Describing and mapping where people experience tranquillity. An exploration based on interviews and Flickr photographs

Mapping tranquillity based on interviews and social media data

Abstract

It has been demonstrated that there are health benefits associated with tranquillity, but tranquil areas are increasingly threatened by development. Consequently, the need arises to map areas where people experience tranquillity. As conducting interviews and surveys across large areas is often cost-prohibitive, we examine the utility of social media data in studying tranquillity. For a case study in the Loch Lomond and The Trossachs National Park in Scotland we combined field-based interviews with an analysis of social media data. By asking respondents what made a setting tranquil, we collated a list of words positively associated with tranquillity. Based on this list we selected georeferenced Flickr images with tags matching our keywords and mapped the location of these images. The tranquillity map from social media data portrays areas near large water bodies as tranquil, which corresponds well the responses from field-based interviews. These findings differ from existing noise maps, suggesting that people experience tranquillity despite distractors such as human presence or traffic noise. Based on our findings we propose to distinguish two notions of tranquillity:'potential tranquillity' as modelled using data on land use and infrastructure and'experienced tranquillity', which are areas where people actually experience tranquillity. From a management and planning perspective both approaches have validity and can be combined for an integrated assessment of tranquillity.

Keywords: tranquillity mapping, user-generated content, social media photographs, landscape perception, landscape planning, Loch Lomond and The Trossachs National Park Scotland

1. Introduction

There is an increasing recognition of the restorative qualities of tranquil landscapes (Bieling et al., 2014; Kaplan, 2001; Watts et al., 2013), and areas

where people find tranquillity have been shown to provide positive health effects (Seresinhe et al., 2015; Shepherd et al., 2013; Velarde et al., 2007). The protection of tranquil areas has become an important policy objective at the European level, with the Environmental Noise Directive (END) highlighting the importance of protecting such areas (EEA, 2016b). In the UK, tranquillity was included in the National Planning Policy Framework (2012, §123). Such is its importance that UK government policy effectively places an obligation on local authorities to identify zones of tranquillity in consultation with local communities (Department of Communities and Local Government 2012, 52). Existing maps that can be used for such assessments include the 'quiet areas' defined by the EEA (2016b). Efforts to model potential tranquillity are reflected in the Tranquillity Map for England published by the Campaign to Protect Rural England (CPRE, 2007). These maps portray an expert-based view of tranquillity, which does not necessarily reflect realities on the ground. This is problematic in the context of protected area management, which is meant to be in response to societal needs.

Thus, with the strategic aim to identify and protect areas of tranquillity in the UK and elsewhere, the need arises to provide maps about where such areas exist, and how they can be accessed - these maps then forming an integral part of evidence-based landscape planning and decision-making. We take as an example the case of Loch Lomond and The Trossachs National Park (LLTNP) in Scotland, which has identified the need for a tranquillity map that takes into account people's experience in order to plan and manage recreational amenities and further improve overall recreational service provision in the national park (pers. comm. S. Melville, Landscape Officer LLTNP).

Qualitative interviews and detailed surveys are well-established methods that might be used to elicit information about where tranquillity is experienced, but interviewing people across large areas is often cost-prohibitive. In this respect, the advent of social media platforms where people upload content about their experiences in different places provides us with a novel data source that can be used to analyse environmental experiences (Dunkel, 2015). With the availability of these sources of information, questions arise as to what insights we are able to gain from social media data, and whether such information could eventually be harnessed as a surrogate for more conventional sources of geographic information (van Zanten et al., 2016; Wartmann et al., 2018). The ambition of this paper is to illustrate the potential of social media data as a way of exploring the notion of tranquillity as it is

experienced. Specifically we aim to:

1. Demonstrate the role of social media data in describing tranquillity 'as experienced'
2. Assess the truthfulness of Flickr geotagged data by comparison with data gathered via questionnaires conducted in the LLTNP
3. Comment on the efficiency of using Flickr data in gathering large samples, over large geographic extent as compared with field based techniques
4. Illustrate the use of complimentary forms of analysis to explore tranquillity

To address these aims, we developed a hybrid methodology that combines field-based interviews and tranquillity ratings with an analysis of social media data.

2. Background

In the Oxford English dictionary, tranquillity is defined as *'The quality or state of being tranquil; freedom from disturbance or agitation; serenity, calmness; quietness, peacefulness.'* (`http://www.oed.com/`). From a research perspective, tranquillity has been investigated using a variety of approaches from different fields, including environmental psychology, acoustics, the social sciences, and Geographic Information Science.

2.1. Image rating experiments in environmental psychology

Kaplan's attention restoration theory states that natural environments offer escape from the pressures of everyday stress. In contrast to urban environments, natural environments are considered to relieve our fatigued attentional capacity through what Kaplan and Kaplan coined 'soft fascination' (Kaplan and Kaplan, 1989) - the effortless pleasure of watching a burbling stream, or clouds passing overhead. Herzog and Bosley (1992) explored whether tranquil environments could be distinguished from preferred ones through an image rating experiment of different landscape settings. Preference and tranquillity ratings were highly correlated, but tranquillity was rated higher for certain landscape settings, including scenes showing large water bodies (Herzog and Bosley, 1992). Herzog and Chernick (2000) showed that tranquillity was rated significantly higher in natural settings than in urban ones, with perceived open space, how well-cared a setting appeared to be and the

amount of foliage positively correlated with tranquillity ratings in natural areas.

2.2. Measuring soundscapes

Various researchers have explored the connections between anthropogenic and natural soundscapes and tranquillity. Pheasant et al. (2008) exposed subjects to combinations of imagery and soundscape in order to explore their correlation with tranquillity. They developed a tool for predicting tranquillity based on the naturalness of a scene, and sound pressure levels - the so called TRAPT model (Pheasant et al., 2009), which revealed a linear relationship between increasing tranquillity and naturalness and an inverse relationship with decreasing levels of noise. Watts et al. (2013) explored refinements to the tranquillity prediction tool of Pheasant et al. (2009), examining its utility in urban green spaces. The same methodology was applied in the context of wind farms (Watts and Pheasant, 2015a) and then more broadly in rural contexts (Watts and Pheasant, 2015b). They concluded that soundscape impacts people's sense of tranquillity and should therefore be an integral part of the assessment process.

The importance of sound is reflected in the European wide Quietness Suitability Index (QSI) - a model that uses a combination of naturalness and noise modelling (EEA, 2016b).

2.3. Mapping tranquillity

The Campaign to Protect Rural England (CPRE) has been drawing attention to tranquillity and tranquil areas since the 1990's (CPRE, 2005; CPRE and the Countryside Commission, 1995; MacFarlane et al., 2004; Jackson et al., 2008), defining'tranquil areas' as: *'places which are sufficiently far away from the visual or noise intrusion of development or traffic to be considered unspoilt by urban influences'* (CPRE and the Countryside Commission, 1995). The first mapping was undertaken by Simon Rendel and ASH consulting in 1991 for the Department of Transport, showing how significant tracts of land affected by a proposed transport corridor in Central England were undesignated and therefore vulnerable to development. This original work brought to the fore the merits of mapping tranquil areas for policy-making and planning (Rendel, 1998). In producing a set of tranquil area maps for England, the focus was on the impact of audio-visual aspects such as roads, railways, power stations, and large towns on tranquillity in terms of distance thresholds (CPRE and the Countryside Commission, 1995).

On behalf of CPRE, Levett (2000) produced a report detailing a number of limitations of the model used to map tranquil areas, which subsequent mapping projects attempted to address; these included the use of fixed thresholds of distances from noise sources, the failure to model the cumulative effects of multiple low-level noise sources, and expert-based definitions of criteria and thresholds (Levett, 2000). A subsequent mapping project in the Northumberland National Park and West Durham Coalfield in England sought to address Levetts criticisms and in particular, to include the views of the public (MacFarlane et al., 2004). However, most answers from the public consultation exercise were deemed incompatible with the requirements for a model in a Geographic Information System (GIS). The operationalisation of factors contributing and diminishing tranquillity was thus done by the researchers themselves, with layers weighted according to scores defined through another public consultation phase (MacFarlane et al., 2004). This approach was further developed in a follow-up study a tranquillity map for the whole of England produced (Jackson et al., 2008; CPRE, 2007). For this national tranquillity map (CPRE, 2007), over 1000 people were consulted in five locations to rate the factors contributing to, and detracting from, tranquillity. In order to define the thresholds for the criteria represented as GIS layers (e.g. the distance at which the impact of a road on tranquillity decreases), the study encompassed photo-rating tasks (Jackson et al., 2008). Another study in the Dorset Area of Outstanding Beauty incorporated views from different stakeholders in the protected area (local authorities and agencies, visitors and residents, including those considered hard to reach), totalling over 800 participants, whose views were assessed through participatory appraisals including focus groups, household and on-site surveys (Hewlett et al., 2017). The on-site surveys identified the importance of open landscape, and the absence of anthropogenic noise, traffic and people in influencing visitors' sense of tranquillity. From these data, the information that was deemed quantifiable was represented in a GIS model. Such a mixed-methods approach is valuable to planners and decision-makers because it integrates both qualitative and quantitative data, and using GIS, offers ways to visualise a subjective concept such as tranquillity (Hewlett and Brown, 2018).

3. Materials and Methods

In this study, we developed a methodology to investigate tranquillity through language-based approaches, linking terms to space via user-generated images, making use of increasingly available volumes of social media data. In what follows, we describe in more detail how we applied this methodology to our case study area of the Loch Lomond and The Trossachs National Park in Scotland.

3.1. Study area

The Loch Lomond and the Trossachs National Park was created in 2002 as the first national park in Scotland, covering an area of 1865 km^2. The terrain is varied, with mountains and glens, as well as many saltwater and freshwater lochs, including iconic Loch Lomond. The vegetation includes native woodlands, plantation forests, meadows and agricultural fields. Importantly, the landscapes in the national park are cultural landscapes that have been shaped by people for generations. Currently, over 15,000 people reside in the park (LLTNP, 2017). The landscapes of Loch Lomond have long proved popular for national and international tourists alike, their beauty reflected, for instance, in the writings of Sir Walter Scott (1771-1832). Nowadays the park attracts over 4 million visitors every year (LLTNP, 2017). Although some public transport exists, many areas of the park are difficult to reach, and a recent survey found that over 85% of visitors rely on private transport (LLTNP, 2017).

3.2. Selecting locations for field-based interviews and tranquillity ratings

To elicit information about how people experience tranquillity, we conducted interviews and tranquillity ratings with participants recruited at different locations in the park. A map of interview locations is shown in Fig. 1 and the landscapes at some of the interview sites are illustrated in Fig. 2.

We selected the interview sites as the locations used for viewpoint analysis in the 'Special Landscape Qualities' report by Scottish Natural Heritage SNH (2010) to stratify our sample based on landscape types. The sites were distributed across the national park and were chosen in anticipation of future comparative research that is not reported here. Remote locations were excluded if they did not yield more than the threshold of 2 visitors per hour. Additional sites (e.g. Loch Chon, Loch Lubnaig, Loch Venachar) were added on the advice of park managers keen to learn whether recent interventions to

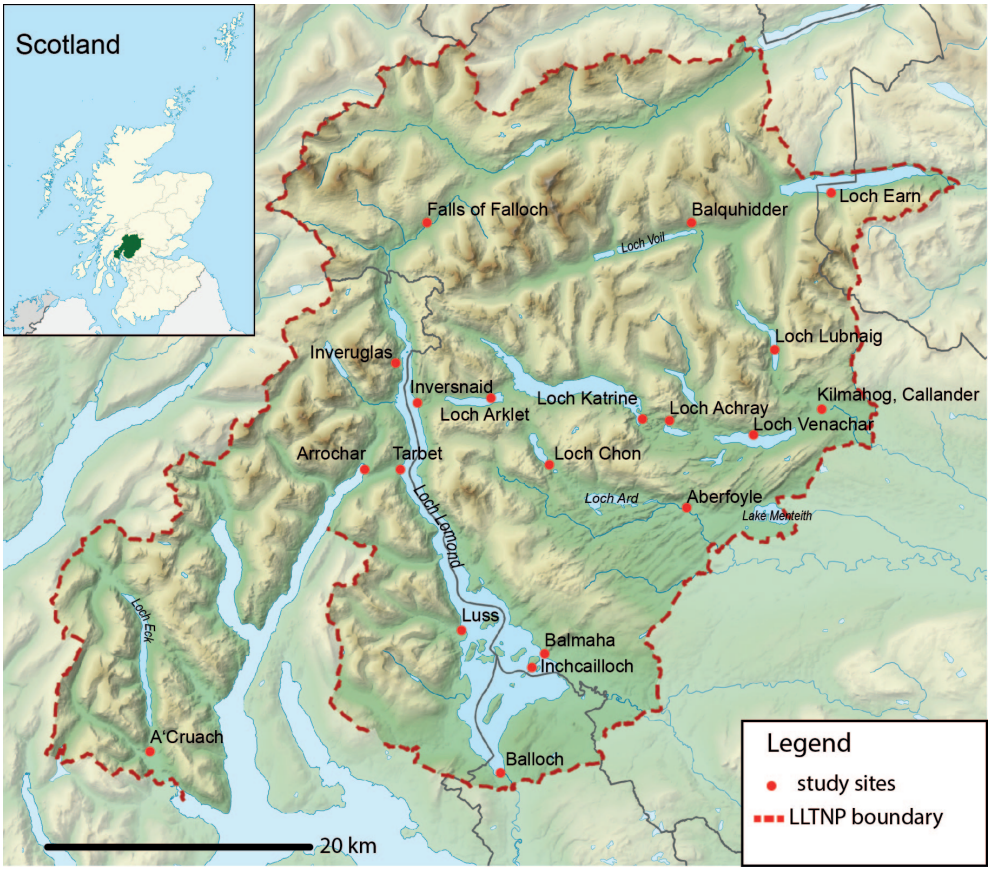

Figure 1: Locations of interview sites (base map credit: Nilfanion, licensed under Creative Commons CC BY-SA 3.0, contains Ordnance Survey data ©Crown copyright and database right, image accessed from https://tinyurl.com/y97u9nqv, 23.1.2018).

improve recreational experiences had improved visitor's perception of tranquillity.

3.3. Field-based interviews about people's experience of tranquillity

To reduce the influence of weather condition and interviewer variation, the first author of this study conducted all interviews on relatively sunny days between 11th July and 3rd August 2017. We selected participants based on a convenience sample, while seeking to balance our sample with respect to age and gender. Respondents were asked the following open questions: 'what makes this place more tranquil?', and 'what makes it less tranquil?'. Respondents were then asked to rate the tranquillity of the place where the

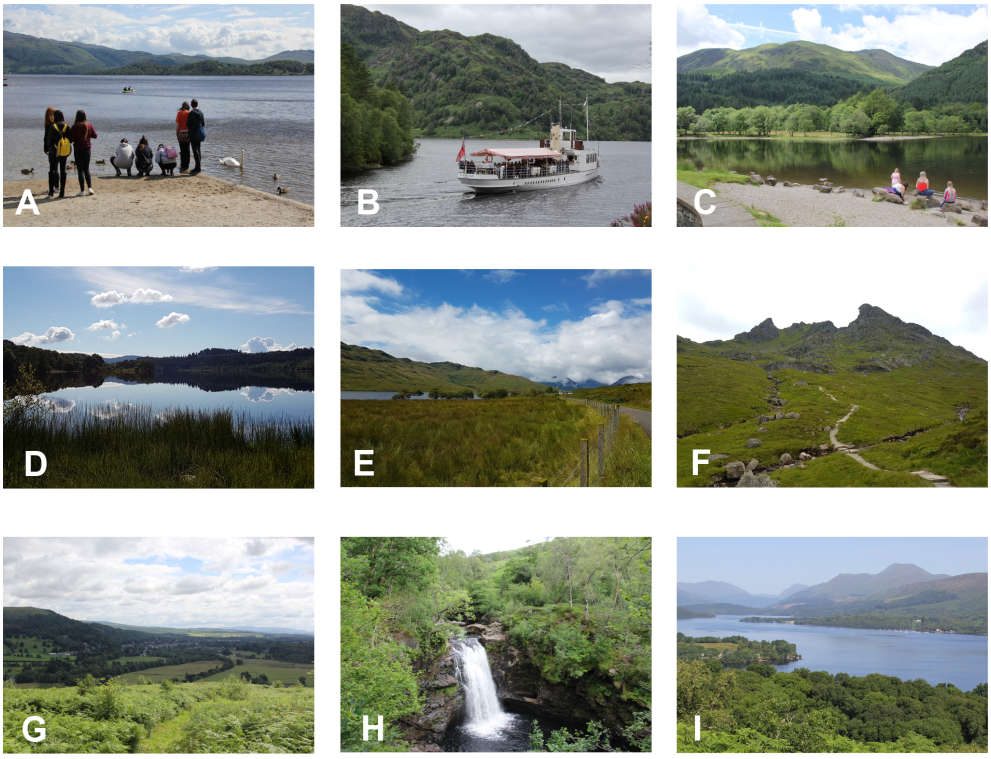

Figure 2: A: Tarbet, Loch Lomond; B: Loch Katrine; C: Loch Lubnaig; D: Loch Venachar; E: Loch Arklet; F: Ben Arthur, Arrochar; G: Callander and surrounding areas; H: Falls of Falloch; I: Inchcailloch, Loch Lomond

interview was conducted on a 5-point scale, where 1 was 'not tranquil' at all and 5 was 'very tranquil'. Respondents were also asked to list places in the LLTNP that they thought were particularly tranquil, and to state what made them so. The question was repeated for places that they thought were not tranquil. The interview concluded with a set of closed questions about activities respondents conducted while in the national park, their frequency of visits, residency (classified as: within the LLTNP, elsewhere in Scotland, in the UK, outside UK), how they classified their current place of residence (urban, rural, or in between), age group, and gender.

3.4. Analysing interview responses

We applied 'open coding' (Crang and Cook, 2007), a method from social sciences to identify emerging themes in our data. With a list of topics we then conducted 'structured coding' (Crang and Cook, 2007), where all interview

statements are allocated to identified themes. Assuming the more a theme was mentioned, the more important it was, we enumerated the number of mentions per theme.

From the interview responses we then produced a list of terms according to the frequency of mentions. From this list we removed negated expressions (e.g. *not busy, no people, no trash*) and stop words (e.g. *they, only, it, and*). We thus retained single terms that had positive connotations (e.g. *peaceful, quiet, relaxation, water*), resulting in a list of 216 terms associated with tranquillity.

3.5. Modelling tranquillity from user-generated content

We used content from the photosharing Flickr (`www.flickr.com`) as a data source. On Flickr, registered users can upload images. These are often titled and labelled with terms describing the image – so-called 'tags' (Fig. 3). The tags help other users find images, which provides an incentive for users to provide accurate and meaningful tags so that their photos can be 'liked' by other users. Tags encapsulate the atmosphere and experience of the photographer, making them an interesting source of information to study place-based experiences that, at the time of writing, was available free of charge for research purposes. A proportion of images are also furnished with geographic coordinates that enable us to spatially analyse their distribution.

We used the set of 216 keywords defined from interviews to search for images on Flickr with tags that matched at least one of those keywords. We accessed Flickr images through the Flickr Application Programming Interface (API), which, for the terms selected, enabled us to retrieve georeferenced images falling within a bounding box covering our study area. We accessed the API through a Java-programme that we developed specifically for this purpose. The resulting dataset consists of meta-information from images matching the search criteria in the bounding box of the national park, which include a set of decimal degree coordinates for each image, tags, title, date taken, the URL of the image, and the username of the contributor. As a preprocessing step we filtered bulk uploads. A bulk upload is where one user adds many images with the same tags (Hollenstein and Purves, 2010), which artificially increases the sample size without adding any new information.

To obtain information about how unexpected our result were, the distribution of Flickr images with all selected tranquil tags (observed distribution of Flickr images, *obs*) needs to be corrected for the overall underlying distribution (expected distribution, all Flickr images, *exp*). We therefore applied

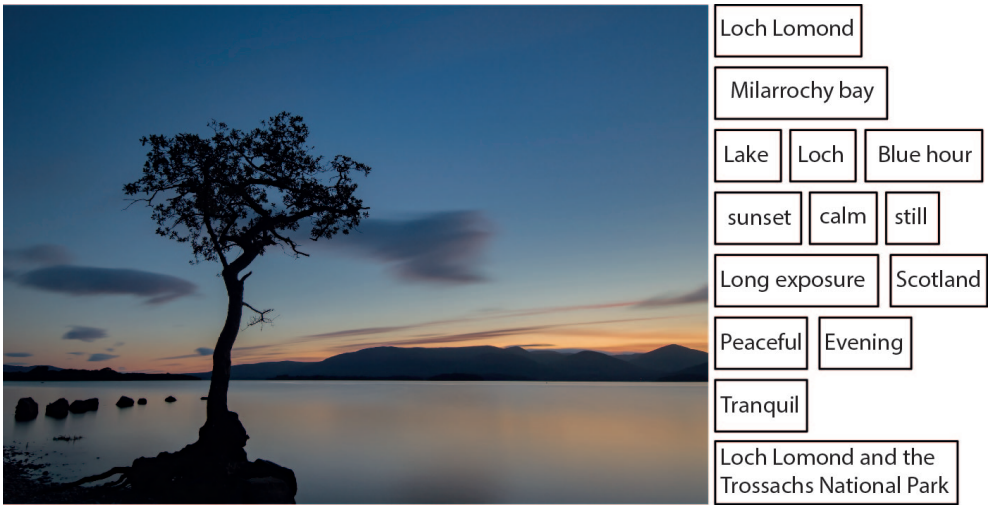

Figure 3: Users generate content in the form of images and text descriptions (tags). Image: 'Blue Hour at Loch Millarochy' by Rob Donnelly on Flickr.com, licensed under Creative Commons (CC BY-NC-ND 2.0)

correction methods reported in similar studies that use Flickr data (Hollenstein and Purves, 2010; Gschwend and Purves, 2012) and calculated a χ-expectation surface that highlights where we found more, equal or less content than expected as compared with the underlying distribution:

$$\chi = \frac{(obs - exp)}{\sqrt{exp}} \tag{1}$$

To generate the expected distribution (exp), we created a 1x1km grid cell raster. We chose a relatively large raster size because the content of an image might be reflective of the environment of both the local environment where the image was taken, not just the location itself. We then calculated the number of images per grid cell, both for images with selected tags (obs) and for all images (exp). We normalised the obs grid by multiplying each grid value by the total number of Flickr images in the bounding box divided by the total number of Flickr images in the dataset that contain that selected tag. We then calculated the χ-expectation surface. This expectation surface is based on our full list of terms from interviews positively connotated with tranquillity, representing a participant-based view of tranquillity.

3.6. Comparing tranquillity map from user-generated content with field-based tranquillity ratings and quiet area map

We analysed tranquillity ratings from interview respondents using descriptive statistics and tested for significant differences between mean tranquillity ratings at different interview locations, as well as between mean ratings from people living in rural, urban and peri-urban settings. Since the data were not normally distributed, we applied the non-parametric Kruskal-Wallis test using a significance level of $\alpha = 0.05$. As a final step, we compared our map showing the χ-expectation surface of images with all tags from interviews positively associated with tranquillity with two other outputs: 1) tranquillity ratings we collected from interview respondents in the field and 2) the map of quiet areas produced by the European Environmental Agency (EEA, 2016b). This was done by visually assessing differences between the different approaches.

4. Results and Interpretation

4.1. Exploring tranquillity through interviews

In total we interviewed 100 respondents, 49 women and 51 men. People between 30 and 49 years were overrepresented in our sample (n=40), compared to other age groups (18-29 years: n=21; 50-64 years: n=18; 65+ years: n= 21). The largest part of respondents lived in Scotland (n=43), followed by international visitors from outside the UK (n=35). Eighteen respondents lived elsewhere in the UK, and four were residents of the national park. For 46 respondents it was their first visit, while other respondents had visited the park before with varying frequencies. The three main reasons for visiting the park were hiking, enjoying the views and tranquillity. Fresh air and camping were also mentioned, but to a lesser degree (Fig. 4).

We identified several themes that respondents thought made the interview location more tranquil (Tab. 1). The absence of people was most prominently mentioned, followed by the presence of certain landscape elements, such as water bodies and mountains, and the absence of noise from traffic and other disturbances. Other positively contributing factors were the presence of nature and wildlife, as well as scenery and natural sounds. Furthermore, several respondents stated that other people who behaved responsibly, and the absence of trash contributed to their feeling of tranquillity (Tab. 1). The most frequently mentioned terms that were positively associated with tranquillity included *water, tranquil*, and *nature*. When people described tranquil places

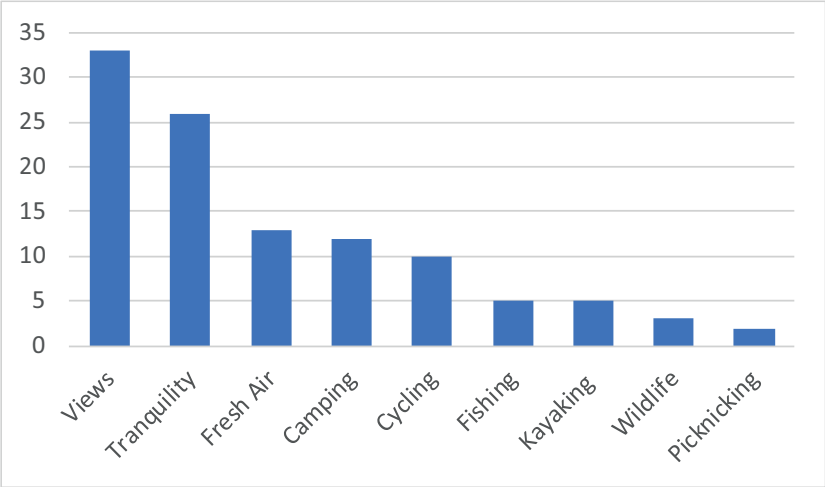

Figure 4: Reasons for visiting the national park (multiple answers were possible)

they also used terms that were semantically closely related to tranquillity, including: *atmosphere, calmness, peace, peaceful, pleasant, serene, serenity, tranquillity, tranquil, silence, silent, quiet*.

In contrast, the presence of people, and traffic was stated as making interview locations less tranquil (Tab. 2). Windy and rainy weather was also frequently mentioned as decreasing tranquillity.

4.2. Exploring perception of tranquillity through user-generated content

Using our terms extracted from interviews, we collected and retained a set of 22,082 images after pre-processing. User contribution was unequal (Max=780 images; Min=1 image; Mean=21.80; Median=2; ±5.63) and showed a long-tail. For example, 3537 users each uploaded 10 images or less, while 21 users each uploaded over 100 images. The data set representing the complete underlying distribution for the study area contained 46,886 images after pre-processing, stemming from 6851 different users (Max=1081 images; Min=1 image; Mean=6.84; Median=2; ±30.61).

The χ-expectation surface shows that people uploaded more pictures with tags relating to tranquillity around Loch Lomond and other freshwater bodies such as Loch Katrine, Loch Venachar and Loch Lubnaig than would be expected from all Flickr images uploaded (Fig. 5) indicating the experience of tranquillity may be linked to these landscape elements. Fewer images with tags related to tranquillity than expected were uploaded around settlements

Theme	No. of responses
Absence of people	38
Landscape elements	28
Absence of noise	21
Nature and wildlife	18
Scenery	14
Water	12
Change from everyday life	10
Absence of infrastructure	11
Friendly people	8
Fresh air	7
Absence of trash	4

Table 1: Interview responses for the question on 'what makes this place more tranquil'

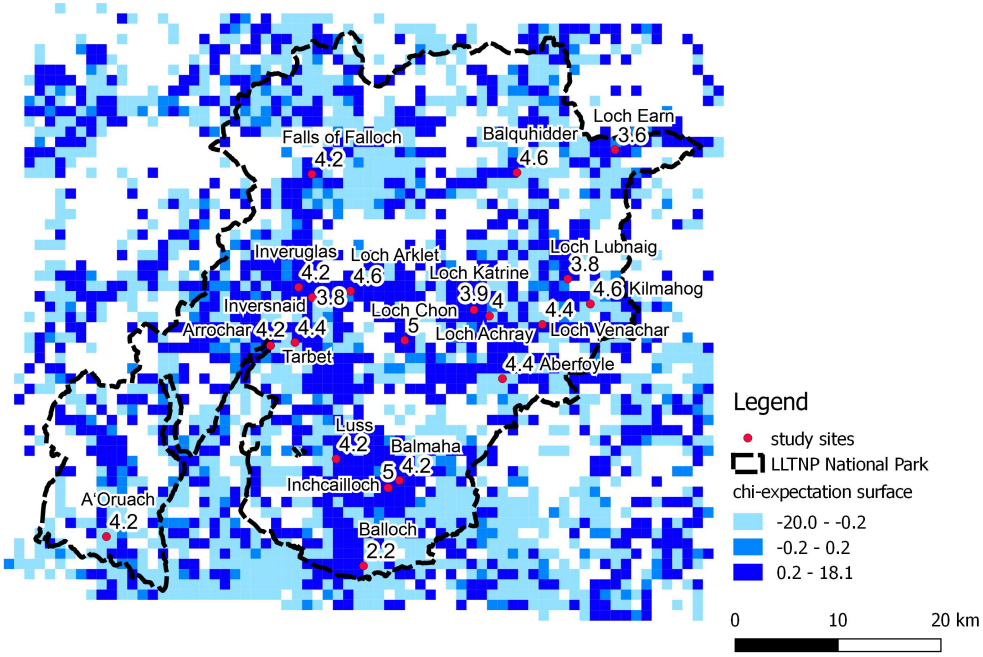

Figure 5: χ-expectation surface for Flickr images with all tags related to tranquillity and mean tranquillity ratings from respondents in the field (5: very tranquil, 1: not tranquil)

Theme	**No. of responses**
Presence of people	39
Presence of traffic and infrastructure	29
Windy or rainy conditions	14
Antisocial behaviour	12
Anthropogenic noise	11
Litter	6
Time of year	3
Land use	2

Table 2: Interview responses for the question on 'what makes this place less tranquil'

and towns such as Callander, Balloch, and Aberfoyle. At the shores of Loch Lomond near Balloch less content was uploaded than expected, despite the closeness to a water body. Other areas where we observe less images than expected despite the presence of water were Lake Menteith and the Western shore of Loch Earn at Lochearnhead. We also observe 'white spots' on the tranquillity map where there is no user-generated content available. We hypothesise these areas are either not photogenic, or are not accessed by users inclined to upload photos. The area North of Loch Katrine is not accessible by motorised transport and is characterised by glens and hills, suggesting this area might be challenging to access for many people. However, for the topographically challenging terrain between the Northernmost point of Loch Lomond and Loch Voil people uploaded content. This area is characterised by negative χ-values, indicating that there is less content related to tranquillity than expected from the overall distribution.

4.3. Field-based tranquillity ratings

Across the 20 interview locations, the mean perceived tranquillity rating was relatively high with 4.18 out of 5 ($\pm$0.92, median=4; N=100). The locations with highest rated tranquillity were the island of Inchcailloch in Loch Lomond and the campsite at the shores of Loch Chon, which were both rated 5 by all respondents. The lowest mean tranquillity rating for an interview location was 2.2 ($\pm$0.45; n=5) at the shores of Loch Lomond in Balloch. There were significant differences between interview locations (Kruskal-Wallis χ^2=32.768; df=19; p=0.026). Across all interview locations, we did not find differences in how people living in rural, urban or peri-urban

areas perceived tranquillity (Kruskal-Wallis χ^2=2.646; df=2; p=0.266).

4.4. Comparing different approaches for mapping tranquillity

We first compare our approach based on user-generated content with the *in situ* ratings we collected, before comparing both these results with the map of 'quiet areas' (EEA, 2016b). Comparing the tranquillity ratings from interviews in the field with the χ-expectation surface of user-generated content we observe the following: the interview locations are almost all located in grid squares with positive χ-values, indicating more content semantically related to tranquillity was uploaded in these squares. The highest tranquillity ratings from respondents coincide with relatively contiguous areas of high χ-values, such as around Loch Chon and Inchcailloch. The lowest tranquillity rating for Balloch is at the border of an area with negative χ-values, suggesting lower perceived tranquillity. The tranquillity ratings collected in the field thus correspond well with the χ-expectation map from user-generated content, with some exceptions. For example, one site at the Southwestern tip of the national park was rated as relatively tranquil (mean rating of 4.2 out of 5), but is located in an area with negative χ-values. The same applies to Kilmahog, near Callander. Thus, while the overall insights we gain about areas perceived as tranquil correspond with the map from user-generated content and respondents' rating, user-generated content fails to capture finer-grained nuances of the experience of tranquillity we capture through interviews.

Comparing the map of tranquillity ratings from interview respondents with the quiet area map (EEA, 2016b), we observe agreement over freshwater bodies, which are considered highly tranquil/quiet, such as Loch Lomond, Loch Katrine and Loch Chon (Fig. 6). However, stark contrasts between the two maps exist in areas where major roads run alongside water bodies. The quiet area map depicts this area with the lowest possible rating of quietness, whereas participants rated most of these areas (except Balloch) 4 or higher (out of 5). In some cases, the entire area of freshwater bodies is rated as the lowest quietness index (such as Loch Earn), whereas respondents rated this location as moderately tranquil (mean=3.6).

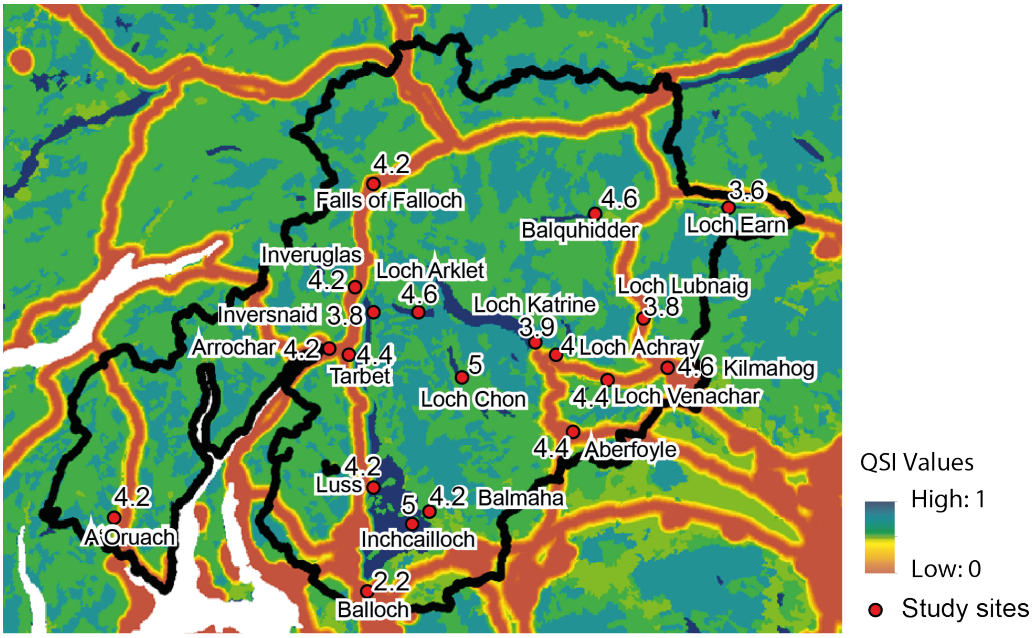

Figure 6: Quietness Suitability Index values (EEA, 2016a) overlaid with mean tranquillity ratings from respondents at study sites (5: very tranquil, 1: not tranquil)

5. Discussion

5.1. A hybrid methodology to assess and map experienced tranquillity

Our aim was to assess where people visiting a Scottish national park experience tranquillity using a combination of qualitative and quantitative approaches. Our results from interviews show that most respondents perceive tranquillity as a multi-sensory experience involving not only sound and sight, but also smell, as well as emotional responses to the environment. This is in line with previous research highlighting that tranquillity was influenced not only by sounds but also by visual stimuli (Watts and Pheasant, 2015b; Pheasant et al., 2010). The results of our qualitative interviews about factors contributing to tranquillity are in line with previous studies in England highlighting the importance of people and traffic (Jackson et al., 2008; Hewlett et al., 2017), although some nuances may be found in responses between different groups of people. For example, a tranquillity mapping study in the Dorset Area of Outstanding Natural Beauty showed how visitors rated traffic as a higher detractor from tranquillity as compared with the local residents (Hewlett et al., 2017). Although our interview results are in line with other

studies, in some instances they reveal locations experienced as being tranquil despite many people being present, and which were readily accessible by motorised transport. We found high correspondence between the tranquillity map based on UGC and the tranquillity ratings from respondents in the field – suggesting that this form of UGC is a meaningful alternative to field based interviews.

We found marked differences with an existing map of quiet areas (EEA, 2016b). While tranquillity ratings and the UGC map show tranquil areas around freshwater bodies, often irrespective of roads nearby, the map of quiet areas depicts these areas as heavily impacted by noise. One reason for these differences may be that the maps of quiet areas allocate high importance to detractors such as noise, whereas tranquillity as experienced in the field seems to be less influenced by traffic noises, but more by perceived aesthetic qualities of the visible surroundings. This suggests that people were able to stand in a busy layby, 'see' past the noise, and allow the visual stimuli to dominate their experience. In this way, a busy layby became a tranquil place. This integrated experience may be different in field settings where people have certain expectations about the areas they visit for recreation, compared with controlled experiments, where anthropogenic noise was shown to reduce tranquillity ratings of natural scenes (Watts and Pheasant, 2015b).

5.2. From a potential for tranquillity towards experienced tranquillity

In tandem with others, our findings suggest that the presence of other people and the absence of noise are the main drivers for people's experience of tranquillity in outdoor settings. Landscape elements and characteristics may play a prevalent role in conjuring up tranquillity despite the presence of other people or traffic. Perhaps this experience in the outdoors differs from how one imagines and describes an ideal tranquil setting during an interview situation when at home or in a classroom. We thus propose to distinguish two notions of tranquillity: 'potential tranquillity' is how people imagine a tranquil place to be and how they describe such a place. This notion of tranquillity can be modelled as areas where tranquillity can be said to potentially exist, using GIS data and criteria such as remoteness from infrastructure and people (Hewlett et al., 2017; Jackson et al., 2008). The other notion is 'experienced tranquillity', namely areas where people actually experience tranquillity. In this study we investigated experienced tranquillity based on interviews in the field and user-generated content. Our results show that areas of experienced tranquillity do not always overlap with

where potential tranquillity is said to exist. 'Potential tranquillity' models identify remote mountain glens and hill tops with unobstructed views across natural landscapes. These are highly tranquil areas. But only relatively few people possess the motivation, willingness and abilities to physically reach such areas. Analysis of our data showed that areas where tranquillity is actually experienced by many people may be popular parking spots, or loch sides next to roads or camp sites. Thus many people experience tranquillity at the edges or boundaries of tranquil areas. Those edges are zones that are easily accessed and retain enough of the properties to make them feel tranquil. We suggest that such tranquil zones are thus more important to a mass appreciation of tranquillity than the core areas of tranquil areas that may have the highest level of perceived tranquillity (or quietness). Given the emphasis on 'tranquillity as perceived', we argue that planning decisions need to take account of the difference between areas most tranquil, and areas where most people experience tranquillity. Levett (2000, p.13) observed that many visitors to areas valued for their tranquillity '*never venture more than a few hundred yards from car parks on busy roads*'; he concluded that by exploring what kind(s) of access people want could satisfy a large number of visitors without opening up more remote areas. Our findings showed that the provision of amenable infrastructure (e.g. parking, picnic tables, maintained walking paths to loch shores) close to roadsides provide opportunities for many visitors to experience tranquillity. Such observations have important implications for the identification and management of tranquil areas.

5.3. Implications

It is apparent that visitors to LLTNP experienced tranquillity along a continuum. For example, the busy car park on a main road afforded just as much self-reported tranquillity for many people as it did to the few who make the long journey to a remote summit. Accommodating this broad spectrum of experiences within the planning process is very challenging. Do we 'pave over paradise' and facilitate access for the many or do we use a notion of tranquillity more akin to wilderness, and safeguard tranquillity by limiting access to, and development of, such areas? We would argue they are best resolved through participatory planning processes and consultations with stakeholders. In order to provide the necessary information for such decision-making processes in the form of spatial information we should include the complete continuum of tranquillity experiences. Doing so requires the integration of different methodologies, including qualitative and quan-

titative approaches. There is increasing acceptance of the need to develop innovative hybrid methodologies that capture the experience of the public alongside those of experts in decision-making to increase participation – the benefits being ultimately a shared ownership in decision making, greater transparency and accountability (Arnstein, 1969; Sieber, 2006). Our research supports this idea, with the additional benefit of potentially accommodating a broader (less exclusionary) definition of tranquillity. Such broader definitions have the potential to guide decision-making in landscape management, though the question remains as to how different experiences of tranquillity are prioritised.

We acknowledge the considerable effort invested in processes of public engagement, but that environmentally deterministic models (typically using GIS) tend to exclude such experiences and opinions, because of their subjective (non-numerical) form (Thatcher et al., 2016). Leszczynski (2009) argues that the hunger to formalise tends to rule out the qualitiative and the imposition of quantitative measures acts to constrain a richer description of place. More generally the failure to encapsulate people's perceptions of place within GIS reflects a complex set of semantic and ontological issues that go beyond qualitative/quantitative debates. We argue it is not useful to see as a binary the difference between what is publicly experienced and what is represented in GIS models, but to integrate them into decision-making and thus deepen the debate.

5.4. Contribution

In our study, we explored the usability of social media in the form of user-generated tags for exploring tranquillity in space. Previous studies based on tags from user-generated content often used sets of tags defined by experts (van Zanten et al., 2016; Hollenstein and Purves, 2010), or described areas based on tag frequencies and other measures (Gschwend and Purves, 2012). The originality of our approach lies in the combination of field-based assessments of natural language terms people positively associate with tranquillity and user-generated content containing such terms. Such an approach allows the definition of tranquillity to emerge through the language respondents used in describing the concepts they associated with it, and thus addresses issues involved in expert-led, sometimes narrow, definitions of tranquillity. Furthermore, the spatial pattern revealed from user-generated content provides an additional perspective to tranquillity mapping (Hewlett et al., 2017;

Jackson et al., 2008). By comparing the map of user-generated content related to tranquillity with ratings collected from respondents in the field, we provide an empirical evaluation of the efficacy of our approach. In the following, we highlight some limitations of our work and suggest avenues for further research.

5.5. Limitations and further work

We conducted our fieldwork on relatively sunny summer days. However, several respondents stated specifically that they would find the location more tranquil if it was winter, or less tranquil if it was windier. This anecdotal evidence suggests that environmental factors play an important role, and future studies should explore this relationship, for example producing tranquillity maps for different weather conditions. Another limitation is that our sample of interview locations was based on pragmatic considerations related to the number of visitors. This sample only covers a small part of the national park. Furthermore, our sample of interview participants included mostly visitors to the park, whereas local residents may hold different views on where tranquillity can be found (Hewlett et al., 2017). We did not find differences in tranquillity ratings between people residing in urban and rural areas, which could be due to relatively low sample size and the possible influence of factors we were unable to control in a field-setting. The relationship between residential environment and the experience of tranquillity should therefore be explored.

User-generated content such as Flickr data is increasingly being used as a cost effective measure of sentiment, trends and activities (Tenkanen et al., 2017), though authors have also cautioned against data analysis in the absence of theory in the age of 'big data' (Kitchin, 2014). The use of Flickr (more specifically the tags and locations associated with the images) is biased insofar that it is a sample, shaped by the technology and the data ontology employed. Because we can only gain insights about experiences of people who choose to share them through social media it is not a representative sample of the overall population. Nonetheless, research is showing that such data provide information comparable with more cost-intensive approaches (Mancini et al., 2018; Heikinheimo et al., 2017). These limitations notwithstanding, we argue that user-generated content provides insights into tranquillity as perceived, in a manner that is free of the constraints and bias of interviews and questionnaires, whilst providing a sample size large enough for spatial analysis. In future work we aim to scale up our approach to mapping tranquillity

with UGC to study experienced tranquillity across Scotland.

We chose Flickr for its unique combination of geolocation and semantic content of tags, and although a range of other social media platforms could be tested, they are likely to exhibit similar bias. To remedy these limitations, we propose testing further data collection and elicitation methods. This could be done using active inclusion of the public through a citizen science approach, where people are invited to contribute by rating the tranquillity of grid squares on a web map, or through smartphone applications at sample points in the field. Additionally, other forms of UGC may be explored, such as full-text hiking blogs, which include accounts of experiences of people actively exploring the landscape (Wartmann et al., 2018). We also see value in analysis of the images themselves; these can be processed using automated image recognition and annotation to broaden the available data sources and extend our analysis beyond the use of language associated with images.

6. Conclusion

Tranquillity is recognised as an important landscape quality that helps ameliorate our stressful lives. Therefore various efforts have attempted to incorporate notions of tranquillity into policy-making and planning. Hewlett et al. (2017) acknowledge noise as an important factor influencing peoples sense of tranquillity, commenting in their study site in Dorset, England that 'visitors considered traffic to be the most significant detractor from tranquillity' (2017, p.193). However, our study revealed that among the various constituents of visitors to the Loch Lomond and The Trossachs National Park in Scotland, many appeared able to set aside the impact of crowded spaces and noise, and to experience tranquillity where models would predict none existed. Such differences highlight 1) the need to avoid generalisation when interpreting results from tranquillity modelling, and 2) the idea of tranquillity as a social construct. It emphasises the need for broad consultation and inclusivity in all aspects of protected area planning.

Although the broad and multi-sensory nature of tranquillity is commonly acknowledged and has been empirically substantiated (Jackson et al., 2008; Hewlett et al., 2017; Pheasant et al., 2010; Watts and Pheasant, 2015a,b), tranquillity models have yet to incorporate more experience-based data. We argue that user-generated content provides exciting possibilities in this regard; the present study constitutes a first step towards harvesting such data sources. The novelty of our approach lies in showing that by using not only

the locations of images, but investigating their semantic content through tags, we are able to identify areas of experienced tranquillity. While many critiques of the earliest tranquillity mapping approaches have been addressed as models have developed, further research is needed in order to build models that comprehensively incorporate people's notions and place-based experiences of tranquillity as a basis for planning and decision-making.

Exploring the notion of tranquillity is part of a broader debate on how we classify and value different landscapes (Cosgrove, 1984; De Groot et al., 2010; Stephenson, 2008), and how we both protect and provide access to them. A systematic approach to landscape characterisation and the identification of landscape qualities is a critical step to their conservation. Understanding the public's experience and imagining of landscape is critical to inclusive planning strategies – strategies made all the more important given increasing levels of urbanisation and associated loss of green space.

7. Disclaimer

The views and opinions expressed in this article are those of the authors alone, and do not necessarily reflect those of the institutions they work for or those of the Loch Lomond and the Trossachs National Park.

8. Acknowledgements

Anonymised for double-blind review.

9. References

Arnstein, S.R., 1969. A ladder of citizen participation. Journal of the American Institute of planners 35, 216–224.

Bieling, C., Plieninger, T., Pirker, H., Vogl, C.R., 2014. Linkages between landscapes and human well-being: An empirical exploration with short interviews. Ecological Economics 105, 19–30. doi:10.1016/j.ecolecon.2014.05.013.

Cosgrove, D., 1984. Social Formation and Symbolic Landscapes. The University of Wisconsin Press, Madison, Wisconsin.

CPRE, 2005. Mapping Tranquillity. Defining and assessing a valuable resource. Technical Report. Campaign to Protect Rural England. Northumberland. URL: https://www.cpre.org.uk/resources/countryside/tranquil-places/item/download/369.

CPRE, 2007. Tranquillity Map: England. URL: https://www.cpre.org.uk/resources/countryside/tranquil-places/item/download/352.

CPRE and the Countryside Commission, 1995. Tranquil areas: England map. URL: https://www.thenbs.com/PublicationIndex/documents/details?Pub=CPRE{\&}DocID=273255.

Crang, M., Cook, I., 2007. Doing ethnographies. Sage, London.

De Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecological complexity 7, 260–272.

Dunkel, A., 2015. Visualizing the perceived environment using crowdsourced photo geodata. Landscape and urban planning 142, 173–186.

EEA, 2016a. Quiet areas in Europe dataset. URL: www.eea.europa.eu/data-and-maps/data/quiet-areas-in-europe.

EEA, 2016b. Quiet areas in Europe The environment unaffected by noise pollution. EEA Report No 14/2016. Technical Report. European Environmental Agency. Luxembourgh. URL: https://www.eea.europa.eu/publications/quiet-areas-in-europe.

Gschwend, C., Purves, R.S., 2012. Exploring geomorphometry through user generated content: Comparing an unsupervised geomorphometric classification with terms attached to georeferenced images in Great Britain. Transactions in GIS 16, 499–522.

Heikinheimo, V., Minin, E.D., Tenkanen, H., Hausmann, A., Erkkonen, J., Toivonen, T., 2017. User-Generated Geographic Information for Visitor Monitoring in a National Park: A Comparison of Social Media Data and Visitor Survey. ISPRS International Journal of Geo-Information 6, 85. doi:10.3390/ijgi6030085.

Herzog, T.R., Bosley, P.J., 1992. Tranquility and preference as affective qualities of natural environments. Journal of Environmental Psychology 12, 115–127. doi:10.1016/S0272-4944(05)80064-7.

Herzog, T.R., Chernick, K.K., 2000. Tranquility and danger in urban and natural settings. Journal of Environmental Psychology 20, 29–39. doi:10.1006/jevp.1999.0151.

Hewlett, D., Brown, L., 2018. Planning for tranquil spaces in rural destinations through mixed methods research. Tourism Management 67, 237–247.

Hewlett, D., Harding, L., Munro, T., Terradillos, A., Wilkinson, K., 2017. Broadly engaging with tranquillity in protected landscapes: A matter of perspective identified in GIS. Landscape and Urban Planning 158, 185–201. doi:10.1016/j.landurbplan.2016.11.002.

Hollenstein, L., Purves, R., 2010. Exploring place through user-generated content: Using Flickr to describe city cores. Journal of Spatial Information Science doi:10.5311/JOSIS.2010.1.3.

Jackson, S., Fuller, D., Dunsford, H., Mowbray, R., Hext, S., R., M., Haggett, C., 2008. Tranquillity Mapping: developing a robust methodology for planning support. Technical Report. Report to the Campaign to Protect Rural England, Centre for Environmental & Spatial Analysis, Northumbria University, Bluespace environments and the University of Newcastle upon on Tyne.

Kaplan, R., Kaplan, S., 1989. The experience of nature: A psychological perspective. CUP Archive.

Kaplan, S., 2001. Meditation, restoration, and the management of mental fatigue. Environment and behavior 33, 480–506.

Kitchin, R., 2014. Big Data, new epistemologies and paradigm shifts. Big Data & Society 1. doi:10.1177/2053951714528481.

Leszczynski, A., 2009. Quantitative Limits to Qualitative Engagements: GIS, Its Critics, and the Philosophical Divide. The Professional Geographer 61, 350–365. doi:10.1080/00330120902932026.

Levett, R., 2000. A headline indicator of tranquillity: definition and measurement issues. Interim report to CPRE by CAG Consultants 7th July 2000. Technical Report. CAG Consultants for CPRE.

LLTNP, 2017. National Park Partnership Plan. A view to 2018 - 2023. Draft for Consultation. Technical Report. Loch Lomond and The Trossachs National Park Authority. Balloch, UK.

MacFarlane, R., Haggett, C., Fuller, D., Dunsford, H., Carlisle, B., 2004. Tranquillity Mapping: developing a robust methodology for planning support. Technical Report. Report to the Campaign to Protect Rural England, Countryside Agency, North East Assembly, Northumberland Strategic Partnership, Northumberland National Park Authority and Durham County Council, Centre for Environmental & Spatial Analysis, Northumbria Univ.

Mancini, F., Coghill, G.M., Lusseau, D., 2018. Using social media to quantify spatial and temporal dynamics of nature-based recreational activities. PloS one 13, e0200565.

National Planning Policy Framework, 2012. Conserving and enhancing the natural environment. URL: https://www.gov.uk/guidance/national-planning-policy-framework/11-conserving-and-enhancing-the-natural-environment.

Pheasant, R., Horoshenkov, K., Watts, G., Barrett, B., 2008. The acoustic and visual factors influencing the construction of tranquil space in urban and rural environments tranquil spaces-quiet places? The Journal of the Acoustical Society of America 123, 1446–1457.

Pheasant, R.J., Fisher, M.N., Watts, G.R., Whitaker, D.J., Horoshenkov, K.V., 2010. The importance of auditory-visual interaction in the construction of tranquil space'. Journal of Environmental Psychology 30, 501–509. doi:10.1016/j.jenvp.2010.03.006.

Pheasant, R.J., Watts, G.R., Horoshenkov, K.V., 2009. Validation of a tranquillity rating prediction tool. Acta Acustica united with Acustica 95, 1024–1031.

Rendel, S., 1998. Simon Rendel: an appreciation. Landscape Research 23, 83–88. doi:10.1080/01426399808706527.

Seresinhe, C.I., Preis, T., Moat, H.S., 2015. Quantifying the Impact of Scenic Environments on Health. Scientific Reports 5. doi:10.1038/srep16899.

Shepherd, D., Welch, D., Dirks, K.N., McBride, D., 2013. Do quiet areas afford greater health-related quality of life than noisy areas? International Journal of Environmental Research and Public Health 10, 1284–1303.

Sieber, R.E., 2006. Public participation geographic information systems: A literature review and framework. doi:10.1111/j.1467-8306.2006.00702.x.

SNH, 2010. The Special Landscape Qualities of the Loch Lomond and The Trossachs National Park. Scottish National Heritage Commissioned Report, No. 376 (iBids and Project n 648). Technical Report. Scottish National Heritage and Loch Lomond and The Trossachs Natiobnal Park Authority.

Stephenson, J., 2008. The cultural values model: an integrated approach to values in landscapes. Landscape and urban planning 84, 127–139.

Tenkanen, H., Di Minin, E., Heikinheimo, V., Hausmann, A., Herbst, M., Kajala, L., Toivonen, T., 2017. Instagram, Flickr, or Twitter: Assessing the usability of social media data for visitor monitoring in protected areas. Scientific Reports 7, 17615. doi:10.1038/s41598-017-18007-4.

Thatcher, J., Bergmann, L., Ricker, B., Rose-Redwood, R., O'Sullivan, D., Barnes, T.J., Barnesmoore, L.R., Beltz Imaoka, L., Burns, R., Cinnamon, J., 2016. Revisiting critical GIS. Environment and Planning A 48, 815–824.

Velarde, M., Fry, G., Tveit, M., 2007. Health effects of viewing landscapes Landscape types in environmental psychology. Urban Forestry & Urban Greening 6, 199–212. doi:10.1016/j.ufug.2007.07.001.

Wartmann, F.M., Acheson, E., Purves, R.S., 2018. Describing and comparing landscapes using tags, texts, and free lists: an interdisciplinary approach. International Journal of Geographical Information Science 32, 1572–1592. doi:10.1080/13658816.2018.1445257.

Watts, G.R., Miah, A., Pheasant, R., 2013. Tranquillity and soundscapes in urban green spaces - predicted and actual assessments from a questionnaire survey. Environment and Planning B: Planning and Design 40, 170–181.

Watts, G.R., Pheasant, R.J., 2015a. Identifying tranquil environments and quantifying impacts. Applied Acoustics 89, 122–127. doi:10.1016/j.apacoust.2014.09.015.

Watts, G.R., Pheasant, R.J., 2015b. Tranquillity in the Scottish Highlands and Dartmoor National Park The importance of soundscapes and emotional factors. Applied Acoustics 89, 297–305. doi:10.1016/j.apacoust.2014.10.006.

van Zanten, B.T., Van Berkel, D.B., Meentemeyer, R.K., Smith, J.W., Tieskens, K.F., Verburg, P.H., 2016. Continental-scale quantification of landscape values using social media data. Proceedings of the National Academy of Sciences 113, 12974–12979. doi:10.1073/pnas.1614158113.