

Marine wildlife as an important component of coastal visits: The role of perceived biodiversity and species behaviour

Mathew P. White^{a,*}, Abigail Weeks^a, Tom Hooper^b, Luke Bleakley^c, Deborah Cracknell^d, Rebecca Lovell^a, Rebecca L. Jefferson^b

^a European Centre for Environment & Human Health, University of Exeter Medical School, UK

^b Centre for Conservation Science, Royal Society for the Protection of Birds (RSPB), The Lodge, Sandy, Bedfordshire SG19 2DL, UK

^c Department of Psychology, University of Plymouth, UK

^d National Marine Aquariums Ltd, UK

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ABSTRACT

Although the (perceived) biodiversity of a natural environment can influence people's actual, or predicted, restorative experiences, little is known about the generality of these effects or the importance of other aspects such as wildlife behaviour. The current research used an experimental approach (with photographs and videos of coastal scenes) to investigate these issues among a large heterogeneous UK sample ($n=1,478$). On average, coastal settings with higher perceived biodiversity were rated as offering greater restorative potential and were associated with higher willingness-to-visit. Men, and people with lower overall ratings, tended to be more sensitive to biodiversity levels, and older respondents believed coastal settings in general offered more restorative potential. Locations where a species was exhibiting High vs. Low fascination behaviours (e.g. murmuring vs. sleeping) were also rated more positively, highlighting the importance of wildlife behaviour on psychological outcomes, in addition to biodiversity. Implications for conservation and communication are discussed.

1. Introduction

1.1. Overview

The majority of the world's population now live in urban areas, often quite detached from the kinds of 'natural' settings humans have evolved in both physically and culturally over millennia ([1]; [15,43,50,55]). Although there are many benefits to individuals and societies from urbanisation, there may also be costs. Theories such as Attention Restoration Theory (ART, [42]) and Psychophysiological Stress Recovery Theory (PSRT, [67]), argue that busy, modern urban environments may deplete attentional and emotional resources leading to mental fatigue and negative mood. One potential antidote, the theories claim, is to spend time in the kind of natural environments to which humans are arguably more adapted because these environments: a) Put fewer demands on our limited attentional processes, allowing these cognitive resources to be 'restored' [40,41]; and b) Arouse less psychophysiological stress responses, because the environmental demands are less likely to outweigh inherent coping resources [68]. According to ART, this is possible because many natural settings offer

'softly fascinating' stimuli, the kind which capture and maintain attention without conscious effort (e.g. watching waves on the shore), while many urban stimuli demand 'directed' attention where people are forced to focus on something not intrinsically fascinating in order to achieve other goals (e.g. waiting for a gap in the traffic in order to cross a busy road).

However, it is also recognised that there is a wide variety of natural, and urban, environments and that there is still much to learn about the importance of specific environmental contents which may aid (or hinder) restorative processes [63,7,70]. The current study focused on a characteristic of many natural settings that has received relatively little attention to date, namely the presence and behaviour of wildlife. Although research suggests that some biomes [32], landscapes (e.g. [27]), vegetation density patterns (e.g. [8]) and levels of plant species richness [12,61] tend to be perceived as more 'restorative' than others, far less is known about the potentially restorative effects of different sorts of wildlife and their behavioural repertoires or how these factors relate to marine/coastal (as opposed to inland) locations.

Wildlife watching is a popular activity, possibly reflecting an innate connection with other species [22,23,28,43]. In England, for instance,

* Correspondence to: European Centre for Environment and Human Health University of Exeter Medical School Knowledge Spa Royal Cornwall Hospital Truro, TR13HD, UK.
E-mail address: mathew.white@exeter.ac.uk (M.P. White).

it is estimated that 13% of all visits to natural places are motivated by the desire to see wildlife, resulting in some 372 million visits a year [52] and people adapt routines, such as commuting routes, in order to increase the potential to experience wildlife [4]. As a country with relatively little terrestrial mega-fauna, wildlife watching in England often means bird watching, and research has shown that visitors to urban and peri-urban parks tend to believe that the cognitive and emotional restoration opportunities offered by these places is greater when there is greater diversity in bird species ([24,29]; see also [56] on the potential importance of bird song, and [18] on wellbeing and bird feeding in domestic gardens). Assuming that the birds found in English parks and gardens are 'softly fascinating', in that they capture and maintain attention without being threatening, then bird watching would be consistent with restoration possibilities as outlined by ART. Nevertheless, although the idea that people tend to feel better in natural settings high in biodiversity is intuitively appealing, the evidence is mixed and conclusions constrained by methodological and geographical limitations [30,45,59,74,57].

1.2. Psychological restoration at the coast

As far as we are aware, all research investigating the relationships between (perceived) biodiversity and psychological restoration to date has been conducted in urban parks (e.g. [12,24,29]). The current work extends this line of research to coastal settings. In England alone, some 8 million people live within 3 miles of the coast, and proximity is highly related to visit frequency [73]. Coastal sites are among the most stress-reducing of all natural environments [71] and 'wildlife watching' on coastal visits is consistently perceived to improve mood among both lay visitors and marine experts [75]. Further, in Australia, Maguire, Miller, Weston & Young [48] found that people considered the pristineness of the beach, including opportunities for watching wildlife, to be important when choosing a beach to visit. Combined, these findings suggest that many people do consider the opportunity to view wildlife when choosing a coastal setting to visit and that seeing nature in coastal settings is potentially important for restoration-related outcomes. With respect to the 'charismatic' properties of marine animals, Jefferson et al. [39] used an online survey with 1,047 participants, and found that participants showed more interest in 'charismatic' marine species such as seals, puffins and seahorses than other species such as oysters, kelp or anemones. Although, 'charismatic' was not clearly defined, the presence of seals suggests that behaviour may be key since they are not particularly aesthetic to look at when compared to the far more colourful puffins and seahorses.

1.3. Current research

In sum, the present study extends earlier work in four key ways. First, a large, demographically diverse sample of the English adult population was used to explore how natural settings with different levels of (perceived) biodiversity may be more or less restorative in terms of promoting positive emotions and helping restore one's depleted emotional resources. Previous work in this area has tended to explore how restorative visitors find the places they are in as a function of different levels of biodiversity (e.g. [12,24,29]). Although important, visitors to these places tend not to be representative of the population [2] and people in socio-economically deprived neighbourhoods are less likely to have access to biodiverse spaces [33], making generalising to the population problematic.

As it was not possible to expose a large heterogeneous sample of individuals, including those with potentially little interest in the topic, to a range of real settings, following Jefferson et al. [39], the study used an online experimental protocol and asked people to imagine how they believe they would think and feel in a range of settings presented as photographs and short video clips. The study is thus concerned with *perceived restorative potential* rather than actual restoration of

depleted cognitive/emotional resources. Although photos and videos are only proxies of real experiences, previous work into landscape preferences finds the two are highly correlated suggesting they are useful tools for research [64,65]. Moreover, wildlife documentaries may be the only time many people get to see some species, and thus videos of wildlife may be more reflective of many people's actual experiences of some species [51].

Further, our study did not attempt to assess the actual biodiversity of the scenes used (c.f. [24,29]). Although our scenes were carefully selected by two ecologists at the Royal Society for the Protection of Birds (RSPB) to represent a range of biodiverse settings, no claims are made about the relationship between actual biodiversity and perceived restorative potential. Rather our research speaks to people's perceptions of biodiversity, animal behaviour, and these psychological outcomes. Although a potential limitation, earlier work also found that perceived biodiversity may be a better predictor of psychological outcomes than actual biodiversity, reflecting the fact that many lay people will only be using heuristics to assess a location's biodiversity and that it is these perceptions which are likely to be the proximal factor influencing beliefs and experiences [24].

Our second contribution was to address the issue that it is hard to study the effect of wildlife behaviour on perceived restorative potential *in situ*. Animals do not perform on command, and the chances of a visitor witnessing a particularly 'fascinating' behaviour on any given visit may be slim. By contrast, our experimental approach enabled us to show all respondents the same behaviours that had been pre-tested as either high or low in intrinsic 'fascination'. We reasoned that no matter how much perceived biodiversity there was, if the species that were visible were not doing anything particularly 'fascinating' (e.g. sleeping), then these locations would be rated as less restorative than ones where the wildlife was performing behaviours that effortlessly capture and maintain attention (e.g. flocking/murmuring). This suggestion will come as no surprise to keepers of wildlife in captivity, who know about people's preference for feeding time at the zoo, or wildlife film makers who sift through hours of footage of a species in order to broadcast short segments of high fascination behaviours.

Third, our measures of perceived restorative potential focused on the more affective, rather than cognitive, aspects of restoration and were thus perhaps more linked to Ulrich's [67] PSRT than Kaplan & Kaplan's [42] ART. Specifically, our indices of perceived restorative potential were adapted from several previous photographic studies [19,27,6,72] and participants were asked to imagine themselves in each scene and rate how it might make them feel in terms of: a) 'Mood' (including both valence and arousal); and b) 'Recovery' as operationalised by helping them to feel refreshed/revitalised following a draining/tiring day. The valence and arousal dimensions of mood are consistent with Russell's [58] circumplex model of affect which argues that affective states fall along the perimeter of a circle with two-orthogonal dimensions of valence (positive/negative) and arousal/activation (low/high). For instance, one can be in a positive mood with high arousal (excited) or low arousal (calm), or a negative mood with high arousal (angry) or low arousal (depressed). Previous work in an aquarium setting using the same items used in the current study, suggested that as biodiversity of an exhibit increased, affective responses also showed increases on both dimensions, indicative of more energised/excited states [20]. Finally, the survey also asked participants how willing to visit the site they would be as an indicator of general behavioural preference [72].

Our fourth contribution was to focus on coastal settings, as opposed to urban parks and gardens [12,18,24,29]. Coastal settings are arguably characterised by many other features that might invoke soft fascination, whether or not wildlife was present. If the restorative potential of coastal settings could be shown to be influenced by perceived levels of biodiversity and wildlife behaviour, this would be a relatively strong test of the hypotheses because this is already one of the most restorative environments available [71].

In sum, the study had two hypotheses and a more general research question. First it was predicted that coastal scenes with greater perceived biodiversity would be associated with higher levels of perceived restorative potential and willingness-to-visit. Second, it was predicted that perceived restorative potential and willingness-to-visit would be higher for coastal locations where the same species were exhibiting High vs. Low fascinating behaviour. Finally, the study explored whether there were systematic differences in the associations between perceived biodiversity/behaviour type and restoration outcomes across different demographic groups (i.e. age and gender), and among those with an interest in wildlife issues, and greater familiarity with coastal settings in general.

2. Methods

2.1. Participants

Participants were part of the 'Cint' on-line survey panel and the study was co-ordinated by PFA Research in Cornwall (www.pfa-research.com). A total of 1,643 panel participants from around the UK completed the survey during March 2014. Since it is difficult to interpret very quick and long completion times in on-line surveys (e.g. potentially suggesting not taking the study seriously or interrupted completion) the top and bottom 5% of the surveys in terms of time were excluded *a priori* [47]. This left 1,478 completed surveys with completion times ranging from 7 to 38 min (mean=15.71 mins). Preliminary analysis suggested no important differences in key relationships for those who took <15 min or ≥15 min so duration was not considered further.

The sample comprised 714 males and 760 females. Ages ranged

from 18 to 80 years. For current purposes (and based on data pre-screening) ages were split into young adults (18–34yrs, n=296) and middle-aged and older adults (35+yrs, n=1,178). Nineteen percent of respondents (n=285, 19.3%) lived within 3 miles of the coast, and were thus categorised as 'coastal' dwellers; the remainder classified as 'inland' dwellers (n=1,152, 78%; 41 (2.8%) 'don't knows'). A total of 199 participants (13.5%) stated affiliations with wildlife organisations (e.g. RSPB/WWF), and were thus considered to be relatively High in interest in nature.

2.2. Materials

The study had two parts. In Part A, participants were asked to rate nine photographic images and in Part B they were asked to rate six video clips. All images and videos were pre-tested to: a) Establish that the images presented a range of levels of biodiversity (as assessed by two ecologists from the RSPB); and b) That the videos did indeed present high vs. low fascinating behaviours. Due to word count limitations, further details on the development of these stimuli can be found in [Supplementary File 1.A](#). The nine photographs and stills from the six videos can be seen [Figs. 1 and 2](#).

2.3. Measures

Exact question wording and response scales are presented in [Table 1. Perceived biodiversity](#). Participants were presented with the same definition of biodiversity as for the expert raters above (i.e. the RSPB ecologists, [Supplementary File 1.A](#)) and asked to estimate the level of biodiversity in the scene in terms of three broad categories: 'Low' (scored 1), 'Moderate' (2) and 'High' (3). To encourage respon-

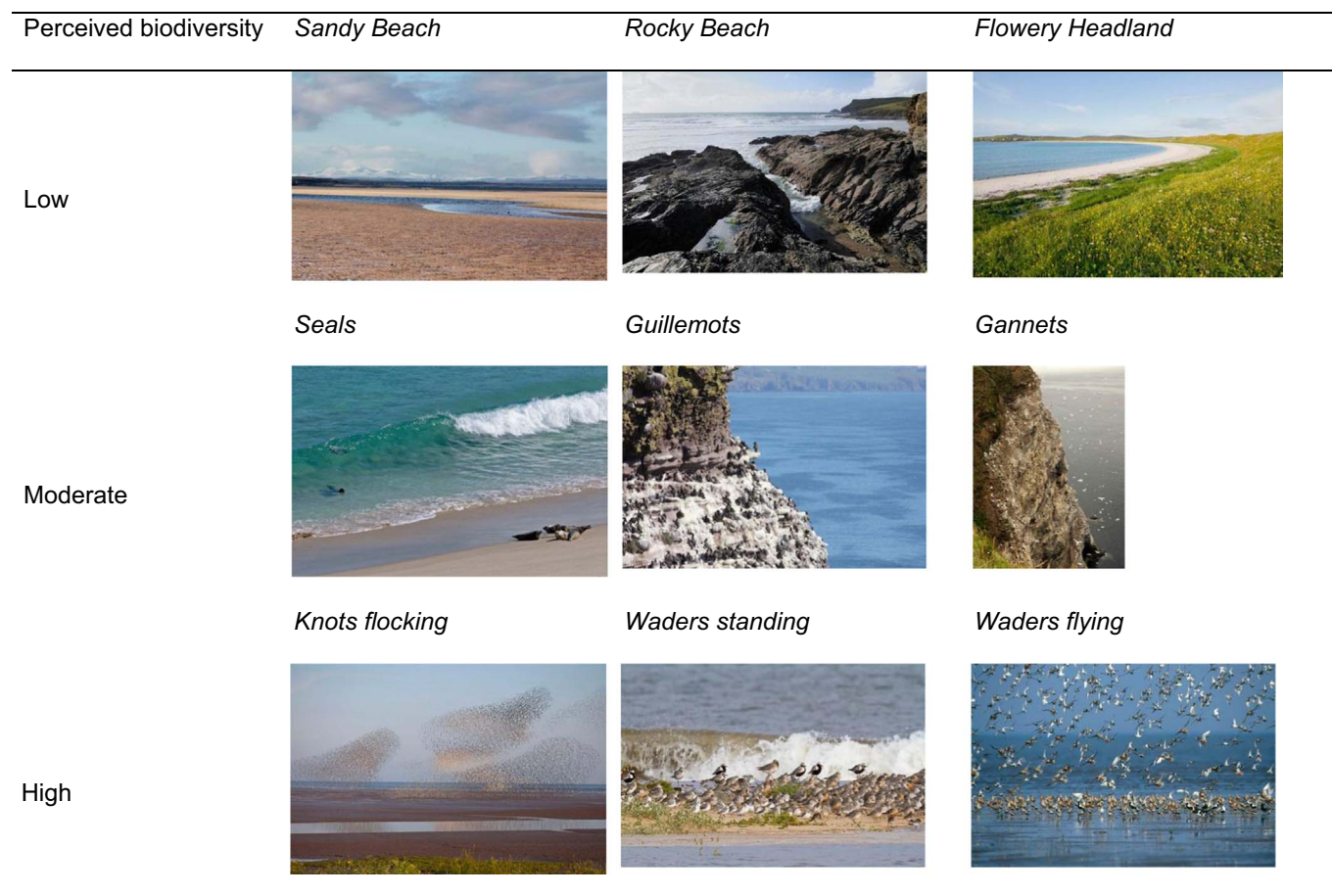


Fig. 1. Photographic images shown in Part A.

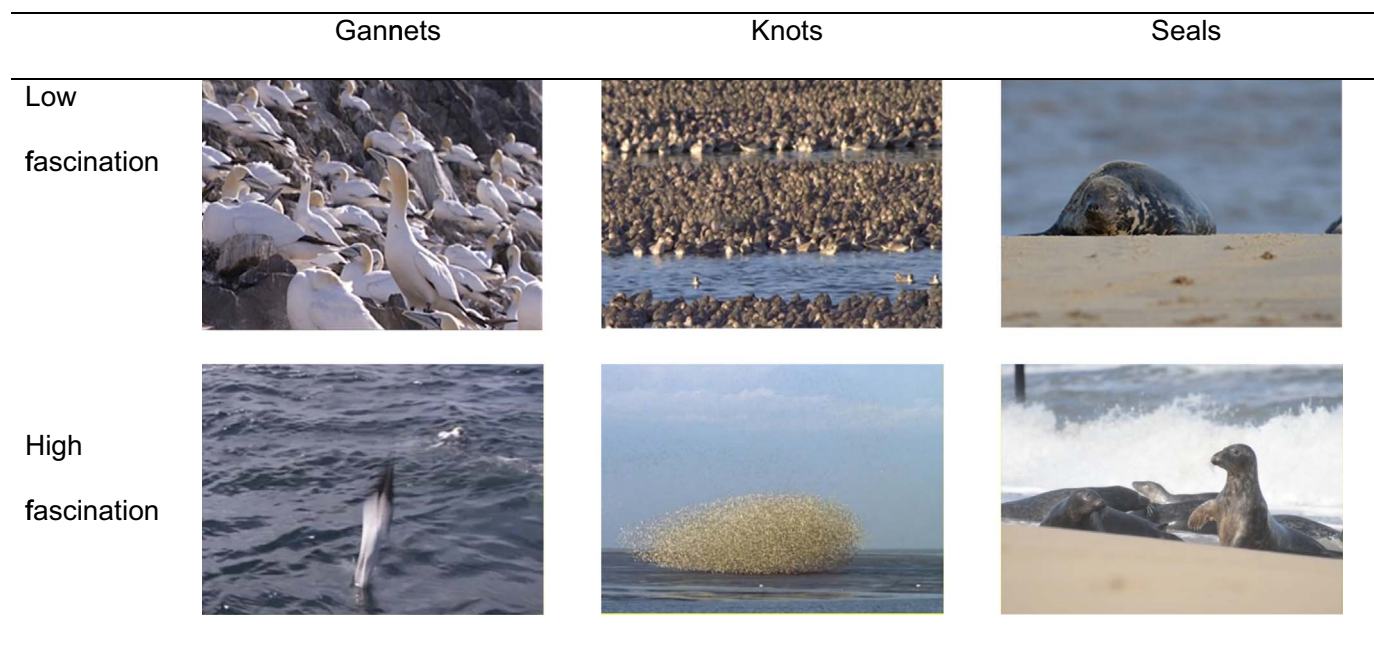


Fig. 2. Stills from the 30 s videos presented in Part B.

Table 1

Questions wording and responses for key items in both Part A and Part B of the study.

Part	Response scale
<i>Part A) Photos</i>	
Q1) Would you say that compared to other <i>coastal places</i> in the UK this scene depicts <u>low</u> , <u>moderate</u> or <u>high</u> biodiversity (i.e. number and types of animals and plants)?	Low, Moderate, High (1–3)
Q2) Please <u>imagine</u> you are sitting in this place looking at the view. How do you <u>think</u> you would <u>feel</u> ?	a) Very negative – Very positive (1–10) b) Bored/Calm – Anxious/Excited (1–10)
Q3) Please <u>imagine</u> you felt tired and drained after a long day. How <u>good</u> do you <u>think</u> being in this place would be at helping you to feel <u>refreshed</u> and <u>revitalised</u> ?	Not at all – Extremely (1–10)
Q4) How willing would you be to <u>visit</u> this place?	Not at all – Extremely (1–10)
<i>Part B) Videos</i>	
Q1) Having watched this video and <u>imagined</u> you were <u>there</u> , how do you think you would <u>feel</u> ?	a) Very negative – Very positive (1–10) b) Bored/Calm – Anxious/Excited (1–10)
Q2) Please <u>imagine</u> you felt tired and drained after a long day. Having watched this video, how <u>good</u> do you think visiting this place would be at helping you to feel <u>refreshed</u> and <u>revitalised</u> ?	Not at all – Extremely (1–10)
Q3) How <u>willing</u> would you be to visit this place?	Not at all – Extremely (1–10)

dents to make location specific judgments they were asked to consider each image in terms of “*other coastal places in the UK*” to avoid implicit comparisons to less relevant, but possibly more wildlife rich, habitats (e.g. tropical coastlines).

Perceived restorative potential. All other outcomes were based on earlier studies examining ratings of multiple photographs, where it is impossible to expect people to complete large scales for each image (e.g. [6,27,72]). People were asked to imagine being in the scenes presented and to estimate two distinct, yet related, components of restorative experience, namely: a) ‘Mood’ (in terms of both valence and arousal with items being adapted from the single-item *Feelings Scale* [34] and *Felt Arousal Scale* [66] respectively); and b) ‘Recovery’ (i.e. feeling refreshed/revitalised after a long/tiring day).

Willingness-to-visit. As a behaviour-related measure of preference, consistent with economic research into non-market goods, respondents were asked how willing they would be to visit the scene, assuming greater willingness would reflect higher preferences.

2.4. Procedure

UK Cint panel members were sent a request to participate in a study looking at “Public Reactions to Marine Biodiversity”. On clicking the link, participants were told that the study aimed to “*better understand how people feel about different coastal views and wildlife by the sea*” and that their data was anonymous and confidential. They were then told: “*In this survey you are going to see some photos and videos of wildlife by the sea. Each photo and video will have between 3 and 5 questions for you to answer. For some photos you will be asked how ‘biodiverse’ you think a scene is. For the purpose of this survey the term ‘biodiversity’ simply means: “the number, variety and variability of living organisms”. Don’t worry it’s not a test, we’re just trying to understand what ‘biodiversity’ means to people.*”

Participants were then instructed that for each setting, “*we would like you to imagine you are walking along the coast and you stop to look at the view*”. To aid understanding, participants completed a practice session but these data were not analysed. Once the practice was completed, participants proceeded to Part A where they were

Table 2

Image-specific ratings of perceived biodiversity, perceived restorative potential, and willingness-to-visit (From lowest to highest perceived biodiversity).

9 scenes	Perceived biodiversity		Valence (pos/neg)		Arousal		Recovery		Willingness-to-visit	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Sandy beach	1.59	(.67)	6.91	(1.87)	4.95	(2.22)	6.93	(2.05)	6.88	(2.13)
Rocky beach	1.76	(.69)	7.40	(1.64)	5.29	(2.09)	7.42	(1.85)	7.52	(1.92)
Seals	1.99	(.70)	8.02	(1.64)	6.00	(2.48)	7.95	(1.79)	8.17	(1.72)
Flowery headland	2.29	(.69)	8.10	(1.59)	5.23	(2.62)	8.01	(1.81)	8.10	(1.77)
Guillemots	2.47	(.62)	7.47	(1.76)	6.15	(2.15)	7.10	(2.03)	7.21	(2.13)
Gannets	2.49	(.58)	7.25	(1.94)	6.36	(2.13)	6.86	(2.16)	6.76	(2.34)
Waders feeding	2.51	(.54)	7.41	(1.74)	6.03	(2.13)	7.15	(1.95)	7.16	(2.01)
Waders flying	2.55	(.58)	7.37	(1.86)	6.38	(2.08)	6.91	(2.18)	7.02	(2.16)
Knots flocking	2.62	(.54)	7.63	(1.95)	6.58	(2.32)	7.30	(2.16)	7.32	(2.21)

N.B. Perceived biodiversity ranged from 1 (Low) to 3 (High); All other items ranged from 0 (not at all/very negative) to 10 (Extremely/very positive).

presented with each of the nine scenes in order. Due to on-line programming restrictions it was not possible to randomise the order in which participants saw the images, so all participants saw the nine photos in the same randomised order.

In Part B participants were presented with the following: “*The final task requires you to watch 6 video clips each lasting 30 s. We would like you to imagine you are sitting watching these scenes unfold.*” The videos were presented in the same random order to all participants. Some participants (n=21) were unable to download one or more videos resulting in missing data. Finally, they were asked whether they had any affiliations with conservation organisations such as the RSPB, Wildlife Trusts or National Trust (Yes/No), how far they lived from the coast (in miles), and to provide any comments in an open-text box. Information on age and gender were collected automatically by the survey company.

2.5. Analytical strategy

Rather than focus on specific species or behaviours, our aim was to examine the general notion of perceived biodiversity and behaviour and thus respondents were asked to respond to several different scenes. To account for the repeated-measures nature of the data, a multi-level regression approach was used with perceived biodiversity/restoration ratings as Level 1 (repeated-measures) variables, and person characteristics (e.g. age) as Level 2 variables. This approach accounts for the fact that some individuals are likely to consistently rate all images more positively than others (and thus inflate associations between variables) by assigning person-specific intercepts for level 1 variables (i.e. ‘random intercepts’). The models could also account for the fact that the relationships between our key predictor, perceived biodiversity, and perceived restoration may differ systematically between individuals such that the slope of the relationships might be relatively steep for some, but flat for others. By allowing the slopes of the relationships to vary across individuals (i.e. ‘random slopes’), the covariance between the intercepts and slopes could also be explored to find out whether the slopes differed systematically as a function of intercept. For instance, a negative covariance would suggest that as the intercepts increased, the slopes tended to decrease. To take willingness-to-visit as an example, this would suggest that the less willing respondents were to visit locations in general, the more sensitive they were to perceived biodiversity levels. Such information is of interest because it tells us whether individuals with relatively positive or negative beliefs about the restorative properties of natural environments in general are more or less affected by the levels of biodiversity in these places.

Preliminary analyses confirmed that in the case of the photos it was justified to use a ‘random intercepts, random slopes’ model to explore these relationships because both intercepts and slopes showed significant variance across individuals and the models were improved by incorporating these factors (contact first author for more details). By contrast, because the videos only had two-levels of Fascination a

random-slopes approach could not be used, limiting us to using random-intercept models only. To explore whether the relationships between perceived biodiversity and behaviour type and perceived restorative potential were moderated by individual level characteristics, four cross-level interactions were added to the models, one for each characteristic under investigation. As cell sizes quickly become untenable when three- four- and five-way interactions are added, the current models were restricted to the main two-way interactions of interest.

3. Results

3.1. Part A: photos & perceived biodiversity

3.1.1. Descriptives and the circumplex model of affect

The means for each image in terms of perceived biodiversity and the four measures of restoration potential are presented in Table 2. Supporting our aim, there was a wide spread of perceived biodiversity ratings ranging (on the 1–3 scale) from M=1.59 (SD=.67) for the ‘Sandy beach’, to M=2.62 (SD=.54) for ‘Knots flocking’.

Although not directly relevant to the current research questions, there was high consistency between these ratings and those of the two RSPB experts (contact first author for more details). In terms of the circumplex model of affect, the means for all nine images were plotted on a two-dimensional graph with valence on the horizontal, and arousal on the vertical, axis. To aid interpretation the mean valence and arousal scores for each image were subtracted from the global means to provide a relative score (Fig. 3).

Of note, the mean valence scores were always above the mid-point suggesting a positive mood overall, so these relative results are only relative to other ‘positive’ scenes. Importantly, all three images with no visible fauna scored relatively low on the arousal scale. When mood is

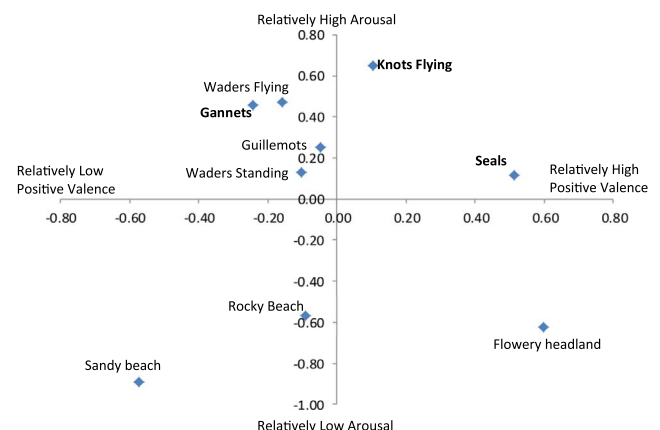


Fig. 3. Perceived restorative components of valence and arousal for all nine photos. N.B. Photos in bold show species also presented in Part B.

Table 3

Hierarchical-linear regression models predicting perceived restorative outcomes from perceived biodiversity and individual differences.

	Valence (pos/neg)			Arousal			Recovery			Willingness-to-visit		
	B	(se)	t/Wald ^a	B	(se)	t/Wald ^a	B	(se)	t/Wald ^a	B	(se)	t/Wald ^a
Level 1 factors												
Intercepts variance	4.02	(.23)	17.38***	3.34	(.24)	13.76***	4.10	(.25)	16.16***	4.96	(.30)	16.54***
Slopes variance	.52	(.03)	15.86***	.50	(.04)	12.34***	.55	(.04)	14.34***	.61	(.04)	14.35***
Intercept/slope covariance	−1.17	(.08)	14.25***	−.73	(.09)	8.38***	−1.09	(.09)	12.03***	−1.34	(.11)	12.77***
Perceived biodiversity	.56	(.07)	8.44***	.92	(.07)	12.58***	.42	(.07)	5.79***	.50	(.08)	6.66***
Level 2 factors												
Aged ≥35 (ref=≤34)	.25	(.17)	1.51	.31	(.18)	1.77	.47	(.18)	2.65**	.31	(.19)	1.59
Female (ref=male)	.40	(.13)	3.02***	−.29	(.14)	2.08*	.68	(.14)	4.81***	.66	(.15)	4.29***
Affiliated (ref=no)	.34	(.20)	1.72	.21	(.21)	1.00	.31	(.21)	1.47	.53	(.23)	2.32*
Coastal resident (ref=no)	.01	(.17)	.08	.37	(.18)	2.09*	.22	(.18)	1.24	.09	(.19)	.46
Cross-level interactions												
Biodiversity x age	.04	(.06)	.62	−.14	(.07)	2.00*	.02	(.07)	.22	−.00	(.07)	.05
Biodiversity x gender	−.10	(.05)	2.01*	.09	(.06)	1.57	−.22	(.06)	3.99***	−.23	(.06)	4.01***
Biodiversity x affiliation	.09	(.08)	1.25	−.07	(.08)	.81	.14	(.08)	1.73	.08	(.09)	.94
Biodiversity x coastal	−.03	(.06)	.43	−.09	(.07)	1.27	−.11	(.07)	1.61	−.07	(.07)	.89
Intercept	5.80	(.17)	33.35***	3.82	(.18)	21.04***	5.77	(.18)	31.31***	5.82	(.20)	29.29***
−2LL	43,938			50,150			47,592			48,755		

N.B. All models include Random Intercepts and Random Slopes and allow for covariance between the two.

^a t-test used for parameter coefficients, and Wald Z used for (co)variance estimates; −2LL=−2Loglikelihood.

*** p < .001.

** p < .01.

* p < .05.

relatively positive (e.g. flowery headland) this can be interpreted as relative ‘calm/relaxation’. When the relative mood is negative this can be interpreted as ‘boredom’. Two scenes (seals/knots) had relatively high levels of both arousal and mood, associated with relative ‘excitement’. The remaining images, e.g. gannets and guillemots on cliffs, were rated relatively low in mood but high in arousal which tends to be linked to relative ‘anxiety’. Additional comments provided by some respondents might help explain this finding: “I love watching birds cruising overhead but hate the sound of squawking birds on cliff faces”.

3.1.2. Hypothesis 1: perceived biodiversity and restoration potential

The Level 1 results for all four models in Table 3 show that it was appropriate to use random-intercepts/random slopes models as the variance in both was highly significant (see also Supplementary materials 1.B). As predicted, the results found a significant relationship between perceived biodiversity and all four outcomes. Specifically, a one point increase in perceived biodiversity (from low to medium, or medium to high) was associated with a .56 point increase in positive affect, a .92 increase in arousal, a .42 increase in perceived (cognitive) restorative potential, and a .50 point increase in willingness-to-visit. The significantly negative covariance between intercepts and slopes suggested that individuals with lower intercepts (i.e. those who tended to rate the images less positively), nonetheless had steeper slopes (i.e. their ratings were more sensitive to perceived biodiversity).

3.1.3. The role of demographics and individual differences

The models also show that: a) Females rated the combined set of images as more positive than males on all four ratings; b) Respondents ≥35 years tended to rate the set of coastal images as having greater cognitive restorative potential than those < 35 years; c) Affiliates of environmental organisations were more willing to visit the locations than non-affiliates; and d) Coastal residents found the images more arousing. That different groups seemed to have been particularly sensitive to different outcomes supports the notion that it is appropriate to measure these different aspects of restoration potential.

In terms of the potential moderating effects of these individual difference variables, gender moderated the effect of perceived biodiversity on affective valence, perceived restorative potential and will-

ingness-to-visit. The significantly negative interactions reflect the fact that although women had higher ratings in general, men's ratings were more sensitive to the (perceived) level of biodiversity in the images. The only other significant (negative) interaction (between perceived biodiversity and age) suggests that although older people in general tended to rate the scenes as more arousing, it was the younger generation who were more sensitive to the level of perceived biodiversity.

3.2. Part B: videos & fascination level of behaviour

3.2.1. Descriptives

The means for all ratings can be seen in Table 4. Apart from arousal, it is clear that the clips containing High Fascination behaviours were rated more positively on all dimensions than Low Fascination behaviours of the same species.

3.2.2. Hypothesis 2: behavioural type and restoration potential

As predicted, the results of the regression analyses (Table 5) found a significant relationship between perceived biodiversity and all four outcomes. Specifically, High vs. Low fascinating behaviours were associated with a .21 point increase in positive affect, a .39 decrease in arousal, a .43 increase in perceived cognitive restorative potential, and a .24 point increase in willingness-to-visit.

3.2.3. The role of demographics and individual differences

The models also show that: a) Respondents ≥35 years tended to rate the videos showing high fascination behaviours as being more arousing and having greater restorative potential than those < 35 years; b) Females rated locations with more fascinating behaviours as more arousing than males; c) Affiliates of environmental organisations rated high fascination behaviour locations as more restorative on three of four outcomes; and d) Coastal residents rated high fascination behaviours as more arousing and would be more willing to visit these places than inland residents. The significantly negative interaction term between gender and the effect of behaviour type on perceived arousal potential, reflects the fact that men were more sensitive to the fascination level of behaviour, in terms of arousal, than women. Finally, coastal dwellers were less sensitive to behaviour type and

Table 4
Video clip ratings of perceived restorative potential and visit willingness.

Fascination level	Valence (pos/neg)		Arousal		Recovery		Visit willingness	
	M	(SD)	M	(SD)	M	(SD)	M	(SD)
<i>Gannets</i>								
Nesting (Low)	6.65	(2.13)	6.11	(2.14)	6.03	(2.46)	6.26	(2.51)
Diving (High)	7.47	(1.91)	6.05	(2.36)	7.10	(2.14)	7.08	(2.24)
H-L	.82	(1.77)	-.07	(2.20)	1.07	(2.11)	.82	(2.04)
<i>Knots</i>								
Feeding (Low)	7.19	(2.24)	6.60	(2.31)	6.56	(2.49)	6.67	(2.58)
Flocking (High)	7.69	(2.05)	6.45	(2.54)	7.28	(2.27)	7.31	(2.33)
H-L	.50	(1.53)	-.15	(2.04)	.72	(1.78)	.65	(1.74)
<i>Seals</i>								
Sleeping (Low)	7.25	(2.06)	5.33	(2.56)	6.98	(2.26)	7.12	(2.32)
Playing (High)	8.16	(1.78)	6.70	(2.46)	7.82	(1.98)	8.06	(1.97)
H-L	.92	(1.64)	1.37	(2.28)	.85	(1.78)	.95	(1.71)

N.B. HF=High Fascination, LF=Low Fascination; HF-LF=difference between High vs. Low Fascination. Ns range from 1339 to 1346 due to videos not working for some participants.

Table 5
Hierarchical-linear regression models predicting perceived restorative outcomes from behaviour type and individual differences.

	Valence (pos/neg)			Arousal			Recovery			Willingness-to-visit		
	B	(se)	t ^a	B	(se)	t ^a	B	(se)	t ^a	B	(se)	t ^a
Level 1 factor												
Intercepts variance	2.42	(.10)	23.17***	3.18	(.14)	22.84***	2.97	(.13)	22.97***	3.24	(.14)	23.20***
High fascination (ref=Low)	.21	(.08)	2.68**	-.39	(.10)	4.04***	.43	(.09)	4.81***	.24	(.09)	2.70**
Level 2 factors												
Aged ≥35 (ref=≤34)	.37	(.16)	2.30*	-.11	(.19)	.56	.55	(.18)	3.04**	.26	(.18)	1.41
Female (ref=male)	.03	(.13)	.22	.66	(.15)	4.37***	.02	(.14)	.14	-.01	(.15)	.05
Affiliated (ref=no)	.87	(.19)	4.16***	.24	(.22)	1.09	.98	(.21)	4.63***	1.05	(.22)	4.85***
Coastal resident (ref=no)	.28	(.16)	1.73	.44	(.19)	2.31*	.35	(.18)	1.90	.44	(.19)	2.38*
Cross-level interactions												
Fascination x age	-.07	(.08)	.89	.13	(.09)	1.41	-.09	(.09)	1.02	-.03	(.09)	.39
Fascination x gender	.01	(.06)	.12	-.41	(.07)	5.64***	.00	(.07)	.05	.02	(.07)	.35
Fascination x affiliation	-.07	(.09)	.73	-.01	(.11)	.11	-.12	(.10)	1.20	-.08	(.10)	.74
Fascination x coastal	-.10	(.07)	1.25	-.19	(.09)	2.07*	-.16	(.09)	1.80	-.23	(.09)	2.64**
Intercept	56.72	(.17)	4.57***	6.63	(.20)	33.82***	5.84	(.19)	31.25***	6.39	(.19)	33.55***
-2LL	30,805			33,801			32,901			33,012		

N.B. All models include Random Intercepts.

^a - t-test used for parameter coefficients.

*** p < .001.

** p < .01.

* p < .05.

more willing to visit coastal locations regardless of behaviour type than inland dwellers who tended to express greater willingness-to-visit coastal locations where species were exhibiting more fascinating behaviours.

4. Discussion

4.1. Summary of findings

The current study is, as far as we are aware, the first to investigate the relationships between perceived biodiversity and wildlife behaviour, and people's perceived restorative potential and willingness-to-visit different coastal settings. Results supported earlier work in urban parks by finding that locations with higher perceived levels of biodiversity were also associated with higher perceived restorative potential [12,24,29,31]. We extended previous findings by showing these effects in coastal locations, by exploring restoration in terms of both valence and arousal, and by exploring willingness-to-visit as a proxy for behavioural preferences. Perhaps more significantly, we also showed that the behaviours exhibited by specific species in the settings (as opposed to

species diversity) also influenced outcomes. In line with predictions from Attention Restoration Theory [42], locations where the same species were exhibiting high vs. low fascination behaviours (i.e. ones which effortlessly capture and maintain attention) were seen as more likely to result in positive mood states and better cognitive restoration, and people would be more willing to visit them.

By using a large online panel, we were able to explore whether effects were affected by age and gender, a demonstrable interest in nature (as proxied by affiliation to wildlife organisations), and familiarity with coastal settings (as proxied by how close people lived). Supporting earlier findings for inland settings, older adults tended to see coastal settings as offering more restorative potential than younger adults [62]. Further, men tended to be more sensitive to the level of biodiversity in the scenes, and behavioural fascination in the videos, than women. In practice this meant that women tended to rate all locations fairly positively, but men tended to rate locations higher in perceived biodiversity, and greater behavioural fascination, more positively than those low in these qualities. In a similar vein, younger versus older respondents were more sensitive to the biodiversity in photographic scenes, and inland dwellers were more sensitive to behavioural fascination levels than coastal dwellers.

4.2. Implications for understanding site management and public engagement

Our findings support the suggestion that human well-being may be another justification for protecting and preserving high-biodiversity (and high behavioural fascination) sites [11]. This is not to suggest sites with less psychologically engaging species, in terms of them being sedentary, less visible or less aesthetically pleasing should be ignored, not least because they may be keystone species ecologically, but it does highlight the fact that behavioural repertoires may be influencing people's willingness to visit and protect certain environments [16,25], including marine/coastal settings [39], and this could have implications for site management and public communication [38]. For instance, if organisations want to attract different individuals (e.g. younger, male, inland dwellers) to certain sites, or get them more engaged in conservation efforts, they may be more successful if they stress levels of biodiversity present and/or behaviours that could be witnessed.

The current research also has connections to much larger, global research agendas investigating some of the harder-to-quantify values people derive from natural environments, often through the 'ecosystems services' approach [3,49,69,57]. Some initiatives, such as the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), the World Health Organisation and Convention on Biological Diversity have begun the specific challenge of identifying the ways in which biodiversity within ecosystems relate to human wellbeing [26,57]. Whilst some services, such as 'provisioning services' like fish catches, are relatively (though by no means perfectly) easy to quantify and thus given a monetary value, other services, such as the kinds of 'cultural ecosystems services' of interest in here (e.g. psychological states) are difficult to evaluate and quantify and thus may be underappreciated in decision making contexts. By demonstrating that people believe that both (perceived) coastal biodiversity and species behaviour can have positive effects on psychological outcomes, the current research adds to the argument that greater attention should be paid to these cultural ecosystem services [13,37]. Moreover, by developing our understanding of the value to psychological well-being from existing wildlife variety and behaviour, we begin to better understand the potential losses associated with the threat of biodiversity loss [10,46,54,9].

As noted above, the coast is one of the most popular destinations for recreation and recognising the importance that wildlife plays in drawing visitors ([48]; [75]; [5]) makes the outcome of this research potentially relevant to marine planners and decisions being made nationally and locally on the designation and management of Marine Protected Areas (MPAs). Research for the RSPB, for instance, showed that nine selected seabird watching locations in 2005 attracted between 250,000 and 400,000 visitors. Nevertheless, we remain cautious about recommending that more people should experience these potential benefits first hand because large numbers of visitors may disturb certain species and alter natural behavioural repertoires. For instance, there is evidence that excessive amounts of dolphin-watching tourism can change dolphin behaviour [17], which has led to an accreditation scheme (WiSe, www.wisescheme.org) for commercial marine wildlife watching to ensure that operators are not disturbing wildlife. A number of our participants demonstrated appreciation of these issues in their additional comments. For instance one said: *'I am not sure I agree visiting marine enclosures ... as wildlife does not need humans trampling over their domain.'* Another commented, *'I don't actually want to visit places where animals are meant to be alone in the wild.'*

In terms of conservation and management, this suggests a need for carefully managed sites and reserves that include observation hides and routes that enable positive human experiences while at the same time limiting the disturbance to wildlife. Although beyond the scope of the current study, there are now attempts to value the provision of such infrastructure through the use of a choice experiment paradigm (for

further details see [44], e.g. p.249–250). For some coastal locations, however, such as parts of Australia's Great Barrier Reef (e.g. <http://www.gbrmpa.gov.au/visit-the-reef/zoning/zoning-guide-to-using-the-marine-park/interpreting-zones>) and the Galapagos Islands, the delicate ecosystems mean that visitors are highly restricted and visits are mainly limited to scientific research. In these instances, human psychological benefits may need to be restricted to indirect experiences (e.g. via video documentaries).

In terms of public engagement, reconnecting people with nature is increasingly seen as a key driver in creating support for environmental policy, with an increase in participative approaches to public engagement being seen as a powerful means of enhancing conservation behaviours [25,35,60]. Our findings suggest future research could investigate the additional benefits of participatory learning and citizen science. Participants in citizen science programmes, tasked with making more detailed observations of environments beyond casual observation, are potentially subject to experiencing a wider range of animal behaviours which, if the video study results are reliable, suggests enhanced psychological benefits which may reinforce the importance of the environment to them. The above results thus suggest some interesting avenues for research around the benefits of observation and participatory approaches as a means of connecting with the environment and enhancing conservation outcomes.

4.3. Limitations & future research

The most obvious limitation of the current research was its hypothetical nature. People were asked to look at photos and videos and 'imagine' they were in the location. This is clearly different from the more visceral experiences of people *in situ* (e.g. [12,24,29]). However, as noted above, photos and videos are still useful for research purposes [64], and videos may be the only way in which many individuals will ever witness fascinating but relatively rare behaviours. Moreover, there is evidence that people tend to underestimate how positive *in situ* experiences will be when making hypothetical judgments about spending time in nature [53]. Thus our participants may have underestimated, rather than overestimated, the impact (perceived) biodiversity and wildlife behaviour might have had on different aspects of the restorative experience.

Other potential limitations included relatively few exemplar scenes and videos, a lack of image randomisation at the individual level, and the use of single items (rather than scales) to measure perceived restorative potential. All three issues resulted from practical constraints relating to the length of time studies are expected to take on the internet panel that was used (ideally approx. 15 min) and programming issues relating to download speeds which meant a set order of images/videos was easier to manage. At the moment we cannot therefore rule out potential order effects in the results, such that seeing one type of image at the start has systematic influences on subsequent images. Full randomisation would improve confidence in future results.

Further, more scenes with an even broader range of wildlife variety and behaviours, including ones that were even more carefully controlled in terms of species richness and abundance, would also be an important step forward in future research. One way of doing this might be to adapt selected images, e.g. using Photoshop, by systematically adding or subtracting elements of biodiversity to the same background. In this way a more accurate control could be made over the species richness participants observed in any given scene. Further work could also use more established response scales, such as the Perceived Restoration Scale, to reduce potential mono-operational bias arising from the use of single item measures (which have nonetheless been used successfully in past work, [6,19,27,72]). Both possibilities would be more feasible using a between-participant, rather than within-participant, design. Further work could also extend the range of psychological constructs explored. For instance, the concept of 'mystery' in ART, "refers to the promise of further information if one could

penetrate more deeply into a setting” ([36], p.430). ‘Mystery’ is generally positively related to scene preference and it may be that higher preferences for greater biodiversity and more fascinating behaviours in the current work reflect a sense of mystery by participants and an interest to explore these locations, in particular, further. Again, future studies could explore these and other processes in an effort to better understand the psychological triggers of species-related environmental preferences.

Finally, although some of the potential implications of demographic factors on perceived restoration-related outcomes were examined, more could be done. Although age, gender, wildlife organisation affiliation and coastal proximity were considered in the current work, other individual differences could be considered in future. Research into how people from different backgrounds and with different values [21] react to different levels of wildlife variety and behaviour in marine/coastal settings in particular [39] is thus an important future step [14].

5. Conclusions

Supporting earlier work in urban parks, our results suggest that members of the public believe coastal environments with higher levels of perceived biodiversity have greater emotional and cognitive restorative potential. We also demonstrated that the behaviour of marine wildlife is also thought to be important for restorative potential. Individuals believed that they would find a coastal location where species were exhibiting relatively fascinating behaviours more emotionally and cognitively restorative than ones where the same species were exhibiting relatively uninteresting behaviours. The challenge now is to establish what these findings might mean for coastal management plans and conservation promotion by integrating these findings into policies such as Marine Protected Areas and reserve design.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.marpol.2017.01.005.

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