Report on findings from a survey on public preferences for peatlands restoration: timing and long term resilience of peatlands under climate change

Klaus Glenk (Scotland's Rural College)

Michela Faccioli (James Hutton Institute and University of Exeter)

Julia Martin-Ortega (University of Leeds)

August 2018

The work reported in this report was funded through the Scottish Government Rural Affairs and the Environment Portfolio Strategic Research Programme 2016–2021. JMO and KG acknowledge support through the Natural Environment Research Council (NERC) through the project 'Understanding ecosystem stocks and tipping points in UK peatlands' (grant number NE/P00783X/1). Thanks to Rebekka Artz, Jacqueline Potts, Anja Byg, Paula Novo and Carol Kyle.

Contents

Summary

This report summarises key findings from an online survey conducted in 2017 with members of the Scottish public to understand their views and preferences regarding peatland restoration. Results from an earlier survey conducted in 2016 suggest that people perceive significant benefits associated with peatland restoration accrued in a relatively short time period following restoration (15 years). The results were used to investigate whether it is socially desirable to invest in peatland restoration in Scotland. However, the 2016 study did not consider important medium to long term implications of restoration, which may affect preferences and thus values associated with peatland restoration to be used in cost-benefit assessments of peatland restoration programmes. The medium to long term implications are related to the notion that 'healthy' peatlands are likely to be more robust to climate change impacts in the long term than peatlands with ongoing degradation. Giving peatlands more time to restore their initial functioning may increase their resilience against climate change impacts. This implies a greater robustness of peatlands against climate change if they are restored early on, and represents an important synergistic relationship between peatland restoration as a climate change mitigation strategy and as a climate change adaptation response. A central element of the survey focused on eliciting monetary values associated with peatland restoration using a choice experiment. Additionally, the survey asked about attitudes towards peatland restoration and climate change attitudes and beliefs.

Confirming the findings of the 2016 survey, this study finds that more than three quarters of respondents were generally supportive of peatland restoration, placing significant value on the ecosystem services that peatland restoration provides. With respect to timing of restoration and associated impacts for the long term robustness of peatlands under climate change, respondents have strong preference for early implementation of restoration action. This provides an additional economic argument for not delaying restoration action. Delaying restoration to the last decade up to 2050 is associated with a welfare loss that is equivalent to the welfare gain associated with increasing the share of peatlands in good condition achieved in 2050 by 30%. Despite widespread support for early restoration efforts, some respondents also expressed concerns about early peatland restoration at a large scale until uncertainties regarding future climate change are resolved.

Based on our results, up to a third of respondents are sceptical in at least one dimension of climate change (for example, with respect to attribution of the source of climate change (natural vs. man-made) and of who has responsibility for addressing it). Importantly, more than 40% of respondents state that they are not confident in their knowledge regarding climate change. This suggests that efforts need to be maintained or even increased to raise awareness about climate change and its impacts on Scotland's natural capital, including on peatlands and their restoration, particularly as strategic policy documents such as the climate change plan for Scotland suggest that restoration efforts are likely to be scaled up over the coming years.

1. Background and motivation

This report summarises initial findings from a valuation survey conducted in 2017 in the context of peatland restoration in Scotland. The questionnaire builds on a previous survey on conducted in 2016, which provided an understanding of public views and preferences for peatland restoration as well as an estimation of the (monetary) benefits secured by peatland restoration as perceived by the general public (see Box 1 for a summary of results of the 2016 survey).

Intact or growing peatlands over time reduce the concentration of greenhouse gases in the atmosphere (i.e. they act as a carbon sink), especially if compared against a baseline of continued degradation associated with the emission of greenhouse gases. This potential is well documented globally (Leifeld and Menichetti 2018), for the UK (Bain et al. 2011) and for Scotland (Artz et al. 2012). Additionally, concerns have been raised about the future of peatlands under climate change. The bioclimatic space for blanket bogs is likely to shrink driven by expectations of warmer summers (Gallego-Sala et al. 2010; Gallego-Sala and Prentice 2013). This implies greater stress on peatlands and may imply that they slow down to accumulate carbon or entirely cease to be carbon sinks (Gallego-Sala and Prentice 2013; Ise et al. 2008). There is a large degree of uncertainty associated with the response of peatlands to climate change, and with the time span over which changes occur, which in addition to uncertainty about the extent of climate change can be attributed to positive or negative feedbacks that either accelerate or slow down changes in peatlands (Page and Baird 2016). Nevertheless, peatlands may show some resilience to gradual changes in the climate if they exhibit a healthy cover of *Sphagnum* moss (Gallego-Sala and Prentice 2013). Consequently, peatland sites that are in poor ecological condition, i.e. sites that are continually degrading, are likely to be more susceptible to future climate change than sites that are in good ecological condition. This also implies that degraded sites that are restored earlier will likely be more resilient against future climate change, because they will have had more time to restore their vegetation cover and functioning as climate change effects will increasingly affect the ecosystem.

Against this backdrop, the 2017 survey investigates the preferences of Scottish citizens for the extent of peatland restoration, and for the timing of restoration in the period from 2018 to 2050. The expectation is that, especially under more severe climate change scenarios, earlier restoration efforts will result in a greater area of peatlands that will be retained in good ecological condition by the end of the century. Delaying restoration efforts to the decade 2040-2050 is expected to result in a greater loss of peatland area in good ecological condition by the end of the century. In line with literature on the resilience of peatlands summarised in Page and Baird (2016), we do not expect peatlands to disappear but to shift to different systems or to degrade.

Preferences for peatland restoration and its timing are elicited using the discrete choice experiment method. Respondents to choice experiment surveys are (repeatedly) asked to

choose their preferred alternative among a number of alternatives that are characterised by a number of attributes, taking different levels across the alternatives, following a given experimental design. One of the attributes represents a monetary cost to the respondent associated with realising the alternatives. This allows to investigate trade-offs between money and attributes that reflect environmental improvements and thus the estimation of willingness to pay (WTP) for environmental improvements. One of the alternatives is typically representing the status quo either in terms of the current situation or a future business as usual scenario. This, then, allows estimating the welfare effects of experiencing changes in the environment relative to the status quo alternative. Because climate change is central to this survey both in terms of characterising the mitigation potential through restoration and in terms of shaping the long-term future of peatlands, the survey also includes questions on climate change beliefs, in addition to questions on the respondents' socio-economic profile.

This report is structured as follows. Section 2 will introduce the survey instrument used in the survey and give an overview of the sampling strategy. Section 3 will report on the sample composition, descriptive statistics of selected survey questions and the results of the choice experiment part of the survey. Section 4 will briefly discuss some key findings.

2. Survey design and administration

The survey instrument comprised of several sections, described in more detail further below:

i. Introduction to peatlands, peatland restoration, the role of peatlands in the provision of ecosystem services and the possible futures for peatlands in the face of climate change (with and without restoration); this section also included questions on attitudes towards peatland restoration and beliefs regarding the extent of future climate change
ii. Questions to elicit preferences and (monetary) values attached to the benefits of peatland restoration, measured through willingness to pay (WTP) in a choice experiment and a series of debriefing questions
iii. Questions regarding attitudes towards climate change in general, attitudes towards risk and optimism/pessimism in life
iv. Socio-demographic characteristics.

Box 1. Results of 2016 valuation survey on peatland restoration

The survey was aimed at understanding public views and preferences for peatland restoration and at estimating the (monetary) benefits associated with peatland restoration as perceived by the general public in Scotland at a national level. In the first part of the survey, respondents were informed about the state of Scottish peatlands, and received a detailed explanation of how degradation and restoration of peatlands affects ecosystem services related to greenhouse gas emissions and provisioning services, but also co-benefits regarding water regulation and the effects on biodiversity (see Martin-Ortega et al. 2014 and Glenk et al. 2014 for a review on ecosystem benefits of restoration). The explanation of ecosystem service impacts was related to descriptions about the ecological condition of peatlands (bad, intermediate or good). Respondents then answered a series of questions related to peatland restoration, including a choice experiment on preferences regarding possible restoration programmes. Respondents were asked to choose between two restoration alternatives and a business as usual alternative. The restoration alternatives were characterised by the share of Scottish peatlands in good condition (as a result of restoring peatlands in bad and intermediate condition), and spatial criteria for prioritising restoration. Hypothetical restoration alternatives were offered at a cost to respondents, allowing us to estimate the value in terms of willingness to pay (WTP) per person or per hectare for restoring peatlands depending on condition and focal location for restoration.

The survey was implemented online in February/March 2016 with 1,795 respondents. Approximately 80% of respondents are found to be supportive of restoration. Estimates of WTP values based on the choice experiment vary depending on the initial condition of peatlands (poor or intermediate condition) and location of restoration effort (in wild land are or not; in areas with higher or lower share of land cover made up by peatlands). Per hectare values for shifts from intermediate to good condition are £190 on average, and £273 for shifts from bad to good condition. Respondents are also found to make greater distinction regarding the location of restoration for shifts from intermediate to good condition compared to shifts from bad to good condition.

Per hectare benefit (WTP) estimates were compared to potential cost of restoration finding that, on average, benefits of peatland restoration projects are likely to outweigh costs. Additionally to Martin-Ortega et al. (2017a, b) and Glenk and Martin-Ortega (2018), Faccioli et al. (2018) used the data from the 2016 survey to investigate the impact of environmental attitude and place identity on WTP. Both a more positive environmental attitude and stronger place identity beliefs are found to positively impact willingness to pay for peatland restoration.

The development of the survey instrument and main findings of this survey are reported in Martin-Ortega et al. (2017a), Martin-Ortega et al. (2017b) and Glenk and Martin-Ortega (2018).

2.1 Information regarding peatlands and peatland restoration

The survey was implemented online (self-completion). It draws heavily on the information materials that had been previously used for the 2016 survey (see Martin-Ortega et al. 2017a for a detailed description). Textual information was enhanced through the use of graphical information generated by a visual artist in collaboration with the research team, and photos that illustrate various techniques available for restoring degraded peatlands. The description

follows a narrative of what peatlands are and what changes have historically occurred in peatlands that are drained. Peatlands could be assigned to one of three possible categories of ecological condition - bad, intermediate or good condition (see Figure 1). The three conditions were related to varying provision of ecosystem goods and services (greenhouse gas emissions, water quality, wildlife and impacts on rural (farm) businesses). We asked respondents prior to the survey to rate their knowledge on peatlands, and asked again after providing the information above to indicate if respondents thought that their level of knowledge about peatlands had changed.

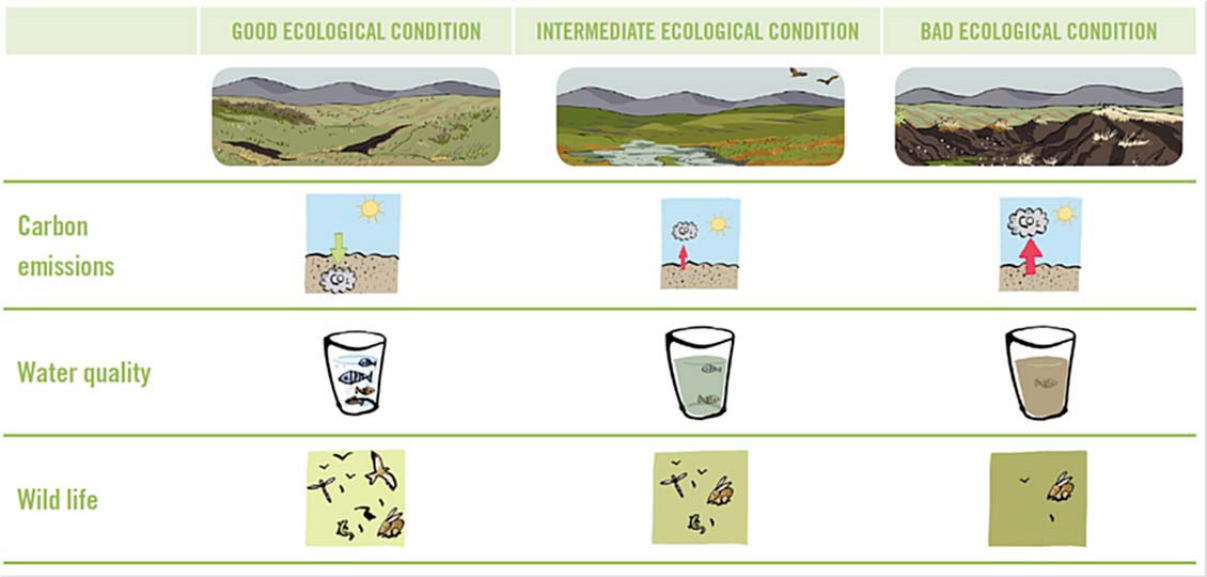

Figure 1: **Peatland ecological conditions and depictions of associated ecosystem service impacts** (from Martin-Ortega et al. 2017b)[1]

The survey then introduced respondents to the potential climate change impacts on peatlands. The information provided was as follows:

"*More than two thirds of Scottish peatlands are thought to be in intermediate or bad ecological condition. If current land use remains the same and if no action is taken, peatlands will continue to degrade in the future. If no action is taken, scientists also project that especially towards the end of this century climate change will accelerate the degradation of peatlands. For Scotland, experts project climate change to result in a rise in temperature and more extreme rain patterns (more rain in winter and less rain in summer). This will mean that peatlands degrade faster and could ultimately be replaced by degraded heather moorland or degraded grassland*"

Respondents were then told that climate change projections are not known with certainty and thus there may be a range of possible scenarios of climate change. We asked

[1] The information and images shown in Figure 1 are open access under the conditions of the Creative Commons copyright and can be freely used by anyone who would like (see Martin-Ortega et al. 2017a,b for more details or download here www.see.leeds.ac.uk/peatland-modules/embeds/index.php). The images were drawn by Ximena Maier

respondents by how much they believe average annual temperature will have increased in Scotland by 2080 (on a scale from +0.5 degrees Celsius to +5 degrees Celsius), and how certain they would be about their response (possible responses ranged from 1: completely uncertain to 10: completely certain).

Respondents were then informed that *"[t]he effects of climate change will be most damaging for peatlands that are in bad ecological condition. Peatlands in good ecological condition will be more robust.*" They were then shown how the share of Scottish peatlands in good condition is expected to change if no further action is taken (business as usual scenario). The business as usual scenario is depicted in Figure 2. The figures and climate change impacts were developed in close consultation with peatland experts. We distinguished between two climate change scenarios: a more severe scenario, in line with the A1FI scenario in the IPCC Special Report on Emission Scenarios (SRES), and a less severe scenario that would be more in line with the B1 scenario and impacts as descfribed in UKCP09 (Murphy et al. 2009). This information was followed by an explanation of peatland restoration, including an overview of different restoration techniques.

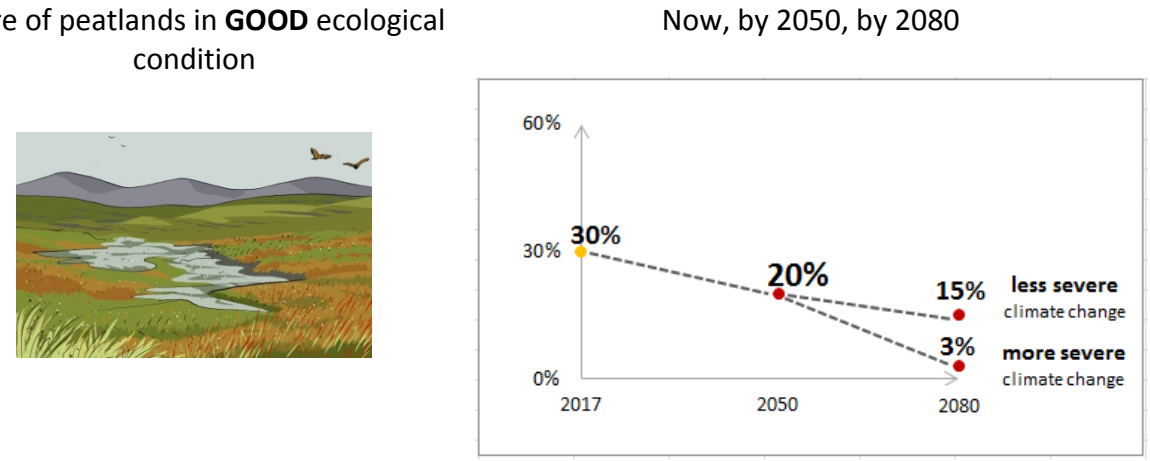

Figure 2. Description of changes in the share of peatlands in good ecological condition over time in the business as usual scenario

Respondents were then informed about the possibility of a (hypothetical) peatland restoration programme. Specifically, respondents received the following information, over several web pages:

"*To do something about the degradation of peatlands in Scotland, a restoration programme could be established. Through this programme, peatlands that are currently in bad or intermediate condition would be restored, with the aim of achieving good ecological condition in the future and avoiding further degradation […] The restoration programme would start this year and be in place up until 2050. During this period, most of the restoration efforts could be concentrated either early, midway or late in the programme. Restoring earlier in the programme means that the benefits of restoration could be enjoyed sooner. Restoring later in the programme would provide an opportunity to learn more about peatlands and their restoration before restoring larger areas of peatlands. […]The*

restoration programme would end in 2050. However, how much of the restored Scottish peatland areas will remain in good ecological condition once the programme ends (after 2050), will depend on when restoration has taken place in the lifetime of the programme; how much has been done until 2050; how severe climate change will be […] If restoration happens early in the programme, restored peatlands will be more robust to potential climate change effects. As a result, most of the restored peatlands will likely remain in good condition once the programme ends. If restoration happens late in the programme, restored peatlands will be more vulnerable to potential climate change effects and therefore a smaller share of the restored peatlands will remain in good condition once the programme ends."

A series of Likert-scale questions (1: completely disagree; 4: completely agree) was then asked to elicit people's motivations for timing and uncertainty associated with restoring Scottish peatlands. Respondents were asked to indicate their level of agreement or disagreement with the following statements: "*I think it is important to preserve Scottish peatlands for future generations*"; "*We need to restore Scottish peatlands now to make sure they will not be at risk in the future*"; "*We should wait until more is known before restoring peatlands at a large scale*"; "*Uncertainty about climate change should not prevent us from restoring peatlands now*"; "*I think that Scottish peatlands should be restored immediately to enjoy the benefits of peatland restoration earlier*".

Respondents were told that there is a cost associated with restoration, and that payments towards restoration would be funded "*by the tax payer through an annual tax to a Peatland Trust. This Peatland Trust would be managed by an independent body of scientists, government agencies, farmer and land owner organisations, nature conservation and community representatives. The peatland restoration programme and the tax would start this year and be in place until 2050. The tax would have to be paid by all tax payers. Different alternatives of a restoration programme can vary in the cost to the taxpayer depending on the restoration intensity and effort required*." This was followed by a budget reminder, stating that "[p]aying for a restoration programme means that your household will have less money available to spend on other things."

2.2 Choice experiment design

The choice experiment used to elicit monetary values for peatland restoration consisted of eight choice questions. In each, respondents were asked to choose their preferred alternative from three alternatives; where two represent a restoration scenario that differs in three dimensions or attributes, as described in Table 1. The third alternative represents the business as usual scenario (no restoration), as shown in Figure 2. An example choice task is shown in Figure 3.

The first attribute (GOOD2050) related to the share (in %) of peatlands that would be in good condition by 2050 (i.e., the extent of restoration undertaken) relative to business as

usual scenario. The attribute TIME referred to the time period when restoration would take place in the period between 2017 and 2050. The third attribute (COST) refers to the payment to the Peatland Trust fund as explained above.

How much of the peatlands will be in good ecological condition by 2080 was assumed to depend on i) how much peatland will be in good condition by 2050, and ii) when restoration will take place in the period to 2050. We assumed that, in a more severe climate change scenario, between 20% and 80% of the increase in peatlands in good condition achieved by 2050 (relative to the BAU) could be retained by 2080, depending on the timing of restoration. Under less severe climate change, it was assumed that between 85% and 95% of the increase in peatlands in good condition could be retained by 2080. This information is summarised in Table 2. For the business as usual scenario, we assumed that 15% of peatlands in good condition would be retained in good condition under a more severe climate change scenario, and 75% under a less severe climate change scenario.

Table 1. Attributes and levels

Attribute label	Description	Levels
GOOD2050	Change (increase) in the share of peatlands that will be in good condition by 2050 (i.e., the extent of restoration undertaken) relative to business as usual scenario, in %. This describes the extent of restoration undertaken,	0,10,20,30,40
TIME	Time period when restoration will take place in the period between 2017 and 2050 (and, associated with that, how much peatlands will be left in good condition by 2080 under a more severe or less severe climate change scenario)	Early (2017-2027), Midway (2028-2038), Late (2039-2050)
COST	Annual cost (tax towards Petland Trust fund), in GBP	0,10,25,50,75,150,250

Table 2. Percentage of the increase in peatlands in good condition (achieved by 2050) that would be retained by 2080 as a result of different timings of restoration

	Early	Midway	Late
More severe climate change	80%	50%	20%
Less severe climate change	95%	90%	85%

The three attributes (GOOD2050; TIME; COST) varied across generic (i.e. unlabelled) alternatives and choice tasks following an experimental design. For this study, we employed a Bayesian D-efficient design that allows for the estimation of all main effects and second-order interaction effects between the attributes. The priors used to inform the construction of the experimental design were based on the results of MNL models estimated from data collected as part of two pilot study campaigns (with N=93 respondents in the first pilot and N=95 respondents in the second pilot). The design comprised of 48 choice tasks, which were allocated to six blocks so that each respondent faced eight choice tasks. Respondents were

randomly allocated to a block of choice tasks. The order of choice questions within each block was again randomised.

Four versions of the choice experiment were created and each was randomly allocated to respondents to create four split samples. The survey versions differed with respect to one or both of the following aspects: i) the framing of the valuation scenario and the choice tasks and ii) the type of choice(s) that respondents were asked to make in the choice experiment tasks. Versions 1-3 presented the policy alternatives as potential increases in the share of peatlands in good condition (good framing). Version 4 presented the policy results as a potential reduction in the share of peatlands in bad conditions and how much of the decrease in the share in bad ecological condition resulting from restoration is retained by 2080 (bad framing). The increase in the share of peatlands in good condition presented in Versions 1-3 was equivalent to the decrease in the share of peatlands in bad condition in Version 4, such that respondents were presented with the same improvements across split samples, however framed in a different way. This was motivated by the fact that we wanted to test whether respondents are sensitive to how information is presented in the choice experiment, despite presenting equivalent outcomes. In addition, the different versions also asked respondents to make different types of choices among the three alternatives. Version 1 asked individuals to choose the most preferred out of the three alternatives. Version 2 asked for choosing the most preferred and the least preferred alternative, while Version 3 asked respondents to select the most preferred alternative and the second best alternative. Versions 2 and 3 therefore allow deriving a complete ranking of the three alternatives. The same applies to Version 4, which asked for choosing the most preferred and the least preferred alternatives.

For this report, we pool the data from the four Versions or split samples, and analyse data only with respect to most preferred (best) choices, transforming decreases in the share of peatlands in bad ecological condition in Version 4 to their equivalent increase in good ecological condition as in Versions 1-3.

Debriefing questions were asked about how confident respondents were about the choices they had just made and about beliefs regarding the consequentiality of their choices (i.e., whether they thought the information obtained from the survey would actually influence policy decisions, or actually result in a payment/cost to respondents). We also asked for motivations of respondents who decided to always choose the business as usual option that did not imply a tax contribution to a Peatland Trust. Some of the motivations may be considered as indicative of not being able or willing to pay anything towards peatland restoration (for example, not being able to pay due to budget constraints or not being willing to pay based on not finding restoration important), while others may reflect protest against the valuation scenario, the question mechanism or elements of both (for example, not accepting a further tax increase; perception that government is responsible and should pay for restoration).

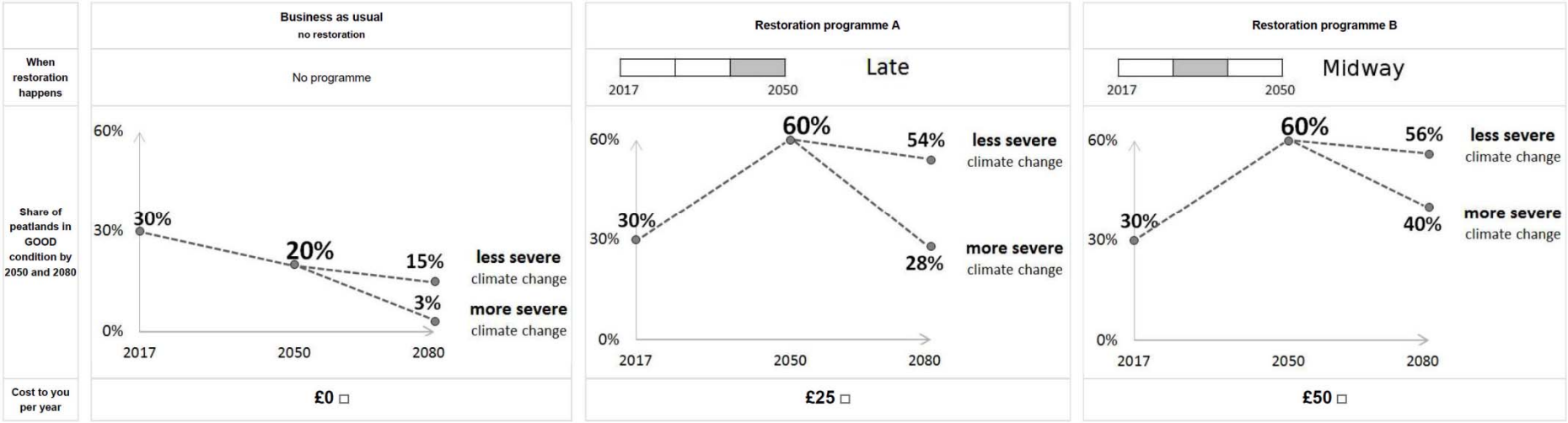

Figure 3. Example choice task

2.3 Attitudinal questions and socio-demographics

The questions regarding climate change beliefs were based on a scale used in Glenk and Colombo (2011) and additionally included items taken from Capstick et al. (2015) and Corner et al. (2012). Respondents were asked about their level of agreement and disagreement with eleven statements relevant to different dimensions of climate change concern, awareness, knowledge and the need for action to counteract climate change. Additionally, we asked respondents about their beliefs regarding changes in the annual average temperature (if any) in Scotland to be expected by 2080, compared to today. We informed respondents that annual mean temperature has increased by 1°C over the last 30 years.

We were further interested in exploring the effect, if any, of people's optimism or pessimism in life on preferences for peatland restoration with (uncertain) long term impacts. To measure the degree of optimism or pessimism of people, we adopted the Life Orientation Test – Revised (LOT-R) scale developed by Scheier et al. (1994) that contains ten items. Further, we used the Risk Propensity scale as suggested in Meertens and Lion (2008) to obtain information about respondents' risk-taking propensity and attitude. Both results from the optimism scale and regarding risk attitudes will be analysed elsewhere and are thus not reported in this report.

Socio-demographic questions were additionally included in the survey. We collected information on: household size and composition, location of residence (postcode and classification according to urban-rural gradient taking into account both remoteness and size of settlement), level of educational attainment and household income (after tax). Information on gender, age and social grade were used as quotas (see Table 3) and thus also recorded. Membership to environmental organisations (yes/no) was also inquired.

2.4 Survey administration

The survey was extensively pre-tested in two focus groups run with 5 participants each (members of the general public) to make sure that the presented scenarios (including projected climate change effects on peatlands and potential restoration options) were clearly conveyed to and understood by respondents. After survey refinement following the pre-test, we also run two pilot studies (the first with N=93 and the second with N=95 respondents) to check the plausibility of responses, modelling results and the sensitivity to the cost attribute (choke price), as well as to understand the need for refined wording of the valuation scenario and survey questions. Some changes were introduced after the first pilot. Only minor changes were made to the survey instrument after the second pilot study.

The survey was programmed using a platform hosted at the University of Leeds and administered online to a sample of the Scottish population between May and August 2017 by a professional market research provider. We used a quota based sample with quotas based on age and gender, and a 'soft' quota based on social grade. The screening procedure

also asked whether respondents were resident in Scotland (non-Scottish residents were discarded). We collected 1,813 responses.

Socio-demographic characteristics of the sample are summarised in Table 3. As expected due to the quota sampling, there is a good match on gender and age. Household income is slightly lower than for the overall Scottish population; however, the sample figure is based on only 58% of the sample who reported an exact figure for their monthly household income. In terms of educational attainment, there are differences compared to the overall population profile. Respondents with higher education appear to be over-represented. This may in part be due to a different lower age bound (age 16) used for calculating the population data.

Table 3. Socio-demographic characteristics of the sample compared to the overall Scotland's population

Variable	Sample	Overall Population (Scotland)*
Gender distribution		
Female	52.34%	51%
Male	47.66%	49%
Age distribution (years old)		
18-24	11.7%	11.9%
25-44	32.6%	33.0%
45-64	34.47%	34.2%
≥ 65	21.24%	20.9%
Monthly household income (after tax)		
GBP per month	£2,815	£3,192
Educational attainment (highest achieved Scotland census level)**		
No qualifications	3.87%	26.79%
Level 1	11.93%	23.08%
Level 2	21.76%	14.33%
Level 3	16.34%	9.70%
Level 4	45.39%	26.09%
Prefer not to tell	0.72%	
Average household size		
Persons per household	2.37	2.25

Based on 1813 respondents, expect income (1056 who reported an exact figure), educational attainment (1811) and household size (1811). *Scotland Census (2011) by National Records of Scotland (http://www.scotlandscensus.gov.uk/). **it should be noted that population figures include population 16 years old or older while our survey includes respondents 18 years old or older.

3. Results

3.1 Knowledge, attitudes and beliefs

Table 4 summarises the results concerning attitudes towards peatland restoration. A large majority of respondents agree that peatlands should be restored now to be able to enjoy the benefits earlier, and agree on the importance of restoring peatlands for future generations. While 90% of respondents somewhat agree or completely agree that uncertainty about climate change should not prevent peatland restoration now, 25% of respondents accept that there is value in waiting until more is known before restoring peatlands at a large scale. This suggests (in line with the 2016 survey reported in Martin-Ortega et al. 2017a,b) that respondents are overwhelmingly supportive of peatland restoration; however, it also indicates that respondents are somewhat cautious about large scale restoration in the presence of uncertainty.

Table 4. Attitudes regarding peatland restoration

Item	completely disagree	somewhat disagree	somewhat agree	completely agree
I think that Scottish peatlands should be restored immediately to enjoy the benefits of peatland restoration earlier	1.77	7.53	46.51	44.19
We should wait until more is known before restoring peatlands at a large scale	24	49.28	22.01	4.71
We need to restore Scottish peatlands now to make sure they will not be at risk in the future	1.16	4.82	40.66	53.35
Uncertainty about climate change should not prevent us from restoring peatlands now	2.27	7.15	38.56	52.02
I think it is important to preserve Scottish peatlands for future generations	1.22	2.49	31.75	64.54

Figure 4 summarises respondents' beliefs regarding average annual temperature in Scotland by 2080. Both the mean and median value of the distribution equal an expected increase of two degrees Celsius. While 23% expect temperatures to increase by less than one degree Celsius (and 6% expect no increase at all), approximately 10% believe that a temperature increase of four degrees Celsius or more might be expected. Overall, this shows that there is a considerable heterogeneity in the sample regarding the perception of the extent to which Scotland will be affected by future climate change. When asked about their degree of certainty regarding the expected temperature increase on a ten point scale (ranging from 1: completely uncertain to 10: completely certain), only 30% of respondents indicated to be more certain than uncertain (i.e., they rated their degree of certainty with a score of six or above).

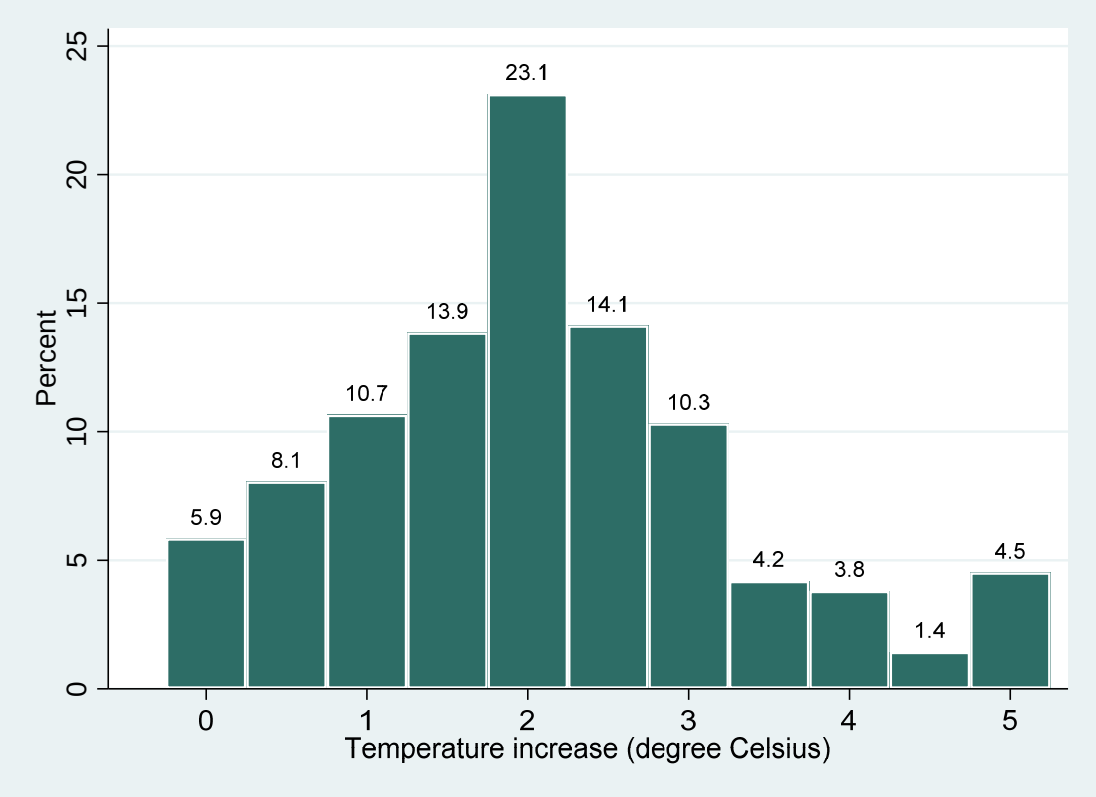

Figure 4. Beliefs regarding average annual temperature in Scotland by 2080

The questions regarding climate change attitudes provide an interesting and nuanced picture (Table 5). 85% of respondents somewhat agree or completely agree that climate change is happening now, and that action is needed to address it. However, only 73% and 69% of respondents believe that more should be done irrespective of the degree of action taken by other countries and big industries, respectively. 78% of respondents believe that climate change is mainly due to human activities rather than natural causes. 72% of respondents feel deeply concerned about climate change and 71% believe that claims about climate change and its impacts have not been greatly exaggerated. Similarly, 88% of respondent think that climate change poses a personal threat to them or people close to them. Only 59% of respondents state that their level of knowledge on climate change is sufficient for them to feel confident in discussions about it, and 58% of respondents state that they do not frequently talk about climate change with family and friends. The overall degree of climate change concern is not much different to what was found using a very similar set of questions in a survey on soil carbon sequestration conducted ten years earlier, in 2008 (Glenk and Colombo 2011). A fifth to a quarter of respondents state beliefs that are in line with climate change scepticism, showing that the considerable increase in media coverage in the past decade has not been allowing for a significant change in Scottish citizens' views. Possibly, scepticism was reinforced, and the relatively low level of confidence in respondents' knowledge on climate change suggests a continued need for improving education and awareness regarding what is arguably the biggest challenge of this century.

Table 6. Climate change attitudes and knowledge

Item	completely disagree	somewhat disagree	somewhat agree	completely agree
There is not much point in reducing the climate change contribution of Scotland as long as other countries don't seem to care much	34.73	37.39	20.41	7.47
If the climate is changing, it is due to fluctuations in the climate that naturally occur	20.32	44.08	29.07	6.53
Before the big industries start to take climate change seriously, people like me shouldn't be expected to do much about it	27.69	41.29	24.32	6.69
It is absolutely certain that climate change is occurring now	4.21	10.85	41.31	43.63
Climate change is mainly due to natural causes, not human activities	32.04	45.99	17.21	4.76
I know enough about climate change to feel confident in discussions about it	6.25	34.83	47.37	11.55
I feel deeply concerned about climate change and its possible impacts	6.42	21.57	43.81	28.21
I think more action is urgently needed to tackle climate change	4.49	11.52	43.41	40.59
I believe that claims about climate change and its possible impacts have been greatly exaggerated	34.29	37.5	21.52	6.69
I frequently talk about climate change to family and friends	20.19	38.22	34.57	7.02
I do not believe that climate change will harm me and my loved ones	37.91	40.51	17.54	4.04

3.2 Valuation results

From the total sample of respondents (N=1813), we excluded nine respondents, for which information on their responses to choice tasks was missing. In addition, we excluded 50 respondents because they were classified as protesters (see Section 2.2) based on their responses to selected in debriefing questions aimed at identifying protest motives. After cleaning the dataset, the final sample consisted of 1,754 respondents.

Table 6 reports findings regarding respondents' perceived consequentiality of the survey (in terms of influencing policy and in terms of actually facing a cost). In addition, Table 5 reports findings on respondents' views about the credibility and understanding of the valuation exercise. 87% of respondents somewhat or completely agree that the survey results can affect future decisions regarding peatland restoration. About 65% of respondents thought that, if peatland restoration was implemented, they themselves would actually have to bear the cost of a peatland restoration programme.[2] Furthermore, 88% of respondents found

[2] The fact that there is a non-negligible share of respondents who thought that they would not actually have to pay for peatland restoration, if peatland restoration was implemented in practice, may have different explanations. This result may partly be explained by some ambiguity regarding whether the government's budget, using public money, would contribute to fund the restoration policies or whether, on top of this, households would additionally be required to pay to contribute to restoration. An additional explanation could be that at least some of the respondents may actually believe that, should the peatland restoration policy be implemented, they would not have to pay the costs of restoration (as detailed in the choice tasks). If that was

that the choice situations presented were credible to them, and 90% said that they understood the valuation task. We investigate the impact that respondents who doubt the credibility of the scenario, and who lacked understanding, may have had on the results of the choice experiment survey by estimating and comparing two models: one in which we consider the full sample and another one with a reduced sample which excludes 338 respondents who stated a low degree of understanding and credibility.

Table 6. Perceptions regarding the survey and its potential implications

Item	completely disagree	somewhat disagree	somewhat agree	completely agree
I believe that the results of surveys like this one can influence future decisions regarding peatland restoration in Scotland	2.54	10.65	61.78	25.04
If a peatland restoration programme is implemented, I doubt that I will personally ever have to pay for it	14.07	51.35	28.35	6.23
The peatland restoration alternatives presented in the choice situations were credible to me	2.21	9.93	64.62	23.23
I didn't understand what I was supposed to do	66.94	22.52	8.55	1.99

Table 7 reports modelling results of two models: one in which a conditional logit model was estimated based for the full sample, and one in which a reduced sample was considered. In both models, the share of peatlands in good condition by 2050 (GOOD2050) enters the model continuously (i.e., resulting WTP estimates represent the value in £ per person of a one per cent shift from bad condition to good condition as a result of restoration). The attribute regarding timing of restoration in the period up to 2050 (TIME) was dummy coded, taking value 1 for 'early' and 'midway' restoration (relative to 'late'). This way, WTP values represent the value associated with implementing restoration early or midway through the period up to 2050 compared to restoring late. The alternative specific constant (ASC) captures the value associated with doing nothing (business as usual) rather than implementing a restoration programme that cannot be explained by variation in the attributes.

Table 7. Choice model (conditional logit model) results and associated willingness to pay (WTP) estimates in GBP per person and year

	Model 1: Full sample			Model 2: reduced sample*		
	Coef.	|z|-value	Marginal WTP	Coef.	|z|-value	Marginal WTP

the case, such respondents may have chosen alternatives at a higher cost than they would actually be prepared to pay (a phenomenon known in the stated preference literature as hypothetical bias). This may have some implications for estimates of willingness to pay for peatland restoration. The stated preference literature does not provide straightforward guidance on how to deal with this potential problem. In the absence of concrete guidance we follow the mainstream approach of including all individuals in the analysis. An alternative approach to be investigated in the future is to make the impact of differences in perceived payment consequentiality on WTP transparent by allowing WTP to differ by levels of perceived payment consequentiality.

			[95% confidence interval]			[95% confidence interval]
ASC	-1.173	28.85		-1.533	31.68	
GOOD2050	0.02	16.47	**2.11** [1.88; 2.34]	0.023	17.11	**2.29** [2.06; 2.53]
TIME_MID	0.393	12.52	**41.69** [35.22; 48.17]	0.496	14	**48.86** [42.06; 55.66]
TIME_EARLY	0.599	17.65	**63.47** [57.15;69.78]	0.757	19.63	**74.55** [68.00; 81.09]
COST	-0.009	43.92		-0.010	41.03	
Log-Likelihood		-12745.4			-9497.08	
Pseudo-R2		0.173			0.237	
# of respondents		1754			1416	

* Excludes respondents with low perceived credibility of the valuation scenario and low stated level of understanding of the valuation exercise (N=338)

Respondents have clear preferences for increasing the share of Scottish peatlands in good condition by 2050 and are willing to pay £2.11 per person and year for a one per cent increase. Regarding the timing of restoration action, and the associated longer term implications on the robustness of peatlands in the face of climate change, the results indicate a strong preference for restoring earlier rather than later in the period up to 2050, and therefore to increase the chance of retaining a greater share of peatlands in good condition by 2080 and beyond. Deciding to restore peatlands late rather than earlier in the period up to 2050 would imply that a 30% increase in the share of peatlands that is in good ecological condition relative to the business as usual scenario would be entirely offset by the welfare loss associated with restoring later rather than earlier (30 x £2.11 = £63.3 associated with a 30% increase in the share in good condition, compared to a welfare loss of £63.47 associated with late rather than early implementation). It is impossible to distinguish whether this result is due to time preferences of respondents (discounting future benefits) or due to the benefits accrued from retaining a greater share of peatlands in good condition once climate change may severely affect peatland health. However, this finding has important consequences of for policy in suggesting considerable welfare gains may be achieved by not delaying peatland restoration action and thus by concentrating restoration efforts within the next decade.

Generally, results from Model 1 and Model 2 are fairly similar with respect to attribute preferences, demonstrating some robustness of results with respect to including respondents whose answers to the choice task may have either been unreliable (low level of understanding) or whose answers may not reflect true preferences for attributes (low level of credibility of valuation scenario).

With respect to systematic preferences for restoration alternatives relative to the business as usual alternative, the negative and statistically significant estimate for the ASC in both

models suggests that respondents had a propensity to choose the restoration alternatives rather than the business as usual alternative, for reasons other than the information entailed in the attributes. The fact that this estimate is higher for Model 2 suggests that respondents with a low level of understanding and a perception of low credibility of the valuation scenario had a stronger tendency to choose the business as usual alternative. Generally, the relatively high estimate of the ASC (in WTP terms for model 1: £124) may suggest a perceived urgency to act among parts of the sample, independent of the actual improvements achieved through restoration and irrespective of the associated cost. This may, at least for some respondents, reflect a perceived need to address environmental problems in general.

4. Conclusions

Confirming previous findings, this research shows how there is a substantial public support for the restoration of peatlands in Scotland. The public places significant value on the ecosystem services that peatland restoration provide. With respect to timing of restoration and associated impacts for the long term robustness of peatlands under climate change, there is a strong preference for early implementation of restoration action. Due to the confounding of timing of restoration and long-term robustness, it is impossible to distinguish whether this preference is driven by discounting of future benefits or by values associated with knowing that peatlands will be more likely to be in good condition in the long run. Irrespectively, however, it provides an additional economic argument for not delaying restoration action. In fact, delaying restoration to the last decade up to 2050 is associated with a welfare loss that is equivalent to the welfare gain associated with increasing the share of peatlands in good condition in 2050 by 30%. While the conclusion of our study suggests that acting early on is advisable, not all respondents agree with this position. There is concern among some respondents about implementing peatland restoration now at a large scale rather than waiting until uncertainties regarding future climate change are resolved.

Results of this study suggest that efforts need to be maintained or even increased to raise awareness about climate change and its impacts on Scotland's natural capital, including on peatlands and their restoration, particularly as strategic policy documents such as the climate change plan for Scotland suggest that restoration efforts are likely to be scaled up over the coming years.

References

Artz, R., Chapman, S., Donnelly, D., Matthews, R. (2012). Potential Abatement from Peatland Restoration. ClimateXChange enquiry number 1202-02. Edinburgh, ClimateXChange.

Bain, C.G., Bonn, A., Stoneman, R., Chapman, S., Coupar, A., et al. (2011). IUCN UK Commission of Inquiry on Peatlands. Project Report. IUCN UK Peatland Programme, Edinburgh.

Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N., Upham, P. (2015). International trends in public perceptions of climate change over the past quarter century. WIREs Climate Change 6, 35–61.

Corner, A., Whitmarsh, L., Xenias, D. (2012). Uncertainty, scepticism and attitudes towards climate change: Biased assimilation and attitude polarisation. Climatic Change 114, 463–478.

Faccioli, M., Czajkowski, M., Glenk, K., Martin-Ortega, J. (2018). Environmental attitudes and place identity as simultaneous determinants of preferences for environmental goods. Working Papers 02/2018, Land, Environment, Economics and Policy Institute, University of Exeter.

Gallego-Sala, A.V., Clark, J.M., House, J.I., Orr, H.G., Prentice, I.C., Smith, P., Farewell, T., Chapman, S.J., et al., (2010). Bioclimatic envelope model of climate change impacts on blanket peatland distribution in Great Britain. Climate Research 45, 151–162.

Gallego-Sala, A.V., Prentice, I.C., (2013). Blanket peat biome endangered by climate change, Nature climate change 3, 152–155.

Glenk, K., Colombo, S. (2011). Designing policies to mitigate the agricultural contribution to climate change: an assessment of soil based carbon sequestration and its ancillary effects. Climatic Change 105, 43–66.

Glenk, K., Schaafsma, M., Moxey, A., Martin-Ortega, J. & N. Hanley (2014). Valuing peatland restoration for spatially targeted ecosystem service delivery. Ecosystem Services 9, 20–33.

Glenk, K., and Martin-Ortega, J. (2018). The Economics of Peatland Restoration. Journal of Environmental Economics and Policy. DOI:10.1080/21606544.2018.1434562.

Ise, T., Dunn, A.L., Wofsy, S.C., Moorcroft, P.R. (2008). High sensitivity of peat decomposition to climate change through water-table feedback. Nature Geoscience 1, 763–766.

Leifeld, J., Menichetti, L. (2018) The underappreciated potential of peatlands in global climate change mitigation strategies. Nature Communications volume 9, Article number: 1071 (2018) doi:10.1038/s41467-018-03406-6.

Martin-Ortega, J., Allot, T.E., Glenk, K., Schaafsma, M. (2014). Integrating hydrological and economic knowledge to value water quality improvements from peatland restoration: evidence and challenges. Ecosystem Services 9, 34–43.

Martin-Ortega, J., Glenk, K., and Byg, A. (2017a). How to make complexity look simple? Conveying ecosystems restoration complexity for socio-economic research and public engagement. PloS one 12 (7), e0181686.

Martin-Ortega, J., Glenk, K., Byg, A., Okumah, M. (2017b). Public's views and values on peatland restoration in Scotland: results from a quantitative study. The James Hutton Institute, Scotland's Rural College and The University of Leeds joint report. www.see.leeds.ac.uk/research/sri/peatlands-and-the-public.

Meertens, R.M., Lion, R. (2008). Measuring an individual's tendency to take risks: The risk propensity scale. Journal of Applied Social Psychology 38(6), 1506–1520.

Murphy, J.M., Sexton, D.M.H., Jenkins, G.J., Boorman, P.M., Booth, B.B.B., Brown, C.C., Clark, R.T., Collins, M., Harris, G.R., Kendon, E.J., Betts, R.A., Brown, S.J., Howard, T. P., Humphrey, K. A., McCarthy, M. P., McDonald, R. E., Stephens, A., Wallace, C., Warren, R., Wilby, R., Wood, R. A. (2009). UK Climate Projections Science Report: Climate change projections. Met Office Hadley Centre, Exeter.

Page, S.E., Baird, A.J. (2016). Peatlands and global change: response and resilience. Annual Review of Environment and Resources, 41 35–57.

Scheier, M.F., Carver, C S., Bridges, M.W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A re-evaluation of the Life Orientation Test. Journal of Personality and Social Psychology 67, 1063–1078