Ocean & Coastal Management 88 (2014) 53–63

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Perceived risks and benefits of recreational visits to the marine environment: Integrating impacts on the environment and impacts on the visitor☆

Kayleigh J. Wyles [a,*], Sabine Pahl [a], Richard C. Thompson [b]

[a] School of Psychology, Portland Square, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, UK
[b] School of Marine Science & Engineering, Davy Building, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, UK

ARTICLE INFO

Article history:
Available online 11 November 2013

ABSTRACT

Marine environments provide a range of important ecosystem goods and services. To ensure the sustainability of this environment, we require an integrated understanding of the activities taking place in coastal environments that takes into account the benefits to human visitors but also the risks to the environment. This paper presents two studies on the perceived risks and benefits associated with recreational visits to rocky shores in the UK and internationally. Marine experts and recreational users of the coast responded to questionnaires that explored the marine awareness and wellbeing effects of different activities on the visitor and, in turn, the perceived harmfulness of these activities to the environment. Two studies found that a visit to a rocky shore was seen to improve visitors' awareness regarding the marine environment as well as their wellbeing (with some activities being calming such as sunbathing and relaxing, and others exciting such as rock pooling). However, this was perceived to be at a cost to the environment, as some activities were noted to have detrimental effects on the habitat. Marine experts and coastal users gave very similar answers, as did British (Study 1) and international respondents (Study 2). Using an integrative approach, the perceived impacts on both the environment and visitor were then explored together. Walking and rock pooling were seen to provide considerable wellbeing benefits but had high negative impacts on the environment. In contrast, resource focussed activities such as fishing, bait collecting and crabbing were perceived as less important for visitor wellbeing yet also had negative environmental impacts. Using this integrative approach, this analysis begins to suggest priorities for management that benefits both the environment and the recreational users.

1. Introduction

Coastal marine environments provide important industrial, recreational and biological services. The UK alone has 20 000 km of coastline, with over 320 million visits annually (Natural England, 2010) and over 300 000 jobs associated with the tourism industry (EU, 2011). The majority of Britain's coastline consists of rocky shores, the intertidal coastal area where solid rock predominates (Oakley, 2010). This specific environment is a valuable asset with high biodiversity. It also offers a number of important services, including food, natural sea defences and recreation (Branch et al., 2008). However, rocky shores experience numerous threats, and to preserve the benefits of this environment, we need to encourage sustainable use and management. Considering the activities that take place is crucial for a consensual approach and for developing policies that regulate these activities effectively. In particular, perceptions of both risks and benefits associated with using the environment need to be considered together, and impacts on both the environment and the user need to be taken into account in management strategies. This paper firstly reviews the literature regarding the typically negative impacts visits have on the environment, and the literature regarding typically positive impacts on the visitor themselves. Two studies are then reported that examine perceptions of risks and benefits for both the environment and the user simultaneously. Samples of marine experts and recreational users of rocky shores were surveyed, focussing on recreational visits to rocky shores in the UK (Study 1) and more globally (Study 2).

* Corresponding author. School of Psychology, B223 Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA, UK. Tel.: +44 (0)1752 584859; fax: +44 (0)1752 584808.
E-mail addresses: Kayleigh.Wyles@plymouth.ac.uk, k.wyles@hotmail.com (K.J. Wyles).

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http://dx.doi.org/10.1016/j.ocecoaman.2013.10.005

1.1. Literature review

1.1.1. Impacts on the environment

Marine scientists have examined the effects recreational visitors have on rocky shores by examining activities (e.g. Addison et al., 2008; Natural England, 2010; Porter and Wescott, 2004; Smallwood, Beckley and Moore, 2012) and relating them to potential impacts on the habitat (e.g. Beauchamp and Gowing, 1982; Fitzpatrick and Bouchez, 1998; Fletcher and Frid, 1996). For example, Pinn and Rodgers (2005) compared areas frequented by visitors with areas less commonly visited and found that the former had lower levels of biodiversity. Fletcher and Frid (1996) systematically manipulated the amount of walking on different communities (often referred to as "trampling" in the literature) and found that the abundance of some species increased whilst others declined as a consequence. There is a vast amount of literature examining recreational ecology, the study of the ecological relationships in recreational contexts between human and nature; however many of the empirical studies focus on one particular activity (e.g. trampling; Beauchamp and Gowing, 1982; Brosnan and Crumrine, 1994; or four-wheel driving; Priskin, 2003a) and/or on one particular species (e.g. mussels; Smith et al., 2008). Consequently, apart from descriptive review articles (e.g. Branch et al., 2008; UK CEED, 2000), there appears to be little research simultaneously examining the impacts caused by a range of activities on this particular environment (rocky shores), or focussing on the benefits such activities may have on the visitor.

Priskin's paper (2003b) is one exception that examined the detrimental effects of different activities. Using a survey completed by visitors as they left the shore, Priskin examined tourists' perceptions of twelve activities according to their impact on sandy shores and compared this with her personal knowledge guided by the literature. Some activities were seen as more damaging than others, for instance fishing was seen as *very harmful* whilst swimming was rated as *slightly harmful*. Visitors were generally aware of some of the impacts activities had on the environment but rated these consistently as less harmful than the expert did. Priskin's contribution is important as it compared visitor and expert perceptions, which helps work towards consensual solutions, and it compared a range of activities, which improves our understanding of the relative harm of individual activities. However, several questions remain. First, Priskin found preliminary differences between the public and her own ratings, but conclusions would be more powerful if perceptions from the general public were compared with a larger sample of experts within the coastal field. Second, the ratings in Priskin's study assumed that all activities were similar in frequency; hence it would be useful to see if conclusions differ when commonness is taken into account. Third, it is unknown whether these findings would be similar in other habitats, such as rocky shores. Finally, and perhaps most importantly, Priskin examined the negative impacts associated with a visit to the coast, but what are the *benefits* associated with the different activities, for instance on the visitor's wellbeing? Only considering both together will allow us to properly understand the impacts, which could then potentially help inform management techniques.

1.1.2. Impacts on the visitor

Current psychological research examining impacts on the individual uses a much more general environmental context than the ecological research examining the impacts on the intertidal assemblages. Studies involving both outdoor and computer simulated approaches have shown that natural environments in general have a number of psychological benefits compared to urban settings. They have been shown to improve mood (Barton and Pretty, 2010; Hartig et al., 2003; van den Berg et al., 2003; Ulrich, 1984), increase the ability to perform cognitive tasks (Berman et al., 2008; Berto, 2005; Hartig et al., 2003; Laumann et al., 2003; van den Berg et al., 2003) and speed up recovery after surgery (e.g. Ulrich, 1984). More specifically, aquatic or "blue" environments were preferred over green environments such as forests (Felsten, 2009; Laumann et al., 2001) and were associated with more positive mood and relaxation (White et al., 2010; White et al., 2013). Recent qualitative research has also explored how families use beach visits in general for improving psychological and physical health (Ashbullby et al., 2013). However, there is little research on the benefits of specific environments, such as rocky shores, rather than of aquatic or natural environments in general.

As well as looking at nature in a very general manner, the psychological approach has tended to overlook the effect of different activities. Many studies in this line of research simply show natural scenes passively on a computer (e.g. Berto, 2005; Felsten, 2009; Laumann et al., 2001, 2003; Staats et al., 2003; van den Berg et al., 2003) or focus on walking (e.g. Berman et al., 2008; [Study 1]; Hartig et al., 2003). The coastal environment has numerous recreational uses, which can include activities from rock pooling (exploring the pools of water and crevices) to playing or sunbathing. Some research has considered the intensity of a particular activity, such as cycling when viewing a video of a natural scene (Barton and Pretty, 2010); yet there appears to be no research on the psychological effects of different activities in natural settings. Consequently, more research is necessary to examine the psychological wellbeing benefits[1] of different activities in natural environments.

In addition to the wellbeing benefits of visiting the environment, there may also be benefits on visitors' marine awareness. Numerous studies have examined the impact of direct and indirect natural experiences using school groups and excursions (Zeppel and Muloin, 2007). For example, Cummins and Snively (2000) examined an educational programme on grade 4 pupils (age 9–10), which involved a classroom session and a field trip to sandy and rocky shores. Children's knowledge and attitudes towards the ocean significantly increased as a consequence of this field trip. Changes in awareness have also been shown in adults, for example after visits to aquariums, marine awareness was found to increase (Adelman et al., 2000; Falk and Adelman, 2003; Wyles et al., 2013). Similarly, Americans who lived close to the coast had higher levels of marine awareness (Steel, 2005). However, little is known on the impacts of a general recreational visit to a natural environment in the absence of any educational input or interpretation.

1.2. Present studies

As reviewed above, previous research suggests that exposure to aquatic environments is beneficial for wellbeing and marine awareness; and at the same time that certain activities have specific detrimental effects on the marine habitat. However, to the authors' knowledge no previous work has examined these effects on the habitat *and* on people together. As a first step, this paper uses two studies to investigate perceptions of risks and benefits for both the visitor and the environment, in an integrated fashion. Such a broad approach would allow us to identify those activities that are most beneficial to humans but of low negative impact to the environment (and encourage people to engage in them). Conversely, it would also tell us which activities have little benefit to human wellbeing yet considerable costs to the environment, which would

[1] Wellbeing encompasses different concepts; our main focus in the present paper is on hedonic wellbeing, which concentrates on pleasure (e.g. happiness/mood; see Ryan and Deci, 2001).

then be able to guide management strategies that can protect the environment and maximise visitors' wellbeing. As perceptions may depend on the particular background of the person asked, a concise survey approach with marine experts and general coastal users as participants was used. Participants were asked to estimate the impact of a range of human activities on the environment in terms of commonness and harmfulness (combined to calculate a perceived risk score, following traditional approaches to risk assessment). They were also asked to estimate the impact the activities had on the humans engaging in them, in terms of mood and excitement (based on the Circumplex Model, Russell, 1980). Finally, regardless of specific activities, they were asked to estimate the impact of a visit on marine awareness. The pros and cons of such a broad, perception-based approach will be discussed in more detail later but it is important to note that this approach allowed us to compare and integrate the impact of a substantial number of activities. Study 1 used two separate British samples: coastal experts, which we defined as professionals who are linked to the management of coastlines and/or engaged with the public in these coastal environments, and coastal users who visit but have no specialist knowledge of this environment. This study focussed on British rocky shores, whereas Study 2's sample consisted of international academics with expertise specifically relating to rocky shores to allow us to gain an understanding of the generalisability of the issues beyond the British context.

This paper aimed to answer one key question: what are the perceived risks and benefits of visiting rocky shores for both the visitor and to the environment? More specifically, this paper addresses four sub-questions: First, which activities are seen as most harmful to the environment, thus potentially in need of management strategies? Second, are visits to rocky shores thought to be beneficial for the visitor (in terms of wellbeing and environmental awareness)? Third, is there a difference between experts and coastal users in their perceptions? And finally, how can we combine these two aspects in order to identify those activities that maximise visitor benefits and minimise environmental risks?

2. Methods

2.1. Methods used in study 1: coastal users and coastal experts' perceptions

The first study investigated and compared perceptions of risks and benefits associated with visits to rocky shores between coastal experts and non-experts. Specifically, we asked for ratings of 15 recreational activities according to 1) their perceived commonness and harmfulness to the coastal environment, and 2) their perceived influence on visitors' wellbeing in terms of mood and excitement. Perceived changes in marine awareness after a visit were also included.

2.1.1. Participants

The sample consisted of 122 participants: 25 coastal experts (7 men, 18 women) and 97 coastal users (24 males, 72 females, 1 not stated). The majority (40%) of the coastal experts fell into the 25–30 age category, whilst the majority (30%) of the coastal users fell into the 51–60 age category. Coastal experts were professionals predominantly employed by conservation charities such as the National Trust. Their roles linked directly to the management of coastlines and/or involved engaging with the public in these coastal environments, specifically rocky shores, for instance arranging events such as rock pool rambles. This specialised sample was recruited using the snowball sampling technique. They were recruited via professional networking (e.g. at conferences) and were sent an email with the study information and survey link to an online questionnaire that they were asked to forward onto others within the same profession. Of those who were directly contacted by the researcher, 34% responded. This resulted in a sample of coastal experts who, on average, had spent eight years working in the coastal field (SD = 6.57; range = 1–26 years). Their coastal sites varied from the Isles of Scilly to Teesside in the UK, with the majority based in Devon (44%).

For this study, coastal users were defined as individuals that often visit the coast but do not have expertise or work in a profession that involves working on the coast. A convenience sample was recruited using a staff announcement that was placed on Plymouth University's (an institution located near rocky shores in the Southwest of England) internal website that all employees see when accessing any online services. The advert included a short description about the study, the inclusion criteria (that participants often visit the coast and are not coastal experts) and the link to the survey. Even though this sample is not representative of the national population, it did comply with the coastal user definition above; with the majority visiting once or twice a month (38%) or once every couple of months (26%), with no coastal based occupations reported.

2.1.2. Materials

A short survey with three sections was used: Impacts on the Environment, Impacts on the Visitor and Demographics.

2.1.2.1. Impacts on the environment. Based on previous literature that observed and/or examined activities, 15 activities that are typically performed in this particular intertidal area were chosen: walking, dog walking, jogging, swimming, snorkelling, crabbing, fishing, playing with the family, paddling, sunbathing/relaxing, rock pooling, wildlife watching (e.g. bird watching), picnicking, fossil hunting and cycling (e.g. Coombes and Jones, 2010; Pinn and Rodgers, 2005; Priskin, 2003b). Other activities such as power boating and sailing were not included as they were not directly relevant for this inter-tidal environment as they were more offshore than shore-based activities and the list needed to be reasonably concise to reduce demand on participants. Participants were required to rate how common they thought each activity was within rocky shore environments in general on a 5-point Likert scale (1 = *not common at all*; 5 = *extremely common*) and to what degree they perceived them to be harmful to the environment (1 = *harmless*; 5 = *extremely harmful*) (similar to Priskin, 2003b). In order to examine the perceived overall impact on the environment, relate it to the impact on the visitor, and to be in line with traditional risk and utility assessment, commonness and harmfulness were then multiplied to obtain a perceived total risk score (Slovic et al., 1977). There are many different approaches to conceptualising and calculating risk scores (see Vlek, 1996 for critical discussion). We have used one that is fairly common but would call for further testing and development of this approach for use in integrated analyses. Participants were also asked *if there was one visitor-related behaviour you would change in regard to damage caused to rocky shore species or habitats, what would it be and why?* to get a deeper understanding.

2.1.2.2. Impacts on the visitor. Participants also rated the same activities according to their perceived impacts on general visitors. Based on the Circumplex Model of Affect (Russell, 1980) which emphasises that emotion is represented by two-dimensions: arousal and mood, participants were asked to rate how each activity would change visitor mood (1 = *much worse mood*, 3 = *no change*, 5 = *much better mood*) and visitor excitement using a 5-point Likert scale (1 = *much calmer*, 3 = *no change*, 5 = *much more excited*). Participants were also asked to rate whether they

thought visitors' marine awareness changed as a function of the visit, looking specifically at overall biology, ecology, natural threats facing the environment, general human induced threats and specific visitor-induced threats (based on Steel, 2005; 2007). Responses varied from a *large decrease* to *a large increase in awareness* on a 5-point Likert-type scale with a midpoint of *no change*.

2.1.3. Design and procedure

As shown in the schematic diagram (Fig. 1), participants were first presented with a brief description of the study. A short definition of a rocky shore and a photograph was provided to give an indication of the environment being examined. Respondents then completed the three sections of the survey. To reduce order effects of the survey section, half of the respondents were given the Impacts on the Environment section first followed by the Impacts on the Visitor; whereas the other half completed the Impacts on the Visitor section first (see Fig. 1). After completing the survey, the aim of the study was reiterated and contact details were provided.

2.1.4. Analysis

The rating data were first screened by examining boxplots for statistical outliers, checking for skew and kurtosis to indicate normality and running mixed-ANOVAs to explore whether theoretically less important factors such as gender, age and section order influenced the overall findings. Where variables deviated from normal distribution, both parametric and non-parametric tests were used, with the former being reported unless results differ. No main effects of gender, age or section order were found; therefore these variables will not be discussed further.

For the main analyses, analysis of variance (ANOVA) was used to compare activities on each of the ratings and to analyse differences between the two samples. For all analyses, where sphericity was not given, Greenhouse-Geisser correction was applied when the sphericity estimates was below 0.75, and Huynh–Feldt correction when above, as recommended by Girden (1992; as cited in Field, 2005). To assess the magnitude of observed effects, partial η^2 was used for the ANOVA statistics. For post-hoc analysis, familywise error was adjusted for by using Bonferroni correction (Field, 2005). One-sample *t*-tests were also used for the data on Impacts on the Visitor, to see if responses were significantly different to the *no change* response.

For the additional open-response section, content analysis (Millward, 1995) was used. Following qualitative analytical procedures, the entire qualitative responses for the section were initially examined to identify prominent recurring themes (Braun and Clarke, 2006). The themes and sub-themes were then developed further by re-reviewing the data. Once the themes were condensed into suitable categories, the frequency of each theme was recorded in order to be able to compare responses from the coastal experts and coastal users using chi-square tests. All analyses and coding was completed by the first author. A second independent coder coded twenty percent of the qualitative data. Agreement between coders was very high, Cohen's kappa = 0.93 (Landis and Koch, 1977).

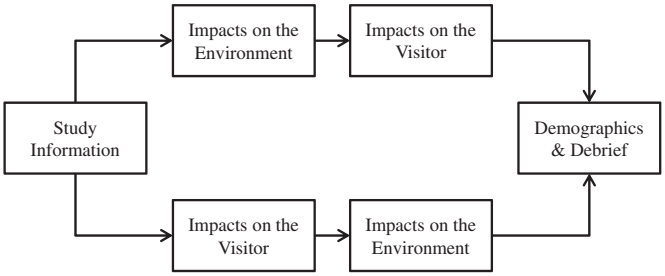

Fig. 1. A schematic diagram of the methodological design used in both Study 1 and Study 2, with participants completing one of the two pathways, to counteract any order effects.

2.2. Methods used in study 2: international academics' perceptions

While Study 1 compared coastal experts and recreational users of the coast for a UK sample, Study 2 recruited a more geographically global but specialised sample of international marine ecologists, who explicitly study rocky shore environments. The methodology was adapted slightly to be more internationally relevant and more concise.

2.2.1. Participants

Participants were conference delegates attending the 9th International Temperate Reefs Symposium that comprised of marine ecologists who engage in research and/or teach university students about rocky shores. Twenty five percent of all delegates completed the survey, resulting in a sample of 44 (26 male, 18 female). The majority of participants were aged between 31 and 40 (34%), worked for a university (89%) and had worked in the coastal field on average for 14 years (SD = 10; range = 1–43 years). The nationality most represented was British (29%); however the sample also consisted of people from the USA, Australia, Italy, Portugal, Chile, France, Hong Kong, Canada, Spain and New Zealand.

2.2.2. Materials

As in Study 1, the sections covered the Impacts on the Environment, Impacts on the Visitor and Demographics. However, there were some modifications to the individual items, which are addressed below.

We reduced the list of activities to eleven for ease and conciseness. The four least common activities from Study 1 were removed (cycling, fossil hunting, snorkelling and jogging) and any seen to be ambiguous for a multi-national sample were also omitted (paddling). Bait collection (harvesting organisms to be later used as bait) was added, as this can be a more common activity in other countries (Thompson et al., 2002).

To examine the impacts on the visitor, a more concise yet sensitive approach was also adopted, where the Overall Happiness Scale (Campbell et al., 1976) was used. Participants marked on a line where they perceived visitors' happiness to be after performing each activity on a rocky shore. The anchor points were *much less happy* and *much more happy*, with the midpoint being *no change*. Ratings were then converted into scores, ranging from zero where visitors were perceived to leave *much less happy* to 100 where visitors were perceived to leave *much more happy*. The score of 50 implied there was *no change in happiness*.

For the perceived change in marine awareness items, the scale was also modified. Originally, Study 1 had a bidirectional scale from *a large decrease in awareness* to a *large increase*; however, less than 1% of answers were below *no change* (3). Consequently, a unidirectional scale was adopted, ranging from *no change in awareness* (1) to *a large increase in awareness* (5), thus being more sensitive to record differences in perceived change in awareness.

2.2.3. Design and procedure

Participants were recruited during the 9th International Temperate Reefs Symposium. The conference delegates were given the survey with their conference pack and explicitly introduced to the study by the conference organiser on the first day. The survey procedure was identical to Study 1 (Fig. 1). Participants then had three days to complete and return the survey. At this point the purpose of the study was explained again and the researcher's contact details were provided.

2.2.4. Analysis

The analysis procedure was identical to Study 1. An independent second coder checked twenty percent of the qualitative data for inter-rater reliability. Excellent agreement between coders was found ($\kappa = 0.91$, Landis and Koch, 1977). Similar to Study 1, data screening was undertaken first and initial analyses examined the effects of gender, age, order and nationality (UK vs. non-UK). No significant findings arose for these variables, thus they will not be discussed again.

3. Results

3.1. Results from study 1: coastal users and coastal experts' perceptions

First, we looked at the two samples together, examining the perceived impacts of visits on the environment and on the visitor. We then explored any differences between coastal experts' and coastal users' ratings.

3.1.1. Impacts on the environment

To calculate the total perceived risk to the environment, perceived commonness of each activity was multiplied by perceived harmfulness (see supplementary material for the individual means). As shown in Table 1, it was found that activities did significantly differ in terms of their perceived risk to the environment; with rock pooling, fishing and crabbing seen to have the highest risk to the shore, and cycling, swimming and sunbathing/relaxing having the least.

3.1.1.1. Content analysis. Qualitative data in response to *if there was one visitor-related behaviour you would change in regard to damage caused to rocky shore species or habitats, what would it be and why* emphasised problematic activities and behaviours further. A total of 106 comments (25 from coastal experts, 81 from the non-expert sample) were collected. From their comments, three prominent themes were found: Littering, lack of rock pooling ethics and general disturbance. Littering represented comments directly referring to the leaving of rubbish (e.g. generally, food-related, fishing, or dog fouling). For instance, "*...The rubbish left behind is an eye sore and potentially dangerous to other visitors or the wildlife*". Lack of rock pooling ethics generally referred to acting in an inconsiderate manner in the rock pools (e.g. displaying general lack of knowledge, not turning boulders back, not returning organisms) that can lead to "…exposing animals and plants to the drying air is not good and will change the ecology of a location in time". The final theme, general disturbance, covers comments that addressed more generally the disturbance by visitors to the habitat and the wildlife such as from walking over the rocks or from rock pooling or crabbing, e.g. "*...in terms of disturbing the habitat of shore creatures.*" Littering behaviours were mentioned the most (Table 2).

Table 1
The statistical results and combined and individual sample (coastal experts [CE] and coastal users [CU]) means and standard deviations for the perceived level of risk on the marine environment associated with each activity ($n_{\text{coastal experts}} = 25$; $n_{\text{coastal users}} = 97$).

Factor	df	*F*	Sig.	Effect size (partial η^2)[a]
Main effect: sample	1, 111	1.05	n.s.	–
Main effect: activities	7.28, 807.96	45.27	$p < 0.001$	Medium (0.29)
Interaction: sample × activities	7.28, 807.96	2.63	$p = 0.001$	Very small (0.02)

	Overall mean (SD)	CE mean (SD)	CU mean (SD)	Difference between samples
Walking	10.37 (4.37)	9.32 (3.68)	10.64 (4.59)	n.s.
Dog walking	11.43 (5.14)	8.82 (5.25)	12.01 (4.99)	n.s.
Jogging	6.23 (3.70)	4.55 (3.54)	6.64 (3.71)	n.s.
Swimming	5.60 (2.89)	5.09 (2.51)	5.69 (3.05)	n.s.
Snorkelling	6.01 (3.80)	6.18 (3.51)	5.70 (3.74)	n.s.
Crabbing	11.52 (5.45)	12.00 (5.86)	11.27 (5.52)	n.s.
Fishing	12.58 (5.06)	12.64 (5.03)	12.55 (5.20)	n.s.
Playing with family	10.78 (4.72)	10.09 (5.04)	10.91 (4.83)	n.s.
Paddling	8.02 (4.19)	8.05 (3.71)	7.87 (4.31)	n.s.
Sunbathing/relaxing	5.77 (3.70)	4.36 (2.52)	6.22 (3.93)	n.s.
Rock pooling	14.48 (5.73)	15.50 (5.73)	13.90 (5.75)	n.s.
Wildlife watching	6.70 (4.10)	8.05 (4.94)	6.25 (3.87)	n.s.
Picnicking	9.93 (5.36)	8.14 (5.50)	10.35 (5.30)	n.s.
Fossil hunting	9.37 (6.04)	8.73 (6.06)	9.31 (6.16)	n.s.
Cycling	4.61 (3.73)	2.77 (2.33)	5.05 (3.91)	$p < 0.01$

Note. Perceived risk was calculated by multiplying commonness ranged from 1 (*not common at all*) to 5 (*extremely common*) with perceived harmfulness ranged from 1 (*harmless*) to 5 (*extremely harmful*). n.s. refers to not significant.

[a] According to Cohen's (1992) benchmark criteria, small effects are those of a partial η^2 value of 0.10, medium is 0.25 and large effects have a value of 0.40.

3.1.2. Impacts on the visitor

All activities were perceived to have a positive impact on visitors' mood, as all values were above the *no change* value of 3 for one-sample *t*-tests (all *ps* < 0.001; Table 3). Activities were found to differ from one another in terms of change in mood; as walking, wildlife watching and snorkelling were seen to have the most positive impact, whereas cycling, fossil hunting and jogging had the least positive impact (Table 3).

For the excitement scale, any values below 3 represent calming feelings, whilst values above 3 represent increased feelings of excitement. One-sample *t*-tests found that playing with the family, crabbing, snorkelling, rock pooling, fossil hunting and cycling were seen to make visitors feel more excited (all *ps* < 0.02). Sunbathing/relaxing, walking, dog walking, picnicking and paddling were seen to make visitors feel significantly more calm (all *ps* < 0.005). These differences between activities were found to be statistically significant (see Table 3).

General visits to rocky shores were also seen to have positive effects on marine awareness regarding the five different topics, with the most perceived change in overall biology of rocky shores and the general human induced threats to the shore (Table 4). Visitors' awareness on all of the topics was perceived to improve (above the *no change* value of 3, all *ps* < 0.001).

3.1.3. Differences between expert and coastal user samples

For the environmental risk variable, a mixed-ANOVA was used to examine whether there were any statistically significant differences between the two samples. As shown in Table 2, the coastal experts and coastal users responded similarly for 14 activities. There was a statistical discrepancy between the two samples for cycling, with the coastal users perceiving this activity as having a greater risk on the environment than coastal experts. Despite this difference, both groups agreed that this activity was associated with the smallest risk compared to the other activities. Consequently, generally both coastal experts and coastal users perceived the impact on the environment of different activities similarly.

Table 2
The frequency of comments falling into the themes and subthemes for Study 1.

Theme	Coastal experts ($n = 25$)	Coastal users ($n = 97$)	Total
General disturbance	9	22	31
Littering	11	62	73
Lack of rock pooling ethics	20	24	44
Total	40	108	148

Note. Some comments addressed more than one theme, hence why the number of comments exceeds the sample size.

Table 3
The statistical results and combined and individual sample (coastal experts [CE] and coastal users [CU]) means and standard deviations for the Impact on the Visitor items associated with each activity ($n_{\text{coastal experts}} = 25$; $n_{\text{coastal users}} = 97$).

Factor	Perceived change in mood				Perceived change in excitement			
	df	*F*	Sig.	Effect size (partial η^2)	df	*F*	Sig.	Effect size (partial η^2)
Main effect: sample	1, 107	0.10	n.s.	–	1, 107	8.69	$p = 0.004$	Small (0.08)
Main effect: activities	5.83, 624.16	12.56	$p < 0.001$	Small (0.11)	9.05, 967.80	33.43	$p < 0.001$	Medium (0.24)
Interaction: sample × activities	5.83, 624.16	0.95	n.s.	–	9.05, 967.80	3.81	$p < 0.001$	Small (0.03)
	Overall mean (SD)	CE mean (SD)	CU mean (SD)	Difference	Overall mean (SD)	CE mean (SD)	CU mean (SD)	Difference
Walking	4.22 (0.86)	4.21 (0.72)	4.22 (0.89)	n.s.	2.01 (0.88)	2.25 (0.90)	1.95 (0.87)	n.s.
Dog walking	3.92 (1.06)	4.00 (0.78)	3.90 (1.13)	n.s.	2.31 (0.90)	2.25 (0.74)	2.33 (0.94)	n.s.
Jogging	3.79 (1.12)	3.92 (0.83)	3.76 (1.19)	n.s.	2.86 (0.98)	2.92 (0.88)	2.85 (1.01)	n.s.
Swimming	4.08 (0.82)	4.17 (0.70)	4.05 (0.85)	n.s.	2.86 (1.01)	3.21 (1.06)	2.77 (0.98)	n.s.
Snorkelling	4.17 (0.85)	4.33 (0.76)	4.13 (0.87)	n.s.	3.32 (1.08)	4.25 (0.53)	3.08 (1.05)	$p < 0.001$
Crabbing	3.97 (0.99)	3.83 (0.96)	4.01 (1.00)	n.s.	3.42 (1.02)	4.00 (0.66)	3.26 (1.04)	$p < 0.001$
Fishing	3.86 (1.08)	3.63 (1.06)	3.92 (1.08)	n.s.	2.97 (1.02)	3.46 (1.06)	2.85 (0.97)	n.s.
Playing with family	4.16 (0.97)	4.21 (0.98)	4.15 (0.97)	n.s.	3.42 (1.02)	3.79 (0.83)	3.32 (1.04)	n.s.
Paddling	4.11 (0.86)	4.13 (0.85)	4.11 (0.86)	n.s.	2.73 (1.02)	3.13 (0.97)	2.63 (1.01)	n.s.
Sunbathing/relaxing	4.04 (0.87)	4.17 (0.70)	4.01 (0.92)	n.s.	1.90 (0.82)	1.83 (0.76)	1.91 (0.84)	n.s.
Rock pooling	4.12 (1.04)	4.13 (1.08)	4.12 (1.04)	n.s.	3.32 (1.12)	4.00 (0.93)	3.14 (1.11)	$p < 0.001$
Wildlife watching	4.20 (0.81)	4.25 (0.85)	4.19 (0.81)	n.s.	2.86 (1.11)	3.38 (1.10)	2.73 (1.08)	n.s.
Picnicking	3.80 (1.12)	3.79 (0.66)	3.80 (1.21)	n.s.	2.58 (0.82)	2.71 (0.75)	2.55 (0.84)	n.s.
Fossil hunting	3.75 (1.08)	3.75 (0.79)	3.75 (1.15)	n.s.	3.23 (0.94)	3.46 (0.78)	3.18 (0.97)	n.s.
Cycling	3.45 (1.19)	3.38 (1.01)	3.45 (1.24)	n.s.	3.21 (0.96)	3.17 (0.92)	3.22 (0.98)	n.s.

Note. Perceived change in mood ranged from 1 (*much worse mood*) to 5 (*much better mood*); perceived change in excitement ranged from 1 (*much calmer*) to 5 (*much more exciting*); both with 3 as *no change*.

As shown in Table 2, the open-ended comments did differ in their focus on littering and lack of rock pooling ethics. Forty eight percent of coastal experts' comments related to the lack of rock pooling ethics, whilst only 21% of the users' comments related to this theme. In contrast, 54% of coastal users' comments related to the litter theme, whilst only 26% of coastal experts' comments related to this. A chi-square analysis found that the two samples significantly differed in the focus of their comments, $\chi^2 = 12.93$, $df = 2$, $p = 0.002$.

Regarding perceived impacts on the visitor, both samples had similar ratings for the mood effects for each activity (Table 3). For the excitement ratings, there was a small effect that coastal experts generally saw activities as more exciting than the coastal users. For the majority of activities, both samples were similar in their perceptions; however, three statistical differences emerged. Both coastal experts and coastal users perceived that visitors would feel excited after snorkelling, crabbing or rock pooling, but the coastal experts perceived that visitors would experience a slightly greater level of excitement.

Coastal users were slightly more optimistic in the marine awareness benefits, as they believed visitors would leave with greater marine awareness than the coastal experts did (Table 4). Specifically, coastal users felt that visitors' awareness regarding the general human threats to the shore would increase slightly more than coastal experts' perceptions.

Table 4
The means and standard deviations for change in marine awareness on five different topics overall, for the coastal experts (CE) and the coastal users (CU) in Study 1.

Factor	df	*F*	Sig.	Effect size (partial η^2)
Main effect: sample	1, 117	4.69	$p = 0.03$	Small (0.04)
Main effect: topic	3.51, 410.41	11.66	$p < 0.001$	Small (0.09)
Interaction: sample × topic	3.51, 410.41	4.45	$p = 0.003$	Small (0.04)

	Overall mean (SD)	CE mean (SD)	CU mean (SD)	Difference
Biology	3.88 (0.64)	3.92 (0.64)	3.87 (0.64)	n.s.
Ecology	3.64 (0.65)	3.48 (0.59)	3.68 (0.66)	n.s.
Natural stressors	3.67 (0.62)	3.52 (0.59)	3.72 (0.63)	n.s.
General human threats	3.79 (0.74)	3.36 (0.49)	3.90 (0.75)	$p = 0.005$
Specific visitor threats	3.50 (0.65)	3.24 (0.52)	3.57 (0.66)	n.s.

Note. Perceived change in marine awareness ranged from 1 (*a large decrease*) to 5 (*a large increase*) with 3 indicating no change.

3.1.4. Integrating impacts on visitor and environment

To integrate perceived impact on the environment and impact on the visitor, the z-scores[2] for perceived risk to the environment and effect on mood were plotted on a risk perception map (Fig. 2a, similar to Slovic, 1987). Mood was chosen over excitement because it was most relevant to wellbeing. The top right quadrant highlights the activities that had high mood benefits to the visitor but also high risk to the environment (e.g. rock pooling and playing with the family), the lower right quadrant highlights activities with greater benefits to the visitor that were less detrimental to the environment (e.g. swimming and sunbathing/relaxing), and activities in the quadrants on the left were seen to be less beneficial to the visitor and either potentially detrimental to the environment (top left; e.g. fishing and picnicking) or not as detrimental (bottom left; e.g. cycling and jogging).

3.2. Results from study 2: international academics' perceptions

3.2.1. Impacts on the environment

When calculating perceived risk, activities were found to significantly differ from one another in terms of perceived total risk to the environment, F (5.91, 224.70) = 12.60, $p < 0.001$, partial $\eta^2 = 0.25$ (medium effect); with fishing, bait collecting and rock pooling being perceived as having the most risk to the environment, and swimming, sunbathing/relaxing and playing were seen as having the least (Table 5 for individual means).

3.2.1.1. Content analysis. There were 34 comments that responded to the open-response item. Four themes arose (Table 6): 1)

[2] Z-scores (values converted to standard deviation units) were used to standardise the two measures that were originally on different scales so that they could be compared.

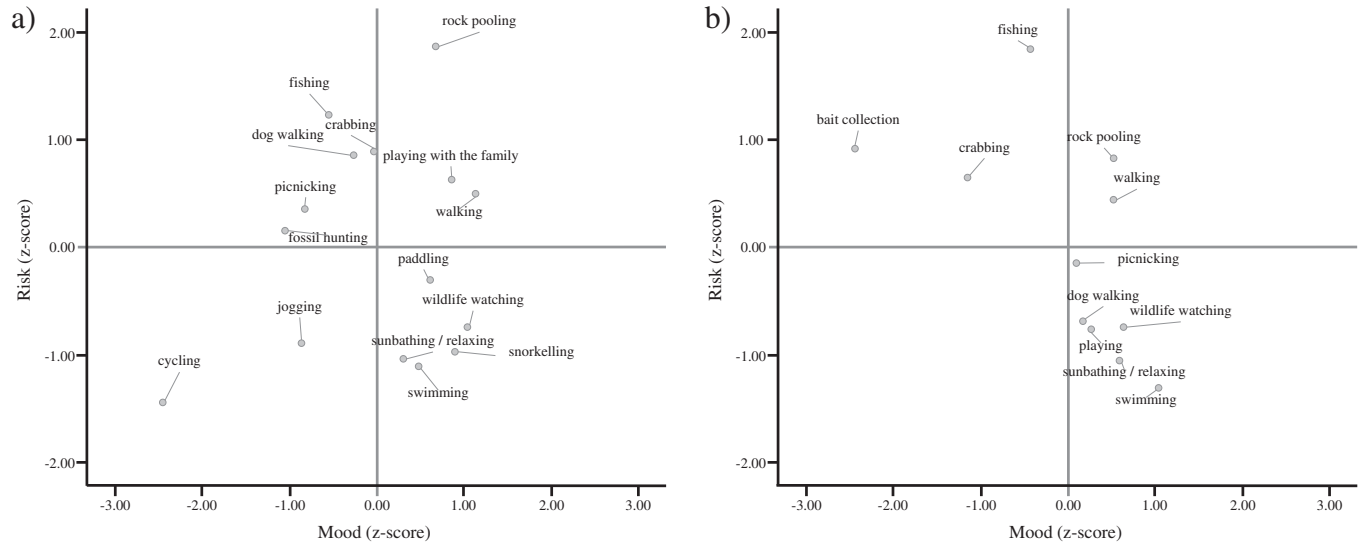

Fig. 2. Activity plots according to impact on the environment (perceived risk, with positive values referring to greater risk) and on the visitor (mood, with positive values referring to great change in positive mood). Fig. 2a) is for Study 1 with coastal experts and coastal users rating 15 activities ($n = 122$); Fig. 2b) is for Study 2 with international experts rating 11 activities ($n = 44$). Note. Even though coastal experts and users significantly differed according to their perceived risk of cycling on the coast, the pattern was the same, thus the overall mean is presented here.

Disturbance, direct manipulation and disruption to the environment such as "*People looking under boulders either for observation or fishing and bait collection WITHOUT turning them back in place* [resulting in] *organisms used to shade will die*". 2) Removal of organisms, damage to the habitat and wildlife by removing individual items; for example "*Harvesting of species – Removing biomass, genetic variability and reproductive potential cannot enhance the dynamics of the system*". 3) Littering, the act of leaving rubbish on the shore; for example being left "*...by visitors using beach for picnics etc*". 4) Trampling, detrimental effects of people walking on the shore on the environment and species including "*… crushable algae & sessile animals like mussels*". To verify that country of residence did not influence these themes, a chi-square analysis compared responses from the UK residents ($n = 12$) to the remaining residents ($n = 29$) (comparing all nationalities was not feasible due to group sizes). Overall they highlighted similar themes, $\chi^2 = 0.75$, df = 3, $p = 0.86$.

Table 5
The means and standard deviations for the 11 activities according to Impact on the Environment (perceived risk) and Impact on the Visitor (perceived change in happiness) for the international academic sample ($n = 44$).

	Environmental risk		Visitors' change in happiness	
	Mean	(SD)	Mean	(SD)
Walking	8.84	(5.09)	79.10	(11.56)
Dog walking	6.07	(4.30)	76.38	(15.68)
Swimming	4.59	(2.95)	82.54	(11.66)
Crabbing	9.32	(5.49)	67.24	(17.23)
Fishing	12.21	(5.91)	72.33	(18.50)
Playing with family	5.93	(4.48)	77.31	(13.29)
Sunbathing/relaxing	5.23	(3.57)	79.07	(15.42)
Rock pooling	9.75	(5.95)	79.42	(15.66)
Wildlife watching	5.95	(4.12)	79.40	(16.01)
Picnicking	7.42	(5.35)	75.91	(13.11)
Bait collecting	9.98	(6.26)	57.93	(17.75)

Note. Perceived risk was calculated by multiplying commonness that ranged from 1 (*not common at all*) to 5 (*extremely common*) with perceived harmfulness that ranged from 1 (*harmless*) to 5 (*extremely harmful*). Happiness responses ranged from 0 (much less happy) to 100 (much more happy), with 50 as the midpoint (no change. All activities were significantly higher than no change $p < 0.01$.

3.2.2. Impacts on the visitor

All of the activities were seen to improve visitors' happiness, as all scores were above the midpoint of *no change* (all *p*s < 0.006, Table 5). It was found that the activities did differ in regards to perceived happiness, F (4.23, 156.40) = 9.68, $p < 0.001$, partial $\eta^2 = 0.21$ (medium effect); with swimming, rock pooling and wildlife watching having the greatest positive influence.

As well as believing that happiness increases with a visit to a rocky shore, participants also felt that marine awareness increased with a visit (Table 7). Marine awareness for all five topics was perceived to significantly increase with a visit (all *p*s < 0.001). Comparing the five topics, awareness of the overall biology, general human induced threats and ecology were seen to increase the most and specific visitor-induced threats to increase the least, F (2.53, 108.80) = 3.46, $p = 0.03$, partial $\eta^2 = 0.07$ (small effect).

3.2.3. Integrating impacts on visitor and environment

The risk perception map in Fig. 2b shows the relationship between impact on the environment and impact on the visitor by plotting the activities' standardised z-scores for risk to the environment and effect on happiness. It shows that bait collecting, fishing and crabbing were perceived to have a high negative impact on the environment but a low positive effect on the visitor (top left quadrant), suggesting they may not be that important to the visitor's wellbeing. In contrast, swimming, sunbathing/relaxing and wildlife watching were perceived to have a small amount of negative impact on the environment but a positive effect on the visitor (bottom right quadrant), suggesting an overall positive effect. Rock pooling and walking

Table 6
The frequency of comments falling into the themes and subthemes for Study 2.

Theme	Overall frequency	UK frequency	Non-UK frequency
Disturbance	17	6	11
Removal of organisms	14	3	11
Litter	7	2	5
Trampling	4	1	3
Total	42	12	30

Table 7
The means and standard deviations for change in marine awareness on five different topics for Study 2 (midpoint = 1).

	Mean	(SD)
Biology	2.45	(0.98)
Ecology	2.14	(1.15)
Natural threats	2.05	(0.96)
General human threats	2.36	(1.16)
Specific visitor threats	1.89	(1.08)

Note. Responses ranged from 1 (*no change in awareness*) to 5 (*a large increase in awareness*). All were significantly higher than 1 at $p < 0.001$.

were seen to have both positive effects on visitors and potentially detrimental impacts on the environment (top right quadrant).

4. General discussion

This paper used a novel integrative approach to examine recreational visits to rocky shores, an important coastal environment. Unlike the previous literature, the two studies in this paper examined the perceived impacts that visits have on the visitor as well as on the environment. Thus the present findings are novel because they begin to provide an integrative approach to inform management and policy strategies. Overall, both studies agree that visits to rocky shores are perceived to be beneficial to visitors in terms of wellbeing and marine awareness. However, depending on the activity performed, these visits are perceived to vary in their harmful impact on the environment. There were few differences between coastal experts and non-experts in Study 1; overall, their perceptions were very similar. These findings were further supported in Study 2 that used a sample of international marine ecologists, which incorporated a more global viewpoint and thus further generalised these findings.

When combining the perceived commonness and harmfulness for each activity to calculate the perceived risk to the environment, foraging/rock pooling activities were seen to be the worst. The qualitative responses in both studies also reflected this, with comments often relating to unsustainable foraging behaviours such as removing organisms, turning rocks over and showing little respect or awareness towards the environment. This finding corresponds well with previous research (e.g. Davenport and Davenport, 2006; Fitzpatrick and Bouchez, 1998; Prescott, 2009). Overall, the current study clearly emphasises that different activities were seen to have different effects on the environment, with these foraging type activities agreed to be the most harmful.

Priskin (2003b) started to examine perceived differences in activities and compared the general public's perceptions to a marine expert's. The current paper has expanded on this approach. The current findings support Priskin's (2003b) original conclusion that the public do distinguish between different activities; however Priskin also found that they generally underestimate the negative impacts on the environment compared to that of the marine expert. However, within the current samples, there were only few differences, with the coastal user sample generally in agreement with the coastal experts. This may be due to methodological differences such as country, type of shoreline (sandy versus rocky) and the time of data collection (data collected in 1999 for Priskin, and 11 years later for this current work). It could also be because of the reliability of the expert ratings. For this current study, we used 25 coastal experts from around the UK and a further 44 international academics, whilst Priskin relied purely on her own expertise. Overall, the views between experts and coastal users were remarkably similar which can increase our confidence in these perception-based findings. We developed the questionnaire further in Study 2 and can therefore not make direct statistical comparisons between the two data sets. However, the pattern of findings was very similar between the two studies and no differences were found between coastal experts from the UK as opposed to elsewhere. This seems to indicate that the findings can be seen as more global issues than only relevant to the United Kingdom. However, the exact level of detrimental impact on the environment may be different in other countries and would be interesting to explore further with a more cross-cultural study.

In addition to the perceived impacts different activities have on rocky shores, the open-ended questions offered in-depth insights. As mentioned above, participants used this opportunity to explain the depreciative behaviours linked with foraging activities, including turning rocks over and lack of knowledge or awareness. Another frequently mentioned theme, especially for the coastal user sample, was littering. Crucially, littering was mentioned spontaneously without a researcher prompt (as this study focussed on purposive recreational activities) yet it turned out to be a consistent key theme. Littering is known to be an important environmental issue, with roughly 2 000 litter items found per kilometre on the UK coastline alone (MCS, 2012). Litter can have numerous effects, including entanglement, ingestion and damage to the environment and its residents (Hall, 2000; Laist, 1997). Interestingly, however, many of the responses did not only emphasise those detrimental effects of litter on the environment and organisms, but also highlighted the effect it has on visitors' experiences. This is in line with the finding that marine litter can be a key deterrent for visiting specific beaches (Tudor and Williams, 2006). Consequently, the current findings highlight that there are some key depreciative behaviours that need to be focussed on further, including littering, not just because of the impact on the environment but also the impact on the visitors' experience.

In contrast to the perceived negative impacts the activities were seen to have on the environment, all activities were seen to be beneficial to visitors, such as leaving the shore happier than when they arrived. All activities were seen to improve visitor mood, with wildlife watching consistently being a more beneficial one. Some activities were also seen to be calming and others more exciting. These findings agree with White et al. (2010) that the aquatic environment is perceived to be beneficial, as, regardless of the activity performed, visitors are seen to leave the shore in a happier mood. However, this research supplements past work as it has started to explore the differences between activities. As participants perceived that activities would have different effects on the individual, it shows that this is an important aspect in need of further investigation. This suggests that a comparative analysis of the different activities taking place in coastal environments is an important addition to research that studies the effects of visits in general (e.g. White et al., 2010) and research that focuses on one particular activity (e.g. walking, Hartig et al., 2003).

As well as the perceived psychological benefits on visitors' mood, these two studies also found that marine awareness is seen to increase with a visit to the shore. Previous literature highlights that experiencing nature is beneficial to people's awareness in combination with educational sessions (Cummins and Snively, 2000; Duerden and Witt, 2010; Zeppel and Muloin, 2007). However, even without formal teaching, a general leisurely visit to a rocky shore was perceived to increase visitors' marine awareness significantly. This is consistent with Steel's (2005) finding that people who live close to the coast had higher levels of marine awareness as they may have more opportunities to visit the shore. Therefore, regardless of whether visitors seek additional information, a general visit to the shore is seen to be beneficial to the visitor by increasing their marine awareness. Consequently, this may be

beneficial for the environment as higher levels of awareness has been associated with more pro-environmental behaviour (Norm Activation Theory, Schwartz, 1977; as cited in Jackson, 2005; Stern and Oskamp, 1987; Wildlife Trusts, 2005). So, as marine awareness increases, people may feel more personally responsible thus adjusting their behaviours accordingly. This was found in a field study by Alessa and colleagues focussing specifically on a coastal area (Alessa et al., 2003).

As well as examining the impacts on the environment and on the visitor independently, a key contribution of this paper was to examine these two components together. Some activities were perceived as better, having positive impacts on the visitor and little negative impact on the environment. For example, sunbathing/relaxing is a calming activity and, as it typically involves little movement, there would be less trampling, fewer depreciative rock pooling behaviours and less overall disturbance to the wildlife. As shown in Fig. 2, some activities (including walking and rock pooling) were beneficial to the visitor but have the potential to be rather harmful to the environment. In psychological terms, these activities allow exploration of this environment, show fascination towards the landscape and wildlife, and may involve learning by finding certain species, or include exercise along a scenic environment (Kaplan, 1995). Environmentally, as these activities are exploratory they may involve walking over vulnerable areas and can involve depreciative behaviours such as turning rocks over and removing organisms. The activities seen to be damaging to the environment and not that beneficial to the visitor (including fishing and bait collecting) are typically associated with the resource and less focussed on a recreational purpose. Consequently, these more resource focussed activities appear to be detrimental to the environment and not that valuable to visitors' wellbeing. This paper adopted a novel approach to explore these trade-offs; however, more research is necessary to investigate these complicated relationships and to conclude the optimum activities to encourage, while discouraging others. For example, health benefits may be higher for activities that involve more exploration of rocky shores (e.g. rock pooling) compared to more passive activities such as sunbathing/relaxing. We focussed on psychological health effects (e.g. changes in mood, happiness) rather than physiological health implications. Future research would be well placed to investigate such additional trade-offs. With our paper we hope to begin a discussion around more integrative approaches that appreciate the complexity of the overall impacts (on both visitors and the environment), with the end goal of informing management practices accordingly.

4.1. Methodological limitations

It was noted that this research only assessed participants' perceptions and not actual experiences. This perceptual approach is both a strength and a weakness. For visitor impacts, we could have recorded actual visitors' experiences via self-report questionnaires and/or physiological measures. Similarly, for the environmental impacts, objective frequency data could have been collected and/or a more experimental approach could have been used, such as examining the effects visits have on rocky shores by manipulating intensity and types of activities and recording their impacts on different organisms. However, as there has been little research examining both components together, it would have been premature to do this. Instead, these two studies used a cost-effective approach by exploring these initial questions using a survey method, which enabled comparisons of many activities from this novel integrative perspective.

The samples recruited provided extremely insightful responses; however they were not formally representative of the populations of interest. In Study 1, coastal users were constrained by using an institution's internal website. This sampling method enabled access to a relevant population of people who are based in the Southwest of England, thus have access to rocky shores. A snowball technique was chosen to recruit our marine experts in Study 1, as this allowed access to this specialised population. In Study 2, we used a convenience sample at a topical conference. As with all sampling strategies, the samples recruited may be more vulnerable to certain biases, such as self-selection bias (Fife-Shaw, 1995). However, overall, the samples used enabled us to fulfil our aim to explore the risks and benefits of visiting rocky shores for both the visitor and the environment simultaneously. Future research may wish to explore different populations' perceptions and cross-cultural differences further.

4.2. Management implications

The current findings add to the existing evidence that rocky shores are valuable assets, not only for marine biology, resources and tourist economy but also for the visitors' psychological wellbeing. However, rocky shores need to be managed appropriately for these benefits to continue. As mentioned above, activities differ in their impacts on the environment and the visitor. By adopting an integrative approach, our findings highlight that certain activities can be greatly beneficial for the visitor but also have the potential to have large detrimental consequences on the environment, which could feed into management strategies accordingly. The risk perception plots in Fig. 2 can help guide these management strategies. For instance the bottom left quadrant identifies activities that are not seen to be hugely beneficial for the visitor's wellbeing but are equally not of main concern for the habitat, thus perhaps require little management. In contrast, activities in the lower right quadrant are beneficial to the visitor and less detrimental to the environment, therefore these activities could be encouraged. The activities requiring the most attention are those in the top quadrants that are potentially harmful to the environment. These activities should not be prohibited or discouraged, especially for those in the upper right quadrant that have been found to have perceived benefits on the visitor, but rather should be regulated so that the benefits are maximised and the risks minimised.

In addition to the risk perception plots looking at a range of activities, some responses focussed on individual activities. Rock pooling was consistently rated high in terms of its risk to the environment, but the open-ended question highlighted that it was mainly detrimental if it was carried out unsustainably (lack of rock pooling ethics) such as not returning boulders. A common reason for such depreciative behaviours is the lack of knowledge regarding the consequences of those actions (Ajzen, 1985; Kaiser and Fuhrer, 2003; Stern, 1992). As a result, a popular management solution is to provide visitors with the appropriate information by the use of information boards, pamphlets and exhibitions (Eastmana et al., 2013; Priskin, 2003b). Another problematic behaviour that was consistently mentioned was littering. A range of management techniques can be used to address this prevalent problem, such as providing education to prevent littering, administering fines to penalise those who litter, and to provide more cleaning and waste facilities (Eastmana et al., 2013). The current findings do not necessarily offer new management techniques but rather provide a starting point on which activities should be given greater priority regarding management solutions. Activity-specific management techniques are required for the visitors to continue to experience the range of benefits rocky shores offer; however more research is still needed within both the recreational uses of this environment and for other uses such as accessibility to the water (e.g. boating).

4.3. Conclusion

The two studies presented here on coastal experts, coastal users and international coastal academics have extended the existing literature by examining recreational visits in more detail. Using an integrative approach examining both perceived risks to the environment and benefits for the visitor, we found that rocky shores are perceived to have great benefits for the visitor, including improving mood and increasing marine awareness. Additionally, these visits were associated with a number of risks regarding the habitat, stressing that certain activities can have more harmful impacts on the environment than others. There was extensive agreement between coastal experts and coastal users in all aspects. Findings were also comparable beyond the British context. By examining a range of activities, we were able to deduce which activities were seen to be especially beneficial for the visitors but have the greatest risk on the environment. By examining the two effects together for the first time, this research offers a new approach to understanding and managing the costs and benefits associated with activities in the coastal environment. With our approach we hope to begin a debate that will contribute to sustaining both visitor benefits and the health of the environment in the long term.

Acknowledgements

The research reported here is funded by an Economic and Social Research Council (ESRC) and Natural Environment Research Council (NERC) interdisciplinary studentship scheme ES/1004130/1). The authors would like to thank Daniel Zahra for his role as the independent second coder for the qualitative data, and numerous coastal experts for their input and support. Special thanks to the Wembury Marine Centre, the National Trust and the 9th International Temperate Reefs Symposium.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ocecoaman.2013.10.005. For additional information regarding materials, please contact the first author.

References

Addison, P.F.E., Koss, R.S., O'Hara, T.D., 2008. Recreational use of a rocky intertidal reef in Victoria: implications for ecological research and management. Aust. J. Environ. Manage. 15 (3), 169–179.
Adelman, L.M., Falk, J.H., James, S., 2000. Impact of national aquarium in Baltimore on visitors' conservation attitudes, behavior, and knowledge. Curator 43, 33–60.
Ajzen, I., 1985. From intentions to actions: a theory of planned behaviour. In: Kuhl, J., Beckmann, J. (Eds.), Action Control: from Cognition to Behavior. Springer, Heidelberg, Germany, pp. 11–39.
Alessa, L., Bennett, S.M., Kliskey, A.D., 2003. Effects of knowledge, personal attribution and perception of ecosystem health on depreciative behaviors in the intertidal zone of Pacific Rim National Park and Reserve. J. Environ. Manage. 68 (2), 207–218.
Ashbullby, K.J., Pahl, S., Webley, P., White, M.P., 2013. The beach as a setting for families' health promotion: a qualitative study with parents and children living in coastal regions in Southwest England. Health Place 23, 138–147.
Barton, J., Pretty, J., 2010. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. Environ. Sci. Technol. 44 (10), 3947–3955.
Beauchamp, K.A., Gowing, M.M., 1982. A quantitative assessment of human trampling effects on a rocky intertidal community. Mar. Environ. Res. 7 (4), 279–293.
Berman, M.G., Jonides, J., Kaplan, S., 2008. The cognitive benefits of interacting with nature. Psychol. Sci. 19 (2), 1207–1212.
Berto, R., 2005. Exposure to restorative environments helps restore attentional capacity. J. Environ. Psychol. 25 (3), 249–259.
Branch, G.M., Thompson, R.C., Crowe, T.P., Castilla, J.C., Langmead, O., Hawkins, S.J., 2008. Rocky intertidal shores: prognosis for the future. In: Polunin, N.V.C. (Ed.), Trends and Global Prospects, pp. 209–225.
Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3, 77–101.
Brosnan, D.M., Crumrine, L.L., 1994. Effects of human trampling on marine rocky shore communities. J. Experi. Mar. Biol. Ecol. 177 (1), 79–97.
Campbell, A., Converse, P.E., Rodgers, W.L., 1976. The Quality of American Life. Russell Sage Foundation, New York.
Cohen, J., 1992. A power primer. Psychol. Bull. 112 (1), 155–159.
Coombes, E.G., Jones, A.P., 2010. Assessing the impact of climate change on visitor behaviour and habitat use at the coast: a UK case study. Glob. Environ. Change 20, 303–313.
Cummins, S., Snively, G., 2000. The effect of instruction on children's knowledge of marine ecology, attitudes toward the ocean, and stances toward marine resource issues. Can. J. Environ. Edu. 5 (1), 305–324.
Davenport, J., Davenport, J.L., 2006. The impact of tourism and personal leisure transport on coastal environments: a review. Estuar. Coast. Shelf Sci. 67 (1–2), 280–292.
Duerden, M.D., Witt, P.A., 2010. The impact of direct and indirect experiences on the development of environmental knowledge, attitudes, and behavior. J. Environ. Psychol. 30, 379–392.
Eastmana, L., Faríasa, P.N., Crettiera, B., Thiel, M., 2013. Identification of self-reported user behavior, education level, and preferences to reduce littering on beaches – a survey from the SE-Pacific. Ocean Coast. Manage. 78, 18–24.
EU, 2011. EU Maritime Policy: Facts and Figures – United Kingdom. Retrieved May 20, 2011 from http://ec.europa.eu/maritimeaffairs/pdf/country_factsheets/uk_en.pdf.
Falk, J.H., Adelman, L.M., 2003. Investigating the impact of prior knowledge and interest on aquarium visitor learning. J. Res. Sci. Teach. 40, 163–176.
Felsten, G., 2009. Where to take a study break on the college campus: an attention restoration theory perspective. J. Environ. Psychol. 29 (1), 160–167.
Field, A., 2005. Discovering Statistics Using SPSS. Sage Publications Ltd, London.
Fife-Shaw, C., 1995. Surveys and sampling issues. In: Breakwell, G.M., Hammond, S., Fife-Shaw, C. (Eds.), Research Methods in Psychology. Sage Publications Ltd, London, pp. 99–115.
Fitzpatrick, S., Bouchez, B., 1998. Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. Bird Study 45, 157–171.
Fletcher, H., Frid, C.L.J., 1996. Impact and management of visitor pressure on rocky intertidal algal communities. Aquat. Conser.: Mar. Fresh. Ecosyst.s 6, 287–297.
Hall, K., 2000. Impacts of Marine Debris and oil: Economic & Social Costs to Coastal Communities. Kommunenes Internasjonale Miljøorganisasjon, Shetland.
Hartig, T., Evans, G.W., Jamner, L.D., Davis, D.S., Gärling, T., 2003. Tracking restoration in natural and urban field settings. J. Environ. Psychol. 23 (2), 109–123.
Jackson, T., 2005. Motivating Sustainable Consumption. A Review of Evidence on Consumer Behaviour and Behavioural Change. Guildford: Sustainable Development Research Network, University of Surrey.
Kaiser, F.G., Fuhrer, U., 2003. Ecological behavior's dependency on different forms of knowledge. Appl. Psychol.: An Int. Rev. 52 (4), 598–613.
Kaplan, S., 1995. The restorative benefits of nature: toward an integrative framework. J. Environ. Psychol. 15 (3), 169–182.
Laist, D., 1997. Impacts of marine debris: entanglement of marine life in marine debris, including a comprehensive list of species with entanglement and ingestion records. In: Coe, J., Rodgers, D.B. (Eds.), Marine Debris: Sources, Impacts and Solutions. Springer, Miami. Series for Environmental Management 1997.
Landis, J.R., Koch, G.G., 1977. The measurement of observer agreement for categorical data. Biometrics 35, 159–174.
Laumann, K., Gärling, T., Stormark, K.M., 2001. The restorative benefits of nature: toward an integrative framework. J. Environ. Psychol. 21 (1), 31–44.
Laumann, K., Gärling, T., Stormark, K.M., 2003. Selective attention and heart rate responses to natural and urban environments. J. Environ. Psychol. 23 (2), 125–134.
Marine Conservation Society, 2012. Beachwatch Big Weekend: 2012 Summary Report Results. Retrieved July 6, 2013 from http://www.mcsuk.org/downloads/pollution/beachwatch/2012/Beachwatch_summary_2012_lowres.pdf.
Millward, L.J., 1995. Focus groups. In: Breakwell, G.M., Hammond, S., Fife-Shaw, C. (Eds.), Research Methods in Psychology. Sage Publications, pp. 274–292.
Natural England, 2010. Monitor of Engagement with the Natural Environment: the National Survey on People and the Natural Environment. Retrieved December 15, 2010 from http://naturalenglandetraderstores.com/NaturalEnglandShop/NECR049.
Oakley, J., 2010. Seashore Safaris: Exploring Rocky and Sandy Seashores with Judith Oakley. Graffeg, Wales.
Pinn, E.H., Rodgers, M., 2005. The influence of visitors on intertidal biodiversity. J. Mar. Biol. Assoc. 85, 263–268.
Porter, C., Wescott, G., 2004. Recreational use of a marine protected area: point Lonsdale, Victoria. Aust. J. Environ. Manage. 11 (3), 201–211.
Prescott, R.C., 2009. An investigation into the impacts of recreational activities on intertidal assemblages at Westward Ho, Devon. Earth Environ. 2, 211–252.
Priskin, J., 2003a. Physical impacts of four-wheel drive related tourism and recreation in a semi-arid, natural coastal environment. Ocean Coast. Manage. 46 (1–2), 127–155.
Priskin, J., 2003b. Tourist perceptions of degradation caused by coastal nature-based recreation. Environ. Manage. 32 (2), 189–204.
Russell, J.A., 1980. A circumplex model of affect. J. Pers. Soc. Psychol. 39 (6), 1161–1178.
Ryan, R.M., Deci, E.L., 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. Annu. Rev. Psychol. 52, 141–166.
Slovic, P., 1987. Perception of risk. Science 236 (4799), 280–285.

Slovic, P., Fischhoff, B., Lichtenstein, S., 1977. Behavioral decision theory. Annu. Rev. Psychol. 28, 1–39.
Smith, J.R., Fong, P., Amrose, R.F., 2008. The impacts of human visitation on mussel bed communities along the California coast: are regulatory marine reserves effective in protecting these communities? Environ. Manage. 41 (4), 599–612.
Staats, H., Kieviet, A., Hartig, T., 2003. Where to recover from attentional fatigue: an expectancy-value analysis of environmental preference. J. Environ. Psychol. 23 (2), 147–157.
Steel, B.S., 2005. Public ocean literacy in the United States. Ocean Coast. Manage. 48 (2), 97–114.
Stern, P.C., 1992. Psychological dimensions of global change environmental change. Annu. Rev. Psychol. 43, 269–302.
Stern, P.C., Oskamp, S., 1987. Managing scarce environmental resources. In: Stokols, D., Altman, I. (Eds.), Handbook of Environmental Psychology. Wiley & Sons, Inc, United States of America, pp. 1043–1088.
Thompson, R.C., Crowe, T.P., Hawkins, S.J., 2002. Rocky intertidal communities: past environmental changes, present status and predictions for the next 25 years. Environ. Conserv. 29 (2), 168–191.
Tudor, D.T., Williams, A.T., 2006. A rationale for beach selection by the public on the coast of Wales, UK. Area 38 (2), 153–164.
UK CEED, 2000. A Review of the Effects of Recreational Interactions within UK European Marine Sites. In: Countryside Council for Wales (UK Marine SACs Project), p. 264.
Ulrich, R.S., 1984. View through a window may influence recovery from surgery. Science 224, 420–421.
van den Berg, A.E., Koole, S.L., van der Wulp, N.Y., 2003. Environmental preference and restoration: (how) are they related? J. Environ. Psychol. 23 (2), 135–146.
Vlek, C.A.J., 1996. A multi-level, multi-stage and multi-attribute perspective on risk assessment, decision-making and risk control. Risk Decis. Policy 1, 9–31.
White, M., Smith, A., Humphryes, K., Pahl, S., Cracknell, D., Depledge, M., 2010. Blue space: the importance of water for preference, affect, and restorativeness ratings of natural and built scenes. J. Environ. Psychol. 30 (4), 482–493.
White, M.,P., Pahl, S., Ashbullby, K., Herbert, S., Depledge, M.H., 2013. Feelings of restoration from recent nature visits. J. Environ. Psychol. 35, 40–51.
Wildlife Trusts, 2005. Conference on Public Understanding of the Marine Environment: Post Conference Report.
Wyles, K.J., Pahl, S., White, M., Morris, S., Cracknell, D., Thompson, R.C., 2013. Enhancing the “marine mindset”: the effects of an aquarium visit and information booklet on attitudes and intentions about fish sustainability and marine pollution. Visitor Stud. 16 (1), 95–110.
Zeppel, H., Muloin, S., 2007. Marine wildlife tourism: education and conservation benefits. In: Luck, M., et al. (Eds.), Proceedings of the 5th Coastal & Marine Tourism Congress: Balancing Marine Tourism, Development and Sustainability, pp. 430–446.