205.77)	55,238.08 (−33,691.56)
Distance to the sea	−1786.31 (1260.10)	1224.95* (−663.53)	−1990.44 (−1815.34)
Visibility of the sea	1801.21 (10,578.61)	−6643.83 (−5043.32)	−13,252.77 (−15,565.70)
House elevation	251.41* (152.02)	−72.84 (−78.95)	258.14 (−189.77)
Housing characteristics	Y	Y	Y
Constant	−3852.17 (16,838.66)	63,239.65*** (−7182.46)	52,327.61* (−27,497.75)
R-squared	0.46	0.25	0.30
Observations	808	405	403

Table notes: Dependant variable is the property price standardised by the HPI; *: $p < .1$, **: $p < .05$, ***: $p < .01$, Y: housing characteristics were significant and positive, see OSM Part F. All distances are in kilometres.
Results of three hedonic models.

when significant, were negative. Living in a small town negatively affected the *place identity*, *therapeutic value*, *social*, *memory*, and *skill* factors by 0.429 (± 0.254), 0.409 (± 0.218), 0.609 (± 0.297), 0.725 (± 0.279), and 0.799 (± 0.276) points respectively. Living in a large urban area had a negative effect up to five times greater than that of living in a small town on all factor scores, with values between 1.847 (± 0.398) and 2.398 points (± 0.476).

5. Discussion

In the present work, the insights provided by combining stated and revealed preferences and comparing results of each individual method were used to: 1) investigate the value of marine and coastal CES, 2) examine potential trade-offs between CES and marine activities, and 3) study the convergence or divergence of monetary and non-monetary valuation approaches. The survey results revealed that CES benefits (in the form of identities, capabilities and experiences) strongly contributed to the well-being experienced by inhabitants of Argyll and Bute. The hedonic pricing results showed that property values in Argyll and Bute were significantly influenced by both aquaculture and MPA/scenic area designations. Impacts of these activities on well-being value

indicators largely converged with the monetary results. The results of the psychometric and hedonic models are discussed below in turn, followed by a discussion of the results of the novel integration of methods. This is followed by a presentation of the study limitations, final conclusions, and implications for policy.

5.1. Eudaemonic Well-Being Value

The well-being value instrument, adapted with modifications from Bryce et al. (2016), was found to perform well despite the relatively small sample size. This was evidenced by strong indicator loadings, satisfactory goodness of fit indicators and very strong Cronbach's alpha scores. The addition of an a priori factor, *challenge and skill*, as well as further indicators for the *social bonding, spiritual value*, and *transformative/memory value* factors allowed more dimensions of CES to be fully explored. While the final multi-factor model outperformed a uni-dimensional model, the different well-being factors were all strongly correlated. This is not unexpected given the closely related and co-emergent nature of CES identities, experiences, and capabilities, which are associated with an experience of place arising from the interaction between natural spaces and human activities and practices (Fish et al., 2016).

Therapeutic value is most felt by the residents of Argyll and Bute, followed by Engagement and interaction with nature, Place identity, Memory/Transformative value, Spiritual value, Challenge and skill, and finally, Social bonding. These results differ from those presented by Bryce et al. (2016), where Memory/Transformative value was most felt, followed by Engagement and interaction with nature, Therapeutic value, Social bonding, Spiritual value, and Place identity. These differences may be explained by the modified version of the questionnaire used in this study as well as through the different populations sampled, namely: recreational divers and anglers in the Bryce et al. (2016) study; Argyll and Bute locals in this study. Recreational users were surveyed regarding the values linked to sites where they had engaged in memorable, challenging activities. These participants were likely to feel the Memory/Transformative value strongly in relation to these sites, which would account for the higher importance of this value in the Bryce et al. study. Conversely, the locals of Argyll and Bute were surveyed regarding the natural environment around their homes. They are understandably found to place more importance on Place identity, as the natural environment related to the values under question is not a site they visit on occasion for recreation, but the environment in which they live their day-to-day lives. Additionally, Argyll and Bute is home to various coastal and environmental climate change projects and policies and this focus on the natural environment can spark Place identity values (Upham et al., 2018).The relationship between the targeted population and the sites in question is wildly different in the Bryce et al. (2016) study, as the sites were spread across the whole of the UK and though recreational users were surveyed regarding areas in the same broad region as their homes, the survey did not place emphasis and importance on the areas as "home".

Engagement and interaction with nature was the second most important factor in both studies. This similarity is likely cultural, as the populations surveyed are from the UK in both studies. Additionally, there are important similarities between recreational users of the environment and Argyll and Bute locals: both groups have a strong interest in the natural environment, expressed by one group through their hobbies and by the other through their decision to live in a rural area surrounded by largely untamed nature. For the former group, their leisure activities involve engaging and interacting directly with nature. For the latter group, attachment to a place has been shown to strongly influence human behaviour, emotional responses, and cognitive processes (Axon, 2016). This is supported by previous research such as Schultz et al.'s, 2004 study, where it was found that concern regarding environmental issues is higher in individuals who consider themselves as a part of their environment. The high importance of Place identity for

Table 8

Results of *Model F1*: influence of features of interest and property location on participants' factor scores.

Models Variables	Model F1Eng	Model F1Plid	Model F1Thval	Model F1Spval	Model F1Soc	Model F1Mem	Model F1Skill
Distance to the nearest aquaculture site	−0.015	−0.017	−0.020*	−0.007	−0.011	−0.025*	−0.028***
	(0.0095)	(0.0116)	(0.0101)	(0.0137)	(0.0138)	(0.0125)	(0.0100)
Visibility of aquaculture sites	−0.928**	−1.255**	−0.948**	−1.196*	−1.170	−1.290*	−1.257**
	(0.3857)	(0.5896)	(0.3976)	(0.6084)	(0.7677)	(0.6440)	(0.5828)
Distance to the nearest MPA of any type	0.001	−0.023	0.003	−0.046**	−0.051*	−0.016	−0.026
	(0.0172)	(0.0235)	(0.0173)	(0.0228)	(0.0261)	(0.0259)	(0.0238)
Visibility of MPAs of any type	−0.516*	−0.342	−0.501	−0.389	−0.250	−0.191	−0.342
	(0.3072)	(0.4250)	(0.3138)	(0.5201)	(0.6216)	(0.4210)	(0.3673)
Distance to the nearest scenic area	−0.054**	−0.065**	−0.058**	−0.062**	−0.062**	−0.068***	−0.059**
	(0.0243)	(0.0262)	(0.0241)	(0.0271)	(0.0272)	(0.0253)	(0.0261)
Visibility of scenic areas	1.331***	1.430***	1.301***	1.367***	1.102*	1.261**	1.249***
	(0.3143)	(0.4322)	(0.3307)	(0.4755)	(0.5881)	(0.4827)	(0.4570)
Distance to the sea	−0.116	−0.117	−0.135	−0.117	−0.080	−0.133	−0.115
	(0.1130)	(0.1435)	(0.1085)	(0.1565)	(0.1919)	(0.1445)	(0.1147)
Visibility of the sea	0.009	0.064	−0.033	0.284	0.260	−0.071	0.068
	(0.3511)	(0.4466)	(0.3519)	(0.5426)	(0.6639)	(0.4539)	(0.4050)
Property located within a small town	−0.336	−0.429*	−0.409*	−0.194	−0.609**	−0.725**	−0.799***
	(0.2129)	(0.2543)	(0.2179)	(0.2626)	(0.2969)	(0.2792)	(0.2758)
Property located within a large urban area	−1.847***	−2.260***	−1.991***	−2.398***	−2.244***	−2.253***	−2.299***
	(0.3978)	(0.4621)	(0.4005)	(0.4755)	(0.4917)	(0.4831)	(0.4237)
Constant	7.292***	7.365***	7.565***	6.846***	6.527***	7.213***	7.260***
	(0.4154)	(0.4697)	(0.4138)	(0.4737)	(0.5205)	(0.4725)	(0.5054)
R-squared	0.434	0.439	0.455	0.421	0.349	0.429	0.468
Observations	66	66	66	66	66	66	66

Table notes: Dependant variables are the factor scores (Eng, Plid, Thval, Spval, Mem, Soc, Skill) *: p < .1, **: p < .05, ***: $p < .01$. Distances are in kilometres. Results of the model investigating interrelations between well-being scores and features of interest.

the local participants from Argyll and Bute likely contributes to the high importance of Engagement and interaction with nature. Future research might test variations in the type of people sampled (by activity, for example) and in participant location to tease out the individual effect of these variations on factor scores.

5.2. Hedonic Pricing Model

The hedonic models estimate significant and strong effects of the distance to and visibility of the features of interest in this study with a negative effect of the visibility of aquaculture sites on property prices and a positive effect associated with proximity to MPAs and visibility of scenic areas.

Proximity of aquaculture was not found to have a statistically significant effect on property prices, while visibility of aquaculture had a significant and negative effect on property prices. This is likely to relate to a loss of the quality of visual amenity provided by the marine environment near properties, but this loss of visual amenity may also have implications for a broader sense of loss of well-being value. The aquaculture site visible from the highest number of properties is Strone Point, operated by The Scottish Salmon Company. This company has a total of 58 aquaculture sites that have been active within the past three years. Net operating revenues for The Scottish Salmon Company were £125.9 million in 2014 (The Scottish Salmon Company, 2014), averaging out to approximately 2.2 million per aquaculture site. The Strone Point aquaculture site is visible from 8 properties and if the aquaculture site in question was not present, each property would be worth an additional £20,032 (± £11,101), equating to £160,256 (± £88,808), or 7.3% of the net profit provided by the aquaculture site. Part of this monetary value may be attributable to the value of CES to the inhabitants of Argyll and Bute. This value is almost certainly underestimated, as determining the total number of houses which have a view of this aquaculture site was not in the scope of this study.

As hypothesised, the preferred OLS model estimated a rise in property value with proximity to an MPA, as well as a positive effect of the visibility of scenic areas. Distance to and visibility of the sea were not significant in this model, which suggests that the rise in property

values attributable to the proximity of MPAs and visibility of scenic areas is not solely due to the fact that an MPA or scenic area is an area of the seascape. Although there is a premium enjoyed by water-front properties in other regions, it may be noted that most properties in Argyll and Bute are within a kilometre of the sea (Scottish Coastal Forum, 2002), possibly lowering said premium. Visibility of MPAs did not have any impact on property prices and as was mentioned in the original hypotheses, this may be due to the invisible nature of this conservation activity. Despite this invisibility, it has been found that Italian citizens are aware of MPAs and understand their *raison-d'être*, positively influencing their willingness to pay for MPAs (Tonin, 2018). This effect may be mirrored in Scotland with a willingness to pay more for a property that is near an MPAs. MPAs are designed to protect certain marine species and habitats, enhancing the overall quality of an environment and the services it provides. It is possible that knowing that an MPA is nearby affects the selection of property location, as it may be assumed that the quality of the sea close to an MPA is superior. Additionally, MPAs correlate with higher levels of biodiversity, an attribute which may be valued by homeowners in Argyll and Bute. Moreover, certain striking marine features are associated with MPAs such as the Corryvreckan whirlpool in the Loch Sunart to the Sound of Jura MPA (Burrows et al., 2017) and proximity to these features may influence homeowners. Finally, there may be correlations between geodiversity (a visible diversity of geological features) and the biodiversity that MPAs are created to protect. These more visible aspects of the conservation activity may also contribute to the effect of MPAs on property values. Based on the results of this study, the proximity of MPAs and the benefits provided (including CES benefits) may be valued at £1960 per kilometre. Scenic areas are areas selected to recognise and protect pre-existing natural beauty and the value of this CES was found to be worth £51,169.40 per property from which scenic areas are visible. Using Zoopla market report for the last 5 years (February 2020–February 2015)[6] reports as a comparison, this is 31.8% of the Average price paid (£160,407), or 27% of the Current average value

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(£187,509 as of February 2020). This significant portion of the house value is likely to be attributable to the qualities of the region; an ocean-oriented destination attracting buyers interested in accessing views of the sea. This estimate – along with the negative impact of the visibility of aquaculture – shows the value of the visual amenity CES to the inhabitants of Argyll and Bute. It must be recognised that the designations at play – National Scenic Areas and Marine Protected Areas – may also have an effect of their own on property values. However, an indicative review of property descriptions online at Zoopla (Zoopla.co.uk, 2018) does not reveal reference to these designations in the descriptions to make houses more appealing to buyers. To fully ascertain this however requires more investigation, as property agents may refer to these areas and point them out to prospective buyers during a visit or buyers may be aware of them through other means.

5.3. Interrelations between Well-Being Scores and Features of Interest

Proximity to aquaculture sites was found to have a positive effect on the therapeutic value, memory/transformation, and skill factor scores. This result is not convergent with the hedonic portion of this study and it may be due to the confounding factor of remoteness: aquaculture sites are often in desirably remote locations (Aquaculture Policy Development Group, 2002). Indeed, remoteness and removal from urban settings enhances certain aspects of well-being (Church et al., 2014). Visibility of aquaculture sites had a negative influence on factor scores for all dimensions of well-being (between 6 and 11% of the maximum score): respondents with a view of aquaculture from their homes reported feeling the CES well-being benefits of the natural places near their homes less strongly. This result supports the findings of the hedonic study. In this context, it is possible that the view of marine industry negatively affects the provisioning of marine CES, which is in line with the findings of Gee and Burkhard (2010) from their study of the effects of offshore wind farming on marine CES. Gee and Burkhard mention the links between the visual amenity of the marine environment and the "symbolic values" associated with the marine environment. Participant statements suggest strong ties between emotional responses (indicating decreases in well-being) and the perceived decrease in the aesthetic qualities of the marine environment.

Proximity to MPAs of any type had a positive influence on the spiritual value and social bonding factors, a result that supports the hedonic study findings. The central purpose of most MPAs is the protection of bio- and geodiversity and many MPAs are likely to be in a relatively pristine state compared to other marine areas. This rhymes with a sense of wholesomeness and purity which are recurring themes in spiritual well-being (McKeever and Johnson, 2000; Özdemir and Frank, 2000) and prior studies have linked spiritual values of CES to provision of clean air and water (Sangha et al., 2011) and biodiversity (Radford and James, 2013)). Our results suggest that the environments protected by MPA designations also enhance social bonding values. Visibility of MPAs also has a positive effect on the memory/transformation factor. This is likely to be the case because MPAs are outstanding environments, suitable for activities promoting where transformative experiences and strongly held memories. This was found in the integrated mixed method approach taken by Kenter et al. (2013) to assess the value of marine sites proposed as MPAs to recreational sea users: participants related a wide range of transformative experiences to MPAs. These experiences sometimes related to particularly memorable or special events – such as interactions with charismatic species such as seals – and at other times related to repeated visitation of favourite places. Finally, many of the other well-being factors could be involved in these experiences, e.g. connecting with other people, intense spiritual and aesthetic experiences, or being challenged by dangerous aspects of the environment such as tidal currents and storms.

Both proximity to and visibility of scenic areas has a positive effect on all factor scores several times stronger than the effects associated with aquaculture. In the hedonic results, visibility enhanced house prices but proximity did not. It is likely that, when houses are advertised and sold, visual amenity is conveyed more readily than experiential aspects associated with the proximate environment. Consequently, even though the results of this study overall show convergence between monetary and non-monetary valuation results, it does appear that both of these very different methods were able to portray complementary aspects of well-being that were overlooked by the other method.

Somewhat surprising was the clear difference in factor scores between residents of towns and those in a more remote location (with the latter scoring substantially higher), particularly given that all towns in Argyll are relatively small; the largest town, Oban, has a population of less than 10,000 (although this more than doubles in the summer as a result of tourism). It may be that even in these small conurbations, residents spend most of their time in built environments, interacting less with nature and thus benefiting less from its cultural services than those living more remotely.

5.4. Conclusions, Limitations, and Implications for Policy

Management of the natural environment involves the resolution of trade-offs and, more broadly, conflicts between different ecosystem services and desired social outcomes. Increasingly, new approaches are being developed for the assessment of cultural services (e.g. Milcu et al., 2013; Sherrouse et al., 2014), but it is often not made explicit how these are expected to feed into decisions, particularly at larger scales (Bryce et al., 2016; Kenter, 2016a). There has also been a lack of integration of methods to enable adequate reflection of the plurality of human values in relation to nature (Jacobs et al., 2016). The approach taken here integrated a well-established monetary revealed preferences method with a multidimensional psychometric instrument that can assess a wide range of the cultural dimensions of eudaemonic well-being value provided by ecosystems.

Positive influences on property values from the presence of marine and coastal conservation designations as well as negative links between property values and the presence of aquaculture emerged through the hedonic models. There were also positive associations between conservation designations and well-being value. These positive effects of MPA designations were surprising, given the intangibility of marine conservation and the limited knowledge that most people have of the underwater environment (Börger et al., 2014; Jobstvogt et al., 2014a, 2014b).

Failure to incorporate CES benefits in cost-benefit analysis and other types of trade-off analyses could result in an under-appreciation and ultimately the loss of natural capital – although the emerging Blue Economy industry studied here, aquaculture, has not been reported to have extensive negative environmental effects in this region. Regional benefits of aquaculture have previously been quantified for Scotland (Alexander et al., 2014; Aquaculture Policy Development Group, 2002). However, effects on housing prices have previously been relatively under-studied and suggested by as Evans et al. (2017), these effects vary regionally.

In light of issues with the replicability and generalisability of studies in social sciences, the following section is intended to support the testing and replication of this study in other regions by pinpointing the key limitations. These include: 1) limited survey responses and the limited size of the sample linking the hedonic and psychometric approaches, 2) skewed psychometric indicators, and 3) clarifying the cause-effect relationships in the hedonic model.

5.4.1. Sample Size

A low number of responses to the survey may result in lower reliability of the results. Type II errors occur with small sample sizes, which may explain the divergences between the hedonic and survey results. The small sample size and recruitment methods also lead to issues with the representativeness of the sample. However, the

development of the instrument undertaken here has been successful and the tool could be further improved for future studies. The sub-sample linking the hedonic and psychometric studies is smaller still, leading to the same types of errors. Nevertheless, the results of this novel model which links the effects of the features of interest on factor scores were mostly in line with the results of the hedonic model, with differences potentially providing some valuable insight.

5.4.2. Skewed Indicator Results

The distribution of responses on the 7-point scale showed a negative skew and values 2 and 3 were almost never selected. Values above 3 were selected 80%–93% of the time and of values 4, 5, 6, and 7, value 7 was selected 44% of the time. Responses 2 and 3 were selected in only 7% of cases overall. Impressions gained from surveys carried out in person suggest that many of those who did not appear to agree much with a statement preferred to assign a value of 4 or 5 than a lower value. This could indicate some acquiescence bias, but it also suggests that the instrument is more suitable to eliciting a response in terms of a strength of agreement, rather than a conventional Likert agree/disagree scale. Alternatively, the indicators could be reworded to be suitable for a scale of importance rather than agreement. Future studies could experiment with and compare the use of different scales in terms of their ability to reduce skewness and gain more variation.

5.4.3. Cause-Effect Relationships

The main limitation in a hedonic valuation study of this type is clarifying the cause-effect relationship for the correlations observed. This could be achieved through further study, for example using a panel dataset and the dates of establishment of the features of interest. However, it is extremely unlikely that property prices influence decisions on the location of MPAs, as these are established due to environmental concerns. As for scenic areas (of which buyers are more likely to be aware than MPAs, as scenic areas are marked on road maps, and which real estate agents are more likely to advertise in the description of houses) it is difficult to differentiate the effect of the high quality of the environment within such areas and the 'branding' effect of the designation. Another limitation which may have affected the precision of the results is that certain relevant housing characteristics such as property age and surface area of the property, or availability of a garden, were not available through this data collection method.

5.4.4. Policy Implications and Future Research

Despite these limitations, the integrated monetary/non-monetary valuation method is easily reproduced, rapid, and can be carried out at relatively low cost. The approach is capable of extracting contextual and region-specific information and can more easily be used at large scales than qualitative and participatory methods for assessing cultural ecosystem services (for an overview, see Kenter, 2016b). Additionally, the combination of methods recognises a degree of value plurality and incommensurability that would be lost when using a monetary approach on its own. Further research is needed in other geographic and cultural contexts to further refine the instrument and in order to test the breadth of its applicability.

The policy implications of this research suggest that there is substantial hidden economic and psychological value to marine conservation for residents of areas proximate to this conservation. The economic value is expressed in the form of higher housing capital stock values. This study provides a more complete understanding of non-monetary benefits though the eudaemonic approach, as suggested by Ryan and Deci (2001). Prior research has primarily demonstrated value to users (e.g. Jobstvogt et al., 2014b; Kenter et al., 2016b), or non-use value to the public (e.g. Börger et al., 2014; McVittie and Moran, 2010), rather than broader values to residents. Such evidence can be used to defend and justify the costs of marine conservation to other sectors (particularly fisheries). In terms of aquaculture, these results suggest that further analysis is needed from surrounding regions to assess whether

Scotland (or the United Kingdom) displays the same degree of spatial variation in the effects of aquaculture property values as has been found in previously studied regions. Furthermore, these results highlight the importance of considering equity implications as much as efficiency and invite deliberation on the distributional impacts of aquaculture, as well as how values should be aggregated across and within dimensions of value (see Kenter et al. (2015, 2019) and Turner (2016) for a theoretical discussion of these issues).

Finally, further studies on marine and coastal CES are necessary to compare results and strengthen the certainty and validity of the findings of this research. An example of this would be a study investigating the cause/effect relationship of the interactions determined here using time series data. These studies use both monetary indicators such as property prices and income-neutral indicators to obtain a full picture of the different values of CES, ensuring that less affluent voices are also heard.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ecolecon.2020.106757.

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