Title: “Relative willingness to pay for ecosystem services in Scotland: A comparative analysis.”

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Abstract

Environmental valuation studies rarely account for the complexity and feedbacks in Estuarine Ecosystem Services (EES). This paper explores how environmental preferences and EES values are influenced by a study site characteristics and by user characteristics. We developed a Discrete Choice Experiment (DCE) to estimate society’s Willingness to Pay (WTP) for improving flood control, recreation and biodiversity with a restoration project in the catchment area. This DCE was delivered through a web-based online survey which reached 589 individuals living in Scotland. We applied diverse choice modelling approaches to the pooled dataset, as well as for each case study in Scotland: Forth, Clyde and Tay. A positive and significant WTP for improving EES provisioning was found. However, respondents stated differences in the WTP values for all EES, across regions and between user types. Firstly, respondents ranked the Tay area at first and Clyde area at last at last when stating their WTP, which are the regions with the best and worse environmental quality, respectively. Secondly, flood control is the most valued EES followed closely by biodiversity. Recreation value was found to be smaller by a factor of two when compared to both of them. In this sense, management options which target flood control and biodiversity are more likely to be accepted among Scottish citizens. Finally, being a visitor is a relevant factor for seeking an environmental change and having higher annual average WTP values. Thus, policies that help to increase the “place attachment” of the overall public could, in turn, increase the willingness of people to fund restoration policies environmental policies.

Keywords

Discrete choice experiment, willingness to pay, ecosystem services, restoration policies, estuaries

"Relative willingness to pay for ecosystem services in Scotland: A comparative analysis."

1. Introduction

The benefits provided by the natural environment represents a financial asset for Scotland with an estimated value between £21.5 and £23 billion per year (The Scottish Government, 2013). Ecosystem services assessments have become a relevant part of the research agenda as a result of a general trend of long-term decline in ecosystem services (ES) (UK National Ecosystem Assessment, 2014). Estuaries are dynamic and productive ecosystems which provide a broad range of ES to society (Costanza et al., 1997; Jacobs et al., 2013; O'Higgins et al., 2010). They are the habitat of diverse living organisms and provide food and energy resources to society, as well as the opportunity for doing spiritual, educational or recreational activities. Besides that, estuarine ecosystems regulate nutrients and pollution levels to provide clean water and serve as natural regulators of water levels to protect species habitats from erosion and flooding.

The objective of this research is to estimate ES value trade-offs of three important estuaries in Scotland: Clyde, Forth, and Tay while exploring potential sources of environmental preferences heterogeneity. A catchment scale of analysis is used to acknowledge linkages among estuarine ecosystems with riverine and coastal ecosystems. This management unit has been previously considered for legislation and policy tools which aim to protect the water environment quality at EU level, such as the Water Framework Directive (200/60/EC); as well as a national level, with the River Basin Management Plans For The Scotland River Basin District (The Scottish Government, 2015a) and The Scottish Biodiversity Strategy (Scottish Executive, 2004). The Catchment Areas of analysis are also consistent with the regions for delivering management plans used by the Scottish Environment Protection Agency (SEPA), called the "Area Advisory Groups". These polygons are delimited to comprise geographic areas to deliver basin management plans (SEPA, n.d.).

The environmental exploitation and rapid change of coastal and estuarine ecosystems is a result of historical urban development, rural land management, and pollution. Interactions among ES, such as synergies and trade-offs are likely to be accentuated as the pressures for estuarine natural goods and services increase in time. The development of sustainable ways of management must account for estuarine complexity while considering the values attached to their ES. Understanding the magnitude and distribution of ES value trade-offs helps to design mechanisms to mitigate management conflicts and develop more optimal management plans.

2. Literature review

Empirical research has been continuously generated to improve environmental valuation methods. The search for new SP techniques resulted from the large criticism (Hausman, 2012; Kahneman and

Knetsch, 1992) and evidence of numerous empirical studies revealing significant problems on what was considered a well-stablished method for eliciting environmental preferences, which is Contingent Valuation (CV) (Hanley et al., 2001). Choice Experiments (CE) are cost-efficient techniques for measuring use and non-use values (Birol and Koundouri, 2008; Hanley et al., 2001, 1998) belonging to a family of empirical approaches known as Choice Modelling (CM). Their conceptual base relies on Lancaster's economic theory of value which explains individual's utility derived from the consumption of a good as the composite of utilities associated with the characteristics or attributes of it. In this technique, respondents are asked to elicit their most preferred option when facing repetitive hypothetical choice scenarios of goods described in terms of their attributes and the variation of their levels (see Hensher et al., 2015). Their decision reflects the willing to trade between attributes (or trade-off), and the inclusion of a cost attribute is necessary to produce welfare estimates. Choice modelling is used to estimate attribute weights and choice probabilities. Afterwards, the WTP for a unitary change of the attributes can be computed by dividing the attributes and cost coefficients.

We use a Discrete Choice Experiment (DCE) for each study site to estimate anuual society's willingness to pay (WTP) for improving ES delivering with a restoration project operating throughout the CGAs (Catchment Group Areas). The catchment restoration policy proposed is aligned with the Supplementary Plan for River Basin Management Plans by Natural Scotland (Natural Scotland, 2013), the Integrated Coastal Zone Management (Scottish Coastal Forum, 2004) and Scotland's National Marine Plan (The Scottish Government, 2015b). We interviewed and modelled the choices of 600 respondents to estimate society's Willingness to Pay (WTP) for three estuarine ecosystem services: flood control, recreation and biodiversity. In agreement with the 'TEEB classification' (De Groot Rudolf et al., 2010) we are analysing one ES for each category (see Table 1), that is, regulating and maintenance, cultural, and supporting services.

Table 1. ***Ecosystem services selected and TEEB classification***

Ecosystem service	TEEB name	Category
Flood control	Regulation of water flows	Regulation and maintenance
Biodiversity	Maintenance of genetic diversity	Supporting/habitat
Recreation	Opportunities for recreation and tourism	Cultural

The CE technique has been used previously in estuarine valuation studies worldwide and has a broad representation of studies inside the UK. Estuarine valuation researchers have estimated WTP for preserving ecosystem's components, such as the mudflats in England (Hooper, 2013) or marine mammals in Canada (Boxall et al., 2012). A few studies have focused on valuing environmental policies for managing their natural resources. That is the case of Kragt & Bennett (2011), who valued catchment management alternatives in Australia; Birol and Cox (2007) valuing wetland management alternatives in England; Rolfe et al. (2004) analysing the introduction of riparian buffers in Austalia; and the valuation of realignments options in England (Natasha, 2012). More recently, some studies have utilised ES framework to value a single estuarine ecosystem. For instance, Vazquez and Iglesias (2015), who analysed willingness to pay for tidal stream energy; and other authors who explored the values of recreational activities such as fishing (Lee et al., 2014), natural tours (Rambonilaza, 2011), and motorised boat trips (Lee et al., 2015).

Valuation literature rarely accounts for ecosystems complexity and have analysed ecosystems in isolation from other ES, and in isolation from other ecosystems. Some studies have employed CE to estimate the value a group of ES in UK riverine (Hanley et al., 2006; Stithou et al., 2011), marine (Börger and Hattam, 2017; Jobstvogt et al., 2014a, 2014b) and coastal ecosystems (Acreman et al., 2011; Birol et al., 2009a; Luisetti et al., 2011). However, to our knowledge, no study has valued several ES in the context of estuarine ecosystems. Moreover, among all the CM studies mentioned above, only four studies (Birol et al., 2009a; Kragt and Bennett, 2011a; Rolfe et al., 2004; Stithou et al., 2011) have accounted for estuarine links with surrounding ecosystems by using a catchment scale of analysis.

Estuarine environmental preferences heterogeneity has been modelled with the inclusion of a systematic and stochastic heterogeneity component in the utility function. The interaction of socio-economic variables with the attributes or the Alternative specific constant (ASC) serves to reveal systematic heterogeneity and to understand the sources of heterogeneity (Birol et al., 2006). On the other hand, analysing the heterogeneity stochastic component requires to include random coefficients (Train, 1998). The distribution of the random coefficients can be continuous in Random Parameter Logit Models (RPL), in contrast to a discrete distribution assumed in Latent Class Models (LCM). Even though prior research has suggested LCM dominance regarding performance and welfare calculations (Birol et al., 2006), we opted for the RPL model as we are interested in examining the drivers of heterogeneity and contrasting their impact on WTP estimates. Some of the estuarine valuation studies have previously used interacted RPL model to explore environmental management preferences in estuaries (Birol and Cox, 2007; Hooper, 2013; Kragt and Bennett, 2011).

This study aims to generate information to guide policy makers and regulators in designing more efficient and contextualised environmental management policies. We contribute to estuarine valuation by developing an analysis which considers the complexity of estuarine ecosystems and the benefits they provide to society. Additionally, we provide a deeper understanding possible sources of heterogeneity by exploring whether environmental preferences and WTP values vary across individuals or/and space. We have augmented the heterogeneity analysis by using a comparative approach of the user types and the study site characteristics. In this sense, this is the first study comparing ES across and within systems in a rigorous way.

The paper is organised as follow: The following section describes the socioeconomic and ecological characteristics of the case studies. Section 4 describes the CE design and administration. Results of the econometric estimations are presented and discussed in Section 5. Section 6 concludes the paper and discuss policy implications for estuarine environmental management policies.

3. Case studies

Three case studies were chosen from the 11 Area Advisory Groups considered by SEPA. Our case studies comprise the Tay, Forth and Clyde CGAs, which are relevant areas in Scotland because of their socio-economic and ecological characteristics.

The Tay Catchment Group Area (TCGA) is the largest study area, with approximately 9126 km2. It includes the River Tay along with its tributaries (e.g. River Garry, Tummel, Lyon, Braan, Dochart, Erich, Isla, and Almond), as well as the catchments of River Dighty, Cowie, Bervie, River North Esk and South Esk, River Earn and River Eden together with Eden estuary. River Tay is considered to be the longest river in Scotland, covering an area of 5000 km2 and 190km in length. Perth and Dundee are the largest populated settlements, followed by places as Arbroath, St Andrews, Forfar, Montrose, Carnoustie, Stonehaven, and Cupar (NRS, 2014). Pitlochry is also an important town in the area for being a popular touristic destination. The TCGA is mainly rural and comprises significant environmental assets distributed along 457,474,900 ha of Forest Woodlands inside 13 National Parks, eight National natural reserves, 28 special area of conservation, 18 special protected areas and six National Scenic Areas.

The Forth Catchment Group Area (FCGA) covers 4658 km2 along the central belt and to the eastern coast of Scotland. It contains all the area draining into River Forth, as well as River Leven, Devon, Allan Water, Teith, Forth, Carron, Avon, Almond, Water of Leith, Tyne and Esk. The highest populated settlements inside the FCGA are Edinburgh, Falkirk, Dunfermline, Livingston, Cumbernauld, Kirkcaldy, Stirling, Glenrothes, and Dalkeith (NRS, 2014). The FCGA comprises diverse land uses, including managed forest, farmland, as well as natural heritage areas of national and international importance. It includes 395,107,415 ha of Forest Woodlands, three World Heritage Sites, one National Park, five National natural reserves, 12 special area of conservation and ten special protected areas and two National Scenic Areas.

Finally, the Clyde Catchment Group Area (CCGA) has an extension of 7445 km2. It contains the catchment areas of River Clyde, Kelvin, Leven, White and Black Cart Waters, Ayr, Irvine, Doon, Water of Girvan, River Stinchar. The CCGA encompasses contrasting landscapes that range from the largest populated settlement in Scotland, the city of Glasgow, to scenic natural areas such as Loch Lomond and The Trossachs National Park. Contained in the CCGA, there is 779,677,326 ha of Forest Woodlands, five National Parks, 15 National natural reserves, 19 special area of conservation, nine special protected areas and two National Scenic Areas. Other largely populated settlements in the CCGA area are Motherwell and Belshill, Coatbridge and Airdrie, Hamilton, East Kilbride, Greenon, and Ayr.

The natural environment of all these estuaries is impacted due to the regular dredging necessary for navigation purposes. When comparing the environmental status of all the areas, the Clyde and Forth estuary have higher levels of pollution as result of the historical discharges (Scotland's Environment, 2011). The environment in the Clyde is one of the most degraded CGAs with instream and riparian habitats severely damaged and a high profile of non-native species (Clyde River Foundation, 2009). The TCGA, on the other side, still holds a rich natural heritage with semi-natural habitats and numerous resources providing habitat for rare wildlife but is facing an increase in pressures from the agriculture, forestry and hydropower generation (Tayside Biodiversity Partnership, n.d.).

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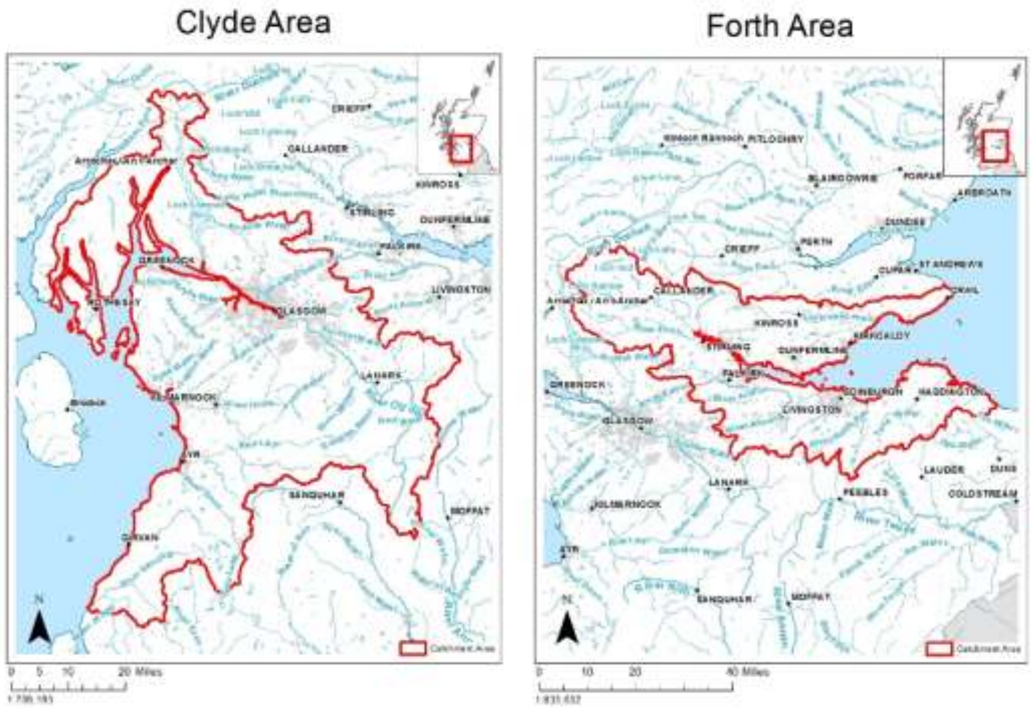
Figure 1. Clyde, Forth and Tay Catchment Group Areas



Tay Area

4. Choice experiment design and application

4.1. Choice experiment design

This study develops a DCE to investigate the trade-offs people is willing to make between estuarine restoration policies aiming to increase ES provisioning at three CGAs. We consulted experts on the topic and developed an extensive literature review to select policy relevant estuarine ES. Careful attention was also paid to design the attributes and appropriated ways to describe their levels as they influence both, the experimental design and the estimation of the choice models (Torres et al., 2011).

The selected attributes and levels are reported in Table 2. We avoided the use of site-specific attributes for allowing a further comparison of environmental preferences among all case studies, and used four generic attributes for all management options: i) flood control (explained in terms of flood risk reduction), ii) biodiversity, iii) recreation, and a monetary attribute describing iv) the annual cost for developing the restoration project. The monetary attribute is necessary to produce welfare and estimating attribute's values in terms of their Willingness to Pay (WTP) for a unitary change on the attributes. For the non-monetary attributes, we used three qualitative levels indicating the ES provisioning levels: i) decrease, ii) a slight improvement and iii) a large improvement. Qualitative levels not only have been proved useful for conceptualising water management options (Birol et al., 2009b, 2006; Hanley et al., 2006) but also they represent a flexible way to explain meaningful and realistic scenarios for all three case studies. All attributes and levels were designed with a complementary text and images to convey the information in various formats.

Table 2. ***Attribute levels and illustrations used in the CE***

Attributes	Levels	Definition	Illustration
Flood control	Increase in flood risk	The frequency of flood events keeps increasing in the area (more events each decade and more chances each year). Flood defences fail because straightening rivers and the absence of vegetation keeps a high-speed flow of water. The failure to provide a free space between the river and human activities (buffers) also mean that the extent of residential and agricultural damages keeps increasing in time.	
	Slight reduction in flood risk	Flooding occurs every fifty years in the area. Already installed flood defences are useful because the restoration of the curvy shape of rivers helps to reduce speed flow. The extent of residential and agricultural damages is reduced significantly as buffers are created in some areas.	
	Large reduction in flood risk	Flooding occurs every hundred years in the area. No need for new flood defences as the restoration of the river shape and vegetation (upstream, in river plain and riverside) helped to lower speed flow. Residential and agricultural damages have almost completely been avoided with the creation of buffers.	
Biodiversity	Decrease in biodiversity	The chances of observing any type of wildlife (fish, birds, butterflies, mammals or reptiles) are reduced in the area because habitat degradation continues. Endangered species disappear.	
	Slight increase in biodiversity	Improvement in chances of observing birds, butterflies and few mammals happen when restoring ecosystems with native vegetation in the area. An increase in the observable number of endangered species happens inside protected areas.	
	Large increase in biodiversity	Improvement in chances of observing fish, birds, butterflies, mammals and reptiles happen when restoring ecosystems and eliminating structures that act as barriers to wildlife movement. An increase in the observable number of endangered species happens inside and outside protected areas.	
Recreation	Decrease in recreation	The quality of outdoor recreation decreases. Degradation of nature has led to non-scenic areas. Insufficient and not well-maintained infrastructure hinders access to the riverside and shoreline. Wildlife watching is possible everywhere but no walking,	

		cycling, recreational fishing, swimming and other water sports.	
	Slight increase in recreation	Restoration and greening policies have increased the scenic quality and access. A path network with multi-purpose trails and resting places has been developed in few isolated areas, improving its quality of outdoor recreation. Wildlife watching, walking, cycling, recreational fishing, swimming and other water sports is possible ONLY in those areas.	
	Large increase in recreation	Restoration and greening policies have increased the scenic quality and access. A path network connects woodland, cities and coast with multipurpose trails and resting places. Wildlife watching, walking, cycling, recreational fishing, swimming and other water sports can be developed all around the area. The quality of outdoor recreation increases everywhere.	
Cost of the policy	Six annual payment levels	One time increase on the annual local tax (council tax), lasting for ten years.	**£5, £10, £20, £50, £75, £100**

A restoration policy was chosen as it is an integrative policy capable of delivering improvements in various ES at the time. This management option is aligned with the Supplementary Plan for River Basin Management Plans by Natural Scotland (Natural Scotland, 2013), the Integrated Coastal Zone Management (Scottish Coastal Forum, 2004) and Scotland's National Marine Plan (The Scottish Government, 2015).

The policy was proposed to be funded with an annual fixed increase on the council tax lasting ten years. This payment vehicle has been used to value environmental policies in the UK context (Birol and Cox, 2007; Garrod and Willis, 1998; Hanley et al., 2006; Luisetti et al., 2008) and unlike voluntary donations, it does not encourage free-riding behaviour (Whitehead, 2006). Possible restoration measures and the ways in which they could impact ES provisioning were explained with an introductory text and were represented visually in two illustrations (see Figures 2 and 3).

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Figure 2. Catchment area before restoration

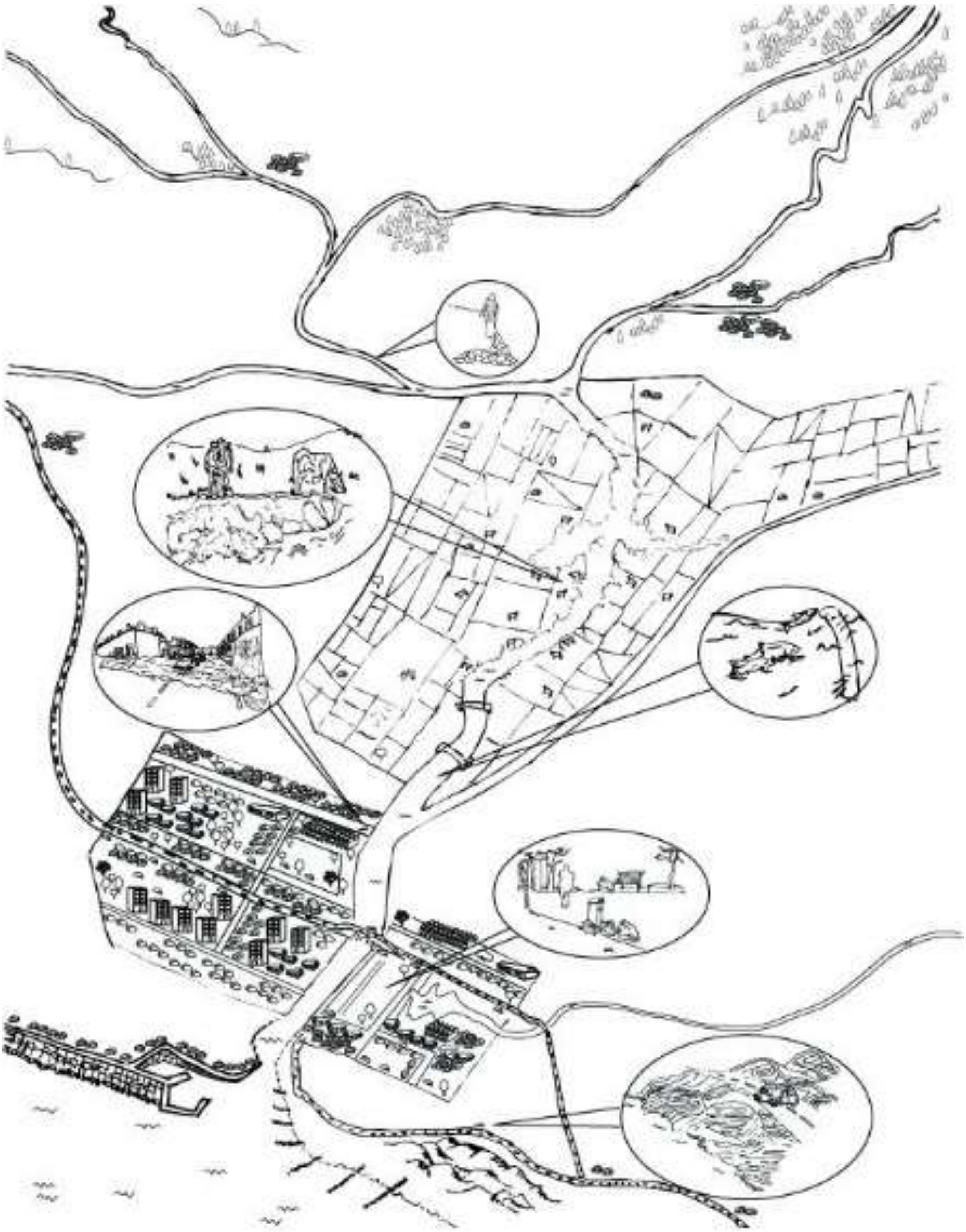
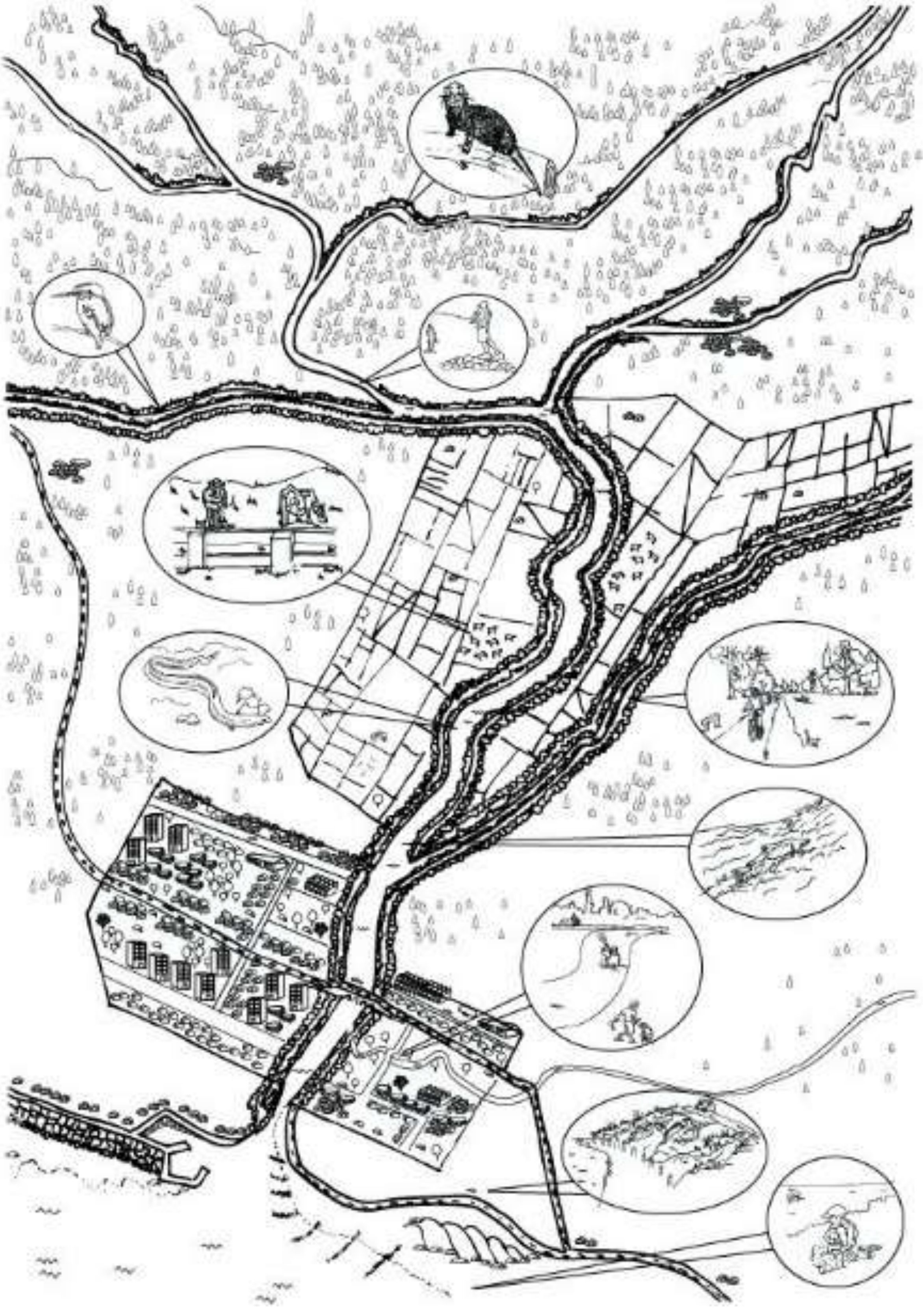


Figure 3. Catchment area after restoration



The experimental design is done to obtain the attribute combinations reflecting the expected policy outcomes. Empirical research suggests that D-optimal designs outperform other design criteria (Carlsson and Martinsson, 2003; Hess et al., 2008; Scarpa and Rose, 2008). The D-efficiency criterion was used for developing a two-stages efficiently constructed experimental design in Ngene software (ChoiceMetrics, 2012). One restriction was added to the designs to force the alternative management options to present an improvement of at least one ES and thus avoiding them to equal the SQ but having a positive cost. Firstly, a D-efficient design without prior information was generated for the pilot survey. By surveying and modelling the choices of 61 pilot individuals, we did a pre-test of the questionnaire, the choice context and experimental design, as well as rectifying the understanding of background information, choice context and additional questions. The pilot choices were modelled for each case study separately to obtain three sets of site-specific attribute coefficients. At the second stage of design, the coefficients were inputted as priors to generate three site-specific final D-efficient designs (See Annexe). We obtained three sets of 18 cards (one per case study), which is a total of 54 unlabelled choice cards showing three alternatives each. The final experimental design aimed to account for environmental preferences information from all the case studies and therefore needed to include choice cards derived from all site-specific designs. Thus, instead of limiting our number of blocks to site-specific designs, we pooled together all 54 choice cards and randomly group them in unique sets of 6 choice cards, which were afterwards presented to the surveyors. The randomization of choice cards provided even greater variation than using a limited number of blocks and was done to avoid the loss of information regarding site-specific environmental preferences throughout the process leading to a final experimental design.

When presented with the choice cards, people was introduced with catchment management alternatives and were asked to choose their most preferred option. In each choice card, Option 1 refers to the “no policy” or “status quo” alternative. Respondents were told that the absence of a restoration policy will have no cost but would result in a prolongation of the “status quo” which is characterised by the degradation and decline of ES in time (UK National Ecosystem Assessment, 2011). Option 2 and 3 always represent restoration management alternatives which improve the provisioning levels of at least one ES and therefore has a positive cost attached to it. An example of a choice card is presented in Figure 4.

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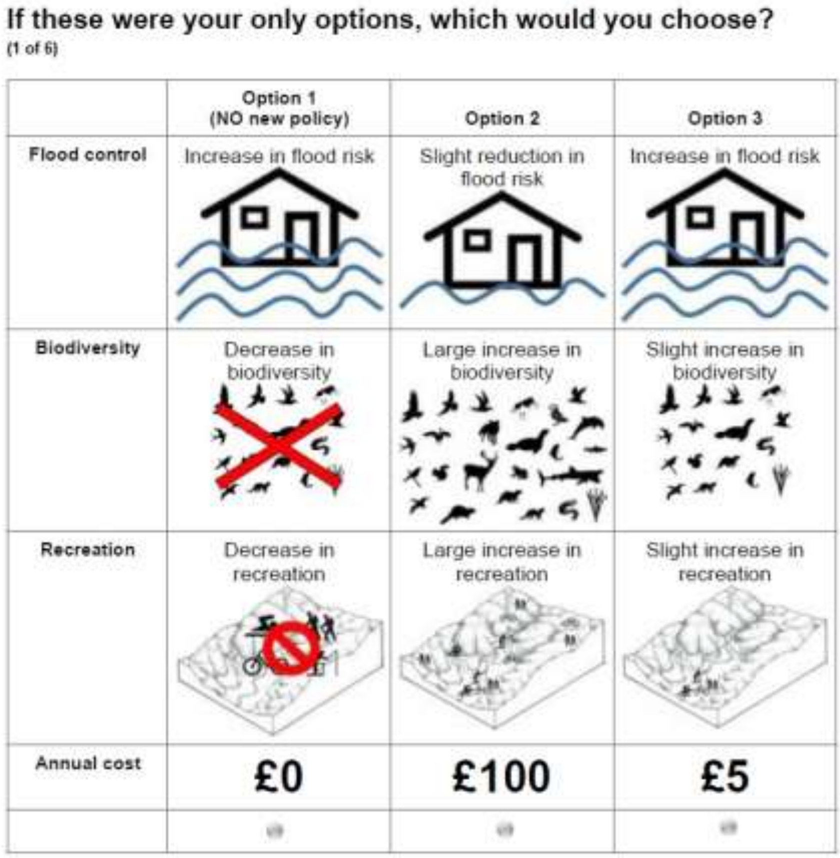
Figure 4. Choice card example



4.2. Choice experiment data collection

The DCE was delivered in a web-based survey and distributed in September 2016 by a market research company (response rate 72.47%). Internet-based surveys have gained use in non-market valuation studies as they are advantageous in marginal costs, speed and response rates (Cobanoglu et al., 2001). Three versions of the survey were used, differing only in the case study they are referring to and the choice tasks given. The surveys were directed to a random sample of potential estuarine ES beneficiaries, that is a random sample of adults (18 years old or more) residing in Scotland. The questionnaires were directed to people residing inside and outside each CGA so that we could measure the use and non-use value associated with ES.

Our survey dealt with unfamiliar and complex environmental goods and comprised four main sections. The first part presented a brief explanation of estuarine ecosystems, their ecosystem services, the environmental issues on the areas of interest and the restoration project proposed to achieve the environmental improvements. On the second section, surveyors were presented with attitudinal questions asking about their environmental perceptions and previous knowledge on the topic, to answer choice experiment afterwards with a follow-up question used to differentiate between genuine and protest zero-bid individuals. A third section, included debriefing and consistency questions to examine surveyor's opinions as well as to explore the quality of their answers. Finally, the last section consisted of socioeconomic questions, including respondent's user type and residency. This information was used to assess sample representativeness and exploring the determinants of environmental preference heterogeneity. Overall, respondents used 20.23 minutes on average to complete the pilot survey and 42.3 minutes on average for the final survey. The full questionnaire can be found in Annex X.

Table 3. ***Attitudinal and environmental perception statistics*** [a]

	Agreement in %			
Statements	All sites pooled (N = 589)	Tay questionnaire (N = 198)	Clyde questionnaire (N = 194)	Forth questionnaire (N = 197)
Attitude towards flood risk				
I am concerned about flooding	57.56	58.25	56.35	58.08
The frequency and extent of flooding are increasing where I live	26.15	24.74	25.38	28.28
I am worried that the current flood defences are not adequate enough to protect my home	22.41	20.62	25.38	21.21
Attitude towards biodiversity				
Biodiversity is essential for the production of goods such as food or fuel	70.97	71.13	68.53	73.23
I am informed about biodiversity issues	28.35	25.26	30.46	29.29
My well-being and quality of life depend on the area's biodiversity	37.69	41.24	38.58	33.33
Perceived quality of the survey				
I had enough information for making my choices and understanding the questions	71.48	72.68	68.02	73.74
Information was neutral and not presented in such a way as to influence me	80.48	81.96	76.14	83.33
I am an appropriate individual to be surveyed for this topic	67.23	70.10	68.53	63.13
I believe that the time frame for the project should be shorter than 10 years	47.88	49.48	48.22	45.96

[a]Six-digit response scale: Strongly disagree, Disagree, Neutral, Agree, Strongly agree, I don't know. Agreement means agree or strongly agree.

Table 3 summarise attitudes and perceptions of respondents and shows that the percentages of the agreement are similar across all study sites and for all the statements. Results reveal an overall concern about flood risk. Approximately half of the respondents (57%) declared to be concerned about flood risk, despite the fact that only around 22% believed flooding is increasing and that current flood defences threaten their households. Regarding biodiversity, 28% consider themselves as informed about biodiversity issues. Interestingly, over two-thirds of the sample (71%) consider biodiversity essential for ES provisioning, yet only one-third (37%) consider that biodiversity impacts their well-being and quality of life. The later suggest, that background knowledge on biodiversity is rather lacking and therefore hinders the understanding of a causal connection between ecosystem's health and well-being. The quality of the survey was determined using the three last statements on Table 3. Overall it can be seen that the majority of respondents agreed with the amount of information presented (71%) and with the neutrality of the survey (80%). Moreover, 67% believed the questionnaire was well targeted and that the proposed timeframe for the policy was adequate 53%.

Table 4. ***Reasons for stating null WTP***

Statement	Number of respondents
Protest zero-bid	
I believe I should not be the one paying for it	5
I don't believe that my payment will be used effectively	5
I don't pay taxes and/or I would prefer another mechanism for paying	1
Total	11
Genuine zero-bid	
I cannot afford to pay	16
I don't think the suggested policies are viable	1
I don't believe there is a need for a restoration project and priorities for public funds should be different	3
Total	20

Table 4 shows the numbers of respondents choosing the SQ alternative and the statements used to identify protest bid individuals. The share of respondents consistently choosing the SQ does not differ significantly between questionnaires. The percentage is 1.98% for the CCGA, 1.97% for the FCGA and 1.48% for the TCGA. After removing protest bid individuals (1.8 %) and surveys without postcode information (8 %), we obtained a final sample of 589 surveys and 3,534 observations (approximately a third for each case study).

Table 5 summarise household sample and sub-sample statistics. T-tests were used to determined that the pooled sample is representative of the Scottish population in terms of most of the available statistics, except age1. The percentage of respondents being above 64 years old is significantly different (16.81%)

[1] The percentage of female is 54.50% in our sample in comparison to 51.41% (Office for National Statistics, 2017). The percentage of employed people is 60.27% in our sample in comparison to 77.6% (Office for National Statistics, 2017). The percentage people with university degree and above (NVQ4 And Above) is 40.4% in our sample in comparison to 42.5% (Office for National Statistics, 2017). The mean monthly income of our sample is £1765 in our sample in comparison to £2249 reported by the Office for National Statistics (2015).

to the 19.69 percentage reported in the UK census (Office for National Statistics, 2011). Differentiated access to the internet or self-selection of panel members might incur to small sample biases. Nonetheless, empirical evidence suggests on-line surveys as a capable method for delivering robust estimations and non-significantly different WTP when compared to other surveying methods (Fleming and Bowden, 2009; Olsen, 2009; Windle and Rolfe, 2011).

From our total sample, 31.75% of respondents have residency in the area, and another 52.80% declared they had visited the area for outdoors recreational activities. As expected, residents seemed to be more keen visitors of the three case studies. Inside the 31.75% of residents, 82.89% declared themselves as visitors of the area. While for the percentage of respondents identified as non-residents 68.24%, only 4% reported having visited the areas.

Table 5. ***Sample summary statistics of respondents and their households*** [b]

Variables	All sites pooled	Tay questionnaire	Clyde questionnaire	Forth questionnaire
Income (net, in £ per month)	1765.11 (1153.54)	1837.80 (1211.64)	1790.81 (1194.73)	1666.75 (1041.10)
Age	50.42 (16.41)	49.50 (16.30)	49.17 (16.68)	52.58 (16.03)
Household size	2.39 (1.84)	2.70 (2.70)	2.33 (1.25)	2.15 (1.05)
Gender (% female)	54.50	58.08	54.64	50.76
Education (% with university degree and above)	40.41	43.43	36.60	41.12
Employment (% economically active)	60.27	65.15	61.86	53.81
Residency in the area (% residents)	31.75	14.65	44.85	36.04
Visited the area for outdoor recreational activities (% vistors)	52.80	49.49	51.03	57.87
People perceiving a better environmental status in the area (% respondents)	18.51	17.17	21.65	16.75
People perceiving a worse environmental status in the area (% respondents)	19.86	23.23	15.98	20.30

[a] Source: Scottish estuarine management Choice Experiment, 2016.
[b] Given are mean and standard deviations in (parenthesis).

5. Results

DCE are based in McFadden (1974) Random Utility Maximization (RUM) theory which assumes individuals to follow an economic rationality and to behave as utility maximizers. RUM discrete choice models can be approximated by a variety of logit models and explain the conditional indirect utility derived from an alternative as a function of a known and unknown component. The following analysis explores preferences heterogeneity for ES preservation in Scotland by means of estimating Conditional Logit (CL) models and Random Parameter Logit (RPL) models, with and without interactions. We examined heterogeneity sources by analysing both, the systematic and stochastic component.

All the models were specified so that the probability of an individual choosing a particular environmental management alternative is a function of the attributes and the Alternative Specific Constant (ASC). After testing for several forms to include attributes into the utility function, we selected a dummy coded specification for qualitative attributes and a linear for the numerical cost attribute. The ASC is used to explain the “status quo” bias (Hanley et al., 1998) and indicates the direction and the strength of the utility impact when choosing to move out from the “status quo” alternative. This variable was specified to take the value of 0 when respondents chose the “status quo” alternative and the value of 1 when they did not. All models were estimated and contrast using R version 3.3.2 and were applied to the pooled choice dataset as well as to each site-specific dataset.

5.1 Conditional logit model

The results of the four CL estimates are reported in Table 6 together with statistics indicating model fitness and the site-specific estimates positioned in the table rows. The CL models present good explanatory power, with values ranging from 0.16 to 0.23 and being close to the range of ρ^2 values (0.2-0.4) suggested by Hensher and Johnson (1981) as extremely good fits.

The coefficients have the expected signs and are found to be significant. The coefficients explaining ES provisioning levels are positive and often show positive scaled effects. Scaled parameters indicate that the increase in ES provisioning levels is a relevant factor when choosing estuarine management options and that respondents have a stronger preference for options with larger magnitude improvements on flood control, biodiversity and recreation. Overall all ES have positively and significantly different from zero coefficients. The larger values are commonly associated with flood control, followed closely by biodiversity. Recreation coefficients are smaller by at least a factor of two when contrasted to both, flood control and biodiversity. The negative sign of the cost attribute indicates that respondents prefer options with lower cost when all other attributes remain constant. The ASC is always negative for all cases, but not significant for the Clyde model, suggesting that respondent’s utility is impacted in a positive way when moving out from the “status quo” and rejecting the existence of a SQ bias, with this effect not being significant in the CCGA.

The conditional logit model (CL) assumes a linear utility function with independent and identically distributed errors with a Gumbel distribution. The assumption of Independence of Irrelevant Alternatives (IIA) implies that the odds of choosing two options depend only on the comparison of their attributes and are not altered by the attributes of any additional alternative. The validity of this assumption was tested on the pooled dataset using the test of Hausman and McFadden (1984), and it was found that IIA is rejected at the 99% level when removing alternative two, but not when removing alternative three. The result of this test suggests that models which relax this assumption, such as the Random Parameter Logit model are more appropriate to model environmental preferences for ES provisioning in Scotland.

5.2 Random parameter logit model

Table 6 also report the results from a RPL with and without interaction terms. The models have normally distributed attributes and ASC parameters (simulated with 1000 sobol draws), as well as a fixed cost parameter. These models account for the random and systematic component of heterogeneity, respectively, by allowing preference deviation around the mean population parameter for each attribute. Including heterogeneity is useful from the policy perspective as it helps to understand which stakeholders might be impacted (positively or negatively) when implementing policies. Thus promotes environmental planning that takes equity concerns into consideration (Boxall and Adamowicz, 2002).

The two forms of RPL models applied to the pooled and individual catchment datasets still present significant mean coefficients with the expected signs for all attributes. The ASC becomes significant in all case studies when including the random component heterogeneity in the simple RPL, but lose the significance in all cases when accounting for systematic heterogeneity associated with the preferences for change of individuals with particular socioeconomic characteristics (RPL interacted with SE variables). The standard deviations follow the same patterns of significance in the two RPL models and reveal significant unobserved heterogeneity across all attribute levels, except in slight improvements of biodiversity and recreation, with coefficients not significantly different from zero. In both RPL models, we can see that the ranking and scale effect persist and apply to the standard deviation parameters as well, showing that variability on preferences increases with the magnitude of ES improvements.

The third model in Table 6 includes the interaction of ASC with dummy variables to find the drivers of heterogeneity. We tested for the significance of the full set of socioeconomic variables and found that for the pooled dataset only the visitors and female dummy, as well as the numeric variable of income, have negative and significant coefficients. In other words, visitors, females and respondents with higher income are significantly more likely to choose scenarios of environmental improvements. The reduction or loss of significance for these variables in the case studies sub-datasets (see Table 6 rows) is due to the considerable reduction of the sample size for each socioeconomic category. Interestingly, the dummy variables for being educated and being economically active were not found to be significant factors when opting to move out of the "status quo" in our choice datasets.

The RPL models (simple or interacted) was found to fit better than all the CL choice models when considering various criteria, including AIC, BIC and the ρ^2. Moreover, when comparing between the two RPL models, we found that the model accounting for both, the random taste heterogeneity and the conditional heterogeneity does not improve model fit for all statistics. The simpler model has more significant variables (all attributes and ASC) and presents the best fit with the higher explanatory power (higher adjusted ρ^2) to describe the choices of the four datasets. The AIC and BIC statistics for the interacted model are lower in RPL with socioeconomic variables. Nonetheless, this is due to the number of parameters of the model and the way these statistics penalise for the number of parameters included in the models.

Table 6. ***Cl and RPL estimates for ES improvement***[a]

		CL			RPL						RPL interacted with SE variables					
Attribute	Dataset	Coefficients		S.E.	Coefficients		S.E.	S.D.		S.E.	Coefficients		S.E.	S.D.		S.E.
Flood control: Slight improvement	All	1.120	***	0.065	1.661	***	0.103	0.609	***	0.142	1.657	***	0.103	0.596	***	0.144
	Clyde	1.116	***	0.114	1.753	***	0.187	0.654	**	0.235	1.729	***	0.185	0.600	*	0.245
	Forth	1.078	***	0.110	1.688	***	0.185	0.702	**	0.248	1.679	***	0.184	0.661	*	0.249
	Tay	1.186	***	0.116	1.570	***	0.168	0.526	+	0.249	1.594	***	0.172	0.589	*	0.239
Flood control: Large improvement	All	1.395	***	0.073	2.122	***	0.129	1.149	***	0.121	2.123	***	0.130	1.139	***	0.119
	Clyde	1.390	***	0.127	2.247	***	0.236	1.245	***	0.211	2.208	***	0.232	1.227	***	0.213
	Forth	1.207	***	0.125	1.921	***	0.228	1.299	***	0.226	1.904	***	0.227	1.300	***	0.227
	Tay	1.644	***	0.132	2.242	***	0.216	0.852	***	0.200	2.276	***	0.221	0.869	***	0.202
Biodiversity: Slight improvement	All	1.000	***	0.073	1.678	***	0.114	0.286		0.224	1.678	***	0.114	0.272		0.244
	Clyde	1.077	***	0.126	1.882	***	0.208	0.262		0.365	1.853	***	0.206	0.103		0.751
	Forth	0.921	***	0.126	1.643	***	0.208	0.626	**	0.232	1.633	***	0.207	0.604	*	0.241
	Tay	1.013	***	0.131	1.502	***	0.186	0.006		0.276	1.528	***	0.189	0.002		0.316
Biodiversity: Large improvement	All	1.096	***	0.075	1.812	***	0.123	0.795	***	0.116	1.813	***	0.124	0.788	***	0.117
	Clyde	0.936	***	0.128	1.700	***	0.210	0.813	***	0.223	1.671	***	0.207	0.596	*	0.216
	Forth	1.071	***	0.130	1.875	***	0.225	0.813	***	0.228	1.853	***	0.224	0.840	***	0.225
	Tay	1.320	***	0.136	1.890	***	0.212	0.862	***	0.182	1.919	***	0.217	0.864	***	0.183
Recreation: Slight improvement	All	0.376	***	0.059	0.641	***	0.079	0.020		0.213	0.640	***	0.079	0.055		0.206
	Clyde	0.366	***	0.104	0.693	***	0.143	0.023		0.348	0.676	***	0.141	0.065		0.358
	Forth	0.419	***	0.100	0.776	***	0.146	0.003		0.289	0.761	***	0.145	0.001		0.273
	Tay	0.343	***	0.102	0.498	***	0.126	0.126		0.681	0.505	***	0.128	0.195		0.417
Recreation: Large improvement	All	0.397	***	0.057	0.634	***	0.081	0.609	***	0.204	0.635	***	0.081	0.613	***	0.123
	Clyde	0.441	***	0.101	0.720	***	0.150	0.669	**	0.204	0.706	***	0.147	0.622	*	0.234
	Forth	0.294	**	0.098	0.580	***	0.152	0.804	***	0.204	0.571	***	0.151	0.795	***	0.200
	Tay	0.456	***	0.098	0.621	***	0.124	0.309		0.204	0.627	***	0.127	0.369		0.264
Cost	All	-0.010	***	0.001	-0.015	***	0.001	-		-	-0.015	***	0.001	-		-
	Clyde	-0.011	***	0.001	-0.017	***	0.002	-		-	-0.017	***	0.002	-		-
	Forth	-0.009	***	0.001	-0.015	***	0.002	-		-	-0.014	***	0.002	-		-

	Tay	-0.010	***	0.001	-0.013	***	0.002	-		-	-0.013	***	0.002	-		-
ASC	All	-0.226	*	0.094	-1.858	***	0.291	3.292	***	0.266	-0.168		0.943	3.093	***	0.253
	Clyde	-0.025		0.162	-1.812	***	0.539	3.863	***	0.528	1.809		1.614	3.472	***	0.514
	Forth	-0.294	+	0.162	-1.834	***	0.508	3.401	***	0.480	-3.166		2.279	2.966	***	0.457
	Tay	-0.398	*	0.167	-1.878	***	0.464	2.787	***	0.406	-1.307		1.685	2.491	***	0.368
*ASC*Resident*	All	-		-	-		-	-		-	0.682		0.439	-		-
	Clyde	-		-	-		-	-		-	0.624		0.858	-		-
	Forth	-		-	-		-	-		-	0.485		0.758	-		-
	Tay	-		-	-		-	-		-	-0.078		0.916	-		-
*ASC*Visitor*	All	-		-	-		-	-		-	-1.129	**	0.414	-		-
	Clyde	-		-	-		-	-		-	-1.037		0.856	-		-
	Forth	-		-	-		-	-		-	-1.531	*	0.729	-		-
	Tay	-		-	-		-	-		-	-0.829		0.602	-		-
*ASC*Female*	All	-		-	-		-	-		-	-0.965	**	0.375	-		-
	Clyde	-		-	-		-	-		-	-0.704		0.707	-		-
	Forth	-		-	-		-	-		-	-1.407	*	0.669	-		-
	Tay	-		-	-		-	-		-	-0.614		0.634	-		-
*ASC*25to34*	All	-		-	-		-	-		-	0.139		0.841	-		-
	Clyde	-		-	-		-	-		-	-0.304		1.445	-		-
	Forth	-		-	-		-	-		-	3.882	+	2.271	-		-
	Tay	-		-	-		-	-		-	-0.466		1.392	-		-
*ASC*35to44*	All	-		-	-		-	-		-	0.667		0.822	-		-
	Clyde	-		-	-		-	-		-	-0.195		1.421	-		-
	Forth	-		-	-		-	-		-	3.315		2.288	-		-
	Tay	-		-	-		-	-		-	1.124		1.321	-		-
*ASC*45to54*	All	-		-	-		-	-		-	-0.819		0.838	-		-
	Clyde	-		-	-		-	-		-	-1.736		1.457	-		-
	Forth	-		-	-		-	-		-	3.135		2.261	-		-
	Tay	-		-	-		-	-		-	-1.327		1.406	-		-
*ASC*55to64*	All	-		-	-		-	-		-	-0.760		0.795	-		-

	Clyde	-	-	-	-	-	-	-2.127		1.361	-	-
	Forth	-	-	-	-	-	-	1.834		2.209	-	-
	Tay	-	-	-	-	-	-	0.189		1.315	-	-
*ASC*65to74*	All	-	-	-	-	-	-	-0.937		0.911	-	-
	Clyde	-	-	-	-	-	-	-2.824	+	1.651	-	-
	Forth	-	-	-	-	-	-	1.567		2.314	-	-
	Tay	-	-	-	-	-	-	-0.246		1.474	-	-
*ASC*above75*	All	-	-	-	-	-	-	-0.861		1.133	-	-
	Clyde	-	-	-	-	-	-	-3.667		2.456	-	-
	Forth	-	-	-	-	-	-	2.116		2.635	-	-
	Tay	-	-	-	-	-	-	0.775		1.854	-	-
*ASC*employed*	All	-	-	-	-	-	-	0.840	+	0.470	-	-
	Clyde	-	-	-	-	-	-	-0.120		0.984	-	-
	Forth	-	-	-	-	-	-	0.568		0.811	-	-
	Tay	-	-	-	-	-	-	1.097		0.752	-	-
*ASC*graduate*	All	-	-	-	-	-	-	0.113		0.387	-	-
	Clyde	-	-	-	-	-	-	0.241		0.776	-	-
	Forth	-	-	-	-	-	-	-0.859		0.714	-	-
	Tay	-	-	-	-	-	-	0.858		0.594	-	-
*ASC*income above average*	All	-	-	-	-	-	-	-0.218		0.744	-	-
	Clyde	-	-	-	-	-	-	-0.776		1.360	-	-
	Forth	-	-	-	-	-	-	0.838		1.517	-	-
	Tay	-	-	-	-	-	-	-0.307		1.165	-	-
*ASC*income*	All	-	-	-	-	-	-	-0.034	*	0.017	-	-
	Clyde	-	-	-	-	-	-	-0.036		0.032	-	-
	Forth	-	-	-	-	-	-	-0.013		0.035	-	-
	Tay	-	-	-	-	-	-	-0.022		0.026	-	-
Log-likelihood	All	-3140.181		-2755.444				-2738.865				
	Clyde	-1062.124		-899.196				-891.377				
	Forth	-1059.956		-924.208				-914.343				

	Tay	-993.398	-911.356	-901.916
Observations	All	3534.000	3534.000	3534.000
	Clyde	1164.000	1164.000	1164.000
	Forth	1182.000	1182.000	1182.000
	Tay	1188.000	1188.000	1188.000
Adjusted rho-sq	All	0.190	0.290	0.290
	Clyde	0.160	0.290	0.280
	Forth	0.180	0.280	0.270
	Tay	0.230	0.290	0.290
AIC	All	6296.360	5540.890	5534.050
	Clyde	2140.250	1828.390	1838.750
	Forth	2135.910	1954.540	1884.690
	Tay	2002.800	1852.710	1859.830
BIC	All	6345.720	5633.440	5706.820
	Clyde	2180.720	1904.290	1980.420
	Forth	2176.510	1954.260	2026.780
	Tay	2043.440	1928.910	2002.070

[a] Source: Scottish estuarine management Choice Experiment, 2016.

[b] Two-tailed t-test indicate values approaching close to significance (+) and with 10% (*), 5% (**) and 1% (***) significance levels.

[c]Standard errors computed by Delta method.

[d] Rows present perameter estimates for the pooled dataset, as well as each case study

5.3 *Heterogeneity source comparative analysis*

The results from the previous section are in agreement to what literature suggest. Some authors previously described income and gender as a significant source of heterogeneity (Birol and Cox, 2007; Börger and Hattam, 2017; Kragt and Bennett, 2011b) and few others have found that visiting is also a relevant factor in seeking for environmental improvement (Birol et al., 2009b; Samdin and Khairil, 2010; Zander et al., 2010). In this section, we will extend the heterogeneity analysis to answer whether environmental preferences of ES improvements vary across individuals or/and space and how this impacts the WTP values. We are particularly interested in including two factors into the comparative analysis with three categories, giving a total of six variables. The first factor is the study site varying considerably in their environmental status: a)Tay, b)Forth and c)Clyde. The second factor is the user type, defined in terms of how direct are the ES benefits and to what extent respondents have an "use" or "non-use" value. We categorised the user type into three categories: d)being a resident of the area, e)visiting the area for outdoor recreational activities and f)being a resident and visitor of the area.

Interacted RPL models were estimated to understand the heterogeneity regarding the preferences for change and the WTP estimates. Firstly, to compare the mismatch in the preferences for change on ES levels for each user types we estimated three RPL with only the ASC interacted with the visitor, resident and both dummy variables, separately. Secondly, to estimate the user-specific attribute coefficients and explore the relative differences in WTP across user types we then run three new RPL interacting all the attributes with the binary version of the visitor, resident and both dummy variables. Similarly to the previous analysis, we applied this six choice models to the pooled choice dataset as well as to each CGA dataset to obtain the site-specific parameters. The estimates for the three RPL models interacting the dummies of interest with ASC are presented in Table 7.

The magnitude and significance patterns of the attributes and standard deviation coefficients remain in the three ASC interacted models, with all attributes having the expected significant coefficients and with non-significant standard deviations only for biodiversity and recreation. Again, the general ASC is significantly negative in the three models. Regarding the group-specific ASC, almost all cases present negative coefficients, meaning that in overall respondents have a preference for change or to avoid the SQ. However, this preference is only significant for the visitor-specific ASC. When analysing the magnitude of the ASC coefficients, we can reach two conclusions. Firstly, visitors declared a stronger preference for change and presented an ASC coefficient that is consistently more negative when compared to the rest of user-type interacted models (see Table 7 columns). Secondly, we found less negative ASC coefficients for the Clyde model when compared to the other case studies, meaning that the lowest preference for change is associated to the CCGA (see Table 7 rows).

Tables 8, 9, and 10 display the results for the remaining RPL models interacting the attributes with a binary dummy of the resident, visitor and both, respectively. These models allow us to test for dissimilar ES preferences between residents and non-residents, visitors and non-visitors, as well as the two of them together. The attribute coefficients for the three RPL present the expected signs and are mostly significantly different from zero. The slight reduction in numbers of significantly different from zero attributes in the RPL interacted 3 is explained by the substantial reduction in sample size as fewer respondents fall into this category. Regarding the standard deviation coefficients, we can see a reduction of significant coefficients in the three models in contrast to the previous models. However, the presence of still significant standard deviation coefficients indicates that even when accounting for the systematic heterogeneity explained by the user type there is still a residual component of heterogeneity in respondent's choices that we are not explaining in our models.

The attribute interacted models reported in Tables 8, 9, and 10 didn't show a general pattern of higher values associated with the use dummy variable (eg.resident) or the non-use dummy variable (e.g., non-resident) for the ES attribute. However, we found that the direct users have a less negative coefficient and therefore are less cost sensitive that indirect users.

The preferences patterns, reflected by the ranking of the ES coefficients are similar as in the non-interacted models for the groups of respondents being "non-residents", "visitors" and "neither residents and visitors", with flood control as the most preferred ES and recreation as the least preferred. However, the group of "non-visitors", "residents" and "both resident and visitors" ranked up biodiversity and declared flood control as the second most preferred ES. Interestingly, those groups assigning a value to the environment even without using it directly (e.g., "non-residents" and "neither") are expressing their non-use value and prioritising flood control over the rest of ES. On the other hand, the more direct users of ES (e.g., "residents" and "both") perceived biodiversity as the most relevant ES. In this sense, being more direct user do not necessarily impact the absolute values of ES a positive way, but influence the relative preferences by determining respondent's priorities for preserving ES in Scotland.

Even though the six RPL interacted models presented in this section (see Tables 7,8,9 and 10) do not outperform the non-interacted RPL in model fitness: they are useful for explaining preference heterogeneity between respondent's groups. Their explanatory power is often lower (adjusted ρ^2), and the BIC statistic is larger than those of the simple RPL. Nonetheless, when considering the likelihood ratio test the only models improving in fitness are the RPL interacted 2 and 5, wich interacts the visitor dummy with the ASC or the attributes. We used the BIC statistic to compare between models as it penalises models with more parameters more strongly than AIC (Burnham and Anderson, 2002).

Table 7. ***User type ASC Interacted RPL estimates for ES improvement***[a]

		RPL interacted 1						RPL interacted 2						RPL interacted 3					
Attribute	Dataset	Coefficients		S.E.	S.D.		S.E.	Coefficients		S.E.	S.D.		S.E.	Coefficients		S.E.	S.D.		S.E.
Flood control: Slight improvement	All	1.660	***	0.103	0.614	***	0.140	1.668	***	0.104	0.633	***	0.138	1.671	***	0.104	0.637	***	0.137
	Clyde	1.731	***	0.182	0.596	*	0.252	1.741	***	0.184	0.632	**	0.238	1.736	***	0.187	0.636	**	0.242
	Forth	1.689	***	0.185	0.695	**	0.243	1.679	***	0.183	0.688	**	0.240	1.698	***	0.188	0.709	**	0.244
	Tay	1.584	***	0.171	0.562	*	0.244	1.585	***	0.171	0.566	*	0.242	1.591	***	0.172	0.589	*	0.243
Flood control: Large improvement	All	2.120	***	0.129	1.140	***	0.119	2.135	***	0.130	1.155	***	0.121	2.133	***	0.130	1.152	***	0.120
	Clyde	2.215	***	0.231	1.217	***	0.210	2.227	***	0.232	1.242	***	0.210	2.221	***	0.235	1.236	***	0.211
	Forth	1.911	***	0.227	1.298	***	0.226	1.903	***	0.225	1.284	***	0.224	1.937	***	0.232	1.306	***	0.228
	Tay	2.265	***	0.221	0.867	***	0.202	2.258	***	0.218	0.857	***	0.200	2.270	***	0.219	0.870	***	0.204
Biodiversity: Slight improvement	All	1.678	***	0.114	0.243		0.286	1.687	***	0.115	0.278		0.236	1.688	***	0.114	0.283		0.233
	Clyde	1.857	***	0.205	0.214		0.445	1.869	***	0.205	0.007		NA	1.867	***	0.208	0.085		1.670
	Forth	1.642	***	0.207	0.627	**	0.235	1.636	***	0.207	0.616	*	0.239	1.649	***	0.209	0.627	*	0.241
	Tay	1.518	***	0.189	0.008		0.286	1.517	***	0.188	0.006		0.298	1.524	***	0.189	0.019		0.296
Biodiversity: Large improvement	All	1.811	***	0.123	0.799	***	0.117	1.821	***	0.124	0.807	***	0.116	1.822	***	0.124	0.811	***	0.116
	Clyde	1.677	***	0.206	0.574	*	0.229	1.690	***	0.208	0.612	*	0.216	1.687	***	0.210	0.591	*	0.224
	Forth	1.867	***	0.225	0.839	***	0.224	1.861	***	0.223	0.822	***	0.225	1.870	***	0.225	0.830	***	0.226
	Tay	1.908	***	0.216	0.866	***	0.181	1.906	***	0.213	0.865	***	0.182	1.913	***	0.215	0.870	***	0.183
Recreation: Slight improvement	All	0.640	***	0.079	0.012		0.217	0.645	***	0.079	0.028		0.222	0.645	***	0.079	0.001		0.222
	Clyde	0.683	***	0.141	0.060		0.350	0.683	***	0.141	0.035		0.293	0.685	***	0.143	0.033		0.323
	Forth	0.769	***	0.145	0.015		0.269	0.766	***	0.145	0.032		0.273	0.777	***	0.147	0.036		0.279
	Tay	0.505	***	0.127	0.155		0.512	0.500	***	0.127	0.214		0.386	0.505	***	0.128	0.184		0.442
Recreation: Large improvement	All	0.636	***	0.081	1.140	***	0.119	0.638	***	0.082	1.155	***	0.121	0.637	***	0.081	1.152	***	0.120
	Clyde	0.711	***	0.147	1.217	***	0.210	0.715	***	0.147	1.242	***	0.210	0.712	***	0.150	1.236	***	0.211
	Forth	0.582	***	0.151	1.298	***	0.226	0.577	***	0.150	1.284	***	0.224	0.587	***	0.152	1.306	***	0.228
	Tay	0.626	***	0.126	0.867	***	0.202	0.625	***	0.125	0.857	***	0.200	0.627	***	0.126	0.870	***	0.204
Cost	All	-0.015	***	0.001	-		-	-0.015	***	0.001	-		-	-0.015	***	0.001	-		-
	Clyde	-0.017	***	0.002	-		-	-0.017	***	0.002	-		-	-0.017	***	0.002	-		-
	Forth	-0.015	***	0.002	-		-	-0.015	***	0.002	-		-	-0.015	***	0.002	-		-
	Tay	-0.013	***	0.002	-		-	-0.013	***	0.002	-		-	-0.013	***	0.002	-		-
ASC	All	-1.911	***	0.315	3.281	***	0.265	-1.420	***	0.331	3.281	***	0.263	-1.823	***	0.307	3.328	***	0.265
	Clyde	-1.953	**	0.634	3.776	***	0.265	-1.456	*	0.597	3.809	***	0.265	-1.674	**	0.584	3.784	***	0.265
	Forth	-1.855	**	0.578	3.344	***	0.265	-1.215	+	0.607	3.339	***	0.265	-1.863	**	0.570	3.373	***	0.265
	Tay	-1.805	***	0.467	2.717	***	0.265	-1.439	**	0.507	2.707	***	0.265	-1.803	***	0.462	2.715	***	0.265

*ASC*Resident*	All	0.165		0.408	-	-	-		-	-	-	-	-	-	-
	Clyde	0.369		0.732	-	-	-		-	-	-	-	-	-	-
	Forth	-0.032		0.724	-	-	-		-	-	-	-	-	-	-
	Tay	-0.253		0.904	-	-	-		-	-	-	-	-	-	-
*ASC*Visitor*	All	-		-	-	-	-0.832	*	0.377	-	-	-	-	-	-
	Clyde	-		-	-	-	-0.726		0.648	-	-	-	-	-	-
	Forth	-		-	-	-	-1.107		0.672	-	-	-	-	-	-
	Tay	-		-	-	-	-0.816		0.584	-	-	-	-	-	-
*ASC*Visitor*Resident*	All	-		-	-	-	-		-	-	-	-0.099	0.437	-	-
	Clyde	-		-	-	-	-		-	-	-	-0.366	0.790	-	-
	Forth	-		-	-	-	-		-	-	-	-0.051	0.696	-	-
	Tay	-		-	-	-	-		-	-	-	-0.376	0.951	-	-
Log-likelihood	All	-2755.336					-2752.045					-2754.542			
	Clyde	-899.887					-898.987					-899.506			
	Forth	-924.247					-923.144					-924.118			
	Tay	-910.742					-909.820					-910.508			
Observations	All	3534.000					3534.000					3534.000			
	Clyde	1164.000					1164.000					1164.000			
	Forth	1182.000					1182.000					1182.000			
	Tay	1188.000					1188.000					1188.000			
Adjusted rho-sq	All	0.290					0.290					0.290			
	Clyde	0.280					0.280					0.280			
	Forth	0.280					0.280					0.280			
	Tay	0.290					0.290					0.290			
AIC	All	5542.670					5536.090					5541.080			
	Clyde	1831.770					1829.970					1831.010			
	Forth	1880.490					1878.290					1880.240			
	Tay	1853.480					1851.640					1853.020			
BIC	All	5641.390					5634.810					5639.810			
	Clyde	1912.730					1910.930					1911.970			
	Forth	1961.690					1959.490					1961.440			
	Tay	1934.760					1932.920					1934.300			

[a] Source: Scottish estuarine management Choice Experiment, 2016.

[b] Two-tailed t-test indicate values approaching close to significance (+) and with 10% (*), 5% (**) and 1% (***) significance levels.

[c]Standard errors computed by Delta method.

[d] Rows present perameter estimates for the pooled dataset, as well as each case study

Table 8. ***Resident Attribute Interacted RPL estimates for ES improvement***[a]

	RPL interacted 4						
Attribute	Dataset	Coefficients		S.E.	S.D.		S.E.
Flood control: Slight improvement*Resident	All	1.186	***	0.158	0.703	**	0.224
	Clyde	1.006	***	0.216	0.563	+	0.318
	Forth	1.575	***	0.279	0.536		0.473
	Tay	1.493	*	0.567	1.574	**	0.637
Flood control: Large improvement*Resident	All	1.330	***	0.194	1.194	***	0.204
	Clyde	1.188	***	0.259	0.865	**	0.268
	Forth	1.379	***	0.356	1.521	***	0.377
	Tay	2.567	***	0.719	2.381	**	0.896
Biodiversity: Slight improvement*Resident	All	1.432	***	0.184	0.411	+	0.271
	Clyde	1.374	***	0.261	0.232		0.558
	Forth	1.550	***	0.319	0.408		0.575
	Tay	1.899	***	0.565	0.206		0.746
Biodiversity: Large improvement*Resident	All	1.424	***	0.187	0.347		0.323
	Clyde	1.075	***	0.255	0.016		0.508
	Forth	1.691	***	0.348	0.806	*	0.388
	Tay	2.897	***	0.703	0.087		0.740
Recreation: Slight improvement*Resident	All	0.713	***	0.134	0.224		0.388
	Clyde	0.628	**	0.192	0.021		0.509
	Forth	0.978	***	0.238	0.019		0.670
	Tay	0.221		0.435	0.847		0.696
Recreation: Large improvement*Resident	All	0.963	***	0.144	0.676	**	0.212
	Clyde	1.015	***	0.199	0.318		0.432
	Forth	0.890	**	0.267	0.980	**	0.313
	Tay	1.141	*	0.436	1.019		0.788
Cost *Resident	All	-0.012	***	0.002	-		-
	Clyde	-0.010	***	0.002	-		-
	Forth	-0.011	**	0.003	-		-
	Tay	-0.023	**	0.006	-		-
Flood control: Slight improvement*Non-Resident	All	1.915	***	0.129	0.620	***	0.173
	Clyde	2.550	***	0.315	0.817	*	0.365
	Forth	1.853	***	0.242	0.779	*	0.303
	Tay	1.627	***	0.174	0.452		0.269
Flood control: Large improvement*Non-Resident	All	2.552	***	0.165	1.113	***	0.150
	Clyde	3.469	***	0.426	1.752	***	0.352
	Forth	2.282	***	0.292	1.164	***	0.295
	Tay	2.280	***	0.220	0.708	***	0.216
Biodiversity: Slight improvement*Non-Resident	All	1.834	***	0.138	0.304		0.277
	Clyde	2.464	***	0.319	0.414		0.551
	Forth	1.762	***	0.261	0.712	*	0.299
	Tay	1.504	***	0.192	0.015		0.318
Biodiversity: Large improvement*Non-Resident	All	2.040	***	0.154	0.990	***	0.140
	Clyde	2.375	***	0.343	1.163	**	0.315
	Forth	2.037	***	0.288	0.959	***	0.277
	Tay	1.842	***	0.219	0.931	***	0.190
Recreation: Slight improvement*Non-Resident	All	0.609	***	0.094	0.012		0.214
	Clyde	0.763	***	0.211	0.043		0.444
	Forth	0.659	***	0.177	0.020		0.258

	Tay	0.500	***	0.133	0.029		0.525
Recreation: Large improvement*Non-Resident	All	0.496	***	0.096	0.559	***	0.161
	Clyde	0.406	+	0.223	0.686	*	0.356
	Forth	0.436	*	0.184	0.709	*	0.271
	Tay	0.536	***	0.129	0.156		0.552
Cost *Non-Resident	All	-0.017	***	0.001	-		-
	Clyde	-0.025	***	0.003	-		-
	Forth	-0.017	***	0.002	-		-
	Tay	-0.012	***	0.002	-		-
ASC	All	-1.829	***	0.289	3.279	***	0.262
	Clyde	-1.785	***	0.533	3.783	***	0.522
	Forth	-1.843	***	0.520	3.373	***	0.479
	Tay	-1.870	***	0.464	2.782	***	0.399
Log-likelihood	All	-2726.303					
	Clyde	-871.784					
	Forth	-916.381					
	Tay	-900.723					
Observations	All	3534.000					
	Clyde	1164.000					
	Forth	1182.000					
	Tay	1188.000					
Adjusted rho-sq	All	0.290					
	Clyde	0.300					
	Forth	0.270					
	Tay	0.290					
AIC	All	5508.610					
	Clyde	1799.570					
	Forth	1888.760					
	Tay	1857.450					
BIC	All	5681.370					
	Clyde	1941.240					
	Forth	2030.860					
	Tay	1999.690					

[a] Source: Scottish estuarine management Choice Experiment, 2016.

[b] Two-tailed t-test indicate values approaching close to significance (+) and with 10% (*), 5% (**) and 1% (***) significance levels.

[c]Standard errors computed by Delta method.

[d] Rows present perameter estimates for the pooled dataset, as well as each case study

Table 9. ***Visitor Attribute Interacted RPL estimates for ES improvement***[a]

		RPL interacted 5					
Attribute	Dataset	Coefficients		S.E.	S.D.		S.E.
Flood control: Slight improvement*Visitor	All	1.576	***	0.132	0.514	*	0.202
	Clyde	1.398	***	0.232	0.712	*	0.301
	Forth	1.835	***	0.263	0.689	+	0.342
	Tay	1.805	***	0.236	0.117		0.623
Flood control: Large improvement*Visitor	All	1.984	***	0.170	1.233	***	0.159
	Clyde	1.796	***	0.287	1.160	***	0.278
	Forth	1.961	***	0.326	1.704	***	0.346
	Tay	2.505	***	0.301	0.956	***	0.256
Biodiversity: Slight improvement*Visitor	All	1.462	***	0.145	0.383		0.241
	Clyde	1.509	***	0.258	0.009		0.464
	Forth	1.542	***	0.287	0.944	**	0.307
	Tay	1.507	***	0.245	0.031		0.456
Biodiversity: Large improvement*Visitor	All	1.660	***	0.159	0.693	***	0.165
	Clyde	1.351	***	0.261	0.302		0.404
	Forth	1.911	***	0.324	1.081	***	0.329
	Tay	2.002	***	0.289	0.826	**	0.255
Recreation: Slight improvement*Visitor	All	0.737	***	0.104	0.034		0.528
	Clyde	0.683	***	0.187	0.042		0.547
	Forth	1.003	***	0.208	0.113		0.440
	Tay	0.656	***	0.173	0.268		0.471
Recreation: Large improvement*Visitor	All	0.843	***	0.108	0.517	**	0.184
	Clyde	0.907	***	0.192	0.348		0.452
	Forth	0.820	**	0.221	0.985	**	0.292
	Tay	0.953	***	0.172	0.062		0.568
Cost *Visitor	All	-0.013	***	0.001	-		-
	Clyde	-0.014	***	0.002	-		-
	Forth	-0.014	***	0.002	-		-
	Tay	-0.014		0.002	-		-
Flood control: Slight improvement*Non-Visitor	All	1.756	***	0.145	0.676	***	0.200
	Clyde	2.257	***	0.292	0.435		0.473
	Forth	1.620	***	0.252	0.688	*	0.329
	Tay	1.511	***	0.244	0.894	**	0.307
Flood control: Large improvement*Non-Visitor	All	2.273	***	0.176	1.005	***	0.181
	Clyde	2.872	***	0.377	1.438	***	0.325
	Forth	1.934	***	0.283	0.694	+	0.361
	Tay	2.153	***	0.287	0.810	*	0.331
Biodiversity: Slight improvement*Non-Visitor	All	1.920	***	0.161	0.070		0.437
	Clyde	2.370	***	0.323	0.635	+	0.377
	Forth	1.854	***	0.279	0.010		0.490
	Tay	1.619	***	0.265	0.028		0.453
Biodiversity: Large improvement*Non-Visitor	All	1.970	***	0.174	0.926	***	0.160
	Clyde	2.174	***	0.336	1.071	**	0.315
	Forth	1.967	***	0.301	0.722	*	0.293
	Tay	1.903	***	0.294	1.027	***	0.264
Recreation: Slight improvement*Non-Visitor	All	0.513	***	0.110	0.043		0.217
	Clyde	0.696	***	0.216	0.072		0.387
	Forth	0.512	**	0.193	0.004		0.264

	Tay	0.338	+	0.181	0.243		0.484
Recreation: Large improvement*Non-Visitor	All	0.385	**	0.115	0.651	***	0.178
	Clyde	0.451	+	0.232	0.775	*	0.355
	Forth	0.387	+	0.204	0.608	+	0.309
	Tay	0.284		0.180	0.477		0.375
Cost *Non-Visitor	All	-0.016	***	0.001	-		-
	Clyde	-0.022	***	0.003	-		-
	Forth	-0.017	***	0.003	-		-
	Tay	-0.012		0.002	-		-
ASC	All	-1.895	***	0.297	3.333	***	0.271
	Clyde	-1.971	***	0.570	3.976	***	0.530
	Forth	-1.828	***	0.525	3.375	***	0.483
	Tay	-1.791		0.454	2.734		0.394
Log-likelihood	All	-2742.396					
	Clyde	-889.115					
	Forth	-915.650					
	Tay	-903.037					
Observations	All	3534.000					
	Clyde	1164.000					
	Forth	1182.000					
	Tay	1188.000					
Adjusted rho-sq	All	0.290					
	Clyde	0.280					
	Forth	0.270					
	Tay	0.290					
AIC	All	5540.790					
	Clyde	1834.230					
	Forth	1887.300					
	Tay	1862.070					
BIC	All	5713.560					
	Clyde	1975.900					
	Forth	2029.400					
	Tay	2004.320					

[a] Source: Scottish estuarine management Choice Experiment, 2016.

[b] Two-tailed t-test indicate values approaching close to significance (+) and with 10% (*), 5% (**) and 1% (***) significance levels.

[c]Standard errors computed by Delta method.

[d] Rows present perameter estimates for the pooled dataset, as well as each case study

Table 10. ***Visitor Attribute Interacted RPL estimates for ES improvement***[a]

	RPL interacted 6						
Attribute	Dataset	Coefficients		S.E.	S.D.		S.E.
Flood control: Slight improvement*Visitor*Resident	All	1.139	***	0.173	0.677	*	0.257
	Clyde	0.878	***	0.233	0.529		0.381
	Forth	1.604	***	0.320	0.443		0.613
	Tay	2.071		1.156	1.365		1.100
Flood control: Large improvement*Visitor*Resident	All	1.285	***	0.220	1.260	***	0.225
	Clyde	1.200	***	0.290	0.887	**	0.288
	Forth	1.233	**	0.415	1.689	**	0.454
	Tay	2.671		1.282	2.592	+	1.282
Biodiversity: Slight improvement*Visitor*Resident	All	1.378	***	0.207	0.333		0.352
	Clyde	1.429	***	0.296	0.007		0.585
	Forth	1.363	**	0.372	0.345		0.633
	Tay	2.041		1.184	0.264		1.038
Biodiversity: Large improvement*Visitor*Resident	All	1.427	***	0.219	0.567	*	0.253
	Clyde	1.145	***	0.294	0.276		0.435
	Forth	1.520	**	0.408	0.994	*	0.438
	Tay	3.463	+	1.574	0.061		0.806
Recreation: Slight improvement*Visitor*Resident	All	0.698	***	0.150	0.229		0.533
	Clyde	0.624	**	0.215	0.198		0.655
	Forth	0.919	**	0.276	0.230		0.843
	Tay	0.372		0.573	1.153		0.856
Recreation: Large improvement*Visitor*Resident	All	0.980	***	0.160	0.626	*	0.245
	Clyde	1.033	***	0.220	0.289		0.502
	Forth	0.870	*	0.310	1.145	*	0.388
	Tay	1.536		0.813	1.018		0.870
Cost *Visitor*Resident	All	-0.011	***	0.002	-		-
	Clyde	-0.011	**	0.003	-		-
	Forth	-0.008	*	0.003	-		-
	Tay	-0.021		0.010	-		-
Flood control: Slight improvement*Non-Visitor*Non-Resident	All	1.767	***	0.160	0.756	***	0.212
	Clyde	2.346	***	0.336	0.464		0.578
	Forth	1.667	***	0.285	0.809	**	0.354
	Tay	1.386	***	0.235	0.779	*	0.311
Flood control: Large improvement*Non-Visitor*Non-Resident	All	2.333	***	0.196	1.061	***	0.202
	Clyde	3.348	***	0.470	1.690	***	0.397
	Forth	1.972	***	0.324	0.789	+	0.405
	Tay	1.908	***	0.275	0.729	*	0.341
Biodiversity: Slight improvement*Non-Visitor*Non-Resident	All	1.924	***	0.177	0.012		0.468
	Clyde	2.715	***	0.384	0.595		0.445
	Forth	1.771	***	0.317	0.009		0.459
	Tay	1.368	***	0.260	0.021		0.447
Biodiversity: Large improvement*Non-Visitor*Non-Resident	All	2.027	***	0.195	1.023	***	0.176
	Clyde	2.541	***	0.413	1.368	***	0.355
	Forth	1.896	***	0.344	0.829	**	0.312
	Tay	1.694	***	0.287	0.971	***	0.264

Recreation: Slight improvement*Non-Visitor*Non-Resident	All	0.461	***	0.119	0.032		0.226
	Clyde	0.722	**	0.247	0.094		0.410
	Forth	0.409	*	0.212	0.016		0.296
	Tay	0.244		0.180	0.024		0.496
Recreation: Large improvement*Non-Visitor*Non-Resident	All	0.317	*	0.124	0.614	**	0.201
	Clyde	0.311		0.268	0.743	*	0.410
	Forth	0.298		0.228	0.624	+	0.332
	Tay	0.196		0.176	0.334		0.405
Cost *Non-Visitor*Non-Resident	All	-0.016	***	0.002	-		-
	Clyde	-0.026	***	0.004	-		-
	Forth	-0.016	***	0.003	-		-
	Tay	-0.010		0.002	-		-
ASC	All	-2.867	***	0.304	3.657	***	0.299
	Clyde	-2.451	***	0.531	3.870	***	0.525
	Forth	-3.016	***	0.562	3.960	***	0.600
	Tay	-2.910		0.435	2.822	***	0.400
Log-likelihood	All	-2851.575					
	Clyde	-901.682					
	Forth	-959.026					
	Tay	-954.983					
Observations	All	3534.000					
	Clyde	1164.000					
	Forth	1182.000					
	Tay	1188.000					
Adjusted rho-sq	All	0.260					
	Clyde	0.270					
	Forth	0.240					
	Tay	0.250					
AIC	All	5759.150					
	Clyde	1859.360					
	Forth	1974.050					
	Tay	1965.970					
BIC	All	5931.920					
	Clyde	2001.030					
	Forth	2116.150					
	Tay	2108.210					

[a] Source: Scottish estuarine management Choice Experiment, 2016.

[b] Two-tailed t-test indicate values approaching close to significance (+) and with 10% (*), 5% (**) and 1% (***) significance levels.

[c]Standard errors computed by Delta method.

[d] Rows present perameter estimates for the pooled dataset, as well as each case study

5.4 Comparative analysis of willingness to pay

The following section presents a comparative analysis of the marginal welfare estimations or the respondent's annual average WTP for a unitary change in a single attribute, valued independently from the others. The WTP consist on the ratio the ES and the fixed cost coefficient. The confidence intervals were calculated with the Krinsky and Robb parametric bootstrap procedure using 1000 replications of the unconditional parameter estimates.

The implicit prices presented in Table 11 were estimated for all attributes using the CL and RPL models without interactions. Table 12, utilise the same models and contrast the annual average WTP estimated for each CGA. Finally, Table 13 collect the estimates of the interacted RPL 4,5,6 (see models in Tables 8,9 and 10) for computing the annual average WTP for the user types.

Overall, all ES are positively and significantly valued with values differing among ES, across CGAs and between user types. As expected, the confidence intervals estimated for the pooled dataset with larger samples are more narrow and precise than the ones estimated for smaller samples (study cases and user types).

The general ranking of WTP for ES preservation in the pooled sample (Table 11), for each case study (Table 12) and particular user types (Table 13), is consistent with the one found for the CL and RPL models (Section 5.1 and 5.2). Tables show that the more highly valued ES is flood control, followed closely by biodiversity. Recreation annual average WTP is smaller by at least a factor of two when compared to both, flood control and biodiversity. There are a few exceptions to this ordering, including a reverse order for the two most valued ES in the RPL model applied to the pooled dataset and the Clyde dataset. Both models have the "slight improvement" in flood control ranked in the first position, suggesting that when accounting for random heterogeneity lesser levels of biodiversity improvement are valued more than small improvements in flood control. Furthermore, when considering the user specific WTP values we found that the ranking differs for those respondents wich declared themselves as "residents" and "both residents and visitors" who valued biodiversity over flood control. This results are consistent with the previous discussion about preferences coefficients and indicate that residents valued recreation the most (regardless if they have visited the area or not). More surprisingly visitors attach a greater value to improvements in flood control, regardless if they reside in the area or not.

In Tables 11 and 12, it is also possible to see that annual average WTP estimates for large improvements are generally associated with higher ES values and indicating the presence of a positive scaled effect. However, the average WTP do not increase with the level of improvements in biodiversity at the CCGA, recreation at the FCGA and for the biodiversity for the resident sample; indicating that the increase in respondent's utility is not higher for all the large improvements.

By comparing the three case studies in Table 12, we can see that people from all over Scotland are willing to spend the most in improving flood and biodiversity inside the TCGA, and the least for the CCGA. The payments for recreation improvements do not have a clear ranking pattern. However, it can be noted that the CCGA is consistently ranked up in the second position for this ES. This results, suggest that the current state of the environment matters. The Tay area is less populated and has a better environmental status, and therefore people target ES which maintains or improve the current situation. Contrarily to more urban areas with lower environmental quality, such as Clyde, where respondents rather focus their expenditure on recreational services.

We found no recognisable patterns of WTP values amongst the direct users of ES presented in Table 13. This means that by comparing between residents and visitors of the catchment no particular user type was not found to be consistently associated with the highest values. Nonetheless, when we contrast these categories with their respective non-use estimates we found some patterns (estimates not presented in this paper). The resident category is not always associated with higher annual average WTP values than the non-resident. However, the visitor category presented repeatedly higher average WTP when compared to the non-visitor category. In other words, visiting the area matters for ES preservation and impacts the annual average WTP of respondents in a positive way.

When linking the WTP results with the ASC analysis presented in Section 5.3, we can conclude that the preference for change is not always translated into the willingness to spend for ES preservation in Scotland. The lowest preference for change and the smallest WTP values were associated to the CCGA. Nonetheless, visitors declared to have the highest preference for change but only stated to have the highest WTP for flood control improvements.

Table 11. ***WTP estimates for ES improvements***[a]

	CL					RPL				
Variables	WTP	C.I.				WTP	C.I.			
Flood control										
Slight improvement	113.543	(	98.605	129.837	)	112.891	(	95.282	132.054	)
Large improvement	141.434	(	125.061	160.995	)	144.423	(	123.431	168.774	)
Biodiversity										
Slight improvement	101.627	(	86.592	117.840	)	114.097	(	95.906	134.825	)
Large improvement	111.268	(	95.740	126.899	)	123.478	(	104.591	144.257	)
Recreation										
Slight improvement	37.845	(	25.580	49.274	)	43.678	(	32.473	55.770	)
Large improvement	40.170	(	29.726	51.583	)	43.238	(	31.218	55.859	)

[a]Unit GBP. All models assumed non-random cost coefficient and used 1000 sobol draws for simulation. Confidence intervals use the Krinsky and Rob (1986) bootstrap method with 1000 draws. Parenthesis indicate the size of the confidence interval. WTP values were computed with the pooled dataset.

Table 12. ***Site-specific WTP estimates for ES improvements*** [a]

	All					Clyde					Forth					Tay				
Variables	WTP	C.I				WTP	C.I				WTP	C.I				WTP	C.I			
Flood control																				
Slight improvement	112.891	(	95.282	132.054	)	102.070	(	79.128	133.421	)	118.209	(	86.337	163.965	)	124.784	(	92.176	165.675	)
Large improvement	144.423	(	123.431	168.774	)	131.480	(	100.802	171.797	)	134.558	(	95.935	186.758	)	178.029	(	134.638	241.178	)
Biodiversity																				
Slight improvement	114.097	(	95.906	134.825	)	109.678	(	82.281	144.354	)	114.239	(	81.781	156.560	)	118.858	(	88.403	158.874	)
Large improvement	123.478	(	104.591	144.257	)	98.792	(	72.875	128.876	)	130.423	(	95.719	177.216	)	149.961	(	111.339	200.977	)
Recreation																				
Slight improvement	43.678	(	32.473	55.770	)	40.706	(	23.108	59.765	)	54.163	(	32.772	78.263	)	39.348	(	18.525	62.913	)
Large improvement	43.238	(	31.218	55.859	)	42.148	(	22.933	63.941	)	40.344	(	18.679	66.676	)	49.422	(	29.737	73.452	)

[a]Unit GBP. All models assumed non-random cost coefficient and used 1000 sobol draws for simulation. Confidence intervals use the Krinsky and Rob (1986) bootstrap method with 1000 draws. Parenthesis indicate the size of the 95% confidence interval. WTP values were computed with the pooled as well as the site-specific datasets.

Table 13. ***User type specific WTP estimates for ES improvements*** [a]

	Resident					Visitor					Resident & visitor				
Variables	WTP	CI				WTP	CI				WTP	CI			
Flood control															
Slight improvement	102.542	(	67.417	147.936	)	120.569	(	87.007	166.189	)	109.981	(	72.745	170.238	)
Large improvement	115.051	(	74.709	167.649	)	151.888	(	109.446	209.997	)	124.318	(	79.737	191.990	)
Biodiversity															
Slight improvement	124.080	(	84.754	178.246	)	111.873	(	79.087	154.591	)	133.048	(	92.821	201.200	)
Large improvement	122.222	(	82.104	176.507	)	126.550	(	91.149	173.999	)	138.318	(	98.962	206.777	)
Recreation															
Slight improvement	61.780	(	35.119	96.140	)	56.480	(	34.724	85.730	)	67.007	(	38.518	109.504	)
Large improvement	83.484	(	52.588	127.265	)	64.196	(	38.730	98.966	)	94.794	(	59.554	148.427	)

[a]Unit GBP. All models assumed non-random cost coefficient and used 1000 sobol draws for simulation. Confidence intervals use the Krinsky and Rob (1986) bootstrap method with 1000 draws. Parenthesis indicate the size of the 95% confidence interval. WTP values were computed with the pooled dataset.

6. Policy implications and conclusions

This paper uses a DCE to estimate the WTP for improvements in flood control, recreation and biodiversity resulting from implementing a restoration project at three CGAs in Scotland. We contribute to valuation literature by doing an analysis that augments the heterogeneity analysis while accounting for the complexity of estuarine ecosystems and the benefits they provide to society. Different modelling techniques were used, including the CL, the simple RPL model and the interacted RPL model (ASC or attributes). These models were used to undertake a comparative analysis of the sources of environmental preferences heterogeneity. Particularly, we explored how environmental preferences and WTP values vary across case studies with different environmental quality, and among user types differing in the degree of direct use of ecosystem services.

Results revealed positive and significant WTP values for all ES that diverge in all case studies and user types. Respondent's from all over Scotland ranked the CGA with superior environmental quality with the highest WTP value, and vice versa. Additionally, results evidence a mismatch of ES priorities amongst residents and visitors and suggest that respondents that incurred on a visit to the area for outdoor recreational purposes are more willing to fund a project to restore ES. Finally, our analysis reveals that preferences for change are not always translated into the WTP, on this basis, we consider that studies exploring the heterogeneity on WTP values are useful to increase the understanding of divergences and to acknowledge equity concerns in a complex socio-environmental scenario.

The research outputs of this paper might help policy makers and regulators in designing contextualised environmental management policies and have three main policy implications. Firstly, a multi-objective environmental management policy targeting flood control and biodiversity improvements is more likely to be accepted by Scottish citizens. Secondly, we found that respondents deviate their funding efforts to areas with already decent environmental status. Even though the relevance of this areas should not be discredited, areas like these could be used as a focus of attention to subsidise restoration projects happening in other regions. Finally, since visiting the areas matters, choosing management policies which are compatible with the promotion of sustainable outdoor recreational visits could increase the willingness of people to pay for ES improvements. Incurring to visits in the areas might boost the sense of "place attachment", which in turn has been suggested to promote pro-environmental behaviour in individuals (Halpenny, 2010; Ramkissoon et al., 2013, 2012; Scannell and Gifford, 2010).

Although the Choice Experiment technique is useful for retrieving welfare estimates, it is also important to recognise it's limitations when informing policy makers. DCE estimates are based on hypothetical scenarios and are applied in very specific scenarios and context, thus potentially limiting their capacity of predicting individual's real behaviours and for extrapolating results into considerably different scenarios. This issue is of particular relevance when dealing with environmental attributes and levels that can be interpreted differently or are relatively unknown for respondents, which is the case of most ecosystem services.

Even though the study obtained a representative sample, our the study sample has some limitations. Firstly, funding restrictions limited our sample size and led to a reduction in the significance levels of the coefficients obtained in the subset datasets. Moreover, our study sample also presents spatial limitations with a large part of the people surveyed clustered around the main population settlements. We did not test for the spatial representativeness of our sample in this study, but it might be the case that in fact, our sample is spatially representative and therefore follows the population patterns that currently exist in Scotland.

Our study has have explored the heterogeneity on WTP estimates explained by socioeconomic variables. Nonetheless, it is likely that some other exogenous factors influence ES values, such as the spatial distribution and the relative scarcity of natural resources in the CGAS. There is a need for future environmental valuation research to account for spatial factors and the authors hope to develop this analysis in a further study.

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Reference List

Acreman, M.C., Harding, R.J., Lloyd, C., McNamara, N.P., Mountford, J.O., Mould, D.J., Purse, B.V., Heard, M.S., Stratford, C.J., Dury, S.J., 2011. Trade-off in ecosystem services of the Somerset Levels and Moors wetlands 56. doi:10.1080/02626667.2011.629783

Birol, E., Cox, V., 2007. Using choice experiments to design wetland management programmes: The case of Severn Estuary Wetland, UK. J. Environ. Plan. Manag. 50, 363–380. doi:10.1080/09640560701261661

Birol, E., Hanley, N., Koundouri, P., Kountouris, Y., 2009a. Optimal management of wetlands: Quantifying trade-offs between flood risks, recreation, and biodiversity conservation. Water Resour. Res. 45, 1–11. doi:10.1029/2008WR006955

Birol, E., Hanley, N., Koundouri, P., Kountouris, Y., 2009b. Optimal management of wetlands: Quantifying trade-offs between flood risks, recreation, and biodiversity conservation. Water Resour. Res. 45, 1–11. doi:10.1029/2008WR006955

Birol, E., Karousakis, K., Koundouri, P., 2006. Using a choice experiment to account for preference heterogeneity in wetland attributes: The case of Cheimaditida wetland in Greece. Ecol. Econ. 60, 145–156. doi:10.1016/j.ecolecon.2006.06.002

Birol, E., Koundouri, P., 2008. Choice experiments informing environmental policy: a European perspective 362.

Börger, T., Hattam, C., 2017. Motivations matter: Behavioural determinants of preferences for remote and unfamiliar environmental goods. Ecol. Econ. 131, 64–74. doi:10.1016/j.ecolecon.2016.08.021

Boxall, P.C., Adamowicz, W., 2002. Understanding Heterogenous Preferences in Random Utility Models: A Latent Class Approach. Environ. Resour. Econ. 23, 421–446. doi:10.1023/A:1021351721619

Boxall, P.C., Adamowicz, W.L., Olar, M., West, G.E., Cantin, G., 2012. Analysis of the economic benefits associated with the recovery of threatened marine mammal species in the Canadian St . Lawrence Estuary. Mar. Policy 36, 189–197. doi:10.1016/j.marpol.2011.05.003

Burnham, K.P., Anderson, D.R., 2002. Model Selection and Multimodel Inference: a Practical Information-theoretic Approach, New York Springer. doi:10.1111/j.1365-294X.2009.04493.x

Clyde River Foundation, 2009. The River Clyde fishery Management Plan 2009-20015. Glasgow.

Cobanoglu, C., Warde, B., Moreo, P.J., 2001. A comparison of mail, fax and web-based survey methods. Int. J. Mark. … 43, 405–410.

Costanza, R., Arge, R., Groot, R. De, Farberk, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., Neill, R.V.O., Paruelo, J., Raskin, R.G., Suttonkk, P., 1997. The value of the world ' s ecosystem services and natural capital. Nature 387, 253–260. doi:10.1038/387253a0

De Groot Rudolf, Brendan, F., Mike, C., 2010. Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. Econ. Ecosyst. Biodivers. Ecol. Econ. Found. 1–422. doi:10.1017/s1355770x11000088

Fleming, C.M., Bowden, M., 2009. Web-based surveys as an alternative to traditional mail methods. J. Environ. Manage. 90, 284–292. doi:10.1016/j.jenvman.2007.09.011

Garrod, G., Willis, K., 1998. Estimating lost amenity due to landfill waste disposal. Resour. Conserv. Recycl. 22, 83–95. doi:10.1016/S0921-3449(97)00046-3

Halpenny, E.A., 2010. Pro-environmental behaviours and park visitors: The effect of place attachment. J. Environ. Psychol. 30, 409–421. doi:10.1016/j.jenvp.2010.04.006

Hanley, N., Mourato, S., Wright, R.E., 2001. Choice Modelling Approaches : a Superior Alternative for Environmental Valuation ? J. Econ. Surv. 15, 435–462.

Hanley, N., Wright, R.E., Adamowicz, V.I.C., 1998. Using Choice Experiments to Value the Environment. Environ. Resour. Econ. 11, 413–428. doi:JEL classification: Q23, Q26

Hanley, N.D., Wright, R.E., Alvarez-Farizo, B., 2006. Estimating the economic value of improvements in river ecology using choice experiments: An application to the water framework directive. J. Environ. Manage. 78, 183–193. doi:10.1016/j.jenvman.2005.05.001

Hausman, J.A., 2012. Contingent valuation: A critical assessment. Elsevier, Amsterdam: North Holland.

Hausman, J., McFadden, D., 1984. Specification Tests for the Multinomial Logit Model. Econometrica. doi:10.2307/1910997

Hensher, D.A., Johnson, L.W., 1981. Applied Discrete-choice Modelling, A Halsted Press Book. Croom Helm.

Hensher, D.A., Rose, J.M., Greene, W.H., 2015. Applied choice analysis: a primer. Cambridge University Press, New York. doi:10.1017/CBO9781107415324.004

Hooper, T.L., 2013. Evaluating the Costs and Benefits of Tidal Range Energy Generation. University of Bath.

Jacobs, S., Vandenbruwaene, W., Wolfstein, K., Maris, T., Saathoff, S., 2013. Ecosystem Service Assessment of TIDE Estuaries 90.

Jobstvogt, N., Hanley, N., Hynes, S., Kenter, J., Witte, U., 2014a. Twenty thousand sterling under the sea: Estimating the value of protecting deep-sea biodiversity. Ecol. Econ. 97, 10–19. doi:10.1016/j.ecolecon.2013.10.019

Jobstvogt, N., Watson, V., Kenter, J.O., 2014b. Looking below the surface: The cultural ecosystem service values of UK marine protected areas (MPAs). Ecosyst. Serv. 10, 97–110. doi:10.1016/j.ecoser.2014.09.006

Kahneman, D., Knetsch, J.L., 1992. Valuing public goods: The purchase of moral satisfaction. J. Environ. Econ. Manage. 22, 57–70. doi:10.1016/0095-0696(92)90019-S

Kragt, M.E., Bennett, J.W., 2011a. Using choice experiments to value catchment and estuary health in Tasmania with individual preference heterogeneity. Aust. J. Agric. Resour. Econ. 55, 159–179. doi:10.1111/j.1467-8489.2011.00533.x

Kragt, M.E., Bennett, J.W., 2011b. Using choice experiments to value catchment and estuary health in Tasmania with individual preference heterogeneity. Aust. J. Agric. Resour. Econ. 55, 159–179. doi:10.1111/j.1467-8489.2011.00533.x

Lee, D.E., Hosking, S.G., du Preez, M., Preez, M., 2014. A choice experiment application to estimate willingness to pay for controlling excessive recreational fishing demand at the Sundays River Estuary, South Africa. Water SA 40, 39–48. doi:10.4314/wsa.v40i1.5

Lee, D.E., Hosking, S.G., Preez, M.D.U., Du Preez, M., 2015. Managing Some Motorised Recreational Boating Challenges in South African Estuaries: A Case Study at the Kromme River Estuary. South African J. Econ. 83, 286–302. doi:10.1111/saje.12059

Luisetti, T., Turner, K., Bateman, I., 2008. An ecosystem services approach to assess managed realignment coastal policy in England, Working Paper - Centre for Social and Economic Research on the Global Environment. Norwich.

Luisetti, T., Turner, R.K., Bateman, I.J., Morse-Jones, S., Adams, C., Fonseca, L., 2011. Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. Ocean Coast. Manag. 54, 212–224. doi:10.1016/j.ocecoaman.2010.11.003

McFadden, D., 1974. Conditional logit analysis of qualitative choice behavior, in: Frontiers in Econometrics. pp. 105–142. doi:10.1108/eb028592

Natasha, B., 2012. Ecological and economic valuation of managed realignment sites, Humber estuary, UK: benefits for society. University of Hul. doi:10.1038/1741121a0

Natural Scotland, 2013. Improving the physical condition of Scotland ’ s water environment: Asupplementary plan for the basin management plans.

NRS, 2014. Mid-2012 Population Estimates for Settlements and Localities in Scotland.

O’Higgins, T.G., Ferraro, S.P., Dantin, D.D., Jordan, S.J., Chintala, M.M., 2010. Habitat scale mapping of fisheries ecosystem service values in estuaries. Ecol. Soc. 15. doi:7

Office for National Statistics, 2017. Regional and National Profile Scotland [WWW Document]. URL https://www.nomisweb.co.uk/reports/lmp/gor/2013265931/report.aspx?town=scotland#tabrespop

Office for National Statistics, 2015. Labour Force Survey.

Office for National Statistics, 2011. Scotland’s Census.

Olsen, S.B., 2009. Choosing Between Internet and Mail Survey Modes for Choice Experiment

Surveys Considering Non-Market Goods. Environ. Resour. Econ. 44, 591–610. doi:10.1007/s10640-009-9303-7

Rambonilaza, T., 2011. Demande de séjour touristique en espace rural et vecteurs de valorisation marchande d ' aménités naturelles et patrimoniales 1 93, 423–441.

Ramkissoon, H., Graham Smith, L.D., Weiler, B., 2013. Testing the dimensionality of place attachment and its relationships with place satisfaction and pro-environmental behaviours: A structural equation modelling approach. Tour. Manag. 36, 552–566. doi:10.1016/j.tourman.2012.09.003

Ramkissoon, H., Weiler, B., Smith, L.D.G., 2012. Place attachment and pro-environmental behaviour in national parks: The development of a conceptual framework. J. Sustain. Tour. 20, 257–276. doi:10.1080/09669582.2011.602194

Rolfe, J., Alam, K., Windle, J., Whitten, S., 2004. Designing the Choice Modelling Survey Instrument for Establishing Riparian Buffers in the Fitzroy Basin. Establ. Potential Offset Trading Low. Fitzroy River RESEARCH R.

Samdin, Z., Khairil, W.A., 2010. ARE THERE DIFFERENCES IN WILLINGNESS TO PAY AMONG VISITORS AND NON-VISITORS OF TAMAN NEGARA NATIONAL PARK ? Manaj. Bisnis 9.

Scannell, L., Gifford, R., 2010. The relations between natural and civic place attachment and pro-environmental behavior. J. Environ. Psychol. 30, 289–297. doi:10.1016/j.jenvp.2010.01.010

Scotland's Environment, 2011. Estuaries [WWW Document]. URL http://www.environment.scotland.gov.uk/media/54824/Water-Estuaries.pdf (accessed 5.11.17).

Scottish Coastal Forum, 2004. A Strategy for Scotland's Coast and Inshore Waters. Edinburgh.

Scottish Executive, 2004. Scotland's Biodiversity It's In Your Hands. A Strategy For the Conservation and Enhancement of Biodviersity in Scotland. doi:0755941209

SEPA, n.d. Area Advisory Groups [WWW Document]. URL https://www.sepa.org.uk/environment/water/river-basin-management-planning/who-is-involved-with-rbmp/area-advisory-groups/ (accessed 4.20.17).

Stithou, M., Hynes, S., Hanley, N., Campbell, D., 2011. The Socio-Economic Marine Research Unit (SEMRU) Working Paper Series Estimating the Value of Achieving " Good Ecological Status " under the Water Framework Directive in the Boyne River Catchment : A Mixed Multinomial Logit Approach, 11-WP-SEMRU-06. Galway.

Tayside Biodiversity Partnership, n.d. Rivers and Burns.

The Scottish Government, 2015a. The river basin management plan for the Scotland river basin district : 2015 – 2027.

The Scottish Government, 2015b. Scotland's National Marine Plan: A Single Framework for Managing Our Seas. Edinburgh.

The Scottish Government, 2013. 2020 Challenge for Scotland's Biodiversity. Edinburgh.

Torres, C., Hanley, N., Riera, A., 2011. How wrong can you be? Implications of incorrect utility function specification for welfare measurement in choice experiments. J. Environ. Econ. Manage. 62, 111–121. doi:10.1016/j.jeem.2010.11.007

Train, K.E., 1998. Recreation Demand Models with Taste Differences over People. Land Econ. 74, 230–239. doi:10.1212/WNL.0b013e3181dba0e6

UK National Ecosystem Assessment, 2014. The UK National Ecosystem Assessment: Synthesis of the Key Findings. LWEC, UK. doi:10.1177/004057368303900411

UK National Ecosystem Assessment, 2011. UK National Ecosystem Assessment Synthesis of the Key Findings, UNEP-WCMC. doi:10.1177/004057368303900411

Whitehead, J.C., 2006. A practitioner's primer on the contingent valuation method. Handb. Conting. Valuat. 1–39.

Windle, J., Rolfe, J., 2011. Comparing Responses from Internet and Paper-Based Collection Methods in more Complex Stated Preference Environmental Valuation Surveys. Econ. Anal. Policy 41, 83–97. doi:10.1016/S0313-5926(11)50006-2

Zander, K.K., Garnett, S.T., Straton, A., 2010. Trade-offs between development, culture and conservation - Willingness to pay for tropical river management among urban Australians. J. Environ. Manage. 91, 2519–2528. doi:10.1016/j.jenvman.2010.07.012