Assessing public preferences for deep sea ecosystem conservation: A choice experiment in Norway and Scotland

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Abstract

Recent events around the world have revealed varying degrees of public support for climate change and environmental regulation. Applying a latent class logit model, this study investigates Norwegian and Scottish publics economic support for proposed deep sea management policies for novel attributes and identifies the presence of preference heterogeneity. Marine litter and health of fish stocks were the attributes with the highest values in absolute terms. This was followed by the size of the protected area coverage, whilst the creation of jobs was the least valued. The results highlight public support for the further collective action required by the EU in moving beyond the 2020 objective of achieving good environmental status of Europe's seas, even after considering the low WTP values of the minority classes in each country.

Keywords: Ecosystem services, deep sea, latent class choice model

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1. Introduction

Environmental valuation studies over the previous decades have raised awareness of the public's willingness to pay for environmental non-market goods and services (Boyer and Polasky, 2004; Togridou, Hovardas, and Pantis, 2006; Czajkowski et al., 2017; Davis et al., 2019) arguing for the need for environmental regulations and policies. Globally, this is reflected in large scale reactions in relation to climate change and biodiversity loss. In the early 1970s, many proponents of environmentalism were characterized by protecting environmental quality as a politically consensual issue (Dunlap and Gale, 1974). Some early studies, therefore, found little if any ideological or partisan differences in environmental concern among members of the general public (Buttel and Flinn, 1974). However, the world saw a noticeable divergence in political support for climate change between liberals and conservatives (or right-wing adherents being more likely to deny climate change and oppose policies aimed at mitigation) in the general public, particularly in the United States from the early 1990s (Dunlap et al., 2001; McCright and Dunlap, 2011). Climate change has been strongly contested and increasingly politicized since its emergence on the national agenda, especially when specific policies such as the Kyoto Protocol were being considered (Dunlap and McCright, 2010). Based on the party sorting theory, such political differences among elites will likely extend to the general public (McCright, Xiao and Dunlap, 2014) and can inhibit further development and implementation of environmental policy.

Recent events around the world have also shown that there exist strong minorities in many countries that are not necessarily willing to pay for environmental taxes and other types of management. This was most violently illustrated by the "yellow vests" (*gilets jaune*) uprising in France in 2018, as a reaction to a proposed environmental fuel tax inspired by the Paris climate accord of 2015. Such a reaction is exacerbated when the burden of environmentally friendly policies is believed to be borne by the least prosperous in society. Another example was the establishment of the successful "No-to-toll-roads party" in Norway in 2019, a reaction against proposed city toll roads aimed at increasing collective travel and reducing pollution. In contrast, in the UK, environmental activists such as the Extinction Rebellion want to force political leaders to take action on the climate emergency. These examples illustrating divergent views in the environmental debate are also increasingly visible in other aspects of public life, as reflected in the Trump election in the US and Brexit in the UK.

The presence of such strong minorities and their reactions is in line with Daniels et al. (2013) who indicate that the public is not “for” or “against” environmental protection, but public opinions depend on the environmental issue in question. Public opinion and preferences play a critical role in shaping policy choices particularly in areas where government action has direct consequences for citizens. In this study, we assess public preferences for deep sea management policy scenarios among the public of Scotland and Norway. Specifically, we evaluate the general public’s preferences and trade-offs for sustainable blue growth reflected in additional marine protected area (MPA) designation, improvement in fisher stock health and environmental quality, as well as an increase in economic activity of the deep-sea environment. The resource under evaluation, the deep sea, presents unique characteristics by being the largest biome on earth yet the least studied territory, and a seemingly remote habitat that is out of reach to the ordinary citizen. The central question then, is, whether people are willing to pay to support policies that support deep sea conservation and if these preferences vary within the general population. This is a critical question given the anthropogenic pressures that threaten deep-sea ecosystems and the services they provide (Huvenne et al., 2016; Puig et al., 2012; Pusceddu et al., 2014).

We apply latent class analysis on stated preference data to identify heterogeneous groups and discuss the policy implications of this. We characterise groups using soccio-economic characteristics and follow up question responses collected during the stated preference survey. We focus on public policy preferences for management of the deep sea derived from the two European Union policies, namely: The Blue Growth Strategy (2012) and the Good Environmental Status of Marine and Coastal waters within the Marine Strategy Framework Directive (MSFD, 2008). Consequently, the survey considers public preferences for deep sea value attributes rarely studied previously: management of marine litter, the health of fish stocks, the size of marine protected areas (MPAs) and creation of blue economy jobs. The identification of heterogeneity in WTP across two countries provides an understanding of the nature and drivers of public positions on environmental protection support. This is a crucial social science contribution towards developing effective responses to the challenging problem of environmental policymaking.

The remainder of the paper is organized as follows: section 2 provides an overview of deep sea valuation; section 3 presents the method used in the design and analysis of the survey, section 4 provides the results and section 5 presents the discussion and concluding remarks.

2. Discrete choice experiments and the marine environment

To investigate whether there is heterogeneity within environmental values of deep sea ecosystem benefits, we employ discrete choice experiments to assess public preferences and willingness to pay for new management options for two deep sea ecosystems: the Mingulay Reef Complex, Scotland and the Lofoten-Vesterålen (LoVe), Norway. Compared to terrestrial and coastal ecosystems, there is a lack of literature valuing the marine environment. Studies such as Wattage et al. (2011), Glenn et al. (2010), Ressurreição et al. (2010), Brouwer et al. (2016) find mixed evidence of the existence of WTP for deep sea conservation management using models which do not capture preference heterogeneity.

In this paper, we use the choice experiment approach to examine the trade-offs when balancing the development of marine-related commercial activities with the "health" or environmental quality of Europe's deep-sea wildlife and habitats. Assessing the benefits of these management scenarios to the public is particularly important given that the EU's Marine Strategy Framework Directive (MSFD) requires achieving Good Environmental Status (GES) of the EU marine waters by 2020 (Directive 2008/56/EC). GES is defined as "the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive". The MSFD has been implemented since 2008 and aims to move marine management from a species-specific focus and instead implement an ecosystem-based management approach that includes new measures for deep sea management. These new marine environment management scenarios can result in externalities that have non-market values. Therefore, non-market valuations techniques such as the stated preference approach using discrete choice experiments can help evaluate these impacts and lead to socially optimal decisions for policy makers.

Under continuous distribution assumption of marine environment attributes, McVittie and Moran (2010) identified significant average WTP for halting the loss of, or increasing environmental benefits and biodiversity when evaluating the UK Marine and Coastal Bill. Jobstvogt et al. (2014) identified the presence of varying preferences and significantly positive average WTP for high medicinal potential and protection of deep sea species. Aanesen et al. (2015) evaluated the world's largest concentration of cold-water coral and identified high average WTP (range of €274 to €287) among Norwegian participants for the size of the protected area, attractiveness for oil/gas and fisheries activities, and importance as a habitat for fish. The most recent being Armstrong et al. (2019) who found that the Norwegians and Irish were willing to pay average values of NOK341 and NOK424 for a small and large increase in protected areas respectively. Norwegians expressed a stronger preference for the pure existence value of cold water corals than the Irish, and the Irish were also less willing to trade-off industrial activities than the Norwegians.

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Assuming the discrete distribution of attribute parameters as a way of latently clustering the population, Kermagoret et al. (2016) and Börger and Hattam (2017) have studied marine offshore areas. In their study regarding recreational users of the Bay of Saint-Brieuc where an offshore wind farm was planned, Kermagoret et al. (2016) identified two distinct groups regarding preferences for environmental offset and welfare compensation. Class 1 was guided by a rejection of monetary compensation in the form of subsidy provision while class 2 preferences were more focused on environmental attributes of compensation. The respective class membership structures were associated with other recreational users and users of wildlife observation.

Börger and Hattam (2017) evaluate preferences for conservation of a marine protected area on the Dogger Bank, a shallow sandbank in the southern North Sea and identify three distinct class preferences. Class 1 members in their study were only concerned about invasive species, class 2 members had significant WTP for all non-monetary attributes while class 4 and class 3 were the most irregular and had the lowest WTP value estimates.

In a study regarding temperate coastal MPAs Ruitz-Frau et al. (2019) identified societal preferences and economic support with three defined opinion groups in Wales (UK). They were distinct in respect of those who favour fishing activities within the MPAs (class 1 and 2) and those who oppose (class 3). In terms of the area covered by the MPA network, 20% of respondents supported it (class 2 and 3) and those who opposed it (class 1). Wallmo and Edwards (2008) also identified three classes of respondents' preferences for MPA size that suggest that while protecting areas as ecological reserves are utility increasing for most size/use combinations, smaller reserves with liberal use policies produce the largest increases. Diminishing marginal utility for MPA sizes was identified.

Class based modelling of marine ecosystem services has been studied to a limited extent, and lags behind substantially in studies of deep sea ecosystems that are more remote, despite their wide application in other ecosystems (see e.g. Garrod et al., 2012; Roberts, Hanley, and Cresswell, 2012; Karlõševa et al., 2016; Semeniuk et al., 2009; Hynes, Tich, and Hanley, 2013 among others).

2. Empirical Approach

2.1 Case study area overview

The survey attempted to understand public preferences for deep sea marine management for two case studies. For Scotland, our study focussed on the Mingulay Reef complex. This is found off the west coast of Scotland at a depth of 100-200m, 8.7 miles east of the Island of Mingulay in the Sea of the Hebrides (Figure 1a). For Norway, our study focussed on the Lofoten-Vesterålen (LoVe) reef. The islands of LoVe are part of an archipelago north of the Arctic Circle in Northern Norway and described as the gateway to the Barrent sea (Figure 1b). Both of these case studies are recognised for their cold water corals and contribution to deep sea ecosystem goods and services. Both sites exhibit similar biodiversity characteristics; hence we used the same attributes and levels for designing the two surveys.

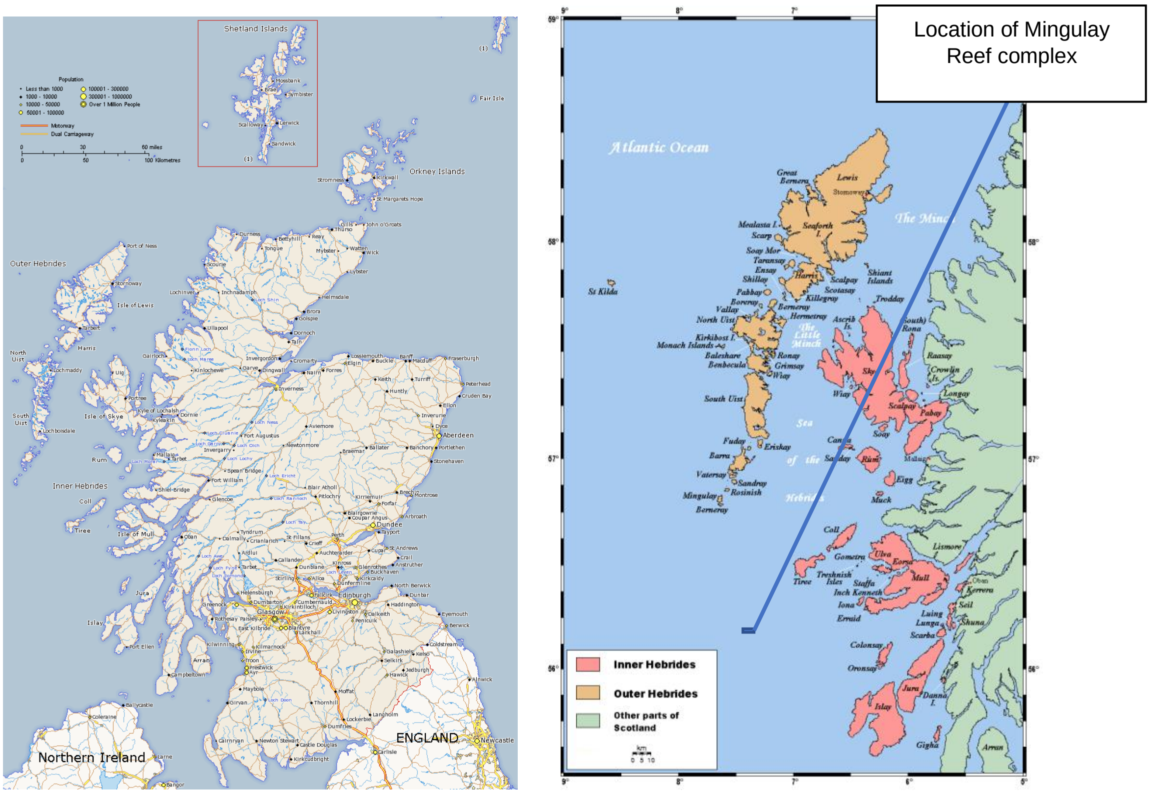

Figure 1a The Mingulay Reef Complex

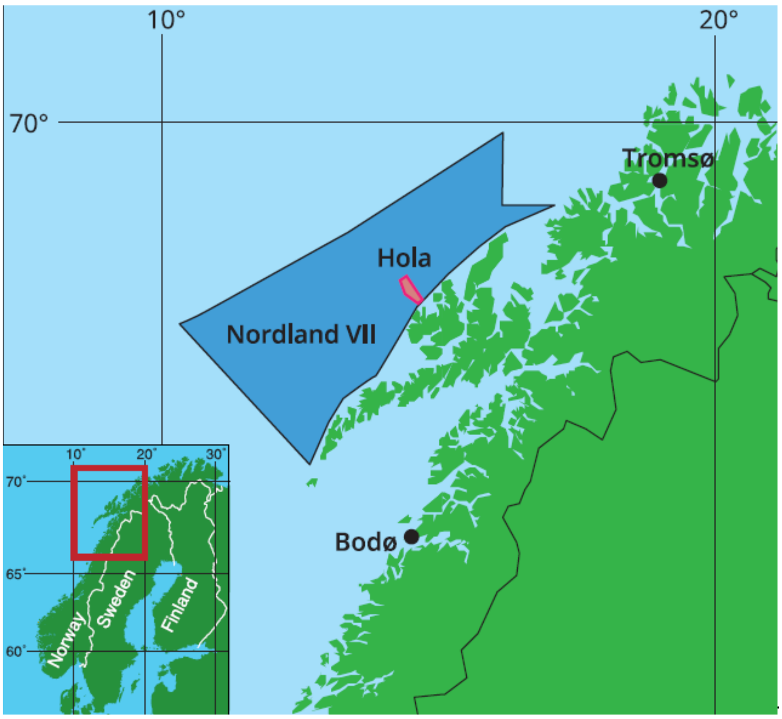

Figure 1b The Lofoten-Vesterålen

DCE were used to elicit the public's preferences for management options in the deep sea for Scotland and Norway. The choice card alternatives were designed such that they helped reveal the public's preferences regarding future management options. All alternatives, excluding the status quo, assumed an improvement in marine environmental status and ocean economy (blue growth), consistent with the current and future situations in the respective countries where the good environmental status of the deep-seas and wildlife is being actively pursued along with targets for ocean economy expansion as envisaged under the EU Blue Growth Strategy.

The alternatives for the future management scenarios were generated based on a Bayesian D-efficient design using priors from a pilot online survey in each country and optimized for a multinomial logit model (Scarpa and Rose, 2008). The implemented design comprised 16 choice cards that were randomly blocked into two of eight choice tasks per respondent. Respondents were randomly assigned to one of the blocks.

Each choice task was composed of three deep-sea management scenario alternatives, described by several attributes taking on a finite number of levels. Two of the alternatives proposed new management plans and the third alternative referred to the current management plan and current ecological status of the ecosystem system (the status quo). In each task, respondents were asked to choose their preferred alternative. Respondents were instructed that by selecting options other than the status quo, they would incur additional financial costs while the status quo never involves a payment. They were further instructed to consider the impacts of deep-sea management on themselves and their families, the amount of money available in their budget considering all other expenses and imagine “actually paying” the specified amounts and their ability to pay. So that cost could be compared between the two surveys, a purchasing power parity adjustment was implemented for the chosen levels of the cost attribute in the two surveys. An example of the sample choice card as presented to respondents is shown in Figure 2.

Each alternative management scenario was described by five attributes, including a monetary attribute that was defined as the additional cost (in unit currency) per person per year payable in the form of an increase to annual personal income tax rates over a 10-year period and 'ring-fenced' into a secure marine fund. The four non-cost attributes related to different deep sea management options in relation to the EC Blue Growth Strategy (2012) and Good Environment Status within the Marine Strategy Framework Directive (MSFD). The attributes and corresponding levels were chosen based on expert opinion and best available scientific evidence from marine scientists within the EU ATLAS Project which was developing indicators of deep sea GES[11]. The attributes were comprised of: the health of fish stocks, amount of marine litter, size of the protected area, and creation of new marine jobs The survey explained to respondents that different levels of each of these attributes could be delivered as part of a new deep sea management plan: i.e. more or fewer jobs, more or less marine litter, healthier fish stocks and a larger protected area. Respondents were encouraged to think about different "bundles" of these aspects of management, and as a taxpayer, how much they would be willing to pay for these different management aspects. It was made clear that any choice apart from the status quo would need to be funded by the taxpayer. This would take the form of an increase to annual personal income tax rates over a 10 year period and 'ring-fenced' into a secure marine fund. A description of the attributes and their levels are presented in Table 1 and further information about each attribute is described in the following paragraphs

[1] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/24499 and https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/14286;keyword=ATLAS%20Policy%20Brief%20on%20MPA%20network%20design;isExactMatch=false

SCENARIO 1		Option A	Option B	Option C (current management)
The health of commercial fish stocks		**High:** 80% of commercial stocks at healthy stock levels	**Moderate:** 50% of commercial stocks at healthy stock levels	**Low:** 40% of commercial stocks s at healthy stock levels
Density of Marine litter		**Moderate** (2 to 3 items of litter per km²)	**Good** (0 to 1 item of litter per km²)	**Poor** (4 to 6 items of litter per km²)
Size of protected area		**3% of the area of Nordland VII**	**7.5% of the area of Nordland VII**	**0.5% of the area of Nordland VII**
Marine economy jobs created from sea based commercial activities in the area		**+ 40 jobs**	**+ 20 jobs**	**No employment change**
Additional costs (per person per year)	**NOK**	**NOK 450**	**NOK 600**	**NOK 0**
Your choice for scenario 1 *(please tick A, B or C)*		☐	☐	☐

Figure 2 Sample choice card (Norwegian version)

Fish are among the main natural resources provided by the sea. Approximately 30% of fish stocks have been overfished/overexploited as a result of excess fishing capacity (FAO, 2018), and hence management is required in order to secure harvesting at a sustainable level (Worm et al., 2009). One requirement of GES is that the "population of all commercial exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock". Therefore, fish health is chosen as one attribute in the DCE survey, presented as the health of commercial fish stocks which is measured by the number of adult fish compared to young fish, following the criterion that the more adult fish, the healthier the population.

Marine litter is a global concern that may have ecological and economic damaging effects on the seabed and in the water column (Deudero and Alomar, 2015). Litter is known to be widely distributed on the seabed (Pham et al., 2014). The primary source of deep sea based litter is from fishing such as discarded fishing nets, and shipping (Macfadyen, Huntington and Cappell, 2009). Preventative measures will be needed to reduce the levels of litter in the deep sea.

The third attribute included in the DCE is the size of the protected area. One measure for achieving GES identified in the Directive is the establishment of a representative and coherent network of marine protected areas (MPAs) which should adequately cover the diversity of the constituent ecosystem together with existing MPAs. Vulnerable Marine Ecosystems such as cold water corals and sponges are protected under the EU Habitats Directive from the harmful impacts of human activities such as bottom trawling. Hence, the size of the protected area is chosen as the third non-cost attribute.

The fourth non-cost attribute chosen for the DCE design is marine economy jobs. The EU Blue Growth Strategy (2012) recognises that the European seas and oceans are central to the European economy with great potential for innovation, economic growth, and job creation. In the North Atlantic, there are potential opportunities to further develop industries such as fisheries, eco-tourism, oil/gas exploitation, cable routes, renewable energy, biotechnology of deep sea creatures and shipping. It is possible that the development of these areas will provide local/international employment. There is also the potential to rebuild depleted fish stocks (for example cod) or collapsed stocks such as the northern prawn. There could however be trade-offs between developing the area commercially and protecting deep water corals, sponges and associated marine wildlife. For example, new installations may damage the sea bed when being anchored or disrupt the ocean currents in the area that feed the coral reefs and the fauna they support. Within the environmental valuation literature, it has been shown that respondents are motivated by both environmental and economic factors when responding to surveys (Aanesen et al., 2018; Blamey et al., 2000; Blamey, Common, & Quiggin, 1995). The most popular economic factor that has been used in environmental valuation surveys is jobs that are framed in the concept of the non-use value of employment (Aanesen et al., 2018). For this DCE we choose three job levels: no change, an increase of 20 and an increase of 40 jobs. This reflects the small scale of the two case studies and the job potential these offer.

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3.2 Econometric Model

The theoretical foundation of the econometric approach to discrete choice experiment comes from the random utility framework (McFadden, 1974) and consumer choice theory (Lancaster, 1966). Consumer choice theory assumes that individuals derive utility from the observed features of the good, here, features of the marine management scenarios. Random utility theory also assumes that individuals would choose one alternative over another when the utility derived from the chosen alternative is higher. Under these assumptions, the analyst can identify the respondents' preferences based on their discrete choices in a survey by decomposing the utility of choice into two components: the deterministic or systematic term and an idiosyncratic error term. The idiosyncratic taste shock is independent and identically distributed Type 1 Extreme Value.

The simplest model for characterizing utility of choice is the multinomial logit model (MNL). However, the MNL always assumes independent and irrelevant alternatives (IIA) assumption, but the assumption may not hold for a given dataset. The random parameter logit (RPL) and latent class logit (LCM) models have evolved to be the most preferred alternatives as they relax the IIA assumption and in addition account for preferences to be heterogeneous in the population following some distribution $g(.)$. The RPL assumes continuous distribution of parameters but in this study, we employ the LCM which assumes a discrete distribution of preference parameters such that individuals with similar preferences are sorted into one specific class modelled around the sources of heterogeneity. The sorting of individuals into classes is essential and practical for policy design.[2]

Considering the LCM, the choice probability that an individual n of class s chooses alternative i from a particular set J, which comprises j alternatives, can be expressed as (Greene and Hensher, 2003):

$$P_n(i) = \sum_{s=1}^{S} L_{ni|s}\ H_{ns}$$

where $L_{ni|s} = \frac{exp\ (\beta_s' X_{in})}{\sum_{j=1}^{J} exp\ (\beta_s' X_{jn})}$ and $H_{ns} = \frac{exp\ (\gamma_s' Z_n)}{\sum_{s=1}^{S} exp\ (\gamma_s' Z_n)}$ for $s = 1, \dots, S$. From these equations, $L_{ni|s}$ denotes the multinomial logit expression for probability of choosing alternative i within the classes. H_{ns} is the class membership function from the standard logit formulation denoting the probability of person n belonging to class s. The parameter β_s' represents the class specific parameters associated with a vector of attributes X_{iq}. Additionally, the classification model is a function of some individual-specific attributes Z_n, used to explain the heterogeneity across classes with the corresponding parameter, γ_s'. The individual-specific parameters for one of the classes is normalized to zero to secure identification of the model.

The most challenging aspect of the model identification is determining the optimal number of classes given that this is not a parameter to be estimated. Often variants of information criteria are used, but solely relying on information criteria can lead to intractable parameter estimates. We follow recommendations by Scarpa and Thiene (2011) and look for mixes of information criteria, theoretical insights (e.g., looking for negative cost parameter) and model parsimony.

Following the identification of class specific preferences, we use the delta method to estimate the welfare estimates. The welfare gain, i.e., the WTP to secure a positive change is the compensating surplus derived from Hicks (1943). Following Freeman (1993), this welfare measure can be expressed as: $u(Q^0 M^0) = u(Q^1, M^0 - CS)$ where u is the indirect utility function, M is income, Q is the non-market good, and superscripts 0 and 1 refer to before and after provision of the non-market good. Empirically, the welfare estimates of the attributes were obtained by computing the class specific marginal willingness to pay (WTP) estimates as the ratio between the coefficient for each attribute and the price coefficient.

The WTP for attribute j in class s is:

$$\widehat{wtp_{sJ}} = -\frac{\hat{\beta}_j}{\hat{\beta}_{cost,s}}$$

Moreover, we also compute the weighted average WTP (WAWTP) estimates defined as (Scarpa and Thiene, 2011):

$$\overline{\widehat{wtp_J}} = \sum_{s=1}^{S} \widehat{wtp_{sJ}} * \widehat{w_s},$$

where w_s is the class share estimate. The WAWTP are then compared to see how different they are from MNL WTP estimates. The model was estimated using the “gmnl” package in R (Sarrias and Daziano, 2017) which showed consistent parameter estimates with NLOGIT.

3.3 Survey Implementation

The first draft of the survey was designed by the authors, with the management plan scenarios and attributes chosen with deep sea marine scientists and ecologists as part of the EU ATLAS project. We aimed to relate the attributes to current EU Marine policies, as such, the choice of attributes and levels was governed by attributes most suited to these policies and the levels chosen based on expert scientific knowledge at the start of the project in 2016. We then undertook extensive focus group testing in Norway and Scotland. The first focus group was held in Norway with 5 academic colleagues to establish the order of the survey and how understandable it was. Public focus groups were then held in Scotland. Two focus groups were held in Scotland consisting of 10 people per focus group. The discussion was centred on whether the survey was engaging, meaningful and applicable to them. The first public focus group highlighted that the use of scientific language in the discussion of the attributes was particularly off-putting and needed to be re-thought. The survey was then re-written and revisited in the second focus group. This allowed checks to be made on the understanding of the choice experiment format and that respondents were motivated to answer seriously and thoughtfully. Using this revised survey, a representative public focus group was held in Norway consisting of 30 persons recruited by an opinion polling company.

Following the focus groups, the questionnaire was then updated and used for the pilot surveys in both countries to get the priors that were used in the final design The surveys were then finalised and approved by the research ethics committees at the University of Edinburgh and Norway.

The survey was implemented online through market research companies that drew from a registered online panel of respondents in Scotland, and via phone recruitment in Norway. The Mingulay-Scottish survey was conducted in January 2019 and lasted over a 4-week period, while the LoVe-Norwegian survey was conducted in March 2019 and lasted over a 3-week period. The samples were required to be representative of the populations in relation to gender, age and geography. A total of 1,025 and 1,024 respondents took part in the Scottish and Norwegian surveys respectively. The socio-demographic characteristics of the respondents are provided in Table 2. The Norwegian sample has a somewhat higher male share (57.2%) compared to the national average (50.4%), and a lower share in the youngest group (18-35 years), but a higher share in the middle (36-55 years) and oldest group (over 55 years) compared to national shares of 30.5%, 34.3%, and 35.2% respectively. Respondents in Norway are skewed in terms of tertiary education (i.e., sample share of 86.4% compared to the national average of 33.9%). The share of tertiary education in Norway is biased upwards due to the inclusion of the "professional/vocational training group". The exclusion of this group leaves tertiary education at approximately 76% of the sample. The Scotland sample has a lower male share compared to the National Average (49%). The 18 – 35 group was underrepresented compared to the national share of 28% with both 36-55 and >55 being oversampled compared to national shares (34% and 37% respectively).

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4. Results

Analysis of the data from the discrete choice survey revealed the presence of protest respondents. Protesters included those who chose the status quo in all 8 choice cards and stating reasons that reflect that they do not have a genuine WTP of zero. As a result, the analysed sample excluded these respondents, leaving us with a total of 994 respondents for the Scottish sample and 966 respondents for the Norwegian sample. Table 3 shows the side-by-side LCM preference space estimation of the Scottish and Norwegian Surveys. Following Scarpa and Thiene (2011), a two-class LCM was identified for each survey. The two-class was selected because for more than two classes, though they showed a slight improvement in information criterion, resulted in positive costs parameter estimate. Positive cost parameter estimates are not in line with economic theory of rational choices under which the model is built and as such difficult to interpret. Such changes in the cost attribute are likely to occur in latent class models as the sample is divided into many units through class size increments. Moreover, it can be due to respondents paying little attention to the cost attribute[2]. MNL parameters were used as priors in the LCM and show a significant improvement in model fit compared to the basic MNL. An LCM with and without class membership variables was estimated for which a likelihood ratio test showed the restricted model is rejected at least at

[2] For example, about 4.5% of Norwegians ignored the cost attribute while about 44% indicated the cost attribute to be not important to them in their evaluation.

the 5% significance level. Hence, we focus on discussing the unrestricted LCM with class membership or socioeconomic variables.

Table 4 presents the class specific marginal WTP estimates derived from the LCM with socio-economic variables valued in Euros and Table 5 presents the LCM weighted average WTP compared to WTP from the MNL estimation. The WTP estimates were computed as the ratio of non-monetary attributes to the cost attribute and the confidence interval estimates computed using the Delta method (Greene, 2011). The two classes in each survey are characterized by respondents who have a preference for all attributes (i.e., class 2) and those who have a preference for selective or specific attributes (i.e., class 1). Though respondents belonging to the class 2 in both surveys have preference for the protection of deep-sea ecosystem and are quite similar, they are also different in some ways regarding their preferences; for example, the Scottish respondents care more about marine protected area expansion and creation of more marine jobs than Norwegians, while the Norwegians have stronger preferences for reducing marine litter and increasing health of commercial fish stock than Scots. The respective class shares for class 1 is 47% and 43% for the Scottish and Norwegian respondents respectively.

Referring to table 3, the ASC parameter indicates the marginal utility for choosing the current (status quo) deep-sea and wildlife management scenario. As shown in all classes for both surveys, the parameter estimates are negative and statistically significant at the 1% significance level, indicating that both the Scottish and Norwegian public on average have a negative preference for the current management plan in their respective countries. In other words, the proposed future management plans are the most preferred. To the Norwegian public, the current management plan is depicted as having low health of commercial fish stocks (<40%), poor density of marine litter (4 to 6 items per km^2), a protected area of about 0.5% of the area of Nordland VII and comes with no change in marine economy jobs. To the Scottish public, the variation in the current management plan as opposed to the Norwegian survey lies in the size of the area protected i.e., 1% of the Sea of Hebrides.

The cost parameter for all classes is negative and statistically significant at the 1% and 5% significance levels. This is in accordance with economic theory and rational behaviour of demand model estimations. The class 1 respondents who show a preference for only selected attribute levels are the most sensitive to cost while class 2 members are the least sensitive. This still holds when the cost parameter is divided by other attribute parameters to control for scale effects.

Class 1 respondents show preferences for a high level of health of commercial fish stocks at the 1% statistical significance level amongst both the Norwegian and Scottish respondents. Class 2 respondents conversely prefer both moderate and high stock health levels. The marginal utility of ‘high’ health is greater than the ‘moderate’ health stock level as expected. To allow comparison of parameter estimates across classes, we account for scale effects by calculating the marginal WTP estimates. As shown in Table 4, class 1 members in Scotland and Norway are willing to pay €8 and €7 in annual income tax over a 10-year period, respectively. The Scottish class 2 members, however, are willing to pay €133 for high fish stock health and €85 for moderate stock health levels. The Norwegian class 2 members, on the other hand, have a WTP of €221 and €183 for high and moderate stock health levels respectively. The LCM weighted average WTP (Table 5) for high and moderate health of commercial fish stocks were estimated to be €74 and €46 respectively for the Scottish public, and €127 and €105 for Norwegians. These weighted average WTPs are greater than and lie outside of the MNL-WTP mean estimates and confidence interval bounds for Scotland but lie within the Norwegian MNL confidence interval estimates.

The density of marine litter per square unit area also shows heterogeneous preferences among respondents (table 3). Using the marine litter attribute level ‘poor’ as the reference, class 2 respondents show statistically significant marginal utilities at the 1% significance level for both ‘moderate’ and ‘good’ levels. As expected, the marginal utility associated with the ‘good’ level of marine litter density is higher than the ‘moderate’ level. In the case of class 1 members in the Scottish survey, a significant marginal utility is only identified for the ‘good’ level of marine litter density, indicating that respondents have no preference for the moderate level which equates to the current poor level of marine density in the deep-sea environment. Contrastingly, Norwegian class 1 respondents show positive preferences for both ‘good’ and ‘moderate’ marine litter densities and expectedly, the preference for the ‘good’ outweighs the ‘moderate’. In table 4, the variation in preferences translates into a marginal WTP of €3 for ‘good’ marine litter density for class 1 while class 2 members value ‘good’ and ‘moderate’ litter density levels at about €184 and €113 respectively in Scotland. The weighted average WTP values are about €99 and €61 respectively and higher than the MNL-WTP estimates as shown in Tables 4 and 5. In Norway, both class 1 and 2 members value ‘good’/‘moderate’ marine litter density at €10/9 and €247/157 respectively. The corresponding weighted average WTP estimates for good and moderate litter densities are €193 and €92 which are comparatively lower than the MNL-WTP values.

Using the current management scenario of marine protected area in the respective countries equivalent to 1% of the Sea of the Hebrides or 0.5% of Nordland VII as the reference level, we uncover variations in preferences for size levels of MPAs as shown in table 3. Concerning the Scottish survey, class 2 members show significant positive preferences for future deep-sea and wildlife management scenarios that increase the size of the protected area as marginal utilities increase with the increase in the size of the protected area. Class 1 members, on the other hand, have only significant and positive preference for the least increase in a protected area (Area2) from the current management (i.e., 1 to 6% of the Sea of Hebrides) but no preference for increases in the area to 10 (Area3) or 15% (Area4). This translates into an additional WTP (table 4) in annual personal income tax of only €3 for ‘Area2’ for class 1. Class 2 members value ‘Area2-4’ increasing from €94 to €118 and to €124, respectively, with a corresponding weighted average of €52, €63, and €65. In the case of the Norwegian survey, we identify a much more distinct preference towards the size of the MPA. Considering the 5% statistical significance level, we identified no preference for any increase in the size of protected area for class 1 members. However, ‘Area2’ and ‘Area4’ were preferred to the current protected area and ‘Area3’ for class 2 members. As a result, Norwegian class 2 members have additional WTP of €57 and €96 for ‘Area2’ and ‘Area4’ respectively. At the 10% significance level, ’Area3’ commands a marginal WTP estimate of €51. The weighted average WTP estimates for future management scenarios that increase the size of protected areas are €30, €27 and €54 for ‘Area2’ to ‘Area4’ respectively.

The creation of new marine economy jobs proposes an additional 20 or 40 jobs compared to the no-change status quo level of no new jobs. Using no change in employment as the reference level in table 3, statistically significant preference for jobs were identified for class 2 members in both Norway and Scotland with Norwegians showing, again, a more distinct preference structure. Class 2 members in Norway are different to Scotland as the former have relatively higher marginal utilities for a low number (+20) compared to a high number of jobs (+40), while the contrary is observed for the Scotland sample. Class 1 members in Norway have no preferences for additional jobs while Scottish class 1 members only have a positive preference for +40 jobs associated with future proposed deep-sea management plans. The additional annual income tax that Scottish class 1 members are willing to pay for the +40 jobs is on the average estimated to be approximately only €5. Scottish class 2 members WTP for +20 and +40 marine jobs is €57 and €93, respectively, and a weighted average WTP of €31 and €51. In Norway, class 2 members value the additional marine jobs at €69 and €62, respectively, and weighted averages of €37 and €34 respectively.

To put this result into perspective, the preference structure consists of two distinct classes where class 2 identifies the WTP group and class 1 indicates those with substantially lower WTP for certain attribute features. Table 6 is an extract from the latent class results in table 3 and presents the socio-economic profile of class 2 members normalized against class 1 members. In terms of age, WTP is determined by age in both countries. However, the effect of age on WTP is stronger in Norway than in Scotland and increases as the age cohorts increase. In Scotland, the middle-aged population have the highest WTP for the new proposed policies. Consistently in both countries, it is shown that females are more likely to be members of class 2 with substantial WTP. Similarly, people with tertiary education have a significantly positive effect on WTP. The effect of education is not surprising since people with high education are more likely to have had education on environmental and marine-related protection, and are more likely to have higher incomes.

Focusing on income and jobs, the negative effect of undisclosed income in class 2 implies that persons unwilling to disclose their annual income range are more likely to be class 1 members and this effect is seen in both countries. For respondents who disclosed income, they were classified into those with incomes above and below the sample median income level groups (i.e., £15,000 or equivalent of €16,800 for Scotland and NOK400,000 or equivalent of €40,000 for Norwegians). As shown in Table 6, income had no significant effects on responses for the Scottish respondents. However, the Norwegian survey showed that those with annual incomes above the median range were more willing to pay. Having a full-time job did not affect WTP.

It can be observed from the Norwegian survey that respondents who are engaged in marine-related hobbies and those who are members of an environmental organization are significant determinants of WTP for new policies to protect the marine environment.

Membership in an environmental organization was however not captured in the Scottish survey.

In terms of the geographic distribution of respondents, we recoded respondents' residential zip codes into those living in the northern and southern parts of the respective country bearing in mind that the Mingulay and LoVe coral reefs are in the northern areas of their countries. While this division showed no heterogeneity among respondents in Norway, it was a significant determinant of WTP among the respondents from Scotland. Those living in the north of Scotland (Highlands-Islands region) are more willing to pay than those in the south. Moreover, evaluating by urban-rural divide, we identified respondents living in large cities (with a population of at least 5,000) in Norway to have higher WTP than rural residents. Similarly, in Scotland, we observed that those living in urban areas (i.e., "larger cities" and "urban with substantial rural areas") have higher WTP than those living in rural areas (i.e., "mainly rural" and "Islands and Remote"). The Scottish classification of the urban-rural divide was based on the new RESAS classification of the rural economy (Kleinert et al., 2018).

---insert table 3 here----

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5. Discussion and Concluding Remarks

The study hypothesized that there is substantial variation in environmental non-market values and preferences amongst the general public. Applying a latent class logit model to a stated preference discrete choice experiment on deep sea marine conservation, we identify preference structures with two distinct groups of the public in Norway and Scotland. Such a bimodal preference structure reflects the presence of diversity in preferences within society towards policies geared toward the conservation of deep sea marine ecosystems. In both countries, the preferences are characterized by groups who have substantial willingness to pay for the new marine policies (class 2) and those who have just a meagre or no willingness to pay for selected attributes (class 1). The class 2 share of the respondents for Scottish and Norwegians are 53% and 56%, respectively. Class 1 members in Scotland have significant but comparatively meagre WTP values for the higher levels of the attributes: stock health, litter and jobs; and the lower level of the area attribute, but not willing to pay for the remaining attribute levels. In Norway, class 1 members are only willing to pay meagre amounts for the higher-level stock health attribute and almost equal values for litter but are also not willing to pay for the remaining levels of attributes as compared to class 2 members.

Despite the distinct variations in classes, the estimates from the class specific status quo parameter indicates that the public generally does not favour the current management scenario. This is not surprising given that only 22% and 33% of Norwegians and Scots, respectively, think the deep sea is well-managed (Ankamah-Yeboah et al., 2020). Despite environmental literature indicating low levels of knowledge about the marine environment and particularly in relation to the deep sea areas (Rose, Dade and Scott, 2008; Jefferson et al., 2014; Ankamah-Yeboah et al., 2019), even the weighted group WTP values show there is economic support for the new policy scenarios analysed. The results reflect the notion of Armstrong et al. (2012) that, it is not always, or even generally, necessary to have prior knowledge about something in order for a value to exist; or, values may be latent because they are information-dependent and hence many individuals agree that it is worth giving something up in order to ensure conservation objectives.

Healthy fish stock levels are one of the 11 descriptors (Descriptor 3) of the MSFD for achieving GES. According to EEA (2018), historically fishing beyond sustainable levels has made it difficult to reach the objective of healthy fish and shellfish populations. Approximately 67% of commercial fish and shellfish stocks in Europe's seas are not in GES, with strong differences between states. While there are improved signs of recovery in the North-East Atlantic Ocean and Baltic Sea, the situation in the Mediterranean and Blacks Seas remains critical. Given that the 2020 EU objective of ensuring healthy commercial fish stock is unlikely to be met, further collective action is required, needing further financial sacrifices. Comparing class specific WTP estimates, the best management option for the health level of commercial fish stocks corresponds to an increase to more than 80% for both countries. For the Scotland survey, the maximum marginal WTP is in the interval of €63 to €203 while Norwegian maximum WTP is in the interval of €90 to €352. In the worst case, more than half of the estimated interval is willing to be paid to attain the 40-80% level indicating that the current existing good health stock levels of 40% are not generally preferred. The distinction in preferences for this attribute is such that the lower bound of the high WTP group (class 2) is at least six times greater than the lower bound of those with low willingness to pay (class 1).

The environmental, economic, health and aesthetic problems associated with marine litter have received global concern (Andrady, 2011; Eerkes-Medrano et al., 2015) and it is integrated as the 10th descriptor of the MSFD to ensure GES of the marine environment. With a current marine litter density of the deep sea being in "poor" condition (about 4 to 6 items per km^2), the findings show a majority of Scots and Norwegians have preferences for reduced marine litter density, a reduction to "good" condition (0 to 1 item per km^2) being the best scenario. The maximum WTP interval of Scots for the best marine litter management scenario is €90 to €278 while Norwegians have a maximum WTP interval of €107 to €388. It may be that the high WTP for a reduction in marine litter has been borne out of the current focus on marine plastic pollution worldwide, which has received significant media attention. Our survey attribute focuses, however, on marine litter in the form of discarded and lost fishing gear and does not refer to marine plastics specifically.

Achieving reduced marine litter densities and improved commercial fish stock health as part of Europe's commitment to GES may be highly dependent on MPAs. MPA size is one of the determinants of MPA effectiveness (Edgar et al., 2014). Assessing the economic trade-offs for increases in MPAs from the respective country's status quo scenarios, we observe a significant positive WTP for size increases in both countries. Contrary to the Scottish sample, Norwegians revealed a WTP value for a 3% increase in area that is greater than for the 5% increase but lower than a 7.5% increase. Nevertheless, the difference in the mean WTPs for the 3% and 5% increases in area are not statistically significant. There is evidence in both countries that the best policy scenario identified corresponds to the largest deep sea MPA size increase; from 0.5 to 7.5% of the area of Nordland for Norwegians and from 1 to 15% of the Sea of the Hebrides. In Scotland, the maximum average WTP for the best policy scenario of the majority was €124 with a 95% confidence interval of €66 to €182. In Norway, the confidence interval for those willing to pay was €70 to €122.

Despite empirical literature showing that the size of the area protected has a positive effect on MPA effectiveness, the assessment of economic values for this feature of MPA is very limited. In Wattage et al. (2011) where 'banning fishing in all areas where corals are thought to exist' was identified to be one of the preferred MPA features by the Irish public, no monetary trade-off was identified. Ruiz-Frau et al. (2019) assessed coastal MPAs in Wales, UK, and identified distinct heterogeneity among the public but with general support for MPAs and opposing potential reduction in MPA network size. Though Ruiz-Frau et al.'s (2019) coastal MPA valuation is not necessarily comparable to our deep sea case, a three-class latent model showed class 1 respondents were willing to pay £43 and £35 to avoid reduction to 10% and 20% respectively of MPA network coverage, compared to the current status quo of 30%.

In contrast, Class 2 respondents were willing to pay £13 to avoid reducing it to 20% and class 3 were willing to pay £91 to avoid reductions to 10%. Our study confirms that the size of the MPA coverage area matters in the designation of deep sea MPAs coverage in a similar vein to the more familiar coastal resources. As opposed to Wallmo and Edwards (2008), this study indicates increasing marginal utility for increasing MPA sizes.

The concept of whether environmental restrictions such as MPAs can promote or restrict economic growth has long been debated. It is often perceived that MPAs may constrain economic activity and restrict opportunities for growth and jobs even including sectors that may benefit from improved marine environment conditions and biodiversity (Hattam et al., 2018). However, it is becoming increasingly evident that economic growth (profusion of new jobs and businesses) can complement the implementation of MPAs (Klein et al., 2008, Ruiz-Frau et al., 2015) despite possible perceived adverse effects of sectors that directly rely on restricted resources (Ruiz-Frau et al., 2019). Individual preferences for economic activities that could be realized from the designation of MPAs have not received the attention of many academics. It is generally left out of non-market valuation studies and so limits MPA importance in policy settings. Our study shows that despite the distinct job preferences between the identified classes, Scottish respondents do have a preference for increasing jobs where the highest level of the job attribute is the most preferred and valued. Norwegians also have a preference for additional jobs but prefer the small to the large increase, i.e., 20 versus 40. The variation evident here is such that those willing to pay have an average of €93 in the case of Scotland as compared to a meagre value of €5 for 40 additional jobs; this is eighteen times lower. In Norway, the highest monetary value (€69) is associated with 20 additional jobs for those willing to pay and €0 for those in the low WTP group. The preference for jobs reflects the non-use value of employment (Aanesen et al., 2018) and signals that people may not only have preferences for their own jobs but also have increased utilities from knowing others are employed. The relative WTP between +20jobs and +40jobs for Norwegians seems to signal uncertainties regarding the acceptance of how too many jobs can complement MPAs without adverse impacts. Alternatively, it could imply that Norwegians care more about marine environment improvement than too much economic growth. Nevertheless, there is a greater affinity for more jobs than having no increase in jobs.

The heterogeneity in preferences is characterized by certain socio-economic determinants. Generally, for both countries, being female, having tertiary education and living in urban areas are significant determinants of WTP. It is possible that people with tertiary education are more likely to have had exposure to environmental education of some form and this could influence WTP values. The rural-urban divide may signal some kind of scarcity value effect where people living in rural areas probably do not experience significant environmental deterioration nor lack natural environments, and hence have lower WTP while there is less nature in urban areas, hence higher WTP.

The urban-rural divide is in line with Bergmann et al. (2008) and Silva et al. (2017) who suggest nature conservation tends to be favoured more by people in the urban areas than people in rural areas. The opposite results also exist (e.g., Olive, 2014; Crastes et al., 2014). The rural residents lack of willingness to pay may be further explained by the fact that rural respondents may depend on access to natural resources for their livelihoods which create the risk of conflict between local authorities and conservationists (Fiallo and Jacobson, 1995). Specific to Scotland, being middle-aged (36-55 years), living in the northern part of the country and having a full-time job are significant and positive enablers for why people are more willing to pay. Specific to Norway, being more than 35 years old, engaging in marine-related hobbies, and being a member of an environmental organization also positively affects WTP.

The degree of heterogeneity in environmental values, that is, those that are willing to pay substantial amounts to protect the deep sea, and those that are not so willing, each being approximately half of the population in both countries, underlines the difficulties of environmental policy. Though weighted mean willingness to pay may be substantially and statistically significant, the fact that approximately half of the people disagree could pose a serious democratic problem for environmental policy when taxation is involved. Furthermore, we find a "deeply divided" public regarding most of the attributes studied, as opposed to a "closely divided" public (Hill and Tausanovitch, 2015), i.e. the two groups are far from indifferent to the attribute preferences. Therefore, the fact that actual environmental policy seldom follows the cost-benefit recommendations of economists (Nyborg, 2012) may, therefore, be due to more than just political expediency.

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Table 1 Attributes and Levels Description

Attribute Definition	Levels	Scotland – Levels	Norway - Levels
Health: % of commercial stocks at healthy stock levels.	Health3 Health2 Health1	High (>80%) Moderate (40 – 80%) Low (<40%)	High (>80%) Moderate (40 – 80%) Low (<40%)
Litter: Density of marine litter measured as number of items of litter per square distance unit. ***Scotland*** *- # per mile^2* ***Norway*** *- # per km^2*	Litter3 Litter2 Litter1	Good (0 to 1) Moderate (2 to 4) Poor (5 to 8)	Good (0 to 1) Moderate (2 to 3) Poor (4 to 6)
Area: size of protected area. ***Scotland*** *- % of the Sea of Hebrides* ***Norway*** *- % of the area of Nordland VII (current area of Hola protected area)*	Area4 Area3 Area2 Area1	15% 10% 6% 1%	7.5% 5% 3% 0.5%
Jobs: number of marine economy jobs created from sea based commercial activities in the area	Jobs3 Jobs2 Jobs1	+ 40 + 20 No employment change	+ 40 + 20 No employment change
Additional costs: Unit currency per person per year	cost	£0 (for status quo option only), £5, £10, £20, £30, £40, £60	NOK0 (for status quo option only), NOK100, NOK150, NOK300, NOK450, NOK650, NOK850

Table 2 Survey Summary Statistics of Socio-Economic Profile

	Mingulay		**LoVe**	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Age group1 (18-35)	0.101	0.302	0.168	0.374
Age group2 (36-55)	0.493	0.500	0.394	0.489
Age group3 (>55)	0.406	0.491	0.438	0.496
Male	0.440	0.497	0.572	0.495
Tertiary Education	0.518	0.500	0.864	0.343
Full time employed	0.380	0.486	0.592	0.492
Part time employed	0.133	0.339	0.092	0.289
Student	0.064	0.246	0.052	0.222
Unemployed	0.044	0.205	0.021	0.145
Resident of Highlands and Islands	0.063	0.244	-	-
Marine Sports	0.384	0.487	0.466	0.499
Member of environmental organization	-	-	0.108	0.311

Table 3 Latent Class Preferences Comparison for Deep-Sea Environment Attributes

	LC Model without Socioeconomics driving class membership				LC Model with Socioeconomics driving class membership			
	Mingulay-Scotland		LoVe-Norway		Mingulay-Scotland		LoVe-Norway	
	Class 1	Class 2	Class 1	Class 2	Class 1	Class 2	Class 1	Class 2
Variables	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
ASC	-0.894***	-1.522***	-0.351	-2.337***	-0.897***	-1.529***	-0.802***	-2.531***
Health3 (high)	0.493***	0.849***	0.151	1.209***	0.491***	0.852***	0.313**	1.240***
Health2 (moderate)	0.172*	0.543***	0.169	1.022***	0.173*	0.546***	0.237	1.028***
Litter3 (good)	0.186**	1.172***	0.421**	1.358***	0.181**	1.179***	0.442**	1.388***
Litter2 (moderate)	0.120	0.718***	0.296**	0.882***	0.116	0.723***	0.392***	0.883***
Area4	-0.084	0.794***	-0.243	0.670***	-0.079	0.795***	0.053	0.539***
Area3	0.040	0.755***	-0.137	0.350**	0.048	0.756***	-0.108	0.284**
Area2	0.200**	0.605***	-0.200	0.400***	0.207**	0.605***	-0.155	0.320**
Jobs3 (+40)	0.291***	0.591***	-0.138	0.424***	0.281***	0.595***	-0.062	0.349**
Jobs2 (+20)	0.096	0.361***	-0.261*	0.408***	0.095	0.363***	-0.158	0.389***
Cost	-0.064***	-0.007***	-0.033***	-0.009***	-0.063***	-0.006***	-0.042***	-0.006**
Class Membership Constant	0.000	0.662	0.000	1.812***		0.115	0.000	0.246*
Number of Panels	994		966		994		966	
Class Share ($\widehat{w_q}$)	0.340	0.660	0.140	0.860	0.471	0.529	0.439	0.561
Loglikehood	-6450		-5808		-6437		-5770	
AIC	12946		11663		12945		11610	
BIC	13107		11822		13189		11854	
LR-Test					25.33**		76.24***	
McFadden R^2	0.262		0.316		0.263		0.320	

***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. See table 6 for the socio-economic part of the results. See Table 6 for Class membership variables.

Table 4 Class specific marginal WTP estimates in €

Var	Class 1 Coef	SE	C.I.(95%)	Class 2 Coef	SE	C.I.(95%)
Mingulay-Scotland						
Health3	**7.77**	**1.32**	**[5.17, 10.36]**	**133.22**	**35.82**	**[63.01, 203.43]**
Health2	2.74	1.51	[-0.22, 5.70]	**85.34**	**24.75**	**[36.83, 133.86]**
Litter3	**2.86**	**1.39**	**[0.08, 5.51]**	**184.30**	**47.91**	**[90.40, 278.21]**
Litter2	1.83	1.39	[-0.90, 4.56]	**113.11**	**30.64**	**[53.06, 173.17]**
Area4	-1.24	1.97	[-5.10, -2.61]	**124.35**	**29.65**	**[66.24, 182.47]**
Area3	0.76	1.59	[-2.36, 3.87]	**118.21**	**31.27**	**[56.93, 1799.50]**
Area2	**3.27**	**1.56**	**[0.21, 6.34]**	**94.61**	**27.42**	**[40.86, 148.36]**
Jobs3	**4.46**	**1.44**	**[1.44, 7.28]**	**93.02**	**26.01**	**[42.04, 144.01]**
Jobs2	1.50	1.45	[-1.34, 4.34]	**56.80**	**17.60**	**[22.30, 91.30]**
LoVe-Norway						
Health3	**7.37**	**3.30**	**[0.90, 13.85]**	**220.71**	**66.80**	**[89.79, 351.63]**
Health2	5.58	3.40	[-1.09, 12.25]	**183.03**	**51.52**	**[82.07, 284.00]**
Litter3	**10.42**	**3.77**	**[3.04, 17.08]**	**247.17**	**71.73**	**[106.59 ,387.76]**
Litter2	**9.24**	**2.84**	**[3.68, 14.80]**	**157.17**	**50.72**	**[57.75,2 56.58]**
Area4	1.26	4.01	[-6.60, 9.11]	**95.95**	**13.27**	**[69.95, 121.96]**
Area3	-2.55	3.66	[-9.74, 4.63]	**50.63**	**10.34**	**[30.35, 70.90]**
Area2	-3.66	3.78	[-11.07, 3.74]	**56.99**	**10.17**	**[37.06, 76.92]**
Jobs3	-1.47	4.16	[-9.61, 6.68]	**62.17**	**10.59**	**[41.41, 82.92]**
Jobs2	-3.73	3.31	[-10.23, 2.76]	**69.26**	**14.81**	**[40.23, 98.29]**

Values in bold indicate statistical significance at least at the 5% level. C.I. are confidence intervals

Table 5 MNL and LCM Weighted Average WTP estimates in €

	MNL			LCM		
Var	Coef	SE	C.I.(95%)	Coef	SE	C.I.(95%)
Mingulay-Scotland						
Health3	**40.46**	**2.52**	**[35.51,45.40]**	**74.09**	**18.94**	**[36.97,111.22]**
Health2	**23.48**	**2.39**	**[18.80,28.16]**	**46.41**	**13.09**	**[20.75,72.07]**
Litter3	**49.38**	**2.49**	**[44.50,54.26]**	**98.79**	**25.34**	**[49.12,148.46]**
Litter2	**27.48**	**2.36**	**[22.86,32.10]**	**60.67**	**16.21**	**[28.9,92.43]**
Area4	**27.86**	**2.52**	**[22.92,32.81]**	**65.16**	**15.71**	**[34.37,95.95]**
Area3	**26.44**	**2.53**	**[21.49,31.40]**	**62.85**	**16.55**	**[30.43,95.28]**
Area2	**25.82**	**2.72**	**[20.49,31.15]**	**51.56**	**14.51**	**[23.12,80.00]**
Jobs3	**29.78**	**2.32**	**[25.24,34.33]**	**51.28**	**13.76**	**[24.32,78.24]**
Jobs2	**17.21**	**2.28**	**[12.73,21.69]**	**30.74**	**9.31**	**[12.48,48.99]**
LoVe-Norway						
Health3	**171.55**	**36.20**	**[100.59,242.51]**	**127.09**	**37.55**	**[53.49,200.68]**
Health2	**132.65**	**25.79**	**[82.09,183.20]**	**105.16**	**28.97**	**[48.37,161.95]**
Litter3	**189.54**	**37.62**	**[115.81,263.27]**	**143.27**	**40.33**	**[64.22,222.33]**
Litter2	**139.80**	**33.17**	**[74.80,204.81]**	**92.25**	**28.49**	**[36.4,148.09]**
Area4	29.65	15.93	[-1.57,60.88]	**54.40**	**7.63**	**[39.44,69.36]**
Area3	-11.33	21.74	[-53.93,31.28]	**27.29**	**5.94**	**[15.64,38.93]**
Area2	-6.36	20.96	[-47.44,34.72]	**30.37**	**5.87**	**[18.86,41.88]**
Jobs3	-16.30	25.98	[-67.22,34.63]	**34.24**	**6.14**	**[22.21,46.27]**
Jobs2	**24.31**	**9.77**	**[5.17,43.45]**	**37.23**	**8.42**	**[20.72,53.73]**

Values in bold indicate statistical significance at least at the 5% level. Exchange rate: £ 1 = € 1.12 and NOK 1 = € 0.10. C.I. are confidence intervals.

Table 6 **Standard Logit Model: Socio-Economic Effects on Class 2 Membership**

Socio-Economic Variables	Mingulay-Scotland Class 2	LoVe-Norway Class 2
Constant	0.115	0.246*
Senior-aged (56 plus)	0.170*	1.189***
Middle-aged (36-55)	0.277***	0.777***
Male	-0.155***	-0.694***
Have Tertiary Education	0.519***	0.413***
Engaged in Marine sport	0.083	0.408***
Undisclosed-income	-0.281***	-0.639***
Above median income group	-0.092	0.402***
Lives in North of country	0.710***	0.144
Lives in Large City	0.283***	0.309***
Lives in Urban with Rural areas	0.160***	-
Have Fulltime job	0.167**	-0.061
Have Part-time job	-0.081	-0.378***
A Member of an Environmental Organization	-	2.552***

***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively.

[1] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/24499 and https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-results-platform/14286;keyword=ATLAS%20Policy%20Brief%20on%20MPA%20network%20design;isExactMatch=false

[2] The RPL model was also estimated but the many individual parameters to be estimated together with their interaction with the respondent characteristics showed a LCM gives better fit of the data.