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1 A Stated Preference Valuation of the Non-Market Benefits of 2 Pollination Services in the UK

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4 **Abstract**

5 Using a choice experiment survey this study examines the UK public's willingness to pay to
6 conserve insect pollinators in relation to the levels of two pollination service benefits: maintaining
7 local produce supplies and the aesthetic benefits of diverse wildflower assemblages. Willingness to
8 pay was estimated using a Bayesian mixed logit with two contrasting controls for attribute non-
9 attendance, exclusion and shrinkage. The results suggest that the UK public have an extremely
10 strong preference to avoid a status quo scenario where pollinator populations and pollination
11 services decline. Total willingness to pay was high and did not significantly vary between the two
12 pollination service outputs, producing a conservative total of £379M over a sample of the tax-paying
13 population of the UK, equivalent to £13.4 per UK taxpayer. Using a basic production function
14 approach, the marginal value of pollination services to these attributes is also extrapolated. The
15 study discusses the implications of these findings and directions for related future research into the
16 non-market value of pollination and other ecosystem services.

17 **1. Introduction**

18 Pollination, the transfer of pollen within and between flowers by insect vectors is a key
19 ecological function facilitating reproduction in 78% of temperate flowering plants (Ollerton et al,
20 2011). These plants underpin the function of a range of ecosystem services, such as food crop
21 production (Klein et al, 2007), soil quality, pest regulation (Sarrantonio, 2007) and improving
22 landscape aesthetics (Lindemann-Matthies et al, 2010). At present, populations of both wild and
23 managed pollinating insects within the UK have experienced substantial long-term declines (Potts et
24 al, 2010; Carvalheiro et al, 2013), raising concerns about the stability of pollination services. As a
25 regulatory, or intermediate, ecosystem service (Fischer et al, 2009), pollination has typically been
26 valued as a component of the final benefits it provides (but see Allsopp et al, 2008). To date only the
27 benefits to crop markets have been economically quantified to assess the value of production
28 changes resulting from pollination services to crops (e.g. Winfree et al, 2011). Unlike crop
29 production, other final benefits of pollination services are not directly traded on markets and are
30 often public (they are not owned by anyone exclusively) and non-excludable (people cannot be
31 prevented from using them) (Cooke et al, 2009). Furthermore, there may be intrinsic values attached
32 to the existence of pollinators (e.g. Mwebaze et al, 2010). As valuation is often used to underpin
33 decision making, an exclusive focus on market benefits will neglect the broader impacts such
34 decisions can have on wider stakeholders.

35 In order to redress the failure of markets to capture the benefits of non-market ecosystem
36 services, economists have exploited a range of techniques, broadly categorized as revealed or stated
37 preference methods. Revealed preference methods utilise existing market or experimental data to

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38 estimate previously uncaptured benefits arising from ecosystem services (e.g. hedonic price models
39 used to value the benefits of proximity to natural habitat on house prices; Hanley et al, 2007). Stated
40 preference methods create a hypothetical market for environmental goods/services using a
41 questionnaire or interview and ask respondents to state preferences for bundles of these
42 goods/services. Costs attached to each bundle act as a price within the market, allowing estimation
43 of respondent willingness to pay (WTP) to acquire or maintain the goods/services or their willingness
44 to accept (WTA) compensation for their degradation of the goods/services if the costs are negative
45 (Bateman et al, 2002), Stated preference allow a wide range of respondent factors to be modelled
46 and compared and, unlike revealed preference techniques, are theoretically applicable to any
47 ecosystem service (Hanley et al, 2007). Stated preference methods are based upon random utility
48 models which assume that respondents are rational, self-serving utility maximisers who will express
49 preferences that optimise their utility (Train, 2003). However, recent research has questioned these
50 assumptions particularly for complex or unfamiliar goods and non-market goods. Subsequently,
51 respondents may express lexicographic preferences, whereby they are unwilling to trade away any
52 quantity of the good (Spash et al, 2009), and a number of biases which may obscure their true
53 preferences. In particular when respondent awareness of the hypothetical nature of the study
54 affects their response (hypothetical bias – e.g. Ivehammer, 2009) or where respondents avoid the
55 risks of change even if they disapprove of the status quo (status quo bias – e.g. Boxall et al, 2009).

56 Stated preference surveys have been used to value a range of ecosystem services such as
57 water quality (Zander and Stratton, 2010), recreation (Christie et al, 2007) and carbon sequestering
58 (MacKerron et al, 2009). However, while final services, those with distinct end products that are
59 directly consumed (Fischer et al, 2009), such as water quality, are more tangible and comprehensible
60 to respondents who interact with them, intermediate services (those which enhance the production
61 of end products), such as pollination, are often complex ecological concepts that the public find
62 difficult to attribute value to. This can make valuations for ecosystem services difficult to elicit
63 accurately with stated preference methods, due to the limited information available to respondents
64 (Christie and Gibbons, 2011). This in turn increases the probability of respondents using decision
65 simplifying strategies rather than fully considering all the information presented when expressing
66 their preferences, further biasing the results (Meyerhoff and Liebe, 2009). Nonetheless, if carefully
67 developed, stated preference studies can be used to capture aspects of ecosystem service benefits
68 that are not included in existing valuation studies.

69 This study uses a choice experiment survey to assess respondents stated willingness to pay
70 to conserve pollinators in order to prevent marginal losses in two previously unvalued final benefits
71 of pollination services; the relative availability of UK grown produce and the diversity of aesthetic
72 wildflowers. Presently, many key insect pollinated fruits are largely supplied by imports, while by
73 contrast the UK is largely self-sufficient in wind-pollinated cereal crops (DEFRA, 2013). Consumer
74 concerns regarding pollution, accountability and local economic impacts involved in food imports,
75 have prompted a growing preference for locally produced foods (Chambers et al, 2007; Brown et al,
76 2009). As such, even if produce can be substituted with imports, loss of UK pollination services will
77 reduce the availability of this preferential characteristic. Insect pollinated wildflowers can provide
78 significant welfare benefits through enhancing the aesthetic quality of landscapes (Soini and
79 Aakkula, 2007), habitats (Lindemann-Matthies, 2010; Junge et al, 2011) and road verges (Akbar et al,
80 2003). This aesthetic quality has substantial impacts on perceptions of landscapes (Natural England,
81 2009) and socio-cultural values associated with connectivity with nature (Kellert, 1996).
82 Subsequently, destabilisation of plant-pollinator networks and the consequent loss of flowering

83 species may diminish these benefits. Based upon this information, this study expects that
84 respondent willingness to pay for pollinator conservation will rise in relation to the improving quality
85 of these final goods.

86 **2. Methods**

87 *2.1. Experiment development and sampling*

88 This study evaluates respondent willingness to pay (WTP) to prevent losses in multiple
89 pollination service end products using a choice experiment questionnaire. Choice experiment
90 surveys present respondents with several bundles of goods and services with different attributes
91 and ask them to indicate their preferred bundle. By attaching a cost to each choice and taking
92 several choice sets per individual, choice experiments can be used to assess respondents' willingness
93 to pay for marginal changes in each attribute rather than just the bundle as a whole.

94 *2.1.1. Design*

95 Typically, attributes are derived from policy, prior preferences elicited or scientific
96 predictions, however quantitative relationships between pollinator populations, pollination service
97 levels and end production are difficult to extrapolate in an easily comprehensible manner. The
98 attributes selected for this choice experiment were aesthetic wildflower diversity, the relative
99 availability of UK produce and price. Attribute levels were specified identically as changes in current
100 levels compared to now from no change to -30% in a linear incremental scale (Table 1) to elicit
101 respondent willingness to pay to avoid losses in these pollination service benefits. These seemed
102 sufficient to incentivise changes between options. The attributes were confirmed as suitable by a
103 focus group, which considered the use of tax as payment vehicle (the hypothetical means by which
104 payment would be collected) and the attribute levels to be comprehensible and believable. The cost
105 attribute was framed as a possible future taxation to maintain realism (Ivehammar, 2009) and
106 presented as both a monthly and annual increase. The cost attribute levels were modified after a 90
107 household pilot survey, so as to increase the variation in choices as most pilot respondents picked
108 only the most expensive options.

109 Values ascribed to these attributes do not directly represent a valuation of pollinators. For
110 simplicity, bees were chosen as a focal species because of their widely recognised importance as
111 pollinators (Klein et al, 2007) and recent UK media coverage of declining populations. A measure of
112 bee populations was considered as an attribute in the initial design however focus group discussions
113 indicated difficulty in placing values on percentage changes in bee populations in relation to other
114 attributes, indicating instead that it was the secure existence of the taxa and the services that they
115 provide that mattered. Furthermore, such a variable could complicate the scenario by creating
116 choice sets where bees decline but their services remain, which although plausible, many
117 participants found hard to comprehend. Alternatively, other ecosystem functions may compensate
118 for lost pollination services (Bommarco et al, 2013) however this introduces complex, multiple
119 ecosystem service concepts into the scenario. The presence of a "do nothing" status quo option,
120 whereby there is no additional effort is made to preserve bees in the UK, instead allows for some
121 estimate of the intrinsic value respondents attach to the continued existence of bees by statistically
122 analysing the impact of "non status-quo" options on WTP.

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124 **Table 1** Choice attribute levels

Attribute	Levels
1. UK grown fruit and vegetables available in local shops compared to now	-30%*, -20%, -10%, Same as now
2. Variety of wildflowers in local green spaces compared to now	-30%*, -20%, -10%, Same as now
3. Monthly tax increase to you	£0*, £0.5, £1, £1.5, £2, £2.5, £3, £3.5, £4

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* = status quo attribute levels

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30 choice sets were initially developed with attribute balanced (i.e. attribute levels of each attribute appear across all choice sets the same number of times), D-optimal design algorithms, which aim to produce more statistically robust choice sets by minimising the standard error or standard deviations of the parameter estimates using initial assumptions about parameter signs and magnitudes. However, typical of D-optimal choice sets generated without adequate prior information, some of the resultant choice sets had little variation and often featured dominant options whereby one option was lower cost and offered higher benefits than the other, non-status quo option. Subsequently, choice sets were subjectively altered to eliminate dominant options and provide greater utility differences while maintaining attribute balance within the alternatives. Each respondent was presented with 6 choice sets, each with two unique alternatives to the status quo to reduce status quo bias by offering a range of alternatives (Rolfe and Bennett, 2009). The final questionnaire, designed following Dillman (2000), contained a cover letter providing respondents with information regarding pollination services provided by bees and the potential impacts of declines and outlined a scenario whereby taxation would be distributed by an apolitical government department to prevent and reverse declining bee populations in the UK.

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To reduce hypothetical bias and incentivise truthful response, the sample was informed that, while presently hypothetical, the changes could be implemented by 2015 with enough popular support and would be applied across the UK. An A4 picture sheet was included containing 4 pictures of the same flower meadow featuring approximately 10 plant species (flowering and non-flowering), with a single species in each removed in all but the first, providing a visual representation of declining floral diversity which may otherwise be difficult for respondents to form preferences for (Bateman et al, 2009). Visual representations of changing levels of UK fruit and vegetables were considered but judged impractical as response to crop deletion may be influenced by respondent food preferences. Final questionnaire content was checked with a focus group for clarity and simplicity of language and relevance of questions.

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2.1.2. Respondent attitudes and attributes

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To capture the effect of respondent attitudes, environmental ethical stance and exposure to the choice attributes, the questionnaire asked respondents a series of questions to evaluate their attitudes and exposure towards the choice attributes, bee conservation and general concern, their ethical stance regarding conserving biodiversity, based upon an environmental-anthropogenic scale (Spash et al 2009) and whether they agreed or disagreed with funding bee conservation through taxes to better identify protest responses (Meyerhoff and Liebe, 2009). A final section contained a

160 series of questions regarding respondent demographics, brackets of which were taken from the
161 national census.

162 2.1.3. Sampling

163 Positive attitudes and willingness to pay for environmental goods/services are often
164 increased by greater exposure and personal relevance of the service (Meyerhoff and Liebe, 2009)
165 and decreased with further distance from the good/service (Bateman et al, 2006). Consequently,
166 sampling was conducted over 3 counties in England; Kent, Lincolnshire and North Yorkshire based on
167 the prominence of horticulture relative to arable crops reported in DEFRA (2013) to capture any bias
168 caused by the significance insect pollinated crops to local agriculture.

169 To maximise the breadth of potential respondents given the budget available to the project,
170 the questionnaire was designed as a postal based survey, allowing for more questions to be posed
171 than phone or interview surveys can be answered at respondent discretion and can be more widely
172 distributed (Bateman et al, 2002). By contrast, postal surveys innately suffer from self-selection bias
173 towards retired and unemployed respondents (Dillman, 2000) and often have low response rates;
174 necessitating large samples. In order to ensure an acceptable number of responses, a total of 2300
175 questionnaires were mailed to a purchased sample of English households, weighted by the number
176 of households within each 4 digit postcode area in order to increase sample representativeness.
177 Budget limitations prevented the sending of reminders which may have increased the response rate.

178 2.2. Analysis

179 2.2.1. Choice analysis and Willingness to Pay

180 Responses were analysed using a hierarchical Bayes Logit model which uses Bayesian
181 processes to assess the probability of a respondent selecting a particular option based on the
182 attributes of options they have been observed to make. Estimates of parameters are made with
183 respect to the individual and for the mean and variance of the population as a whole; if price is
184 included in the choices then the maximum price the bundle will be selected over all other bundles is
185 the maximum WTP for the bundle. Utility, the quantitative benefit to personal wellbeing that a
186 respondent receives from a bundle, is specified as:

$$187 \quad U_{ni} = V_{ni} + \varepsilon_{ni} \quad (1)$$

188 Where U_{ni} represents the utility of respondent n from choosing bundle i , V_{ni} represents deterministic
189 utility, a vector of observed characteristics regarding the attributes of n and i and ε_{ni} represents
190 error, a vector of unobserved characteristics and stochastic variation in respondents which is
191 assumed to have a Gumbell distribution. Respondents are assumed to maximise utility so that the
192 choice probability (P) of n selecting i , is:

$$193 \quad P_{ni} = P(U_{ni} > U_{nj} \forall j \neq i) \quad (2)$$

194 In standard Mixed Logit, an individual's choice probability can therefore be estimated, based on
195 observed characteristics. The deterministic component of utility is modelled as;

$$196 \quad V_{ni} = \beta_n' x_{ni} \quad (3)$$

197 where β_n is a normally distributed vector of parameters for individual n with mean α and covariance
 198 matrix ω

$$\beta_n \sim N(\alpha, \omega) \quad (4)$$

199
 200 x_{ni} represent the attributes levels of bundle i presented to respondent n. Subsequently, the
 201 probability that respondent n chooses bundle i becomes:

$$P_{ni} = \left(\frac{e^{\beta_n' x_{ni}}}{\sum_j e^{\beta_n' x_{nj}}} \right) \quad (5)$$

202

203 Where x_{ni} are attributes within V_{ni} . The marginal utilities for each attribute are the elements of β_n'
 204 within the standard Mixed Logit. Typically normal or log-normal (where the sign of the parameter is
 205 known) and can be specified differently for each element of β_n' .

206 The model utilised in this study estimates β_n' using 500,000 Monte-Carlo Markov Chain
 207 (MCMC) draws, retaining every 50th draw to compile into β_n' in order to decrease the co-dependence
 208 of the sampled values. As estimates of β_n' should be independent of starting points for the MCMC
 209 estimation, an additional 50,000 draws were taken and discarded prior to the main draws. Model
 210 priors for α and ω were estimated using relatively diffuse normal priors for α and Wishart prior ω as
 211 specified in Train (2003 -Chap. 12). Analysis was undertaken in both preference space, where the
 212 distribution of marginal utility is estimated and the rate of marginal utility substitution between
 213 attributes calculated on this basis, and WTP space, which estimates the rate of marginal utility
 214 substitution directly and may produce greater stability in WTP estimates (Balcombe et al, 2009).
 215 Preliminary analysis of the data indicated that model fit was best when evaluated in preference
 216 space rather than WTP space. As preference space estimates can be prone to bias from extreme
 217 values, median attribute coefficients and WTP estimates were used in place of mean estimates.

218 Respondent descriptors were incorporated into the model on the basis of research interest
 219 and a priori expectation regarding their significance. Age and income categories and attitudes
 220 towards taxation were included as continuous variables. Dummy variables were used to account for
 221 income refusal and the 3 counties with North Yorkshire used as a reference. The influence of the
 222 level of urbanisation respondents encountered was assessed on a 1 (urban) to 3 (rural) gradient with
 223 those indicating "other" occupancy placed in category 2. Other demographic and attitudinal
 224 variables were evaluated separately to avoid over-parameterisation (see Appendix 1).

225 2.2.2. Attribute non-attendance

226 Attribute non-attendance (ANA), whereby respondents ignore one or several attributes of a
 227 choice in making their decisions, is often handled by setting the marginal utility of the attribute to
 228 zero for non-attendant respondents (e.g. Balcombe et al. 2011) or removing the respondent entirely
 229 in the case of non-attendance on the cost attribute (e.g. Zander and Stratton, 2010). These
 230 approaches assume that respondents either have no utility, and thus zero WTP, attached to ignored
 231 attributes or are misreporting their preferences (Hensher, 2006). In actuality, respondent decisions
 232 may be dominated by the other attributes or their preferences towards an attribute may be simply
 233 polarised towards or against extreme values. Alternatively, it can be assumed that non-attendant
 234 respondents have a lower marginal utility value for the attribute than attendees. This can be
 235 modelled by incorporating a shrinkage parameter which is assumed to lie on a normally distributed
 236 0-1 scale. Consequently if a respondent is non-attendant on an attribute (k) their marginal utility for

237 that attribute becomes: $\beta_{nk}^* = shrinkage \times \beta_{nk}$. Initial work suggests that this ANA shrinkage
238 approach outperforms other methods of treating ANA (Kehlbacher et al, 2013). The approach used
239 here posits a distribution for the marginal utilities dependant on non-attendance data, making no
240 stronger assumptions about the nature of independence than a latent variable approach.

241 2.2.3. Extrapolation

242 As postal surveys tend to have low response rates and are vulnerable to self-selection
243 biases, whereby only those interested in the questionnaire respond, extrapolating WTP estimates to
244 the total UK working population may overestimate total value. As such, two extrapolations were
245 conducted for each model, one assuming that all 28.2m working adults aged 18-64 in the UK (ONS,
246 2011) would be willing to pay (Upper Bound) while another assumes that the percentage of the
247 sample that did not respond had no WTP for pollination service conservation (Lower Bound).

248 2.3.4. Estimating the value of pollination services

249 Typically, the value of pollination services to crops is estimated using a basic production
250 function, by multiplying each crops insect pollinator dependence ratio by the total market price of
251 the crop (see e.g. Gallai et al, 2009). This study uses a similar methodology to estimate the value of
252 pollination services to the non-market benefits in the questionnaire; estimating the proportion of
253 each benefit that arises from pollination services.

254 For UK produce (fruits and vegetables), this was based on the proportion of UK domestic
255 crop consumption that would be lost without pollination services. The total volume of UK production
256 in 2010 for the domestic market was derived from DEFRA (2013,2012). As only crop produce
257 produced and sold in the UK was valued, the production of each crop was multiplied by 1 - the % of
258 crop exported. Where specific crop data was not available, crop groups (fruit or vegetables) was
259 used as a proxy. The proportion of domestic production lost was estimated by multiplying the
260 volume of production by their insect pollination dependence ratios from Smith et al (2011) and
261 Gallai et al (2009), resulting in an estimate of as ~12% of domestic consumption arising from
262 pollination services. Assuming a linear relationship between pollinator abundance and services
263 (Garibaldi et al, 2013), this means that a 1% decline in insect pollinator populations would produce a
264 0.12% decline in the availability of UK fruit and vegetables.

265 Ollerton et al (2011) estimate that ~78% of temperate flowering plants are pollinated by
266 insects, however it is not yet known what proportion of these depend exclusively upon insect
267 pollination (or specifically pollination by bees), or if this reflects the pollinator dependence of UK
268 flora. Nonetheless, if it is assumed that this ratio is correct and that at least half of these species are
269 entirely dependent on insect pollination this means that a 100% loss of insect pollinators would
270 produce a 39% decline in wildflower diversity. The loss of 1% of insect pollinators would therefore
271 be expected to produce a 0.39% decline in wild plant diversity, assuming again a linear relationship
272 between pollinator abundance and services.

273 3. Results

274 3.1. Response

275 In total 312 questionnaires (14%) were returned, of which 278 were completed sufficiently
276 to be included in analyses, resulting in 1668 choice observations. Those respondents that did not

277 complete a choice set were assumed to have answered “don’t know”. The response rate was
278 approximately equal across counties. Typical of postal questionnaires, a high proportion of
279 respondents were in the higher age brackets with 76.3% of respondents being aged 45 or over and
280 only 7.2% under 30. Most respondents currently live in market or commuter towns (44%) and rural
281 areas (33%) with only 15% of respondents residing in urban areas although the proportion of
282 respondents growing up in each category was approximately equal. Respondent income was largely
283 in the lower income categories although ~11% indicated annual income of >£75k. Approximately
284 15% of respondents stated that they were non-attendant on either UK produce or wildflower
285 diversity while 46% were non-attendant on taxation.

286 Respondent awareness of UK bee declines was very high (88%). More than half of
287 respondents (68%) indicated that they grew their own fruit and vegetables and 22% were members
288 of a relevant Non-Government Organisation. Only 1% kept bees and 8% had work experience in a
289 relevant field. Attitudes towards bee conservation were positive with 97% agreeing with the
290 statement that bee conservation was important and <1% disagreeing. Approximately 75% agreed
291 with the statement that environmental protection would require funding through taxation versus 9%
292 disagreeing. Attitudes towards the attributes were also generally strong and positive, although only
293 18% regularly visit green spaces. Respondent ethical stances were more mixed with ~70% of
294 respondents indicating equitable (humans and other species have equal rights) or anthropocentric
295 (humans have more rights than other species) attitudes.

296 Pearson’s Correlation analysis indicates highly significant relations between several
297 respondent attitude and demographic parameters (Appendix 2). In particular, general environmental
298 concern correlates very strongly with positive attitudes towards the attributes and bee conservation,
299 acceptance of taxation as a means of funding environmental protection and environmentalist ethical
300 stances. Acceptance of environmental taxation positively correlated with respondent qualification
301 and income. Attitudes towards bee conservation correlated positively with respondent age and
302 negatively with number of dependants.

303 *3.2. Choice Probability Parameters and Willingness to Pay*

304 In both the attribute non-attendance (ANA) shrinkage (Model 1) and Cost Attendees only
305 (Model 2) models, all choice attributes had the expected signs for both preferences and WTP
306 estimates (Table 2) (£175.88/respondent/year vs £95.83/respondent/year) with attribute specific
307 WTP approximately twice that of Model 1. As the questionnaire offered bundles with varying
308 degrees of loss of attributes, all attributes entered the model as negative values, including cost -
309 reflecting its nature as a negative impact upon respondent utility. In Model 1 ANA shrinkage was
310 estimated at 0.44 (s.d. 0.07), indicating that attenders derived approximately twice as much utility
311 from these attributes as non-attenders. In both models, the alternative specific constant (ASC)
312 parameter, representing willingness to pay to avoid the status quo situation, was negative and
313 produced high WTP values indicating that respondents strongly rejected the “do nothing” status
314 quo. There was little difference in WTP for a 1% increase between UK produce or wildflower
315 diversity in either model, suggesting that respondents were largely concerned with avoiding the
316 status quo.

317

318 **Table 2** Model coefficients and WTP for choice attributes (standard deviations in brackets)

Attribute	Model 1		Model 2	
	Choice Probability	WTP	Choice Probability	WTP
ASC	-1.04* (1.16)	-£73.4 (5692.1)	-1.195* (1.44)	-£46.3 (7861)
UKP	0.2757* (0.29)	£1.79 (1066.9)	0.2361 (0.31)	£0.81 (1514.8)
WDF	0.2335* (0.34)	£1.63 (1047.9)	0.1751* (0.38)	£0.84 (1182.4)
CST	0.9512* (1.53)		1.2856 (2.51)	
Total WTP/Respondent ¹		£175.88		£95.83
ANA Shrinkage Parameter		0.44		
Maximum Simulated Log-Likelihood		-811.21		-515.19
Pesudo R ²		0.72		0.49
Number of Respondents		278		151

319 Key: ASC = Alternative specific constant; UKP = UK produce availability retained (in %); WDF = Wildflower diversity retained
 320 (in %); CST = Cost in £/year; Total WTP/respondent = WTP for an alternative that results in a 0% change of UKP and WDF. *
 321 = significant at the 5% level. * = significant effect based on Pseudo t-values approaching 2, ANA Shrinkage = the attribute
 322 non-attendance shrinkage parameter. Pseudo R² = The McFadden's Pseudo R2 value.

323

324 Against expectations, most respondent descriptors proved non-significant⁴ upon selecting
 325 non status-quo alternatives, particularly in Model 2 (Table 3). As expected, respondents that
 326 disagreed with paying for taxes to provide environmental protection were significantly more likely to
 327 accept the status quo in both models. In Model 1 these respondents were significantly less likely to
 328 accept options which produced greater levels of wildflowers and UK produce but not less likely to
 329 select options which had a greater cost. By contrast, in Model 2, strong tax avoidance attitudes only
 330 significantly reduce the probability of respondents selecting higher cost options. In both models,
 331 respondents from Lincolnshire were significantly more likely to select higher cost options, regardless
 332 of other attributes, indicating a greater WTP for bee conservation. In common with past research
 333 (e.g. Broberg and Brännlund, 2009), Model 2 demonstrates differences between urban and rural
 334 respondents with rural respondents holding lower WTP than urban residents. Finally, in Model 1,
 335 higher respondent income marginally increased the likelihood of selecting options with greater
 336 availability of UK produce.

337

⁴ The term significant is used here to signify that the standard deviations were more than twice that of the means as Bayesian analysis does not technically allow for tests of significance.

338 **Table 3** Extrapolated upper bound and lower bound population total WTP values

	Upper Bound		Lower Bound	
	Model A	Model B	Model A	Model B
All Attributes	£4.96bn	£2.70bn	£695M	£379M
ASC	£2.07bn	£1.30bn	£290M	£183M
UKP	£1.5bn	£685M	£212M	£96M
WDF	£1.3bn	£711M	£193M	£100M

339 Key: ASC = Alternative specific constant; UKP = UK produce availability retained (in %); WDF = Wildflower diversity retained
 340 (in %); CST = Cost in £/year. Total population = WTP values extrapolated to all 28.2m UK working adults aged 18-64.
 341 Response Rate = WTP values are extrapolated to 3.9m members (14%) of the working population, reflecting the response
 342 rate of the questionnaire itself. Model A considers ANA using an ANA shrinkage method. Model B considers ANA by
 343 removing non-attenders from the sample.
 344

345 Upper bound extrapolations of the WTP values, which assume all 28.2M working adults in
 346 the UK would be willing to pay the values reported in table 2, result in an extremely high total value
 347 of £4.96bn and £2.70bn for Models 1 and 2 respectively (Table 4). However, this value is likely to be
 348 exaggerated by stronger response rate from those willing to pay than those who are not, a lower
 349 bound analysis was conducted which assumes that a proportion of UK working adults equal to the
 350 response rate (14% - 3.94M adults) are willing to pay these values. This resulted in much more
 351 conservative extrapolations of £695M - £379M for Models 1 and 2 respectively; equivalent to an
 352 annual tax increase of £24.6 and £13.4 per UK taxpayer.

353 **Table 4** Coefficients for mean effects for respondent descriptors (standard deviation in brackets)

	Model 1				Model 2			
	ASC	UK Produce	Flowers	Tax	ASC	UK Produce	Flowers	Tax
α	-1.40*	0.27*	0.51*	2.6*	-3.24*	0.26	0.50*	2.88
	(0.58)	(0.13)	(0.15)	(1.46)	(1.66)	(0.2)	(0.24)	(2.04)
Age	0.01	0.02	0.01	-0.09	-0.15	0.02	0.02	-0.08
	(0.08)	(0.02)	(0.02)	(0.23)	(0.24)	(0.03)	(0.03)	(0.3)
Income	0.01	0.03*	0.00	0.23	0.08	0.01	-0.01	0.07
	(0.07)	(0.02)	(0.02)	(0.2)	(0.19)	(0.03)	(0.03)	(0.26)
Income Refused	0.22	0.02	-0.09	-0.73	0.98	-0.04	-0.16	-1.24
	(0.29)	(0.08)	(0.09)	(0.77)	(0.84)	(0.12)	(0.14)	(0.99)
Kent	-0.26	-0.03	-0.07	-1.05	-0.67	-0.04	-0.08	-1.35
	(0.22)	(0.06)	(0.07)	(0.64)	(0.69)	(0.11)	(0.12)	(1.09)
Lincolnshire	-0.18	-0.01	-0.13	-1.87*	-0.32	-0.08	-0.16	-2.74*
	(0.27)	(0.07)	(0.08)	(0.82)	(0.8)	(0.12)	(0.15)	(1.32)
Urban/Rural	-0.10	0.02	-0.01	-0.52	-0.09	0.002	-0.06	-0.97*
	(0.13)	(0.03)	(0.04)	(0.39)	(0.38)	(0.06)	(0.06)	(0.52)
Tax Attitudes	0.36*	-0.07*	-0.10*	0.39	0.9*	-0.03	-0.05	0.94*
	(0.13)	(0.03)	(0.03)	(0.33)	(0.42)	(0.05)	(0.05)	(0.44)

354 Key α = constant/intercept. Age = Age category as per the 2001 UK census. Income = Income categories as per the 2001 UK
 355 census. Income refused = dummy variable where 1 indicates a refusal to state income. Kent = Dummy variable denoting
 356 respondent from Kent. Lincolnshire = Dummy variable denoting respondent from Lincolnshire. Urban/Rural = continuous
 357 variable indicating urban or rural dwelling. Tax Attitudes = continuous variable indicating increasing aversion to tax. * =
 358 significant effect based on Pseudo t-values approaching 2

359 The marginal value of pollination services to these end benefits was estimated by
 360 multiplying the WTP for each attribute by the proportion of the attribute that can be attributed to
 361 pollination services (12% and 39% respectively) (Table 5). Multiplying the values per 1% of service by
 362 30, representing the maintenance of all services under risk in the scenario presented, results in a

363 total WTP to fully maintain these end benefits of £25.5/person under model 1 and £12.6/person
 364 under model 2. Extrapolated using the upper and lower bound estimation, this indicated pollination
 365 services have a value of between £50M to £720M to these non-market benefits.

366 **Table 5** Estimated WTP values for pollination services

		Model 1	Model 2
Willingness to Pay to maintain 1% of the attribute	UK Produce	£1.79	£0.81
	Wildflower Diversity	£1.63	£0.84
% change from a 1% loss of pollinators	UK Produce	0.12	0.12
	Wildflower Diversity	0.39	0.39
Estimated WTP for a 1% maintenance of pollination service	UK Produce	£0.21	£0.10
	Wildflower Diversity	£0.64	£0.33
Estimated WTP to maintain 100% of services	UK Produce	£21.48	£9.72
	Wildflower Diversity	£63.57	£32.76
Estimated Total WTP	Upper Bound	£720M	£350M
	Lower Bound	£101M	£50M

367 Key: Upper Bound = the sum of WTP to maintain 100% of pollination services extrapolated to the entire tax paying
 368 population of the UK. Lower Bound = the sum of WTP to maintain 100% of pollination services extrapolated to 14% of the
 369 tax paying population of the UK. Model 1 = Analysis including Attribute non-attendance shrinkage Model 2 = analysis made
 370 by removing respondents that did not attend cost.

371 **4. Discussion**

372 *4.1. Model Outputs*

373 This study has demonstrated that respondents possess a high willingness to pay for avoiding
 374 the loss of the non-market end benefits of pollination services. However the results are likely to be
 375 upwardly influenced by a number of biases and respondent factors, potentially exaggerating final
 376 estimates. Especially strong status quo aversion was prevalent throughout the responsive
 377 population, producing very high Willingness to Pay (WTP) values for the alternative specific constant
 378 (the willingness to pay to avoid the status quo) in both the models estimated. This may be the
 379 product of high existence values, (the innate utility respondents attach to knowing that a good or
 380 service exists) for both bees and the end products of pollination services used as attributes. This is
 381 supported by the strong similarities between the alternative specific constant determined using
 382 attribute non-attendance shrinkage and the findings of Mwebaze et al (2010) which estimate a total
 383 WTP for bee conservation alone of £71.24/respondent. This study made some reference towards the
 384 benefits of pollination services but did not describe them in detail. As such the values reported in
 385 this study may represent value added to this existence value due to more explicit information on the
 386 benefits of pollination services. Alternatively, the findings could be interpreted as a disambiguation
 387 of the WTP reported by Mwebaze et al (2010) with some, moderate increase in WTP due to differing
 388 information. Respondent's highly positive attitudes towards bees and the products of pollination
 389 further substantiate this notion. Another possibility is that respondents may have held an anti-status
 390 quo bias - completely rejecting the status quo situation of pollinator losses. This may reflect
 391 lexicographic preferences against the status quo, where respondents found the do nothing scenario
 392 totally unacceptable. Alternatively the costs of action may not have disincentivised payments
 393 enough to favour the no-cost status quo, especially as no other benefits of accepting the status quo
 394 were presented (e.g. Hynes et al, 2010). This is supported by the lack of significant income effects
 395 upon either the alternative specific constant or the tax attribute in response probability.

396 Although the high proportion of respondents were of retired age (>60years) may cause an
397 upward bias in WTP as these respondents would not have to pay any tax imposed, no significant
398 effect of age category was found for either alternative specific constant or the cost attribute.
399 Hypothetical bias, where respondents exaggerate their willingness to pay because of the
400 hypothetical nature of the questionnaire, may also explain the low significance of the cost attributes
401 on respondent choices, high tax non-attendance among respondents and the number of
402 respondents who indicated objections to taxation still expressed preferences for conservation
403 options. Future research in this area may benefit from the introduction of cheap talk devices in
404 choice experiment scenario (Carlsson et al, 2005), which explicitly explain some or all of the survey
405 mechanics that may cause bias, such as overstating preferences, to deepen respondents
406 consideration of actual preferences (but see Henscher, 2010).

407 Of the two approaches to handling attribute non-attendance; using a shrinkage factor
408 (Model 1) was found to produce significantly greater WTP estimates than removing respondents
409 that expressed non-attendance for costs (Model 2 - Table2). This arises because Model 1 indicates
410 that cost had approximately half the effect on utility of non-attenders compared to attenders,
411 resulting in non-attenders maintaining a substantial influence on WTP estimates. Under both
412 models, respondent WTP for each of the insect pollinated benefit attributes was very similar. This
413 may result from similar levels of exposure to these attributes, resulting in stronger (Christie and
414 Gibbons, 2011), more stable preferences (Bateman et al, 2008). Another possible means of
415 controlling for the effects of attribute non-attendance is the use of Bayesian stochastic attribute
416 selection (Scarpa et al, 2009), or by asking respondents whether they were non-attendant in each
417 choice set (Scarpa et al, 2010). These methodologies however are limited by their respective
418 applicability of Latent class models and increased question complexity respectively. These findings
419 highlight the importance of considering attribute non-attendance in choice modelling, particularly if
420 the findings are to be extrapolated beyond the sample population.

421 The findings of this study also raise questions regarding the extrapolation of choice
422 experiment results towards total populations. National WTP values ranging from £4.96bn-£695M
423 and from £2.7bn-£379M under Models 1 and 2 respectively based on the extrapolation method
424 involved. Contrarily, this lower bound estimate assumes that non-respondents have no WTP where
425 they may in fact simply be unwilling or unable to respond, particularly as reminders were not sent to
426 prompt further response. Typically national scale extrapolations of stated preference value have
427 assumed that non-respondents hold similar WTP values to respondents. However the lower bound
428 estimates in this study, whereby the values were only assumed to apply to a percentage of the
429 population equal to the response rate, illustrate not only the disparity in estimates, particularly
430 where WTP is high, but the resultant tax increase required. A deeper examination of the means to
431 extrapolate WTP from stated preference studies could make such studies more applicable to policy.
432 Ideally, this should be accompanied with further analysis of the trade-offs in welfare for those
433 unwilling to pay for the new policy.

434 *4.2. Valuing Pollination Services*

435 Most critically, the results provide a basic first indication of the value of pollination services
436 to final goods and services beyond crop production. The values estimated (£25.5-£12.6/person)
437 strongly hinge on the assumption that pollination responds linearly to pollinator abundance within
438 the landscape. Although this has been broadly demonstrated for insect pollinated crops (Garibaldi et
439 al, 2013) the shape of this relationship within wild plant networks is presently unknown and it is

440 likely to plateau after a certain level of pollen deposition. Furthermore it does not include the
441 potential additive or multiplicative effects of pollinator diversity (e.g. Greenleaf and Kremen, 2006).
442 However these estimates remain useful as an initial valuation of the value of pollination services to
443 non-market public benefits which have been hereto overlooked by valuation studies. The high value
444 placed on the diversity of aesthetic wildflowers in particular highlights the potential value of
445 pollination services outside of crop production. Furthermore, they do not capture the value added to
446 consumers outside of the landscape that benefit from the availability of preferred nationally sourced
447 produce.

448 *4.3. Implications*

449 Strong respondent concern about the pollinator declines and high WTP both for the end
450 benefits of pollination services and the avoidance of the status quo suggest there may be scope for
451 enhancing public participation in pollinator conservation, beyond perhaps, that of monetary
452 contribution. For instance voluntary monitoring and recording schemes, have yielded substantial
453 information on urban bumblebee nesting (Osborne et al, 2008), distribution (Kadoya et al, 2009) and
454 population dynamics (Kawk, 1997). At a larger scale such public participation in wildlife monitoring
455 schemes can also provide significant primary data for use in future research (e.g. Carvalheiro et al,
456 2013). Although further research will be required to translate the preferences recorded within this
457 study into measures of public willingness to participate in such efforts, the findings nonetheless
458 provide compelling evidence that the public are likely to be supportive of efforts and public spending
459 on pollinator conservation.

460 Most significantly, the findings highlight the importance of considering other benefits from
461 pollination services beyond crops. However, the capacity of this study to accurately elicit these
462 values is limited both by the extent of the survey and by a number of economic and ecological
463 knowledge gaps. Although quantities of produce available for home production are broadly known,
464 an unknown proportion of this will be used in processing rather than sold fresh. Consequently it is
465 not possible to accurately estimate the proportion of UK produce for domestic consumption. This
466 can be improved upon with a more detailed analysis of supply chains of insect pollinated produce
467 within the UK, facilitating broader economic understanding of the vulnerability of UK consumers to
468 losing domestic supplies. The relative importance of produce origin compared to price or quality also
469 remains unquantified. As such, it is not possible to assess the impacts of other trade-offs that may
470 result from a loss of pollination services; if consumer welfare increases more from a lower price than
471 consuming local produce then lower cost imports may increase welfare overall. While recent studies
472 have begun to draw generalised trends in the impacts of pollinator communities on service provision
473 (e.g. Garibaldi et al, 2013) the relationships between pollinator abundance and diversity has not
474 been similarly generalised. Furthermore, despite extensive assessment of the flora of the UK, to date
475 there has not been an assessment of how many UK plant species benefit from pollination services to
476 varying extents (unlike crops – Klein et al, 2007). Subsequently it is not possible to accurately
477 determine how wild plant communities will react to a loss of pollinators despite evidence of parallel
478 declines between pollinators and wild plants within the UK (Carvalheiro et al, 2013). Similarly, it is
479 not know to what extent members of the UK public value different aspects of floral diversity within a
480 viable landscape; for instance people may have a preference for orderly arrangements of flowers or
481 a range of visually distinct species (Lindemann-Matthies et al, 2010). Understanding this would allow
482 for a more accurate assessment of the aesthetic value of floral diversity and the subsequent
483 contribution that pollination does or can make to it.

484 5. Conclusions

485 The findings of this study demonstrate that respondents have a very strong preference for
486 situations that avoid the status quo scenario of pollinator and pollination service losses and are
487 prepared to pay for these accordingly. These preferences are equally strong between the two
488 benefits of pollination services, wildflower diversity and availability of UK produce, presented to
489 respondents and were perhaps surprisingly not strongly influenced by respondent age, income or
490 ethical stance. Although respondents who protested against tax were less likely to accept an
491 alternative scenario they were nonetheless in favour of preserving pollination services and nearly all
492 respondents felt that preserving pollinator populations was an important issue. With many drivers of
493 pollination service decline set to continue, further research into public preferences for pollinator
494 conservation will likely yield beneficial insights into both raising public support for pollinator
495 conservation and the quantitative impacts of pollination services upon human welfare. A stronger
496 understanding of public preferences for attributes of the produce they consume and the landscapes
497 they view will enhance the accuracy and interpretation of these findings.

498 6. References

- 499 Akbar K.F., Hale W.H.G. and Headley A.D. (2003) Assessment of scenic beauty of the roadside
500 vegetation in northern England; *Landscape and Urban Planning* 63, 139-144
- 501 Allsopp M.H., de Lange W.J. and Veldtman R. (2008) Valuing Insect Pollination Services with Cost of
502 Replacement; *PLoS One* 3 0.1371/journal.pone.0003128
- 503 Balcombe K., Burton M., Rigby D. (2011) Skew and attribute non-attendance within the Bayesian
504 mixed Logit model, *Journal of Environmental Economics and Management* 62, 446–461
- 505 Bateman I., Carson R.T., Day B., Hanemann M., Hanley N., Hett T. Jones-Lee M., Loomes G., Mourato
506 S. Ozdemiroglu E., Pearce D.W., Sudgen and Swanson J. (2002) Economic Valuation with Stated
507 Preference Techniques: A Manual; Edward Elgar Press; Cheltenham
- 508 Bateman, I.J., Day, B.H., Georgiou, S. and Lake, I. (2006) The Aggregation of Environmental Benefit
509 Values: Welfare Measures. Distance Decay and Total WTP; *Ecological Economics* 60 (2), 450–460.
- 510 Bateman I., Burgess D., Hutchinson W.G. and Matthews D.I. (2008) Learning design contingent
511 valuation (LDCV): NOAA guidelines, preference learning and coherent arbitrariness; *Journal of*
512 *Environmental Economics and Management* 55, 127-141
- 513 Bateman I., Day B.H., Jones A.P. and Jude S. (2009) Reducing gain–loss asymmetry: A virtual reality
514 choice experiment valuing land use change; *Journal of Environmental Economics and Management*
515 58, 106-118
- 516 Boxall P., Adamowicz W.L. and Moon A. (2009) Complexity in choice experiments: choice of the
517 status quo alternative and implications for welfare measurement; *The Australian Journal of*
518 *Agricultural and Resource Economics* 53, 503-519
- 519 Broberg T. and Brännlund R. (2008) On the Value of Large Predators in Sweden: A Regional Stratified
520 Contingent Valuation Analysis; *Journal of Environmental Management* 88, 1066-1077

- 521 Brown E., Dury S. and Holdsworth M. (2009) Motivations of consumers that use local, organic fruit
522 and vegetable box schemes in Central England and Southern France; *Appetite* 53, 183-188
- 523 Carlsson F., Frykblom P and Lagerkvist C.J. (2005) Using cheap talk as a test of validity in choice
524 experiments; *Economics Letters* 89, 147-152
- 525 Carvalho L.G., Kunin W.G., Keil P., Aguirre-Gutierrez J., Ellis W.E., Fox R., Groom Q., Hennekens S.,
526 Landuyt W., Meas D., de Meutter F.V., Michez D., Rasmont P., Ode B., Potts S.G., Reemer M.,
527 Roberts S.P.M., Schaminee J., WallisDeVries M.F. and Biesmeijer J.C. (2013) Species Richness
528 Declines and Biotic Homogenisation have Slowed Down for NW-European Pollinators and Plants;
529 *Ecol. Lett.* 16, 870-878
- 530 Chambers S. Lobb A., Butler L., Harvey K. and Traill W.B. (2007) Local, national and imported foods: A
531 qualitative study; *Appetite* 49, 208-213
- 532 Christie M. and Gibbons J. (2011) The effect of individual 'ability to choose' (scale heterogeneity) on
533 the valuation of environmental goods; *Ecological Economics* 70, 2250-2257
- 534 Christie M., Hanley N. and Hynes S. (2007) Valuing enhancements to forest recreation using choice
535 experiment and contingent behaviour methods; *Journal of Forest Economics* 13, 75-102
- 536 Cooke I., Queenborough S.A., Mattison E.H.A., Bailey A.P., Sandars D.L., Graves A.R., Morris J.,
537 Atkinson P.W., Trawick P., Freckleton R.P., Watkinson A.R. and Sutherland W.J. (2009) Integrating
538 socio-economics and ecology: a taxonomy of quantitative methods and a review of their use in agro-
539 ecology; *Journal of Applied Ecology* 46, 269-277
- 540 DEFRA (2012) Farming statistics: land use, livestock populations and agricultural workforce at 1 June
541 2012 – UK; [https://www.gov.uk/government/publications/farming-statistics-land-use-livestock-](https://www.gov.uk/government/publications/farming-statistics-land-use-livestock-populations-and-agricultural-workforce-at-1-june-2012-uk)
542 [populations-and-agricultural-workforce-at-1-june-2012-uk](https://www.gov.uk/government/publications/farming-statistics-land-use-livestock-populations-and-agricultural-workforce-at-1-june-2012-uk) last updated 18/03/11
- 543 DEFRA (2013) *Agriculture in the UK 2012* [https://www.gov.uk/government/statistical-data-](https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom)
544 [sets/agriculture-in-the-united-kingdom](https://www.gov.uk/government/statistical-data-sets/agriculture-in-the-united-kingdom) last updated 25/07/13
- 545 Dillman D. (2000) *Mail and Internet Surveys – The Tailored Design Method*; Wiley, London
- 546 Fisher B, Turner R.K. and Morling P. (2009) Defining and Classifying Ecosystem Services for Decision
547 Making; *Ecological Economics* 68, 634-653
- 548 Gallai N., Salles J. M., Settele J. and Vaissiere B. E. (2009) Economic Valuation of the Vulnerability of
549 World Agriculture Confronted with Pollinator Decline; *Ecol. Econ.* 68, 810-821
- 550 Garibaldi L.A., Steffan-Dewenter I., Winfree R., Aizen M.A., Bommarco R., Cunningham S.A., Kremen
551 C., Carvalho L.G., Harder L.D., Afik O., Bartomeus I., Benjamin F., Boreux V., Cariveau D., Chacoff
552 N.P., Dudenhöffer J.H., Freitas B.M., Ghazoul J., Greenleaf S., Hipólito J., Holzschuh A., Howlett B.,
553 Isaacs R., Javorek S.K., Kennedy C.M., Krewenka K.M., Krishnan S., Mandelik Y., Mayfield M.M.,
554 Motzke I., Nault B.A., Otieno M., Petersen J., Pisanty G., Potts S.G., Rader R., Ricketts T.H., Rundlöf
555 M., Seymour C.L., Schüepp C., Szentgyörgyi H., Taki H., Tscharrntke T., Vergara C.H., Viana B.F.,
556 Wanger T.C., Westphal C., Williams N. and Klein A.M., 2013. Wild Pollinators Enhance Fruit Set of
557 Crops Regardless of Honey Bee Abundance. *Science* 339, 1608-1611.

558 Greenleaf, S. and Kremen, C. (2006) Wild Bees Enhance Honey bees Pollination of Hybrid Sunflower;
559 *Proceedings of the National Academy of Sciences of The United States of America* 103, (37), 13890–
560 13895

561 Hanley N., J.F. Shorgen and B. White (2007) *Environmental Economics in Theory and Practice* (2nd
562 Edition), Palgrave Macmillan, Hampshire, New York

563 Hensher D.A. (2006) How Do Respondents Process Stated Choice Experiments? Attribute
564 Consideration under Varying Information Load; *Journal of Applied Econometrics* 21, 861-878

565 Hensher D.A. (2010) Hypothetical bias, choice experiments and willingness to pay; *Transportation*
566 *Research Part B* 44, 735-752

567 Hynes S., Campbell D. and Howley P. (2010) A Holistic vs. an Attribute-based Approach to Agri-
568 Environmental Policy Valuation: Do Welfare Estimates Differ?; *Journal of Agricultural Economics* 62,
569 305–329

570 Ivehammar P. (2009) The Payment Vehicle Used in CV Studies of Environmental Goods Does Matter;
571 *Journal of Agricultural and Resource Economics* 34, 450-463

572 Junge X., Lindemann-Matthies P., Hunziker M. and Schüpbach B. (2011) Aesthetic preferences of
573 non-farmers and farmers for different land-use types and proportions of ecological compensation
574 areas in the Swiss lowlands; *Biological Conservation* 144, 1430-1440

575 Kadoya T., Ishii H.S., Reina H., Shin-ichi S. and Izumi W. (2009) Using Monitoring Data Gathered by
576 Volunteers to Predict the Potential Distribution of the invasive alien Bumblebee *Bombus terrestris*;
577 *Biological Conservation* 142, 1011-1017

578 Kehlbacher, A., Balcombe, K. and Bennett, R. (2013) Stated attribute non-attendance in successive
579 choice experiments. *Journal of Agricultural Economics In Press*

580 Kellert S. (1996) *The Value of Life – Biological Diversity and Human Life*; Island Press, Washington

581 Klein, A. M., Vaissiere, B. E., Cane, J. H., Steffan-Dewenter, I., Cunningham, S. A., Kremen, C.,
582 Tschardt, T. (2007) Importance of Pollinators in Changing Landscapes for World Crops;
583 *Proceedings of the Royal Society B-Biological Science* 274, 303-313

584 Kwak M.M. (1997) Public Bumblebee Survey in the Netherlands in 1994 and 1995; *Acta Horticulturae*
585 437, 413-417

586 Lindemann-Matthies P., Junge X. and Matthies D. (2010) The influence of plant diversity on people's
587 perception and aesthetic appreciation of grassland vegetation; *Biological Conservation* 143 195-202

588 MacKeron G.J., Egerton C., Gaskell C., Parpia A. and Mourato S. (2009) Willingness to Pay for Carbon
589 Offset Certification and Co-Benefits among (high-)Flying Young Adults in the UK; *Energy Policy* 37,
590 1372-1381

591 Meyhoff J. and Liebe U. (2009) Status Quo Effect in Choice Experiments: Empirical Evidence on
592 Attitudes and Choice Task Complexity; *Land Economics* 85, 515-528

593 Mwebaze P., Marris G.C., Budge G.E., Brown M., Potts S.G., Breeze T.D. and MacLeod A. (2010)
594 Quantifying the Value of Ecosystem Services: A Case Study of Honeybee Pollination in the UK;
595 *Contributed Paper for the 12th Annual BIOECON Conference*

596 Natural England (2009) Experiencing Landscapes: capturing the cultural services and experiential
597 qualities of landscape; <http://naturalengland.etraderstores.com/NaturalEnglandShop/NECR024>

598 Ollerton J., Winfree R., Tarrant S., (2011) How many flowering plants are pollinated by animals?
599 *Oikos* 120, 321–326.

600 ONS (2011) Labour Market Statistics November 2011; http://ons.gov.uk/ons/dcp171766_241671.pdf

601 Osborne J.L., Martin A.P., Shortall C.R., Todd A.D., Goulson D., Knight M.I., Hale R.J. and Sanderson
602 R.A. (2008) Quantifying and comparing bumblebee nest densities in gardens and countryside
603 habitats; *Journal of Applied Ecology* 45, 784–792

604 Potts S.G., Biesmeijer J.C., Kremen C., Neumann P., Schweiger O. and Kunin W.E. (2010) Global
605 Pollinator Declines; Trends, Impacts and Drivers; *Trends in Ecology and Evolution* 25, 345-353

606 Rolfe J. and Bennett J. (2009) The impact of offering two versus three alternatives in choice
607 modelling experiments; *Ecological Economics* 68, 1140-1148

608 Samnegård U., Presson A.P. and Smith H.G. (2011) Gardens benefit bees and enhance pollination in
609 intensively managed farmland; *Biological Conservation* 144, 2602-2606

610 Sarrantonio M. (2007) *Managing Cover Crops Profitably* (3rd Edition); Sustainable Agricultural
611 Networks, Boltsville MD

612 Scarpa R., Gilbride T.J., Campbell D. and Hensher D.A. (2009) Modelling attribute non-attendance in
613 choice experiments for rural landscape valuation; *European Review of Agricultural Economics* 36,
614 151-174

615 Scarpa R., Thiene M. and Hensher D.A. (2010) Monitoring Choice Task Attribute Attendance in
616 Nonmarket Valuation of Multiple Park Management Services: Does It Matter?; *Land Economics* 86,
617 817-839

618 Smith P., Ashmore M., Black H., Burgess P., Evans C., Hails R., Potts S.G., Quine T., Thomson A.,
619 (2011) UK National Ecosystem Assessment - Chapter 14: Regulating Services. UNEP-WCMC,
620 Cambridge.

621 Soini K. and Aakkula J. (2007) Framing the biodiversity of agricultural landscape: The essence of local
622 conceptions and constructions; *Land Use Policy* 24, 311-321

623 Spash C., Urama K., Burton R., Kenyon R., Shannon P. and Hill G. (2009) Motives behind willingness
624 to pay for improving biodiversity in a water ecosystem: Economics, ethics and social psychology;
625 *Ecological Economics* 68, 955-964

626 Train K. (2003) *Discreet Choice Modelling With Simulations* (3rd Edition) Cambridge University Press,
627 Cambridge

628 Winfree R., Gross B. J. and Kremen C. (2011) Valuing pollination services to agriculture; *Ecological*
629 *Economics* 71, 80-88

630 Zander K.K. and Straton A. (2010) An economic assessment of the value of tropical river ecosystem
631 services: Heterogeneous preferences among Aboriginal and non-Aboriginal Australians; *Ecological*
632 *Economics* 69, 2417-2426

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