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Do charismatic species groups generate more cultural ecosystem service benefits?

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ABSTRACT

The relationship between nature and cultural ecosystem service (CES) benefits is well accepted but poorly understood, as is the potential role of biodiversity in the relationship. By means of a public questionnaire survey in Wiltshire, UK, the relationship between the presence of a range of common species groups, species group 'charisma', group abundance in the landscape, and the benefit that people felt that they derived from the species groups was investigated for a lowland multifunctional landscape.

Findings showed that species group charisma influenced the benefit reported by respondents for current abundance levels, and influenced their response to potential increases or decreases in abundance. Respondents reported high levels of benefit from species groups hypothesised to be charismatic (birds, flowering plants, butterflies) and there was high consistency in the pattern of response. Respondents reported less benefit from groups hypothesised to be less charismatic (beetles/bugs, brambles and nettles), the latter response patterns showing much greater variation. These results could be used to promote a more holistic understanding of the value of biodiversity by educating and informing the public so that they derive benefit not just from the charismatic, but also from the everyday, the commonplace and less obviously charismatic species.

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1. Introduction

The existence of a relationship between nature, wildlife, 'green space' or biodiversity on the one hand, and human well-being on the other is widely assumed and accepted (MacKerron and Mourato, 2013; Russell et al., 2013; Lovell et al., 2014a,b; Alcock et al., 2015; Wheeler et al., 2015). As a result, indicators of quality of life (level of human well-being) often include metrics such as composite trends of farmland bird species because of the assumed relationship between natural features and the benefits that humans derive from nature (BirdLife International, 2004). However, this relationship between the natural world and human well-being is not well characterised or understood (Church et al., 2011, 2014). Given that there is considerable concern globally about declining biodiversity (Burns et al., 2016; Butchart et al., 2010; Barnosky et al., 2011), it is unclear how changes in biodiversity could affect our well-being and quality of life. In consequence, the potential impact of biodiversity loss or enhancement on human well-being is an area of concern and active research (Bullock et al., 2011; Keniger et al., 2013). Yet researching the relationship presents a range of challenges.

Firstly, there is limited understanding of how CES provision and benefit generation respond to variations in specific elements of biodiversity (e.g. within-species, between-species, and at the ecosystem-level), and of the mechanisms of benefit generation (Hooper et al., 2005; Costanza et al., 2007; Schneiders et al., 2012; Clark et al., 2014; Lovell et al., 2014a,b; Sandifer et al., 2015). This is therefore true of the importance of particular taxa or broad taxonomic groups to which conservation effort might be directed (e.g. Czech et al., 1998; Clergeau et al., 2001; Luck et al., 2011).

A further challenge is the variety of different definitions of cultural ecosystem services that have evolved as research has progressed, such that at the moment no clear consensus has been reached (Millennium Ecosystem Assessment, 2005; Chan et al.,

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2011; Church et al., 2011, 2014). Part of the problem is methodological, including the difficulty of quantifying CES-derived benefits, which is commonly based on self-reporting methods (Boerema et al., 2016).

The sheer diversity of types of potential benefits also complicates the quantification of CES-derived benefits. These can include: psychological restoration (Kaplan, 1995; Hartig et al., 2003; White et al., 2013), improved physiological health (English et al., 2008; Jordan, 2009; Hanski et al., 2012), better social relations (Kuo and Sullivan, 2001; O'Brien and Murray, 2006; Morris and Urry, 2006; Weinstein et al., 2015), and spiritual development (Bhagwat, 2009; Lewicka, 2011), among many others as defined by a range of authors. King et al. (in review) hypothesised a series of six 'interpretive repertoires' to interpret the processes by which the diverse range of benefits may be generated.

There is also the challenge of defining the public's perception of biodiversity both in terms of what they perceive (can detect with the senses) and how they perceive it (evaluation of what they are aware of). Studies of the former appear to be limited in number but wide ranging in scope (Iftekhar and Takarna, 2008; Bayne et al., 2012; Qiu et al., 2013; Coll et al., 2014; Kaltenborn et al., 2016; Silva-Andrade et al., 2016; Gundersen et al., 2017). Russell et al. (2013) see 'perceiving' as one of a series of 'channels' to CES benefits which are in effect modes of interaction from 'knowing' at the most detached form of interaction through to 'living within' as the most intimate and intense, with each channel being associated with different CES benefits. Working with groups of members of the public, King et al. (in review) found that the view of countryside biodiversity held by the public in a study in Southern England differed broadly from that of conservation specialists. The public tended to be most aware of diversity at the scale of landscape complexity, broad ecosystems and habitats, then at the scale of broader species groups such as birds, butterflies, wildlflowers, mammals or spiders, and least at the level of individual species, though this varied according to prior knowledge and understanding.

This therefore begs the question of how changes to CES benefits are affected by changes to aspects of biodiversity that people tend not to notice or perceive, and how they derive such benefits from the broader species groups that most people appear to recognise. Lindemann-Matthies et al. (2010) demonstrated that members of the public were able to distinguish the level of diversity of grassland swards, and that they evaluated the more diverse swards more favourably, although Qiu et al. (2013) found that for parks, higher biodiversity was not necessarily positively associated with higher preference. Otherwise, however, studies to date that clarify the association between scale of biodiversity (from gene to ecosystem), the role of perception thereof, and CES benefits do appear to be limited with a tendency to focus on the larger scale (ecosystem) (Botzat et al., 2016).

As regards people's evaluation of what they perceive, studies generally consider the public's or farmers' preferences regarding aspects of nature and wildlife, such a species or ecosystem attributes and characteristics (Belaire et al., 2015; Botzat et al., 2016; Grilli et al., 2016; Silva-Andrade et al., 2016; Gundersen et al., 2017). Czech et al. (1998) consider the way in which eight broad taxonomic groups are 'socially constructed' by the public in terms of the way they are positively or negatively evaluated and how this relates to the political power associated with their conservation. They found for example, that plants, birds and mammals were valued significantly higher than fish, reptiles, amphibians, invertebrates and micro-organisms along a spectrum of preference. They also noted in people's responses an 'aesthetic perspective' that favours 'charismatic megavertebrates'.

A range of factors are seen to influence people's perceptions of species and their attributes. Previous research (Lorimer, 2007; Fischer et al., 2011; Ducarme et al., 2013; MacDonald et al., 2015) has identified three broad groups of factors that appear to influence the evaluation by people of species and species groups, namely: intrinsic attributes relating to the species of interest (e.g. size, behaviour, visual appearance, defence mechanisms); context- and status-dependent factors (e.g. rarity, vulnerability, nativeness, previous population change) and; relational and cultural factors (nature of human-species interactions, cultural familiarity, fame, reputation, intellectual interest). In reality, many of these factors overlap or interact. For example, aesthetic appeal represents a subjective appraisal by the observer, during an interaction incident, of the objectively verifiable external appearance of the species. Is also likely to be influenced by prior knowledge and familiarity with, as well as attitudes towards the species. Aesthetic appeal would therefore be the outcome of an interaction with the species which is affected by the range of factors mentioned.

Amongst the species-related attributes found to influence public appraisal of a change in species abundance, Fischer et al. (2011) identified again both contextual factors relating to the species' conservation status (previous population change, rarity, vulnerability, nativeness), and intrinsic species-related attributes as appraised by humans (harmfulness, value, attractiveness). Furthermore, Fischer et al. (2011) found that knowledge of previous population status was a significant factor in how people viewed current species' abundance, suggesting that knowledge and perception of past and present abundance are of importance. Lack of such knowledge, however, may lead to 'shifting baseline syndrome' (Pauly, 1995; Papworth et al., 2009; Steen and Jachowski, 2013) and a difference between how the public and conservation specialists view current species abundance and any changes.

In their study of the relative charisma of a range of mammals, MacDonald et al. (2015) found that significant factors influencing charisma included rarity, visual appearance, size, and dangerousness, as well as cultural familiarity. Ducarme et al. (2013) notes that, unlike other related terms that are widely used in nature conservation such as 'flagship' or 'keystone', charisma is not a clearly defined concept, whilst Lorimer (2007) identified two main aspects of charisma relevant to biodiversity conservation: ecological and affective, whilst the latter could be further divided into aesthetic and corporeal charisma.

Here we consider how the public responds to a number of commonly recognisable species groupings, without the need for specialist or detailed species-level knowledge. More specifically, we seek to answer the following research questions:

1) Is it possible to quantify the satisfaction and associated CES benefits that members of the general public feel that they get from the presence of particular groups of species in the landscape?
2) Is it possible to detect the variation in benefits between different species groups, and due to changes in a given species group's abundance? and if so,
3) Can such variation in benefit be related to the charisma of species groups?

Such findings can contribute to understanding aspects of biodiversity of value and potential cultural benefit to the public, how CES provision to the public may respond to changes in biodiversity provision in the landscape, thereby helping to inform and support policy options to enhance ecosystem service benefits. They may also provide insights on the factors that affect the public's willingness to accept the conservation of species that they do not find attractive or valuable.

As with Ecosystem Services (ES) and CES, there is a range of definitions for the various related associated concepts, such as

well-being, benefit and service (Millennium Ecosystem Assessment, 2005; Chan et al., 2011; Church et al., 2011, 2014). For the purposes of this work, well-being is defined as a holistic positive mental and physical state of an individual or social groups and quality of life as a measure of the extent of well-being. The CES benefits may be considered to be any state or condition, or associated object (such as a work of art), which is positively valued by the receiving person, and which results from the interaction of the person and an environmental setting. The CES 'service' may be considered to be the role that the environmental setting (and associated biodiversity) play in the co-production of such benefits. The term 'satisfaction' used above in question 1 represents a holistic or 'bundled' perceived sense of benefit and well-being and is discussed in more detail in the methodology.

2. Methodology

2.1. Overview

The above research questions were addressed by mean of an intercept questionnaire survey method, administered in the County of Wiltshire, England, which is a focal lowland landscape for the Wessex-BESS project (http://wessexbess.wixsite.com/wessexbess) studying a range of ecosystem services. Wiltshire is situated in Central Southern England, UK, and is approximately 3500 km^2 in extent (including the largest town of Swindon), whilst the Wessex-BESS project is focused on a smaller study area of central and southern Wiltshire, approximately 2700 km^2 in extent. The Wessex BESS study area is readily accessible to a large population in the surrounding area (the population of Wiltshire is approximately 470,000, and that of immediately adjacent counties is 5.4 million), and is popular for tourism, making it a good study landscape for CES benefits. It is typical of multi-functional lowland landscapes in this part of the UK whilst also having distinctive natural and cultural features that contribute to its regionally distinctive landscapes. The study area is particularly characterised by arable land use and grassland (including significant areas of highly biodiverse semi-natural chalk grassland) and is also important for its chalk streams and rivers, with relatively little urban land use (4%) or woodland (9%). As a result of the relative rurality and remoteness of parts of central and southern Wiltshire the area is important for military training and is also important for the many prehistoric and ancient monuments across the landscape. Survey work was undertaken entirely within Wiltshire, with a focus on areas within or close to the boundary of the Wessex BESS study area.

The survey was used to elicit from members of the public their evaluation of the benefit that they considered that they received from the presence of a selected number of species groups commonly encountered in the local countryside landscapes (both at current abundance and under a range of proposed future abundance scenarios), recorded as the respondent's self-reported enjoyment and satisfaction with the various scenarios. For the purpose of this study, we use the terms enjoyment and satisfaction in our survey of the public to denote perceived benefit and wellbeing. While the term satisfaction is in common usage, it has its foundations in the moral philosophy of utilitarianism (Mill, 1863; White, 2006), whereby people seek outcomes that gain pleasure and avoid pain. Utility, expressed in terms of satisfaction, can provide a measure of personal and societal happiness and wellbeing (Bruni and Porta, 2005; Perman et al., 2011:62). Although the data were collected from individual respondents and analysed as a dataset of individual responses, it should be recognised that each individual response will also be influenced by shared societal values, attitudes and perspectives (Kenter et al., 2015). In our survey of the public, we use ordinal categories of satisfaction to indicate the contribution of different groups of species to perceived personal benefit and hence wellbeing, and to explore how satisfaction varies with changes in relative abundance.

As regards the challenges of CES research discussed in the introduction, this work focused particularly on the influence of particular levels of biodiversity (broad recognisable species groups) and variation in their abundance on CES provision, and on the influence of charisma as a step towards a more mechanistic understanding of CES generation. We therefore used a 'bundled' conceptualisation of CES benefits and well-being to avoid the need to consider directly the great diversity of benefit types, and used the enjoyment and satisfaction concepts to maintain a broad view of CES benefits, thereby minimising issues arising from differences of definition and the difficulties of quantification.

2.2. Survey method, sampling approach and procedure

The questionnaire-based intercept survey was undertaken during August–October 2015, as part of a wider survey of members of the public on CES benefits to explore their interactions with biodiversity and the natural world. The research method relied on interviewees' self-reported enjoyment from or satisfaction with a selection of species groups in the Wiltshire countryside under four abundance scenarios (Table 1), as an indicator of actual or potential benefit.

Members of the public were interviewed face to face by a team of 11 trained interviewers in a wide range of locations in Wiltshire in order to obtain a sample of members of the general public which was generally representative of adults in Wiltshire. Avoidance of bias in the sample was addressed in four ways. Firstly, respondents were actively approached by interviewers directly in a broad range of environments throughout the county, such as public streets, shopping centres, supermarket car parks and tertiary colleges. Secondly, the team of interviewers was also diverse in terms of age, gender and employment background in order to assist with ease of approaching diverse respondents. Thirdly, interviewers actively sought 'hard-to-reach' audiences in locations such as parents at children's playgroups and the elderly in care homes. Fourthly, the demographic characteristics of the survey sample were monitored throughout the survey to check for bias in the sample when compared with the broader Wiltshire population. Where any bias was detected, effort was then deployed to compensate for and reduce the bias.

The baseline assessment or 'current' scenario inevitably relies on the interviewee's personal perception of current levels of abundance of the named species group in the contemporary Wiltshire countryside. For this reason it is susceptible to bias according to the interviewees' personal knowledge and experience of the local countryside. Nevertheless, however accurate this perception may be, or however influenced by shifting baseline syndrome (Pauly, 1995), it is related to the interviewee's level of knowledge, understanding and interaction with the Wiltshire countryside. It acts as their personal reference point and perspective from which they may or may not be able to detect personal CES benefits. This understanding of the current situation also serves as a baseline or anchor point from which the implications of change can be assessed, and as noted by Fischer et al. (2011) is likely to influence a person's attitude towards a change in abundance of the named species group.

Each interviewee was presented with a form showing photographs of four (out of a possible six) selected species groups and asked to respond to the questions shown in Fig. 1 in turn for each species group.

Interviewees were asked to provide a satisfaction score for alternative abundance scenarios, namely 'Current', 'Missing',

Table 1
Response rubric to capture interviewee's self-reported satisfaction with the named species group in the Wiltshire countryside under four abundance scenarios.

	Effect on enjoyment or satisfaction from the countryside						
	Very negative	Quite negative	Slightly negative	Neither positive nor negative	Slightly positive	Quite positive	Very positive
	←						→
Current Present as they are now	○	○	○	○	○	○	○
Missing : No longer present at all	○	○	○	○	○	○	○
Decreased: presence*	○	○	○	○	○	○	○
Increased presence**	○	○	○	○	○	○	○

*a halving (50% less) ** half as many again (50% more)

Can you tell us how much the feelings of enjoyment or satisfaction that you get from the countryside in Wiltshire are affected by its plants and animals?

i. **How would you rate the effect of these plants and animals (that currently exist in Wiltshire) on the enjoyment or satisfaction that you get from the countryside, compared to it being without them? Note: "enjoyment" or "satisfaction" here is in any way at all: for example through seeing, hearing, smelling, or just knowing they exist**

ii. **What would be the effect on your enjoyment or satisfaction from the countryside if these plants and animals that currently exist in Wiltshire were no longer there? What would your rating be in this case?**

iii. **What would be the effect on your satisfaction from the Wiltshire countryside if there were only half as many as there are now (50% fewer)? What would your rating be in this case?**

iv. **What would be the effect on your satisfaction from the Wiltshire countryside if there were half as many again as there are now (50% more)? What would your rating be in this case?**

Fig. 1. Question posed to respondents for the species groups.

'Decreased' and 'Increased' (Table 1). 'Current' referred to existing presence in the landscape, 'Missing' refers to a complete absence of the species from the local landscape and 'Decrease' and 'Increase' referred to a change in abundance of .+50% and −50% respectively from the 'Current' scenario. Responses for each scenario were measured on a 7-point scale, with negative and positive scores equally distributed around a zero anchor (Table 1).

2.3. Species group selection

As noted above the level of biodiversity chosen for investigation in this survey was broad species groups with a focus on the potential influence of perceived charisma on CES benefit generation. The groups were chosen to be farmland-relevant groups that members of the public were likely to have seen and be familiar with and that were considered to represent a spectrum of charisma for the public. As noted, Czech et al. (1998) found that plants and birds were rated more favourably than invertebrates by the public in a US study and these groups were selected. However, as these groups are very broad, three plant and two invertebrate species were chosen of varying characteristics to investigate whether public responses to them varied across a spectrum. Although some mammals were also found to be charismatic by researchers, it was decided to restrict the survey to a maximum of six species groups, and so charismatic vertebrates were represented by songbirds.

All forms had images of flowering plants and songbirds. Two batches of forms were used, one batch had in addition an image of a blue butterfly and of nettles, the other an image of a beetle/bug and of brambles. In this way, and in the context of the larger questionnaire as a whole, the interviewee was not overburdened with too many species to assess (four per respondent) but six species groups in total were rated during the survey. The images used are reproduced in Appendix 1 in Supplementary Information.

However, we were careful not to provide actual species names to the respondents (see below). Flowering plants (in practice, either a common spotted orchid *Dactylorhiza fuchsia*, or a view of mixed flowers, predominately ox-eye daisy *Leucanthemum vulgare*) were considered to be visually attractive. Song birds (represented by a Eurasian skylark *Alauda arvensis* or song thrush *Turdus philomelos*) both visually and aurally attractive, whilst butterflies (common blue *Polyommatus icarus* or chalkhill blue *Lysandra coridon*) may be visually attractive, but as insects possibly unattractive to

certain people (Lorimer, 2007) and so perhaps ambiguous in their charisma. These three species groups were hypothesised to be more charismatic than the other three species groups; brambles (*Rubus fruticosus*) were deemed ambiguous, possessing both sharp spines but also tasty/visually attractive fruit. Beetles (*Timarcha tenebricosa*) and shieldbugs (*Canthophorus impressus*), as insects, were likely to be unattractive to some. Finally, white dead nettles *Lamium album* have a similar plant shape, symmetry and growth pattern to stinging nettles but do not possess stings, have potentially attractive white flowers, and have ecological value as food for invertebrates. These last three species groups were hypothesised to be less charismatic or more 'ambiguous'. The intention was to elicit a general response to a broad species group represented by the image and the broad group name with its associated connotations, rather than to the specific species depicted. There was therefore no requirement for the respondent to possess detailed or species-specific knowledge. The specific name of the exact species depicted in the images was not provided, in order to avoid intimidating less knowledgeable interviewees who were not familiar with particular species. Instead the image caption used the broad group categories.

2.4. Data analysis

The majority of the data analysis was conducted in R (R Core Team, 2016); unless otherwise stated, R functions used were from the base set of packages. The response categories (Table 1) were coded from −3 (very negative) to +3 (very positive).

An exploratory analysis of the similarities between responses from the full sample to all six species groups, for each abundance level, was carried out using hierarchical cluster analysis (Everitt, 1974 or Hartigan, 1975) displayed as a dendrogram using the *hclust* function in R. For each level of abundance, the analysis clustered the species groups to which there were similar response patterns. The counts of the number of responses in each category were converted to proportions of the total number of responses to the question in order to remove the effect of the different number of responses, then treated as 7-element vectors. The distances between vectors were calculated using the 'Canberra' distance function (Lance and Williams, 1967).

The main method used for quantitative analysis was the Wilcoxon-Mann-Witney (WMW) non parametric test (e.g. Higgins, 2004), using the *wilcox_test* function from the *coin* package for permutation tests (Hothorn et al., 2006, 2008) to treat the responses as ordinal values without making additional assumptions about the type of scale. The WMW test was used to estimate the difference in location (the 'shift') between the distributions of values, loosely analogous to the difference of the means for parametric distributions, and to give a p-value for the test for non-zero shift.

The WMW test was applied to compare the distribution of self-reported satisfaction responses to different species groups at each abundance level and to compare the responses for changes in abundance of each species group compared with the current level. In each of these, there may be a risk of false-positive results due to multiple simultaneous comparisons. In the comparison by species, for instance, each response for a species group is compared with five others. Similarly, in the comparison by abundance, the current level is compared with three others. The simplest adjustment for multiple comparisons is the *Bonferroni correction* (e.g. Higgins, 2004), which tends to be very conservative. When using the Bonferroni correction, the critical p-value for each comparison is divided by the number of comparisons to control the experiment-wide error rate to the desired value. So, for example, for a test at the 95% level with five comparisons, the critical value would be reduced from 0.05 to 0.01. Where appropriate, the effect of such a correction is considered in the results below.

3. Results

In total, 549 responses were obtained, but some participants omitted some questions, so the number of responses per question varied. Response rates for each species group are provided in Appendix 1, Supplementary Information). The demographic profile of the interviewees broadly matched that for Wiltshire county in terms of age, gender, and ethnicity. In total 77% of interviewees

Table 2
Difference in location of the distribution of satisfaction scores between row species and column species, estimated using the Wilcoxon-Mann-Witney test for six species groups under four abundance scenarios. (All non-zero differences have $p < 0.001$).

	Birds	Butterflies	Beetles	Brambles	Nettles
a. Current abundance					
Flowers	0	0	−1	−1	−2
Birds		0	−1	−1	−2
Butterflies			−1	−1	−1
Beetles				0	0
Brambles					−1
b. Increased abundance					
Flowers	0	0	−1	−1	−3
Birds		0	−1	−1	−3
Butterflies			−1	−1	−3
Beetles				0	−1
Brambles					−1
c. Decreased abundance					
Flowers	0	0	1	1	1
Birds		0	1	1	2
Butterflies			1	1	2
Beetles				0	1
Brambles					1
d. Missing					
Flowers	0	0	0	0	1
Birds		0	0	0	1
Butterflies			0	0	1
Beetles				0	0
Brambles					0

Table 3
Change in location (shift) of the distribution of satisfaction scores estimated using the Wilcoxon-Mann-Witney test for changes in abundance relative to current for six species groups. (All non-zero shifts have $p < 0.001$).

	Increased	Decreased	Missing
Flowers	0	−5	−5
Birds	0	−5	−5
Butterflies	0	−5	−5
Beetles	0	−3	−3
Brambles	0	−3	−4
Nettles	−1	−1	−2

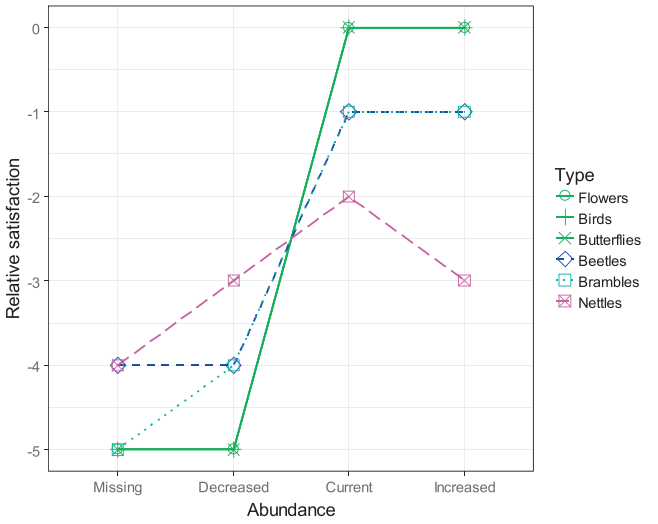

Fig. 2. Change in reported satisfaction with abundance for each species group relative to the current abundance of flowers derived from the distribution shifts estimated by the Wilcoxon-Mann-Witney test.

were permanent residents of Wiltshire, 4.8% temporary residents and the remaining 18.2% described themselves as visitors. The sample obtained was biased towards respondents at the lower end of the income spectrum, towards the higher end of the education qualification spectrum, towards the non-religious and those not in paid employment. A comparison between selected demographic statistics for the survey sample and for the Wiltshire population is provided in Appendix 2, Supplementary Information.

As initial exploratory analysis of any clustering of response patterns, a hierarchical clustering analysis was undertaken that found two clusters of responses at the highest level of the hierarchy, one containing flowers, birds and butterflies, and the other containing beetles/bugs, brambles and nettles. Within the latter, beetles/bugs and brambles consistently clustered more closely together than with nettles (Appendix 3, Supplementary Information).

The magnitudes of the differences in the distributions of self-reported perceptions of satisfaction between the six different species groups under the four abundance scenarios were analysed using the WMW test (Table 2). All of the non-zero differences had $p < 0.001$ which is smaller than the Bonferroni-corrected critical value for significance at the 95% (and 99%) level with five simultaneous comparisons. At all abundance levels, the estimated differences between flowers, birds and butterflies were 0, adding weight to the finding from the cluster analysis that the people in the sample responded similarly to these three species groups. The estimated difference between beetles and brambles was also always 0.

Compared with flowers, birds and butterflies, the reported satisfaction with beetles/bugs and brambles had an estimated shift of −1 (lower satisfaction) for current and increased abundance, and +1 (lesser decrease in satisfaction) for decreased abundance. Therefore, these latter two species groups appear to be viewed similarly to each other and less positively by the survey participants than the three hypothesised charismatics. For nettles, the shift to lower satisfaction for current and increased abundance and to less-decreased satisfaction for decreased abundance was larger again.

For the 'missing' scenario, the estimated differences between most groups were 0, with the exception of nettles relative to flowers, birds and butterflies (1). The distributions in Appendix 4 (Supplementary Information) show that the proposed absence of all species groups tended to produce negative satisfaction (75% negative to strongly negative for beetles/bugs and brambles), and the differences in the distribution were not significant.

The differences in the level of reported satisfaction for each species group with changes in abundance estimated by the WMW test are summarised in Table 3. As before, all the non-zero shifts had $p < 0.001$. This shows a strong negative shift (−5) between current and decreased or missing for flowers, birds and butterflies, a moderate negative shift (−3 or −4) for beetles/bugs and brambles, and a smaller negative shift (−1 or −2) for nettles. For all species groups other than nettles, there was no significant shift between the current and increased levels. Considering the distributions (Appendix 4, Supplementary Information), there appears to be an increase in the proportion of 'Very positive' responses for flowers birds and butterflies, but the cumulative total of 'Quite positive' and 'Very positive' responses together showed little change between the two abundance scenarios. For both 'decreased' and 'increased' abundance, the distributions of responses for nettles were centred around 'Slightly negative'.

These results provide a tentative step towards measures of ordinal utility in terms of self-reported satisfaction associated with the relative abundance of selected species groups in the Wiltshire countryside. The combined effects described above are summarised in Fig. 2 as a set of relative responses. The current level of satisfaction with flowers was used as the anchor. The relative satisfaction for each of the other species groups for current abundance (Table 2a) was calculated from this. The responses to changed abundance for each species group (Table 3) were then added to these to produce four values for each. The points are joined with lines for clarity. Given the results above, flowers, birds and butterflies have a single set of responses, beetles and brambles have almost identical responses, and nettles produce a noticeably different response.

Overall then, the pattern of respondent scores for the six species groups fell into three broad groupings or clusters. Firstly, responses were similar for birds, flowering plants and butterflies, as noted in the dendrograms (Appendix 3 in SI) and pairwise comparisons (Table 2). This corresponded to our hypothesised 'charismatic' species group. For this cluster, most responses were similar under the four abundance scenarios (Appendix 4 in SI), with a strong positive satisfaction score for current abundance in the landscape as assessed by respondents, a strong decline in satisfaction for reduced abundance or absence of the species group from the landscape. Limited evidence suggested that increased abundance may lead to increased satisfaction compared to present so that increased provision in the landscape may lead to enhanced CES benefits for the public. However, the evidence is inconclusive resulting from the clustering of scores for 'current' abundance at the top of a truncated scale with limited scope to increase scores significantly. As noted, the response patterns for these three species groups were not significantly different.

For the hypothesised less-charismatic groups, two clusters of response type were seen. For beetles/bugs and brambles, the response patterns were similar to those for the charismatic group, but with lower reported levels of satisfaction and by implication lower benefit generation at 'current' and 'increased' abundance,

and 'increased' abundance did not lead to significantly greater benefit reported compared with 'current', suggesting saturation of benefit at 'current' abundance that would not be enhanced by increased provision. Similarly, reduced abundance and absence from the landscape led to smaller declines in satisfaction compared with the charismatic group. In essence, the less-charismatic nature of these species meant that the presence of these species groupings in the landscape tends to be associated with a lower overall perception of benefit for the public, and that this is not enhanced by greater supply nor depressed so greatly by reduced supply compared to more charismatic species. The variation between respondents in satisfaction scores indicated a greater divergence of assessment of scenarios than for the more charismatic species, suggesting less consensus on the balance between their positively valued and negatively valued attributes (e.g. for brambles: attractive fruit versus spines), hence the response was more 'ambiguous' (Appendix 4 in SI).

Finally, for nettles the response patterns displayed lower reported levels of satisfaction and by implication lower benefit generation at 'current' and 'increased' abundance relative to charismatic species groups. Furthermore, there is reduced satisfaction with 'increased abundance compared with 'current' abundance, suggesting absolute saturation of benefit at 'current' abundance that would be reduced by increased provision. Similarly, reduced abundance and absence from the landscape led to smaller declines in satisfaction compared with all other species groups. In essence, nettles appeared to be assessed least charismatic. Again, the variation between respondents in satisfaction scores indicated a greater divergence of assessment of scenarios than for the more charismatic species and whether factors such social antecedents or demographics are associated with the variation in respondent scores merits investigation.

4. Discussion

The results demonstrate the ability of members of the public to express their enjoyment and satisfaction with the presence of various common species groups in their local landscape, to articulate the effect of varying levels of abundance in the landscape, and demonstrate how they discriminate between different species groups. The scores assigned by respondents are clearly relative and cannot be anchored to any objective independent scale of benefit external to this assessment. Nevertheless, the patterns of response obtained still allow conclusions to be drawn regarding the association between such species groups as a component of biodiversity in the local landscape and derivation of CES benefits by the public. As regards the impact of charisma, species groups that were hypothesised here as more charismatic did indeed appear to provide greater satisfaction and hence benefit to respondents and stronger responses to proposed changes in abundance. Responses appeared to lie on a spectrum of response rather than in a simple dichotomy (charismatic/uncharismatic), in accordance with the findings of Czech et al. (1998) and Lorimer (2007).

The results reported from individual respondents represent a subjective impression of the overall CES benefit 'bundle' as perceived by the respondent. As noted, there is a wide range of potential CES benefits arising from environmental settings that commonly comprise such 'benefit bundles' (Raudsepp-Hearne et al., 2010; Klain et al., 2014), for example, combinations of nature appreciation and enjoyment of the countryside, that are difficult to disaggregate with members of the public, at least using a formal survey questionnaire method. The analysis here uses satisfaction as a high level construct to represent perceived benefit derived from the presence of natural species associated with the environmental setting of the study area. We recognise that satisfaction and hence benefit is shaped by a mix not only of the positive and negative attributes of the species (as explored here) but also of the characteristics of the individual person and the broader contextual cultural setting. We did not have the opportunity at this stage in the enquiry to explore and disaggregate these underlying factors that merit further research.

The survey method employed relies upon the assumption that, when questioned, members of the public have a sufficiently clear perspective on the benefits that they get from species groups, that they can relate their self-reported satisfaction in a reasonably consistent manner, and that the level of self-reported enjoyment and satisfaction is a reliable indicator of benefits derived from them.

As regards the first point, the clear patterns of results obtained and the low variation in the response between respondents for groups hypothesised to be more charismatic suggests that they generally had a well-formed view and perspective that informed their response. The public appear therefore to have a relatively clear perspective on their evaluation of different groups at this level of biodiversity in accordance with the findings of King et al. (in review). Respondents could therefore relate to the question asked and compare and contrast the different scenarios such that clear contrasts arose in the data between species groups and abundance levels. For species groups hypothesised to be less charismatic the variation was greater (see Appendix 4 in Supplementary Information) and so these species could be considered more 'ambiguously' charismatic.

As regards the second point, as noted, self-reported methods are the most common methods of quantifying CES benefits (Boerema et al., 2016) because they are non-material benefits co-produced by the interaction of the human subject with the environmental setting (Church et al., 2014). This setting has potential, through human interaction, to supply a range of CES benefits relating to, for example, heritage, recreation, enjoyment of nature and sense of place, whose value and potentially beneficial effects are predicated on some cognitive psychological process of interpretation for the individual concerned. Unlike physical goods, such as food crops generated by provisioning services, CES benefits are not independent of the subject and cannot be quantified by conventional methods of objective measurement as for material goods.

Overall, patterns of response to species groups, and to changes in levels of provision appeared to be associated with perceived charisma (MacDonald et al., 2015). The response patterns evident in our results, could provide a method for assigning species to a spectrum of charisma. Metrics of 'charisma' could require a high mean or median current satisfaction score with a low between-respondent variability, and strong responses to increases and decreases of abundance. This indicates greater public consensus and hence less 'ambiguity' regarding the balance of evaluation of associated positive and negative attributes.

While our results suggest that attributes associated with charisma affect the enjoyment and satisfaction and by implication the benefit derived from biodiversity, to be useful it is necessary to identify and explain the attributes that determine this relationship. Data required to identify specific components of charisma influencing individual responses were not collected in this work. However, work by other researchers suggest plausible explanations for the differing responses to the various broad species groups. Our assignment of flowers, birds and butterflies to the charismatic grouping of species is consistent with Lorimer's (2007) concept of 'ecological charisma' arising from detectability (visual and audio) and related physical features, movements and sounds. These ecological properties interact more easily with those of humans: their visually and aurally distinctive attributes have evolved in ways that make them accessible to humans.

Meanwhile Lorimer's 'affective' dimension of charisma is particularly associated with generating strong emotional responses,

especially in response to the aesthetic appeal of appearance and behaviour. Aesthetic charisma, however, may not always be sympathetic and positive and Hillman (1988, 1997) notes four aspects of the 'yuck' factor for insects: multiplicity (tendency to be in large communities with no evidence of individuality), monstrocity (the alienness of insect body plan and behaviour), autonomy (insects don't respond to humans) and parasitism. This may explain the demonstrated ambivalence in the reported satisfaction for beetles and bugs, Orders of the insect Class, yet not of butterflies (Lepidoptera, another Order of insects). In effect, the psychology of negative charisma relates to the alienness of a number of features of insects relative to humans demonstrated by beetles/bugs, but which in the case of butterflies are redeemed by the above aspects of ecological and aesthetic charisma, the patterns and colours of butterfly wings.

Our assignment of beetles/bugs, brambles and nettles to the less charismatic or 'ambiguous' grouping is also consistent with previous research. We noted the ambivalent response to beetles above. Regarding brambles, they have two opposing characteristics, the negative being the sharp spiny stems (harmfulness), versus the fruit (visually attractive and associated with food); a mix of positive and negative associations. Nettles were associated with the lowest overall ranking of satisfaction. Although the image shown was of non-stinging white dead nettle rather than stinging nettle, the association of the name appears to have been sufficient to generate a largely negative association (associated with harmfulness and lack of appeal). This indicates how responses are influenced not just by the image and physical appearance, but also by name and cultural associations. Whilst the species has ecological value for invertebrates, this will not be known to all respondents. More ecologically informed respondents may well give higher ratings of satisfaction recognising their functional significance, and investigation of the association between response score and social factors such as ecological knowledge that may explain the broad variation in response is merited.

The curves in Fig. 2 are broadly indicative of utility functions for species and abundance combinations assuming that ranked scores are arbitrary measures of relative utility (−3 through 0 to +3) and abundance is measured in four equal relative increments from zero (missing scenario) through to a 50% increase on current provision. However, the relatively high satisfaction scores for the 'current' provision of charismatic species (birds, butterflies and flowering plants) possibly prevented some respondents from choosing higher scores beyond the end of the constrained scale, suppressing expression of increased satisfaction at the extreme of the range. For this reason, it is likely that the potential increase in satisfaction associated with an increase in charismatic species is underidentified here, and worthy of further assessment.

Whilst the results were derived in the cultural context and landscapes of Southern England, the broad findings should nevertheless be of interest to conservation practitioners more generally for two reasons.

Firstly, the evidence for saturation or near-saturation of benefit at current provision levels for all or most of the species groups may suggest limited scope to enhance benefit through increased provision. However, the fact that current abundance responses indicated saturation of benefit for less charismatic groups and possibly near-saturation of benefit even for more charismatic groups may indicate a divergence of opinion between conservation specialists who may be concerned about the decline of species such as many farmland songbirds, and the lay public who are influenced by shifting baseline syndrome and a tendency to be satisfied with the status quo and who are unaware of such decline. In effect the public may not miss what they never realised they had. Public expressions of satisfaction may not in fact align well with the expectations of conservation specialists, who have a specialist awareness of declining biodiversity at various scales and of complexity in the landscape. The expert view is that greater public awareness of historic decline would influence the evaluation of the current situation and the potential benefits of maintaining or increasing biodiversity (Fischer et al., 2011). Possibly our results could be influenced by 'shifting baseline syndrome' and a lack of awareness of decline and its implications (Pauly, 1995). Further work is required to compare the responses of conservation specialists and non-specialists to confirm whether this is the case.

Secondly and relatedly, whilst the uniformity of responses to more charismatic species groups is perhaps unsurprising, the broad range of responses to less charismatic groups suggests a range of factors that influence people's responses to the latter groups and the possible association of this variability with social antecedents and demographic factors. Whilst therefore it may be relatively easy to capture the imagination of the public to support conservation of the more charismatic species, it will be of great utility to conservationists to understand the social factors that influence the diversity of response to less charismatic species in order to engage the public better in their conservation. In this regard, the influence of background knowledge and education possessed by respondents may affect the response to alien invasive species which might otherwise be generally considered attractive, such Himalayan balsam (*Impatiens glandulifera*). Whilst less knowledgeable respondents may derive CES benefits by responding to their external appearance, more knowledgeable respondents, aware of the their negative ecological role may evaluate them more negatively.

This will have two further benefits. Firstly, it allows conservationists to ensure that conservation initiatives for less charismatic groups are better supported by the public, but secondly may also allow understanding of whether it is possible to inform and educate the public in such a way as to influence public perspectives on less charismatic groups such that they can themselves derive greater CES benefits from such groups. In this way conservationists will not need to rely so heavily for the conservation of less charismatic species on sheltering under the umbrella of flagship charismatic species, and the public will be able to enjoy and draw benefit from a more holistic appreciation of all of biodiversity, not just a very limited selection of this diversity that they can easily engage.

This could be achieved both through formal education mechanisms by educating the public about the importance of biodiversity and about biodiversity in their local landscapes, but also through less formal and community-based initiatives, getting the public involved in conservation activity and initiatives. The precise policy mechanisms to pursue would be best informed by a clearer understanding of the social factors that influence people's ability to derive CES benefits, as noted above.

5. Conclusions

Using the results of a questionnaire survey of 549 members of the public in Wiltshire, Southern England, we have found evidence for an association between expressions of satisfaction with readily recognisable species groups in the local landscape, and their perceived relative charisma and abundance. The results demonstrate the ability of members of the public to express and at least semi-quantify their enjoyment and satisfaction, to articulate the effect of varying levels of abundance in the landscape, and demonstrate how they discriminate between different species groups.

A range of social factors may be associated with people's responses to less charismatic species groups. It will be of great utility to conservationists to understand these social factors that influence the diversity of response to less charismatic species in order

to engage the public better in their conservation and allow understanding of whether it is possible to inform and educate the public in such a way as to influence public perspectives on less charismatic groups such that they can themselves derive greater CES benefits from such groups. In this way the public will be able to enjoy and draw benefit from a more holistic appreciation of a much wider range aspects of biodiversity, not just from the charismatic, but also from the everyday, the commonplace and less obviously attractive.

Findings also suggest a possible divergence of opinion between conservation specialists who may be concerned about the decline of species such as many farmland songbirds, and the lay public who are influenced by shifting baseline syndrome and a tendency to be satisfied with the status quo and who are unaware of such decline.

Further research is therefore needed to explore: The association between CES benefits and, on the one hand social antecedents and demographic factors, and on the other people's direct and indirect interactions with nature and wildlife including through their activities in the landscape; the influence of charisma with a wider variety of species groups in other landscape and cultural contexts and; to explore with respondents in more detail using qualitative and quantitative methods the relevant aspects and components of this charisma. Evidence for saturation of benefit for the public should also be sought and compared with the perspectives of conservation specialists. Finally efforts could be made to disaggregate the potential component benefits of the benefit 'bundles' measured in this work.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.ecoser.2017.07.007.

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