

1 Willingness to pay for unfamiliar public goods: 2 Preserving cold-water coral in Norway.

3
4
5 **Margrethe Aanesen***, **Claire Armstrong***, **Mikołaj Czajkowski[§]**, **Jannike Falk-**
6 **Petersen***, **Nick Hanley[¥]** and **Ståle Navrud[¤]**

7 8 9 10 **Abstract**

11 The world's largest concentration of cold-water coral (CWC) is found off the Norwegian coast. Most
12 CWC discoveries are recent, posing new challenges for Norwegian coastal and fisheries authorities
13 regarding the management of deep-sea resources. Scientific knowledge of CWC is limited, and many
14 citizens have not even heard about them. This creates problems for the application of stated
15 preference methods to capture their economic value, and very few such studies have been
16 conducted. To fill this gap, we designed a discrete choice experiment, which was implemented in a
17 valuation workshop setting in order to derive estimates of participants' willingness to pay (WTP) for
18 increasing the protection of CWC. Despite the fact that marine industries such as oil/gas and fisheries
19 could be adversely affected by CWC protection, this did not reduce the respondents' willingness to
20 pay for further protection. The possibility that CWC play an important role as habitat for fish was the
21 single most important variable to explain respondents WTP for CWC protection. The survey revealed
22 a high degree of preference heterogeneity, whilst we found an average WTP for CWC protection in
23 the range of EUR 274-287.

24
25 JEL: Q51, Q 57

26
27 Key words: cold-water corals, willingness to pay, unfamiliar public good, discrete choice experiment,
28 natural resource management

29
30 *Arctic University of Norway-UiT, P.O.Box 6050 Langnes, 9037 Tromsø, Norway.
31 Margrethe.aanesen@uit.no

32 [§] Department of Economic Sciences, University of Warsaw, Długa 44/50, 00241 Warsaw, Poland

33
34 [¥] Department of Geography and Sustainable Development, University of St Andrews, North st.,
35 St.Andrews, Fife KY 169AJ, UK

36 [¤] School of Economics and Business, Norwegian University of Life Sciences, P.O. Box 5003,
1432 As, Norway

37

38 **1 Introduction**

39 Marine organisms have long fascinated humans, as well as being of crucial importance for our well-
40 being. Marine ecosystems provide supporting, provisioning, regulating and cultural ecosystem
41 services as defined in the Millennium Ecosystem Assessment (MEA, 2005). Over recent decades,
42 increasing awareness of the benefits our oceans provide has raised an interest in assessing the
43 economic value of these goods and services, although due to their “hidden” nature, many of these
44 benefits go un-noticed until they diminish (Stewart and Smout, 2013). Notwithstanding this, a
45 number of studies have recently emerged which quantify the economic benefits of protecting marine
46 species (Jobstvogt et al., 2014; Rogers, 2013; Hynes et al., 2013; Ressurreicao et al., 2011).

47
48 Tropical corals have been subject to a series of economic valuation studies (see e.g. Spurgeon, 1992,
49 Pendleton, 1995, Parsons and Thur, 2007, Sarkis et al., 2012), and have been identified as the global
50 biome with the highest valued ecosystem services in aggregate (de Groot et al., 2012). Their deep-
51 sea cousins, cold-water corals (CWC) have by contrast so far been subject to only one valuation
52 effort, which was largely inconclusive (Glenn et al., 2010). Moreover, there are many more gaps in
53 scientific knowledge of deep-sea ecosystems than for most terrestrial and coastal ecosystems
54 (Ramirez-Llodra et al., 2011). Indeed, until quite recently our scientific knowledge about CWC and
55 their functions in the deep-sea was very limited. The lack of scientific knowledge of CWC is reflected
56 in the lower degree of public awareness of this resource, and less political pressure to conserve CWC
57 compared to tropical corals. Nonetheless, during the last ten years, a substantial number of CWC
58 protected areas have been established worldwide (Armstrong et al., 2014).

59
60 Although there are indications that CWC may provide habitat for some fish species (Stone 2006,
61 Edinger et al., 2007), our knowledge about how CWC ecosystems function is far from complete.
62 These knowledge gaps clearly complicate economic valuation of CWCs, as illustrated by the discrete
63 choice experiment (DCE) study conducted by Glenn et al. (2010). Participants showed a low level of
64 knowledge of CWC, which may partly explain the lack of statistical significance of the price attribute.
65 Due to this statistically insignificant cost parameter, the authors stop short of estimating WTP for the
66 attributes. In general, the participants in the Glenn et al. (2010) survey had a positive attitude
67 towards protecting CWC areas, and preferred protecting all known and potential CWC areas as
68 opposed to protecting only the known CWC areas. Further, the results showed that whereas the

69 participants wanted to ban all trawling in CWC areas, they did in general not want to ban all fishing
70 activities in these areas. Trawling is a particularly damaging form of fishing for CWC.

71

72 In a related study, Jobstvøgt et al. (2014) value both non-use and use values attached to deep-sea
73 environments around the coast of Scotland. They do not explicitly focus on CWC, although these
74 habitats are found within their study area. The authors describe this deep-sea environment by
75 attributes comprising the potential for organisms to contribute to the development of new
76 medicines, and biodiversity expressed as number of marine species, which are protected. The
77 authors argue that preferences for conserving such species represent non-use values¹. They show
78 that there is a positive WTP on the part of Scottish residents for both attributes, and that WTP for the
79 “best” protection option is in the range of £ 70 – 77 per household per year.

80

81 We carried out our study in Norway, which has one of the highest densities of CWC in the world (IMR
82 2012). The exploration of the sea-bed off the Norwegian coast, partly by oil companies and partly by
83 research institutions, has uncovered many CWC occurrences and reefs. According to the most recent
84 assessments, 1100 CWC occurrences have been identified within the Norwegian exclusive economic
85 zone (IMR 2012). These marine surveys have also shown that many CWC reefs are being adversely
86 affected by human activities; at an early stage of the exploration, scientists estimated that 30-50% of
87 the known CWC reefs had been damaged or impacted (Fosså et al., 2002). Threats to CWC include
88 deep sea trawling, oil and gas exploration, mining and aquaculture. Today, as more CWC reefs have
89 been discovered, the percentage of CWC sites found to be impacted may be lower, since CWC sites
90 are now legally protected from bottom trawling as soon as they are identified. However, it is a fact
91 that CWC have been, and still are being adversely impacted by commercial sea-bed operations, of
92 which bottom trawling is the main culprit. Hence, improvements to the management of the
93 ecosystem services provided by such biogenic habitats are of vital importance. At the same time, it is
94 also necessary to present the social costs of further protection, which for the moment are potential
95 losses in value added for the oil industry and the fisheries.

96

¹ This attribute is described in the survey as follows: “Animals such as deep-sea fish, starfish, corals, worms, lobsters, sponges, and anemones would benefit most from the protection.”

97 This paper reports the results of a stated preferences (SP) study valuing protection of CWC off the
98 Norwegian coast in order to better include these types of resources in ocean management. The
99 objective of the study is twofold: (i) to derive people's WTP for protection of CWC reefs in Norway,
100 and (ii) to analyze what determines people's WTP for CWC protection. We conducted a discrete
101 choice experiment (DCE) in a valuation workshop setting. A valuation workshop is a meeting of
102 sampled participants, who complete choice tasks individually whilst learning about the good to be
103 valued (MacMillan et al, 2006). This setting was chosen to reduce the challenges posed by the
104 unfamiliarity of the good to be valued. Applying the Total Economic value (TEV) framework we
105 identified indirect use values of CWC connected to their role as providing a habitat for fish (and other
106 marine organisms); and non-use values connected to the role CWC play for biodiversity and as an
107 organism, which people might value for its own sake as two components of TEV. However, we cannot
108 neatly disentangle the values people hold for CWC due to their role as habitat and the value related
109 to their mere existence. In section 2 we present the attributes of the DCE, and give an introduction to
110 the methods used and the dataset. Section 3 presents the results, section 4 discusses the results and
111 section 5 concludes.

112

113 **2 Methods and data**

114 **2.1 Methods**

115 CWC is a good unfamiliar to most people. In order to overcome problems connected to the fact that
116 people are not well informed about the good they are about to value, it was decided to use the
117 valuation workshop method of stated preference data collection, instead of postal, internet or face-
118 to-face interviews.² A valuation workshop departs from interviews and postal/web surveys by more
119 extensive provision of information about the good to be valued in a group setting, repeated
120 valuation procedures and time to think and deliberate between the valuation tasks (Macmillan et al.,
121 2002; MacMillan et al., 2006; Colombo et al., 2013). Valuation workshops are usually performed
122 within a geographically concentrated area. As our study covers the whole country (Norway) and in
123 order to be manageable, each respondent was only asked to state their values on one occasion
124 (although this included the completion of multiple choice sets). The main difference between

² See e.g. Macmillan et al. (2002) and Christie et al. (2006) for problems connected to stated preference studies of unfamiliar goods conducted using face-to-face interviews or mail shots. Valuation workshops are also sometimes called the market stall method (Macmillan et al., 2002).

125 valuation workshops and face-to face interviews, postal or internet web survey is the enhanced
126 provision of information and people's opportunity to ask questions about unfamiliar goods. In our
127 study each workshop involved the following steps: 1) a 30-minute power point presentation
128 concerning CWC, where the participants could ask clarifying questions regarding CWC or the survey,
129 2) participants individually completed the questionnaire. Each workshop lasted about 2 hours.

130

131 In the selection of the choice attributes we used results from existing literature and expert
132 interviews. Foley et al (2010) showed that identified ecosystem services connected to CWC are i) as
133 raw material and ornamental resources (direct use and option values), ii) habitat functions, including
134 refuge and nursery functions (indirect use values), and iii) non-use values. In the only previous SP
135 survey which has been implemented on CWC (Glenn et al 2010), the effects of CWC-protection on
136 off-shore industrial activities was included. As there is substantial off-shore industrial activity in the
137 form of oil and gas exploitation and fisheries taking place along the Norwegian coast, we found that
138 including this aspect in our survey was timely. Based on this, it was decided to initially include "size of
139 protected area" to represent non-use values of CWC, and "habitat for fish" to represent indirect use
140 values, and "raw material in medicinal products" to represent direct use values or option values, as
141 this use is negligible as of today. Assuming that protection would imply a total ban of all industrial
142 activities in the protected area, we used the attribute "attractive for industrial activities" to
143 represent the societal costs of CWC protection.

144

145 Prior to the final design of the survey we implemented 3 focus groups with experts and 2 focus
146 groups with "the general public", each consisting of 5-10 participants to get feedback on the
147 selection of attributes. Whereas none of the groups opposed the choice of attributes, each of the
148 groups commented on the rather complex choice situation with 5 attributes, some of which taking
149 more than two levels. Based on this feedback it was decided to reduce the number of attributes, and
150 their levels.. As the use of CWC as input in medicinal products is the most speculative value
151 connected to CWC, this attribute was removed. This yielded a design with two attributes
152 representing the benefits we may attach to CWC and two attributes representing costs to society and
153 the individual of further CWC protection. Table 1 shows the four attributes and the levels they take.

154

155

(Table 1 about here)

156

157 At the time of writing, nine CWC areas are legally protected in Norwegian waters, covering a total of
158 2445 km². This area is used as the reference level for the attribute *Size*. In addition to CWC reefs,
159 these sites also encompass buffer zones around the reefs. The attribute *Size* refers to the *total*
160 protected area, not the additional area protected. It takes two alternative levels; 5000 km² and 10
161 000 km², where the former expresses a realistic estimate of how large areas of CWC could easily be
162 protected as of today, and the latter represents an upper limit for CWC area which could realistically
163 be protected. Note that the size of protected area encompasses both the CWC occurrences and
164 buffer zones.

165

166 The most important off-shore commercial activities along the Norwegian coast which pose the
167 largest threats to CWC are commercial fisheries and oil and gas extraction. The area presently
168 protected includes some locations, which are attractive for oil and gas exploration and for fisheries
169 activities, and some which are not. The attribute *commercial* thus distinguishes between whether
170 areas eligible for future protection are attractive to these commercial activities or not.³

171

172 The CWC sites currently protected may also include some areas which are of considerable
173 importance as habitat for fish (including both commercially caught species and other species), and
174 some which are of less importance. The *habitat* attribute distinguishes between areas being highly
175 important as a habitat for fish, compared to areas that are of less importance to fish. Finally, whereas
176 the cost of maintaining the present size of protected CWC area is set to zero in the design, increasing
177 the area of protection is assumed to imply an additional cost. The cost attribute takes four possible
178 levels, and varies between NOK (Norwegian kroner) 100 and 1000 per household annually.⁴ The
179 payment vehicle we used is a uniform nominal increase in the annual federal tax.

180

181 Our DCE design included 12 choice tasks per respondent. We prepared the choice sets by maximizing
182 the expected Bayesian d-efficiency of a multinomial logit model (Scarpa and Rose 2008). The design
183 was updated after the pilot and twice throughout the main study, in order to utilize more precise

³ Although we merged the two industries into one attribute in the choice card, the two industries were given individual attribute levels (important/not important area) such that they could easily be separated into two dummy variables in the statistical model (see table 1 for the levels for this attribute).

⁴ The nominal exchange rate for Euro against Norwegian kroner is 8.4 (July 2014).

184 information about respondents' preferences as informative priors. An example of a choice card is
 185 provided in Appendix A.

186

187 Altogether, 402 persons, including two pilot groups, were surveyed. Of these, 5 persons did not
 188 complete any of the choice cards and were thus eliminated from the sample. The remaining 397
 189 respondents provided us with 4683 choice observations. In addition to the choice cards, the
 190 questionnaire also contained socio-demographic (SD) variables (gender, age, place of residence,
 191 education level, participation in the labor force, occupation, household size and personal and
 192 household income), and questions regarding attitudes towards environmental protection in general.⁵

193

194 The theoretical foundation for DCE is random utility theory, which assumes that the utility a person
 195 derives from CWC protection depends on observed characteristics and unobserved idiosyncrasies,
 196 represented by a stochastic component (McFadden, 1974). When the survey respondents are
 197 indexed n , the alternative j , and the choice situation t , the utility to individual n of choosing
 198 alternative j in situation t can be expressed by

$$199 \quad V_{njt} = \alpha_n p_{njt} + \mathbf{b}'_n \mathbf{X}_{njt} + e_{njt}, \quad (1)$$

200 where the utility expression is separable in price, p_{njt} , and other non-price attributes, \mathbf{X}_{njt} , and e_{njt}
 201 is a stochastic component allowing for other factors than those observed by an econometrician to
 202 affect individuals' choices.

203

204 Two things in the above specification need to be noted. First of all, α_n and \mathbf{b}_n are individual-specific,
 205 thus allowing for heterogeneous preferences amongst respondents and leading to a mixed logit
 206 model (MXL).⁶ Assuming that they are the same for all respondents implies homogenous preferences
 207 and leads to the basic multinomial logit model (MNL), which although very restrictive, is typically a
 208 starting point for econometric analysis of DCE data.

209

⁵ The questionnaire is available from the corresponding author upon request.

⁶ Is it typically assumed that individual parameters follow a particular distribution (possibly multivariate distribution allowing for non-zero correlation of model parameters).

210 Secondly, the stochastic component of the utility function (e_{njt}) is of unknown, possibly
 211 heteroskedastic variance ($\text{var}(e_{njt}) = s_n^2$). Identification of the model is typically assured by
 212 normalizing this variance, such that the error term $\varepsilon_{njt} = e_{njt} \cdot \frac{\pi}{\sqrt{6s_n}}$ is identically and independently
 213 extreme value type one distributed (with constant variance $\text{var}(\varepsilon_{njt}) = \pi^2/6$), leading to the
 214 following specification:

$$215 \quad U_{njt} = \sigma_n \alpha_n p_{njt} + \sigma_n \mathbf{b}_n' \mathbf{X}_{njt} + \varepsilon_{njt}. \quad (2)$$

216 Note that due to the ordinal nature of utility, this specification still represents the same preferences.
 217 The estimates $\sigma_n \alpha_n$ and $\sigma_n \mathbf{b}_n$ do not have direct interpretation anyway, but if interpreted in relation
 218 to each other the scale coefficient ($\sigma_n = \pi/\sqrt{6s_n}$) cancels out.

219

220 Finally, given the interest in establishing estimates of WTP for the non-monetary attributes \mathbf{X}_{njt} , it is
 221 convenient to introduce the following modification which is equivalent to using money-metric utility
 222 function (aka estimating the parameters in WTP space; Train and Weeks, 2005):

$$223 \quad U_{njt} = \sigma_n \alpha_n \left(p_{njt} + \frac{\mathbf{b}_n'}{\alpha_n} \mathbf{X}_{njt} \right) + \varepsilon_{njt} = \sigma_n \alpha_n \left(p_{njt} + \boldsymbol{\beta}_n' \mathbf{X}_{njt} \right) + \varepsilon_{njt}. \quad (3)$$

224 Note that under this specification the vector of parameters $\boldsymbol{\beta}_n = \mathbf{b}_n/\alpha_n$ is now (1) scale-free and (2)
 225 can be directly interpreted as a vector of implicit prices for the attributes \mathbf{X}_{njt} . Also, in MXL models
 226 an additional advantage of this specification is that the econometrician is able to specify a particular
 227 distribution of WTP in the sample (by specifying the distribution of $\boldsymbol{\beta}_n$) rather than the distribution
 228 of the underlying taste parameters (\mathbf{b}_n). These taste parameters are later divided by a (possibly also
 229 random) price coefficient, indirectly leading to often implausible assumptions about the distribution
 230 of WTP in the sample.

231

232 Estimation of the model parameters is through maximum likelihood techniques. An individual will
 233 choose alternative j if $U_{njt} > U_{nkt}$, for all $k \neq j$, and the probability that alternative j is chosen from
 234 a set of C alternatives is given by

235
$$P(j|C) = \frac{\exp\left(\sigma\alpha_n\left(p_{njt} + \beta_n' X_{njt}\right)\right)}{\sum_{k=1}^C \exp\left(\sigma\alpha_n\left(p_{nkt} + \beta_n' X_{nkt}\right)\right)} . \quad (4)$$

236

237 In the simple (fixed parameter) multinomial logit (MNL) model the n -subscript of all parameters can
 238 be suppressed so that the estimated parameters are no longer individual specific. In the MXL
 239 specification, since the probability is conditional on the random terms the unconditional probability
 240 is obtained by multiple integration, and there exists no closed form expression of (4). Instead, it can
 241 be simulated by averaging over D draws from the assumed distributions (Revelt and Train, 1998). As
 242 a result, the simulated log-likelihood function becomes:

243
$$\log L = \sum_{n=1}^N \log \frac{1}{D} \sum_{d=1}^D \prod_{t=1}^{T_n} \frac{\exp\left(\sigma\alpha_n\left(p_{njt} + \beta_n' X_{njt}\right)\right)}{\sum_{k=1}^C \exp\left(\sigma\alpha_n\left(p_{nkt} + \beta_n' X_{nkt}\right)\right)} \quad (5)$$

244 Whereas the model above yields estimates for marginal WTPs for the attributes, we are also
 245 interested in the total WTP for the protection alternatives relative to no further protection. This
 246 corresponds to the compensating surplus (variation) of protection, which can be calculated using
 247 Hanemann (1984) and Small et al. (1981) approach with minor modifications for WTP-space models.⁷
 248 As the size attributes are mutually exclusive, we present the welfare measures associated with two
 249 exemplary cases – the first, denoted ‘small’ protection, and the second denoted ‘large’ protection,
 250 which differ in size (*size5* or *size10*, respectively) and include all the other choice attributes (*oil/gas*,
 251 *fish*, *habitat*).

252

253 **2.2 Data**

254 A professional survey firm was employed to recruit the workshop participants. In the recruitment
 255 process the targeted persons were told that the survey was about management of marine resources,
 256 but not that it was about CWC. In addition, they were told that there was a payment of NOK 500
 257 (about EUR 60) for each participant who completed the survey. In order to secure statistical
 258 representativeness with respect to gender and age, each group is representative with respect to

⁷ Note that since we are discussing a public program of protecting CWCs we are effectively dealing with a one alternative situation; CWCs are at their current state vs. implementing a new program, which simplifies calculations further.

259 gender and age for their respective municipality. To secure geographic coverage we sampled
260 municipalities across the whole country. Altogether 24 valuation workshops (including 2 pilots) in 22
261 municipalities were conducted. Each workshop had between 12 and 23 participants.

262

263 The sample characteristics are given in table 2.

264 (Table 2 about here)

265

266 The sample has a somewhat lower female share (46.5%) compared to the national average (49.8 %).
267 The age distribution of our sample is very close to the national age distribution, but we have a lower
268 share in the youngest group (18-25 years) and a slightly higher share in the middle aged group (46-55
269 years). Based on postal code we calculated the percentage living in coastal areas (63%) and in urban
270 areas (73%). Both are somewhat higher compared to the national average. About 63% of the survey
271 sample belongs to the labor force, whereas the national share is 73%. Occupationally, the survey
272 sample is biased. Of those working in the private sector, the sample contains a higher share of those
273 belonging to the oil/gas industry, fisheries and aquaculture (8%), whereas it is lower for all other
274 industries, including services. This self-selection into the sample is as expected as the topic for the
275 survey is marine resources, and therefore may be perceived as more relevant for those employed in
276 marine industries. The respondents were divided into ten income groups, each of an interval of NOK
277 100k (EUR 11.9k) and eight household income groups, each of an interval of NOK 200k (EUR 23.8k)
278 except the first and last group. The survey has a lower percentage of low income people compared
279 to the national average. The sample is biased towards more educated people, 57% had more than 12
280 years in school compared to the national average on 26%. Finally, only about 10% of the survey
281 participants were members of an environmental NGO.

282

283 As part of the survey all participants were asked to answer a quiz with eight questions. The quiz was
284 given immediately after the PP-presentation of CWC, and the quiz questions referred to information,
285 which was given during the presentation. Almost 30% of the participants achieved a full score,
286 whereas another 28% scored 7 out of 8, and 25% scored 6 out of 8. Hence, only about 20% got 5 or
287 less of the 8 quiz questions correct. This shows that the PP-presentation was reasonably effective in
288 informing people about the aspects of CWC relevant for the valuation exercises, compared for
289 example with respondents in Glenn et al. (2010).

290

291 **3 Results**

292 In the DCE, the status quo was chosen in 25% of the choices, and in the remaining 75 % of the
293 choices protecting a larger area was chosen. Table 3 shows the estimation results for the MXL model
294 with correlations, and for comparison, also for the MNL model. All models are formulated in WTP-
295 space and hence the parameter estimates for all non-price attributes can be directly interpreted as
296 WTP amounts. In the MXL model we assumed that the marginal WTPs are normally distributed,
297 whereas the cost attribute is assumed to be log-normally distributed.⁸

298

299

(Table 3 about here)

300

301 Table 3 shows that in the MXL model all attributes are significant and so are their associated
302 standard deviations, which is an indication of respondents' unobserved preference heterogeneity.
303 The *habitat* attribute had the highest WTP. Respondents were willing to pay EUR 166 more for
304 protection when the protected area was important habitat for fish compared to when it was not. The
305 estimated WTP for the *oil* and the *fisheries* attributes were positive, which means that if the area was
306 attractive for the fisheries and/or for the oil industry people were willing to pay EUR 39 and EUR 16
307 respectively more for its annual protection, compared if it was not important for these off-shore
308 industries. Finally, regarding the *size* of the protected area, respondents were willing to pay EUR 53
309 for extending the protected area from the current 2445 km² to 5000 km², and EUR 66 for an
310 extension from 2445 to 10 000 km². The MNL model, on the other hand, yields significant WTPs for
311 only three of the attributes in addition to cost; size (large), fisheries and habitat. The "size" attributes
312 in this model have far lower marginal WTPs compared to the MXL model, indicating that these were
313 the attributes which had the highest correlation with other attributes (the results from the MXL
314 model without correlation were closer to the MNL results for these attributes than to the MXL model
315 with correlation).

316

⁸ We have made our dataset and codes available at http://uit.no/prosjekter/prosjekt?p_document_id=349718
and czaj.org for others to be able to replicate our results.

317 We also estimated an MNL and an MXL model in which the choice attributes are separately
318 interacted with each of the socio-demographic (SD) variables. This allows us to identify gross (i.e.,
319 without controlling for differences in the SD variables) effects of each of these variables. These
320 results are included in appendix B.⁹ Most of the parameters for the interaction variables are not
321 significant. Among the significant effects we find that unemployed persons and persons in
322 households with higher total household income were more likely to choose the SQ alternative,
323 whereas retired persons were more likely to choose further protection. Male respondents and those
324 with higher personal income were willing to pay more for the fisheries attribute, whereas older
325 respondents were willing to pay less for the fisheries attribute. People working in the oil industry and
326 in the public sector and people living at the coast were willing to pay more for the habitat attribute.
327 There were no statistically significant differences between respondents living in urban areas
328 compared to rural households.

329

330 Next, we illustrate our results by simulating WTP for two protection scenarios. We call these “small”
331 and “large”, and arrange it so that they differ only in the size of newly protected CWC, but in both
332 cases the areas are important for commercial activities (oil/gas and fisheries) and as habitat for fish.
333 The procedure we used took uncertainty with respect to model parameters into account. The results
334 present the mean, standard error (approximated with the standard deviation) and 95% confidence
335 interval (approximated with the 95% inter-quantile range) of the welfare measures of the two
336 scenarios described above. The results, based on the MNL model and the MXL model with
337 correlations are presented in Table 4.

338

339

(Table 4 about here)

340

⁹ Note that, due to the huge amount of parameters the models where the attributes are interacted with the SD for work and occupation are the MXL model without correlations. For all other interaction models the MXL model with correlations are applied.

341 The WTP for the two protection scenarios resulting from the MNL model is reasonably close to that
342 for the MXL model. The simulated WTP for a small and a large degree of protection of cold water
343 corals equals EUR 274 and EUR 287 per household per year respectively.¹⁰

344

345 **4 Discussion**

346 There may be trade-offs between protecting CWC and the benefits which society derives from other
347 services provided by the marine environment such as commercial deep-sea fisheries and petroleum.
348 From a management and policy perspective, it is thus of considerable interest to identify types of
349 ecosystem service values to which CWC may contribute and their economic significance. Foley et al.
350 (2010), applying the TEEB framework (The Economics of Ecosystems and biodiversity; TEEB, 2010),¹¹
351 identify several ecosystem services (ES) that CWC provide. Whereas we have derived significant
352 estimates on peoples' WTP for CWC protection, it is hard to match these values to specific ecosystem
353 services that this resource provides. The most obvious ecosystem service provided by CWC is a
354 habitat for fish (and other marine organisms), which is an intermediate or supporting ecosystem
355 service. The largest single value for CWC off the coastline of Norway is people's WTP for protecting
356 CWC because of this importance as a habitat for fish, perhaps due to preferences related to the
357 consumption of fish. The single value attached to the attribute *habitat* is four times higher than the
358 value attached to the *fisheries* attribute and two to three times higher than the *size* attributes. The
359 habitat attribute may, however, also relate to non-use values for fish.

360

361 This interpretation arises from the fact that the attribute *fisheries* has a positive sign. This means that
362 even if protecting CWC will imply reduced fisheries activities, and thus less fish for consumption,
363 people are still willing to pay for protecting CWC. Hence, people are not only willing to pay for
364 protecting CWC because then we get more fish to *eat*; they may also be willing to pay for protecting
365 CWC because there will be more fish regardless of whether we eat them or not. So, people value
366 CWC due to its role as habitat for fish not only because fish provides food (and generate income) for
367 them, but also because they care about the existence of fish. We are not able to disentangle these

¹⁰ Note that the WTP for an aggregate scenario is not a simple sum of WTP for separate attributes, since the parameters in the MXL model could be correlated. In order to calculate the WTP we applied a two-tier simulation procedure described in Czajkowski et al. (2015).

¹¹ TEEB in turn applies the TEV (Total Economic Value) to categorize the ecosystem services to be valued.

368 two motives for WTP. The *size* attributes (small and large) have significant WTP estimates. Although
369 it could be tempting to let these attributes represent peoples' valuation of CWC for its pure existence
370 (non-use) values, this attribute could also represent the fact that a larger protected area means that
371 there is more habitat for fish and other marine organisms. As such, the *size* attributes may also
372 encompass intermediate (indirect) ecosystem service values. Given the relatively high welfare level
373 of most people in Norway, it is not unlikely that immaterial concerns play a significant role in
374 peoples' preferences. One such immaterial concern is to safely assume that CWC will continue to
375 exist in Norwegian waters, and that it will continue to provide habitat for fish stocks in the future.

376

377 Due to the complexity of the model and number of observations, including the socio-demographic
378 characteristics as interactions in the model did not provide many significant results. Among those of
379 interest is the fact that men, younger people and those with higher income tended to have higher
380 WTP for the fisheries attribute, whereas people living on the coast, working in the oil industry or
381 working in the public sector had a higher WTP for the habitat attribute. We did not find statistically
382 significant effects of the rural-urban gradient, which has been shown to be a significant explanatory
383 variable in other valuation studies (Martin-Lopez et al., 2012). Neither did we find large gender gaps,
384 such as Funk and Gathmann (2008) found in areas such as health, environmental protection, defence
385 spending and welfare policy.

386

387 Wilson and Howarth (2002) point to a paradox that, whereas most ecosystem services are public
388 goods, the methods applied to elicit how people value them are based on responses from individuals
389 in private settings. In contrast, group settings can encourage people to share their knowledge, which
390 in turn increases the likelihood of more informed choices than would be the case if the decision were
391 left to single individuals (Winquist and Larson, 1998, referred to in Wilson and Howarth, 2002,
392 p.439). This may be especially relevant in cases with unfamiliar (public) goods, such as CWC. Spash
393 (2002) adds nuances to this viewpoint by showing that additional information mainly contributes to
394 inform respondents' preferences rather than changing them. Group discussion of the trade-offs
395 which society faces in environmental management decisions can also produce more consensus over
396 actions, even when preferences are elicited on an individual basis. The fact that previous studies of
397 CWC protection have ended up inconclusive due to a non-significant cost attribute (Glenn et al.,
398 2010) was a strong signal that the "minimum information" modes of WTP elicitation, such as postal,

399 internet, or even face to face (in-person) surveys may not be sufficient to derive useful WTP
400 estimates for CWC management, since this is such an unfamiliar good (Czajkowski et al., 2015).

401 Given this background, we chose a valuation workshop approach, which worked well in the sense
402 that it gave us a robust dataset and significant attribute estimates. This said, it must be admitted that
403 the costs of the survey were significant. Recent experiences have shown that an identical survey, but
404 where all information was provided by the use of videos, can be implemented by the use of internet
405 for only a fraction of the valuation workshop costs (Sandorf et al., 2014). The question is, however,
406 whether such an internet survey could have been implemented without the experiences from the
407 valuation workshops? As we see it, the benefits from implementing valuation workshops were not
408 solely more robust and better informed WTP estimates, but also a learning process for SP-
409 practitioners when valuing unfamiliar (environmental) goods. Whereas focus groups provide
410 information about how to present the good to be valued, and the pilot(s) control for how
411 respondents manage to make “reasonable” choices, nowhere in the process of designing an SP-
412 survey do researchers have the opportunity to be informed about how people actually understand
413 the questions they are asked to respond to.

414

415 Valuation workshops do not come without drawbacks. Although the sample is relatively
416 representative for the Norwegian adult population with regard to socioeconomics and geography,
417 two issues may still make the sample un- representative of the general public. i) Prior to the choice
418 experiment questions the participants were given information about CWC, and ii) the survey
419 participants were allowed to ask questions regarding CWC and deliberate on the issues around
420 protecting such sites. These issues obviously imply that the survey sample on average is more
421 informed about CWC than the Norwegian public in general. This is important since results from the
422 valuation literature show a positive correlation between the level of knowledge of a good and the
423 WTP for the same good (Spash 2002, LaRiviere et al., 2014). In addition we have the so-called “social
424 desirability” effect, which states that people tend to increase their stated WTP for a good when given
425 in a social setting compared to when they are surveyed in social isolation (List et al., 2004, Leggett et
426 al., 2003).

427

428 Based on the results from the survey reported above, the message to Norwegian coastal authorities
429 is that people do care for CWC *per se*, and especially if it constitutes an important habitat for fish.
430 Also, they are willing to accept that commercial fishing and the oil industry are adversely affected by

431 CWC protection. Norwegian coastal authorities and managers emphasize the importance of
432 implementing policy, which to the extent possible, is accepted by those who are subject to these
433 rules and regulations (pers. comm. Egil Lekven, Norwegian Directorate of Fisheries, 28.09.2012).
434 Hence, the authorities are particularly sensitive to the feedback from fishers and other people
435 working in the marine industries. Our results show that people working in the oil industry had a
436 higher WTP for the habitat attribute compared to people working in other industries. In addition,
437 54% of the respondents working in marine industries (fisheries, aquaculture and oil exploitation)
438 state that industrial activities off shore must be executed with care in order to make as little damage
439 to CWC as possible. The remaining 46% of respondents working in the marine sector state that we
440 have to accept that some CWC may get lost due to industrial activities. The corresponding numbers
441 for respondents not working in the marine industries are 68% and 32%. Hence, although respondents
442 from marine industries are to a larger degree willing to accept that CWC are destroyed due to
443 industrial activities, a majority still are of the opinion that such activity must be executed with
444 outmost care in order to avoid damage to CWC. Such a result is of interest for the authorities, as it
445 indicates that protecting areas with CWC from, first and foremost, bottom trawling may gain support
446 from those who have to live with the consequences of the regulations. On the other hand, as only 8%
447 of the respondents belong to the marine sector, and given the problems of self-selection and the
448 knowledge bias, this result must be interpreted with care.

449

450 **5 Conclusions**

451 An increasing awareness that human welfare crucially depends on ecosystem services beyond our
452 daily experiences renders information about these unfamiliar and inconspicuous goods and services
453 highly important. The results presented in this paper show that further protection of CWC is
454 regarded as a benefit for which people have a positive and significant WTP. In addition, although not
455 yet rigorously scientifically proven, scientists suspect that CWC is important habitat for many
456 commercially important species. These aspects make CWC important from a management
457 perspective. The aim of this paper is to derive monetary estimates for people's valuation of CWC, and
458 to determine the motivations behind the derived WTP. The results revealed that people value CWC
459 due to the fact that CWC provide habitat for fish (and other marine organisms), and for its pure
460 existence. However, we were not able to disentangle the values people attach to CWC due to its role
461 as habitat for fish compared to its pure existence.

462

463 There are challenges in valuing intangible, and for most people unheard of, organisms. In the worst
464 case, we may end up with an invalid dataset, because the respondents have not understood what
465 they were responding to. To avoid this pitfall, we implemented the survey as a type of valuation
466 workshop instead of a traditional stated preferences survey. Whereas this rendered the survey highly
467 valid, it came at the cost of possible sample bias due to self-selection and knowledge acquisition and
468 the social desirability effect.

469

470 This paper presents the first direct monetary valuation of CWC. Such a valuation of an intangible and
471 relatively unknown good poses several methodological and practical challenges as described above.
472 On the other hand, it has provided insights, which can be useful in the management of marine
473 resources in Norway. First, we show that people in Norway derive welfare from knowing that CWC
474 exists. Second, assuming that CWC plays a role as habitat for fish, we show that people motivation
475 for protecting CWC is not only motivated by the fact that they consume fish, but also that they value
476 fish having good and sufficient living conditions. Our results indicate that such considerations should
477 be given significant weight in Norwegian resource management. Finally, our work illustrates the
478 challenges inherent in the alignment of the MEA (2005) classification of ecosystem services with the
479 older concept of Total Economic Value (TEV).

480

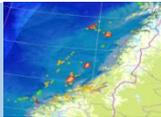
481 **Acknowledgements**

482 The work on this paper is carried out in the project “Habitat-Fisheries interactions: Valuation and bio-
483 economic modeling of cold water corals” financed by the Norwegian Research Council, grant #
484 216485. We would like to thank the participants of 5 focus groups and 24 valuation workshops for
485 their time and effort to provide valuation data on the CWC. We are grateful to Jan Helge Fosså and
486 Pål Buhl Mortensen for valuable input regarding the ecological aspects of CWC. We also thank four
487 referees and an editor for their comments to a previous version of the paper. All errors are our own.

488

489 **Appendix A**

490

<i>Attribute</i>		<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3 (SQ)</i>
<i>Size of protected area (total)</i>		5.000 km ²	10.000 km ²	2.445 km ²
<i>Attractiveness for commercial activities</i>		No, not attractive for any commercial activities	Attractive for oil/gas and fisheries	Somewhat attractive for oil/gas and fisheries
<i>Importance as habitat for fish</i>		Important	Not important	Some importance
<i>Costs per household per year</i>		100 kr/year	1000 kr/year	0
<i>I prefer</i>				

491

492 *Figure A1 Choice card used in the DCE*

493

494 **Appendix B**

495

496 *Table A1 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL*
 497 *and MXL models including interactions with respondents' gender. ***, ** and*
 498 ** indicate estimates significant at 1%, 5% and 10% level, respectively.*

	<i>MNL model</i>	<i>MXL model</i>	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-1.5995 (14.8912)	73.0686*** (15.5776)	202.4771*** (20.1415)
Large-size	40.8928*** (14.8719)	99.5739*** (15.6675)	233.0997*** (20.7660)
Oil/gas	23.3791** (9.8471)	16.9129 (9.3039)	98.2431*** (8.3238)
Fish	13.3119 (10.1590)	11.8287 (8.3010)	105.7522*** (8.5319)
Habitat	175.3952*** (16.9902)	159.5201*** (15.1114)	216.9765*** (20.9028)
Small-size*sex	-21.7111 (20.1577)	-3.1876 (26.8175)	235.1352*** (30.7155)
Large-size*sex	-38.3644 (20.4352)	-24.4888 (29.1217)	239.5579*** (31.8762)
Oil/gas*sex	-21.3664 (13.4468)	-4.6147 (13.3909)	71.8871*** (12.7528)
Fish*sex	28.7139** (14.0689)	32.2458** (12.9890)	91.7690*** (15.4364)
Habitat*sex	-2.0932 (14.9574)	-6.2462 (20.0993)	173.1844*** (25.0731)
Price (in preference space)	77.1318*** (6.4918)	72.7213*** (8.8205)	110.6386*** (10.5950)
<i>N</i>	4683		4683

499 *MXL: LogLikelihood = -3436.4736, AIC/n = 1.5011, pseudo-R2 = 0.3232*500 *MNL: LogLikelihood = -4753.2124, AIC/n = 2.0347, pseudo-R2 = 0.0639*

501

502 Table A2 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 503 and MXL models including interactions with respondents' age. ***, ** and *
 504 indicate estimates significant at 1%, 5% and 10% level, respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-13.5260 (10.7224)	32.7543*** (7.9730)	185.6130*** (15.2903)
Large-size	20.1445** (10.2080)	62.7486*** (8.1677)	241.9214*** (15.6967)
Oil/gas	12.1108 (6.6846)	22.8324*** (6.9099)	80.5276*** (6.1978)
Fish	28.6054*** (7.2109)	44.3110*** (6.7365)	82.2134*** (6.5007)
Habitat	174.8088*** (15.1422)	201.8291*** (11.1838)	152.4431*** (9.5829)
Small-size*age	-13.4574 (9.8426)	-25.7249 (16.6604)	170.1484*** (16.0232)
Large-size*age	4.3242 (10.1029)	-19.7655 (17.7201)	186.2318*** (17.0909)
Oil/gas*age	-3.7183 (6.7089)	-7.8129 (8.0972)	61.6957*** (7.1841)
Fish*age	-23.3420*** (7.2299)	-18.7839** (8.7613)	65.8444*** (8.9848)
Habitat*age	1.2282 (7.4303)	-13.4736 (11.8109)	118.3180*** (12.1190)
Price (in preference space)	77.0820*** (6.5041)	77.0260*** (9.6061)	143.9347*** (11.9415)
N	4683		4683

505 MXL: LogLikelihood = -3424.973, AIC/n = 1.4962, pseudo-R2 = 0.3255

506 MNL: LogLikelihood = -4747.098, AIC/n = 2.0321, pseudo-R2 = 0.0651

507

508 Table A3 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 509 and MXL models including interactions with respondents being members of
 510 environmental non-government organizations. ***, ** and * indicate
 511 estimates significant at 1%, 5% and 10% level, respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-20.1593 (11.2388)	32.7543*** (7.9730)	185.6130*** (15.2903)
Large-size	12.6377 (10.6727)	62.7486*** (8.1677)	241.9214*** (15.6967)
Oil/gas	8.5732 (7.0188)	22.8324*** (6.9099)	80.5276*** (6.1978)
Fish	27.4969*** (7.5175)	44.3110*** (6.7365)	82.2134*** (6.5007)
Habitat	165.2576*** (14.6236)	201.8291*** (11.1838)	152.4431*** (9.5829)
Small-size*age	133.3908*** (41.2960)	-25.7249 (16.6604)	170.1484*** (16.0232)
Large-size*age	140.4976*** (41.0388)	-19.7655 (17.7201)	186.2318*** (17.0909)
Oil/gas*age	33.7738 (22.0476)	-7.8129 (8.0972)	61.6957*** (7.1841)
Fish*age	11.2708 (22.9338)	-18.7839** (8.7613)	65.8444*** (8.9848)
Habitat*age	93.1677*** (26.8177)	-13.4736 (11.8109)	118.3180*** (12.1190)
Price (in preference space)	77.3265*** (6.5145)	77.0260*** (9.6061)	143.9347*** (11.9415)
N	4683		4683

512 MXL: LogLikelihood = -3424.973, AIC/n = 1.4962, pseudo-R2 = 0.3255

513 MNL: LogLikelihood = -4718.3075, AIC/n = 2.0198, pseudo-R2 = 0.0708

514 Table A4 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 515 and MXL models including interactions with the number of adults in
 516 respondents' household. ***, ** and * indicate estimates significant at 1%,
 517 5% and 10% level, respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-11.8140 (10.6661)	25.7892*** (9.8439)	200.4595*** (15.3289)
Large-size	21.6590** (10.1674)	35.1875*** (9.8943)	262.2640*** (15.8401)
Oil/gas	11.9676 (6.6731)	13.4038 (7.3299)	106.3659*** (7.2783)
Fish	28.5654*** (7.1847)	21.0283*** (7.3327)	97.6329*** (6.6465)
Habitat	173.9335*** (15.0483)	163.3156*** (10.9335)	154.2273*** (11.0068)
Small-size*hha	-25.3816** (10.7765)	-4.9400 (18.2107)	122.4152*** (23.0915)
Large-size*hha	-32.7543*** (10.8326)	-20.9364 (20.0943)	149.1938*** (24.8135)
Oil/gas*hha	0.7950 (7.1545)	3.5770 (12.5101)	59.7082*** (12.1311)
Fish*hha	-0.1698 (7.4223)	2.3496 (10.3457)	63.6251*** (11.9274)
Habitat*hha	-1.4092 (8.0611)	-11.7137 (15.2722)	132.9072*** (17.8534)
Price (in preference space)	77.0887*** (6.4900)	82.7339*** (8.5124)	111.8290*** (11.0080)
N	4683		4683

518 MXL: LogLikelihood = -3442.8638, AIC/n = 1.5038, pseudo-R2 = 0.322

519 MNL: LogLikelihood = -4746.7894, AIC/n = 2.032, pseudo-R2 = 0.0652

520 Table A5 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 521 and MXL models including interactions with respondents' number of children
 522 in the household. ***, ** and * indicate estimates significant at 1%, 5% and
 523 10% level, respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-13.3010 (10.7211)	53.1869*** (10.2026)	164.2629*** (15.7049)
Large-size	20.4785** (10.1857)	76.2262*** (10.0514)	227.5745*** (16.2270)
Oil/gas	12.0069 (6.6786)	19.5160*** (6.5856)	70.7980*** (7.1950)
Fish	28.7149*** (7.1968)	27.3992*** (6.4849)	93.9699*** (7.7029)
Habitat	174.3056*** (15.0928)	151.9601*** (11.4279)	180.9822*** (12.1278)
Small-size*hhc	-21.1655** (10.5523)	-17.5428 (15.1447)	154.5121*** (16.5092)
Large-size*hhc	-15.6699 (10.3815)	-8.8567 (16.2101)	164.9145*** (16.8007)
Oil/gas*hhc	4.6687 (6.8014)	6.7790 (9.2063)	79.0411*** (8.7229)
Fish*hhc	7.1066 (7.1383)	7.1389 (8.3740)	66.4795*** (10.8303)
Habitat*hhc	5.4087 (7.7207)	13.8456 (14.3369)	120.4279*** (14.5313)
Price (in preference space)	76.9809*** (6.4867)	90.1376*** (8.6879)	128.1923*** (10.7849)
N	4683		4683

524 MXL: LogLikelihood = -3436.0707, AIC/n = 1.5009, pseudo-R2 = 0.3233

525 MNL: LogLikelihood = -4757.3993, AIC/n = 2.0365, pseudo-R2 = 0.0631

526 Table A6 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 527 and MXL models including interactions with respondents' personal income
 528 level. ***, ** and * indicate estimates significant at 1%, 5% and 10% level,
 529 respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-10.8229 (10.6811)	55.8112*** (6.4389)	179.8279*** (12.9113)
Large-size	22.4657** (10.1992)	68.8861*** (6.2275)	217.8179*** (13.5462)
Oil/gas	11.6468 (6.6842)	26.6931*** (5.1228)	68.0622*** (6.3027)
Fish	28.1360*** (7.1917)	42.0193*** (6.2412)	94.7217*** (5.9729)
Habitat	174.3198*** (15.0923)	173.6742*** (10.6594)	170.3706*** (10.6996)
Small-size*pincome	23.7176** (10.3797)	-6.4925 (14.8224)	87.6955*** (13.9267)
Large-size*pincome	32.6957*** (10.4923)	-1.2910 (14.2723)	132.0466*** (10.9578)
Oil/gas*pincome	4.2861 (6.5967)	12.0139 (7.8879)	87.0703*** (7.6481)
Fish*pincome	13.3946 (6.9835)	22.4610*** (7.9653)	67.3082*** (8.8072)
Habitat*pincome	4.5116 (7.4466)	20.3780 (11.0017)	94.8509*** (12.2034)
Price (in preference space)	77.0632*** (6.4886)	90.6151*** (10.4568)	157.6493*** (13.2144)
N	4683		4683

530 MXL: LogLikelihood = -3434.8275, AIC/n = 1.5004, pseudo-R2 = 0.3235

531 MNL: LogLikelihood = -4736.1811, AIC/n = 2.0274, pseudo-R2 = 0.0673

532 Table A7 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 533 and MXL models including interactions with respondents' household income
 534 level. ***, ** and * indicate estimates significant at 1%, 5% and 10% level,
 535 respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-13.3661 (10.7271)	35.0046*** (8.7921)	219.7241*** (17.0922)
Large-size	20.4588** (10.1862)	51.5938*** (9.6956)	290.3487*** (18.9990)
Oil/gas	11.9487 (6.6821)	10.6724 (6.2237)	92.8634*** (6.4229)
Fish	28.7103*** (7.1988)	19.4476*** (7.2791)	106.0714*** (7.4993)
Habitat	174.4173*** (15.1024)	163.5352*** (10.3174)	162.0451*** (10.3414)
Small-size*hincome	-21.5045** (10.0943)	-64.8025*** (19.5461)	136.2588*** (16.2863)
Large-size*hincome	-15.3735 (10.0542)	-69.4303*** (21.0146)	153.1686*** (17.1366)
Oil/gas*hincome	0.0982 (6.6196)	3.6705 (8.6577)	51.3623*** (9.5468)
Fish*hincome	3.7842 (6.8867)	-0.3982 (9.4339)	65.2110*** (9.7769)
Habitat*hincome	9.3989 (7.5010)	24.3025 (13.1462)	99.8747*** (11.5908)
Price (in preference space)	76.9715*** (6.4854)	98.3476*** (9.0473)	129.4465*** (11.3568)
N	4683		4683

536 MXL: LogLikelihood = -3424.7189, AIC/n = 1.4961, pseudo-R2 = 0.3255

537 MNL: LogLikelihood = -4757.0199, AIC/n = 2.0363, pseudo-R2 = 0.0632

538 Table A8 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 539 and MXL models including interactions with respondents' education levels.
 540 ***, ** and * indicate estimates significant at 1%, 5% and 10% level,
 541 respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	-55.6833 (38.5251)	52.9145 (115.0683)	231.6006 (143.3534)
Large-size	-66.3401 (41.3738)	30.6446 (111.4714)	204.2161** (99.6714)
Oil/gas	-19.9318 (27.6183)	1.0044 (44.5224)	129.3993** (53.1411)
Fish	55.0835 (29.1112)	35.9603 (59.3785)	214.1792** (105.0010)
Habitat	131.7686*** (31.8890)	108.6970 (90.5374)	325.3339** (142.6970)
Small-size*edu2	37.0288 (41.4678)	6.9116 (122.4868)	262.7415*** (86.8379)
Small-size*edu3	16.7393 (42.7366)	-42.1792 (143.9835)	401.1912*** (120.8627)
Small-size*edu4	80.2271 (42.2388)	140.9109 (129.7440)	344.3777*** (90.2168)
Large-size*edu2	49.7075 (44.2281)	19.3465 (122.3543)	285.9476*** (78.0617)
Large-size*edu3	71.3299 (45.3378)	13.0773 (132.5640)	450.0153*** (118.3907)
Large-size*edu4	155.5929*** (45.6179)	216.5508 (127.4247)	380.1734*** (98.6408)
Oil/gas*edu2	31.9527 (29.8401)	17.1055 (50.8481)	190.1547*** (46.1540)
Oil/gas*edu3	21.5652 (30.7015)	-12.8341 (65.8962)	308.1728*** (80.3226)
Oil/gas*edu4	44.7154 (29.9018)	8.6895 (59.3535)	313.6960*** (59.8571)
Fish*edu2	-8.4257 (31.0900)	11.8284 (63.9837)	275.6093*** (88.2622)
Fish*edu3	-27.8989 (32.1424)	-13.7492 (87.4261)	437.4155*** (103.7406)
Fish*edu4	-48.3876 (31.2872)	-45.1519 (69.1979)	318.6273*** (89.0861)
Habitat*edu2	60.3600 (33.3612)	83.4939 (93.1402)	400.8256*** (132.8616)
Habitat*edu3	41.1101 (34.1317)	138.3391 (122.3494)	620.5718*** (141.3993)
Habitat*edu4	30.1602 (33.0277)	108.0396 (98.4263)	451.9211*** (126.5175)
Price (in preference)	78.0016***	108.1200***	261.5705***

space)	(6.5179)	(22.7911)	(27.6411)
<i>N</i>	4683		4683

542 *MXL: LogLikelihood = -3292.3705, AIC/n = 1.5199, pseudo-R2 = 0.3516*

543 *MNL: LogLikelihood = -4725.1207, AIC/n = 2.027, pseudo-R2 = 0.0694*

544

545 Table A9 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 546 and MXL models including interactions with respondents living in coastal
 547 areas. ***, ** and * indicate estimates significant at 1%, 5% and 10% level,
 548 respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	6.2126 (12.7402)	74.4385*** (14.4840)	238.1861*** (21.5538)
Large-size	41.5929*** (12.4917)	75.5606*** (16.6944)	324.8072*** (23.9982)
Oil/gas	19.6872** (8.3170)	1.4302 (8.6984)	101.9891*** (8.0898)
Fish	27.0160*** (8.7904)	30.2755*** (8.1645)	90.3740*** (7.5614)
Habitat	157.6426*** (14.9098)	145.5596*** (11.3516)	138.2143*** (10.2727)
Small-size*coast	-52.7171** (21.1806)	-54.7066 (35.8184)	213.6329*** (38.7826)
Large-size*coast	-57.2663*** (21.4707)	-26.2789 (37.7308)	183.5715*** (36.4916)
Oil/gas*coast	-21.7808 (14.0368)	14.4083 (18.0372)	162.9807*** (21.1854)
Fish*coast	4.6669 (14.4294)	13.6939 (21.3065)	137.0991*** (17.6839)
Habitat*coast	45.4377*** (16.1126)	97.4720*** (30.9601)	229.7873*** (32.7702)
Price (in preference space)	77.2147*** (6.4935)	67.5253*** (9.1344)	116.1603*** (11.3757)
N	4683		4683

549 MXL: LogLikelihood = -3433.7759, AIC/n = 1.4999, pseudo-R2 = 0.3238

550 MNL: LogLikelihood = -4749.9514, AIC/n = 2.0333, pseudo-R2 = 0.0645

551 *Table A10* *Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL*
 552 *and MXL models including interactions with respondents living in urban areas.*
 553 ****, ** and * indicate estimates significant at 1%, 5% and 10% level,*
 554 *respectively.*

	<i>MNL model</i>	<i>MXL model</i>	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	1.4810 (11.9904)	76.3176*** (10.4458)	226.6086*** (17.1932)
Large-size	42.5906*** (11.6284)	76.3361*** (11.5579)	314.1618*** (18.8765)
Oil/gas	11.0700 (7.6741)	-11.8093 (7.0352)	109.4171*** (7.6410)
Fish	28.2822*** (8.1878)	18.8630*** (6.6138)	103.2025*** (6.4224)
Habitat	170.1934*** (15.2815)	150.6411*** (9.7687)	145.9575*** (10.1637)
Small-size*urban	-52.1100** (22.6521)	-59.1299 (40.4203)	263.9154*** (57.7426)
Large-size*urban	-81.5140*** (23.8207)	-53.9697 (47.9150)	250.3831*** (52.6989)
Oil/gas*urban	3.6153 (15.2150)	17.9266 (20.9906)	111.0886*** (26.7661)
Fish*urban	1.3837 (15.7980)	9.7533 (27.2714)	165.2332*** (29.7026)
Habitat*urban	12.5922 (17.0277)	43.6612 (37.8565)	181.9871*** (32.8401)
Price (in preference space)	77.4920*** (6.4826)	84.5579*** (9.4224)	123.8630*** (11.0872)
<i>N</i>	4683		4683

555 *MXL: LogLikelihood = -3427.2631, AIC/n = 1.4971, pseudo-R2 = 0.325*

556 *MNL: LogLikelihood = -4748.8291, AIC/n = 2.0328, pseudo-R2 = 0.0648*

557

558 *Table A11* *Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL*
 559 *and MXL models including interactions with respondents' work status. ***, ***
 560 *and * indicate estimates significant at 1%, 5% and 10% level, respectively.*

	<i>MNL model</i>		<i>MXL model</i>	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)	
Small-size	0.8243 (53.8145)	-4.4598 (5.5013)	99.4286*** (7.0368)	
Large-size	-22.6067 (55.3865)	28.4999*** (6.0846)	139.5364*** (7.4995)	
Oil/gas	-9.3276 (38.1438)	13.8304*** (5.3624)	103.5741*** (6.3692)	
Fish	46.5242 (39.1668)	9.0967 (4.9518)	89.6548*** (5.4167)	
Habitat	115.8885*** (42.3707)	150.7982*** (8.7956)	177.7242*** (9.7333)	
Small-size*work2	-59.0539 (77.7055)	-42.3140 (21.7354)	91.1195*** (15.2229)	
Small-size*work3	-63.7765 (73.3517)	-109.9586*** (23.7990)	194.0534*** (29.9280)	
Small-size*work4	30.0249 (71.5272)	26.7925 (14.8291)	78.0235*** (13.1569)	
Small-size*work5	-40.4722 (59.4563)	-97.7921 (199.0386)	56.4045 (155.3539)	
Small-size*work6	-23.1881 (57.0929)	37.0603*** (11.1199)	41.3516*** (6.5993)	
Small-size*work7	3.2946 (56.0285)	-84.2646** (33.3054)	130.0512*** (23.5257)	
Large-size*work2	-99.1758 (83.5497)	-85.1258*** (15.6630)	97.9256*** (10.4383)	
Large-size*work3	-32.4732 (74.7649)	-72.2749*** (24.1403)	103.0552*** (29.0060)	
Large-size*work4	96.7611 (71.6394)	25.3062 (15.3285)	55.4858*** (9.1889)	
Large-size*work5	43.5072 (60.3195)	-290.5297 (172.6677)	10.0404 (112.2723)	
Large-size*work6	49.2485 (58.3403)	-12.2220 (10.2900)	65.9354*** (10.1995)	
Large-size*work7	51.6266 (57.6741)	-214.1708*** (40.8379)	89.9138*** (32.8634)	
Oil/gas*work2	28.8488 (56.7293)	-36.8899*** (14.2722)	45.9670 (25.6822)	
Oil/gas*work3	9.1289 (50.3809)	-22.2731 (22.4920)	77.0666*** (24.5642)	
Oil/gas*work4	-38.2853 (48.2553)	-22.5833 (11.9559)	47.9016*** (12.3098)	
Oil/gas*work5	-2.5635 (41.8109)	-62.7264 (121.2017)	50.8726 (92.4557)	

	38.5565	-14.4654	88.3497***
Oil/gas*work6	(40.1814)	(7.5714)	(10.8367)
	28.4994	-80.1940**	225.3366***
Oil/gas*work7	(39.6318)	(35.9440)	(51.0156)
	-50.2946	-53.4141***	15.7781
Fish*work2	(58.1704)	(12.5191)	(29.0962)
	31.7633	19.9546	86.3783***
Fish*work3	(53.0338)	(16.1842)	(11.2102)
	15.3837	-40.5906***	13.5980
Fish*work4	(49.5680)	(12.7157)	(11.0613)
	-27.7626	107.7791	10.3423
Fish*work5	(42.9195)	(154.8238)	(130.2092)
	-23.8860	39.8645***	82.0739***
Fish*work6	(41.1161)	(8.9579)	(7.2864)
	-18.0226	95.5073***	23.5889
Fish*work7	(40.5592)	(26.4269)	(25.0750)
	145.4365**	-15.0874	99.3458***
Habitat*work2	(65.7442)	(13.1524)	(15.1267)
	92.1813	94.2700**	197.3185***
Habitat*work3	(56.6761)	(44.0982)	(45.9819)
	81.8422	-45.9610***	3.9604
Habitat*work4	(53.9822)	(15.0920)	(6.2831)
	57.5358	-160.0537	9.9769
Habitat*work5	(46.0944)	(162.5293)	(118.2894)
	65.2822	-43.7796***	95.7271***
Habitat*work6	(44.2724)	(10.8374)	(7.3684)
	47.7620	240.2054***	170.0890***
Habitat*work7	(43.4363)	(46.9806)	(32.4517)
Price (in preference space)	76.9657***	99.4778***	129.0380***
	(6.5106)	(9.4338)	(9.8407)
<i>N</i>	4683		4683

561 *MXL: LogLikelihood = -3627.5998, AIC/n = 1.5805, pseudo-R2 = 0.2856*

562 *MNL: LogLikelihood = -4735.9952, AIC/n = 2.0381, pseudo-R2 = 0.0673*

563 Table A12 Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL
 564 and MXL models including interactions with respondents' occupation type.
 565 ***, ** and * indicate estimates significant at 1%, 5% and 10% level,
 566 respectively.

	MNL model	MXL model	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
Small-size	0.8243 (53.8145)	40.0654 (28.9481)	75.1364*** (7.4301)
Large-size	-22.6067 (55.3865)	-17.8618 (37.7711)	112.3242*** (7.3381)
Oil/gas	-9.3276 (38.1438)	1.8871 (30.3730)	64.8042*** (6.3397)
Fish	46.5242 (39.1668)	-3.7888 (36.5764)	83.4676*** (5.4995)
Habitat	115.8885*** (42.3707)	63.2686 (39.9699)	143.6640*** (7.8136)
Small-size*occ2	-59.0539 (77.7055)	-62.8797 (94.4512)	150.5327 (306.1169)
Small-size*occ3	-63.7765 (73.3517)	-73.0461 (61.5627)	48.6550 (68.1144)
Small-size*occ4	30.0249 (71.5272)	-3.6943 (54.0475)	109.7413** (44.8146)
Small-size*occ5	-40.4722 (59.4563)	-81.9716** (33.1342)	37.1030 (20.0224)
Small-size*occ6	-23.1881 (57.0929)	-14.0227 (30.6159)	69.2227*** (9.7131)
Small-size*occ7	3.2946 (56.0285)	-13.0255 (29.9436)	59.5792*** (11.3611)
Large-size*occ2	-99.1758 (83.5497)	-18.6939 (140.4622)	99.7828 (374.2790)
Large-size*occ3	-32.4732 (74.7649)	-11.9533 (60.1130)	108.4073 (121.8136)
Large-size*occ4	96.7611 (71.6394)	51.9102 (60.2978)	114.1404** (47.3959)
Large-size*occ5	43.5072 (60.3195)	36.9308 (43.4449)	103.7293*** (23.6780)
Large-size*occ6	49.2485 (58.3403)	55.1878 (39.1985)	110.7137*** (13.9700)
Large-size*occ7	51.6266 (57.6741)	28.3444 (37.9817)	86.5913*** (10.6756)
Oil/gas*occ2	28.8488 (56.7293)	47.7096 (249.9466)	157.2712 (147.0846)
Oil/gas*occ3	9.1289 (50.3809)	-68.3551 (63.2195)	147.1971 (78.9228)
Oil/gas*occ4	-38.2853 (48.2553)	-46.6308 (44.8319)	4.6825 (47.1852)
Oil/gas*occ5	-2.5635 (48.2553)	-22.2961 (44.8319)	120.2258*** (47.1852)

	(41.8109)	(37.6613)	(20.9903)
	38.5565	10.0195	112.9328***
Oil/gas*occ6	(40.1814)	(32.2823)	(12.2452)
	28.4994	-4.7238	69.9387***
Oil/gas*occ7	(39.6318)	(31.5316)	(7.9691)
	-50.2946	24.8506	72.6734
Fish*occ2	(58.1704)	(86.4067)	(48.7868)
	31.7633	77.3235	90.7642
Fish*occ3	(53.0338)	(68.9325)	(88.9028)
	15.3837	64.3431	52.3107
Fish*occ4	(49.5680)	(56.8906)	(51.8468)
	-27.7626	11.3251	63.5381***
Fish*occ5	(42.9195)	(39.3054)	(17.5203)
	-23.8860	3.4640	97.7757***
Fish*occ6	(41.1161)	(37.8580)	(17.9779)
	-18.0226	32.7861	64.1400***
Fish*occ7	(40.5592)	(37.3949)	(8.7673)
	145.4365**	158.6720	132.1360
Habitat*occ2	(65.7442)	(169.1785)	(275.8064)
	92.1813	160.5170**	49.2630
Habitat*occ3	(56.6761)	(62.8941)	(52.9652)
	81.8422	104.3213	70.1460
Habitat*occ4	(53.9822)	(62.8461)	(122.1107)
	57.5358	58.2237	77.0704**
Habitat*occ5	(46.0944)	(45.3086)	(33.6302)
	65.2822	96.2504**	207.7326***
Habitat*occ6	(44.2724)	(42.0687)	(20.5507)
	47.7620	62.2234	53.2077***
Habitat*occ7	(43.4363)	(40.7806)	(9.6610)
Price (in preference space)	76.9657***	97.9444***	134.0622***
	(6.5106)	(8.9500)	(11.9855)
<i>N</i>	4683		4683

567 *MXL: LogLikelihood = -3633.0413, AIC/n = 1.5828, pseudo-R2 = 0.2845*

568 *MNL: LogLikelihood = -4735.9952, AIC/n = 2.0381, pseudo-R2 = 0.0673*

569

570 **References**

571 Armstrong, C.W, Foley, N.S., Kahui, V. and Grehan, A., 2014. Cold water coral reef
572 management from an ecosystem service perspective. *Marine Policy* 50, 125-134

573

574 Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., Hyde, T., 2006. Valuing the
575 diversity of biodiversity. *Ecological Economics* 58, 304-317

576

577 Colombo S., Christie M., Hanley, N., 2013. What are the consequences of ignoring attributes
578 in choice experiments? Implications for ecosystem service values. *Ecological Economics* 96,
579 25-35

580

581 Czajkowski, M., Hanley, N. and LaRiviere, J., 2015. The Effects of Experience on Preference
582 Uncertainty: Theory and Empirics for Public and Quasi-Public Environmental Goods.
583 *American Journal of Agricultural Economics*, 97 (1) 333-351.

584

585 Edinger, E. N., Wareham, V.E., Haedrich, R.L., 2007. Patterns of groundfish diversity and
586 abundance in relation to deep-sea coral distributions in newfoundland and labrador waters.
587 *Bulletin of Marine Science* 81 (Supplement 1), 101-122.

588

589 Foley, N., Rensburg, T.M.v., Armstrong, C.W., 2010. The ecological and economic value of
590 cold-water coral ecosystems. *Ocean & Coastal Management* 53, 313-326

591

592 Fosså, J.H., Mortensen, P.B., Furevik, D., 2002. The deep water coral *lophelia pertusa* in
593 Norwegian waters: Distribution and fishery impacts. *Hydrobiologia* 471, 1-12

594

595 Funk, P., Gathmann, C., 2008. Gender gaps in policy making. Evidence from direct democracy
596 in Switzerland. *Economics Working paper 1126*. Department of Economics and Business,
597 University of Pompeu Fabra

598

599 Glenn, H., Wattage, P., Mardle, S., Rensburg, T.M.v., Grehan, A., Foley, N., 2010. Marine
600 protected areas – substantiating their worth. *Marine Policy* 34, 421-430

601

602 Groot, R.d., Brander, L., Ploeg, S.v.d., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N.,
603 Gehmandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., Brink, P.T.,
604 Beukering, P.v., 2012. Global estimates of the value of ecosystems and their services in monetary
605 units. *Ecosystem Services* 1, 50-61

606

607 Hanemann, W. M., 1984. Welfare Evaluations in Contingent Valuation Experiments with
608 Discrete Responses. *American Journal of Agricultural Economics*, 66(3):332-341.

609

610 Hynes, S., Hanley, N., Tinch, D., 2013. Valuing improvements to coastal waters using choice
611 experiments: an application to revisions of the EU Bathing Waters Directive. *Marine Policy*
612 40, 137–144.

613

614 IMR (Institute of Marine Research), 2012. Home page article by Mortensen, P.B., Mortensen,
615 L.B., Bellec, V., published 03.10.2012.
616 http://www.imr.no/nyhetsarkiv/2012/oktober/nye_korallrev_utenfor_trondelag_og_more/
617 en

618

619 Jobstvogt, N., Hanley, N., Hynes, S., Kenter, J., Witte, U., 2014. Twenty thousand sterling
620 under the sea: Estimating the value of protecting deep-sea biodiversity. *Ecological*
621 *Economics* 97, 10–19.

622

623 LaRiviere, J., Czajkowski, M., Hanley, N., Aanesen, M., Falk-Petersen, J., Tinch, D., 2014. The
624 value of familiarity: Effects of knowledge and objective signals on willingness to pay for a
625 public goods. *Journal of Environmental Economics and Management* 68, 376-389

626

627 Leggett, C.G., KLeckner, N.S., Boyle, K.J., Duffield, J.W., Mitchell, R.C., 2003. Social desirability
628 bias in contingent valuation surveys administered through in-person interviews. *Land*
629 *Economics* 79, 561-575

630

631 List, J.A., Berrens, R.P., Bohara, A.K., Kerkvliet, J., 2004. Examining the role of social isolation
632 on stated preferences. *The American Economic Review* 94, 741-752

633

634 Macmillan, D., Philip, L., Hanley, N., Alvarez-Farizo, B. 2002. Valuing the non-market benefits
635 of wild goose conservation: a comparison of interview and group-based approaches.
636 *Ecological Economics* 43, 49-59.

637

638 MacMillan, D., Hanley, N., Lienhoop, N., 2006. Contingent Valuation: Environmental polling
639 or preference engine? *Ecological Economics* 60, 299-307.

640

641 Martín-López B, Iniesta-Arandia I, García-Llorente M, Palomo I, Casado-Arzuaga I, et al.
642 (2012) Uncovering Ecosystem Service Bundles through Social Preferences. *PLoS ONE* 7(6):
643 e38970. doi:10.1371/journal.pone.0038970

644 McFadden, D.L., 1974. Conditional Logit Analysis of Qualitative Choice Behavior. In P.
645 Zarembka (ed.), *Frontiers in Econometrics* 105-142, Academic Press, New York.

646

647 Millennium Ecosystem Assessment, 2005. *Ecosystems and human wellbeing. Synthesis.*
648 *Island Press, Washington DC*

649

650

651 Parsons, G.R., Thur, S.M., 2008. Valuing Changes in the Quality of Coral Reef Ecosystems: A
652 Stated Preference Study of SCUBA Diving in the Bonaire National Marine Park.
653 *Environmental and Resource Economics* 40, 593–608.

654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681

Pendelton, L.H., 1995. Valuing coral reef protection. *Ocean and Coastal management* 26, 119-131

Ramirez-Llodra E, Tyler PA, Baker MC, Bergstad OA, Clark MR, et al. (2011) Man and the Last Great Wilderness: Human Impact on the Deep Sea. *PLoS ONE* 6(8): e22588.

doi:10.1371/journal.pone.0022588

Ressurreição, A., Gibbons, J., Ponce, T., Kaiser, M., Santos, R. S., Edwards-Jones, G., 2011. Economic valuation of species loss in the open sea. *Ecological Economics* 70, 729-739.

Revelt, D., Train, K., 1998. Mixed Logit With Repeated Choices: Households' Choices Of Appliance Efficiency Level. *The Review of Economics and Statistics* 80, 647-657

Rogers, A., 2013. Public and expert preference divergence: evidence from a choice experiment of marine reserves in Australia. *Land Economics* 89, 346-370

Sandorf, E., Aanesen, M., Navrud, S., 2014. Survey mode effects: Valuation workshops versus internet panels. Working paper, Norwegian College of Fisheries Science, University of Tromso, Norway

Sarkis, S., Beukering, P.H.J.v., McKenzie, E., Brander, L., Hess, S., Bervoets, T., Putten, L.L.v.d., Roelfsema, M., 2013, Total Economic Value of Bermuda's Coral Reefs. A summary. In C.R.C.Sheppard (ed) *Coral Reefs of the United Kingdom Overseas Territories. Coral reefs of the world vol 4*, 2013, 201-211

- 682
- 683 Scarpa, R., Rose, J.M., 2008. Design efficiency for non-market valuation with choice
684 modelling: how to measure it, what to report and why. *Australian Journal of Agricultural and*
685 *Resource Economics* 52, 253-282
- 686
- 687 Small, K. A., and Rosen, H. S., 1981. *Applied Welfare Economics with Discrete Choice Models.*
688 *Econometrica*, 49(1):105-130.
- 689
- 690 Spash, C., 2002. Informing and forming preferences in environmental valuation: Coral reef
691 biodiversity. *Economic Psychology* 23, 665-687
- 692
- 693 Spurgeon, J.P.G., 1992. The Economic valuation of Coral Reefs. *Marine Pollution Bulletin* 24,
694 529-536
- 695
- 696 Stone, R. P., 2006. Coral habitat in the Aleutian islands of Alaska: Depth distribution, fine-
697 scale species associations, and fisheries interactions. *Coral Reefs* 25, 229-238
- 698
- 699 Stuart, M., Smout, T.C., 2013. *The Firth of Forth: An Environmental History.* Birlinn Press,
700 *Edinburgh*
- 701
- 702 TEEB, 2010. *The Economics of Ecosystems and Biodiversity: Ecological and Economic*
703 *Foundations.* P. Kumar (ed). Earthscan, London and Washington.
- 704
- 705 Train, K. E., Weeks, M., 2005. Discrete Choice Models in Preference Space and Willingness-
706 to-paySpace. In R. Scarpa and A. Alberini (eds) *Applications of Simulation Methods in*
707 *Environmental and Resource Economics*, 1-16, Springer, Dordrecht.
- 708

709 Wilson, M.A., Howarth, R.B., 2002. Discourse-based valuation of ecosystem services:
710 establishing fair outcomes through group deliberation. *Ecological Economics* 41, 431-443.
711

712 *Table 1 Attributes and attribute levels*

Attribute	Size of protected area (km ²)	Protected area attractive for oil/gas and fisheries activities?	Protected area important as habitat for fish?	Additional costs of protection
Reference level	2.445	Partly	Partly	0
Level 1	5.000	Attractive for the fisheries	Not Important	100
Level 2	10.000	Attractive for oil/gas activities	Important	200
Level 3		Attractive for both fisheries and oil/gas activities		500
Level 4		Neither attractive for fisheries nor for oil/gas activities		1000

713

714

715 *Table 2 Individual specific variables overview*

	<i>Lowest value</i>	<i>Highest value</i>	<i>Mean</i>	<i>Number of observations</i>
Gender	0 (male)	1 (female)	0.465	394
Age	18 years	88 years	46.6years	395
ENGO	0 (not ENGO member)	1 (ENGO member)	0.1	394
Education	1 (only obligatory)	4 (higher deg. Univ.)	2.84	394
Labor force participation	0 (not in labor force)	1 (in labor force)	0.63	393
Working in the marine sector	0 (other industries)	1 (the marine sector)	0.08	391
Household size (cont. var.)	1	8	2.5	397
Personal income	1 (below 200K NOK)	10 (above 1 mill NOK)	3.5	388
Household income	1 (below 200K NOK)	8 (above 1.5 mill NOK)	3.8	385
Coastal areas	0 (interior areas)	1 (coastal areas)	0.63	397
Urban areas	0 (rural areas)	1 (urban areas)	0.73	397

716

717

718 *Table 3* *Marginal willingness to pay (WTP) estimates in Euro resulting from the MNL*
 719 *and MXL models. ***, ** and * indicate estimates significant at 1%, 5% and*
 720 *10% level, respectively.*

	<i>MNL model</i>	<i>MXL model</i>	
	Coefficient (s.e.)	Mean (s.e.)	Std.dev. (s.e.)
<i>Small-size</i>	-13.3056 (10.7111)	53.0080*** (10.1943)	227.0873*** (14.8310)
<i>Large-size</i>	20.4293** (10.1842)	66.5562*** (10.4839)	286.4626*** (16.7408)
<i>Oil/gas</i>	11.9665 (6.6797)	16.3399** (6.5881)	100.2334*** (6.3774)
<i>Fish</i>	28.6764*** (7.1949)	39.0565*** (7.0045)	107.5751*** (6.3688)
<i>Habitat</i>	174.3036*** (15.0876)	166.1023*** (10.1651)	165.9122*** (9.4697)
<i>Price (in preference space)</i>	76.9370*** (6.4839)	59.5790*** (7.0086)	77.3143*** (8.4814)
<i>N</i>	4683		4683

721 *MXL: LogLikelihood = -3483.1453, AIC/n = 1.4992, pseudo-R² = 0.3140.*

722 *MNL: LogLikelihood = -4759.7336, AIC/n = 2.0353, pseudo-R² = 0.0626.*

723

724

725

726 *Table 4 Total WTP per household per year in EUR for small and large protection scenario.*
 727 ****, ** and * indicate estimates significant at 1%, 5% and 10% level, respectively.*

	MNL model		MXL model	
	WTP (s.e.)	95% c.i.	Mean WTP (s.e.)	95% c.i.
Small protection scenario	201.58*** (15.05)	172.09 - 231.08	274.05*** (15.86)	242.98 - 305.17
Large protection scenario	235.28*** (16.55)	202.83 - 267.73	287.37*** (16.57)	254.92 - 319.84

728