Visitors’ place-based evaluations of unacceptable tourism impacts in Oulanka National Park, Finland

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ABSTRACT
Visitors’ assessments of the negative impact of tourism, on physical and social environment, vary based on the location where the evaluation occurs. Research that focuses on identifying visitors’ norms within outdoor recreation settings has not been able to link the geographical location with the corresponding evaluation of unacceptable levels of impact. This study combines a traditional on-site visitor survey with a Public Participation Geographic Information Systems survey to produce spatially explicit information on visitors’ acceptance of tourism impacts. Using a web-based participatory survey, visitors were asked to indicate specific locations where they felt the effects of tourism disturbed the quality of their experience in Oulanka National Park. These evaluations were analyzed at multiple scales to promote more efficient park management. Based on visitor evaluations, we found a collection of hotspots in the park where tourism has already caused unacceptable impacts. Visitors noted that crowding and erosion disturbed their experiences, especially along highly visited trail sections, while littering was considered problematic near wilderness huts. However, participant satisfaction at these sites was not lower than elsewhere in the park. This indicates that the association between negative impacts of tourism and visitor satisfaction is not straightforward, but complex. This study encourages the collection of spatially accurate data on visitors’ assessments of the effects of tourism because it has the potential to more efficiently direct park management policies. In addition, spatial techniques provide a new means to monitor the impacts of tourism, acknowledging that visitors’ perceptions of acceptability of tourism impacts also vary within tourism destinations, such as parks.

KEYWORDS
Tourism impact; visitor; PPGIS; normative theory; satisfaction; Oulanka National Park; Finland

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In this paper, we pilot a new approach that enables gathering users’ place-based evaluations related to natural resources. Studying visitors’ evaluations of tourism impacts is crucial as the perceptions of tourism impacts are about to increase, because visitors are becoming more conscious of environmental impacts they encounter (Moore, Leung,
Matisoff, Dorwart, & Parker, 2012; Van Riper, Manning, & Reigner, 2010). Lyon, Cottrell, Sikkamäki, and Van Marwijk (2011) have called for impact mediation in the Oulanka National Park (Oulanka NP) due to high visitor traffic that has resulted in severe visible erosion and trampling. This study can, therefore, be used to further identify areas of environmental stress caused by tourism and help shape a targeted management plan in our study site.

We aim to integrate a geographical approach to producing evaluative information on the negative impacts of tourism in Oulanka NP in Finland through posing the following questions:

1. **How do different visitor groups sense tourism impacts and evaluate their overall satisfaction?** This is studied as users are shown to differentiate between their sensitivity to impacts (Whittaker, 1992).

2. **Which tourism impacts do Oulanka NP visitors consider unacceptable?** Even though our purpose is not to select indicators of experience quality, this question allows us to test the resemblance of the alternative methods used.

3. **What are the spatial patterns of unacceptable tourism impacts in Oulanka NP?** This question, being our main interest, will help us to define whether there are certain locations in the park where visitors consider their norms against tourism impacts have been negatively exceeded.

4. **How are the unacceptable tourism impacts associated with visitor satisfaction?** Here we explore the observed evidence that perceived negative impacts of tourism lower visitor satisfaction (e.g. Lynn & Brown, 2003; Manning, Valliere, Minteer, Wang, & Jacobi, 2000; Moore et al., 2012; Whittaker, 1992).

To contribute to the research tradition on tourism impacts, we measure and analyze visitors’ evaluations of tourism impacts and test their relationship with visitor satisfaction from a geographical perspective. By combining the results from an on-site visitor survey and a Public Participation Geographic Information Systems (PPGIS) survey, we present the evaluated tourism impacts in Oulanka NP at destination, park zone, and site scales in a spatially explicit way. Based on the results, we observe the effect of scale on the relationship between negative impacts of tourism and satisfaction, and discuss the relevance and potential of the spatially explicit research approach for tourism management planning.

**Background**

**Normative research on tourism impacts**

For collecting evaluative information, outdoor recreation researchers have widely adopted the concept of *norm* from sociology and social psychology (Manning, 2011). According to the normative approach, visitors to natural areas are expected to have preferences, expectations, and other criteria against which to judge situations that they encounter. *Norms*, therefore, mean *standards* that individuals use for evaluating behavior, activities, environments, amounts of resource damage, or management proposals good or bad, better or worse (Shelby et al., 1996).

Even though a wide array of approaches to measure user standards have been applied, many studies are based on work by Jackson (1965), who developed a
methodology for measuring norms. As most normative studies are related to crowding (see a review by Vaske & Shelby, 2008), a common way to apply the methodology within outdoor recreation research is to ask users to evaluate the acceptability, or other evaluative dimensions, of the number of other people seen or encountered as the number of visitors increases. This resulting data is interpreted as a measure of the personal crowding norm, and is further aggregated to inform the level of the social norm and the degree to which the norm is shared across groups (Krymkowski, Manning, & Valliere, 2009).

From a management perspective, normative data helps to focus management directions by identifying goals that are considered desirable (Shelby et al., 1996). Therefore, normative theory and its methods have most often been applied in forming standards of quality (Manning, 2011). In addition, norms are found to help define which impacts are important in a particular setting and the characteristics of high-quality settings (Shelby et al., 1996). Thus, normative theory and its methods have also been used to form impact indicators, which ‘describe the biophysical, social, managerial, or other conditions that managers and visitors care about for a given experience’ (Vaske & Shelby, 2008, p. 111). These indicators are vital for all recent planning frameworks, such as for Limits of Acceptable Change (LAC) (Stankey, Cole, Lucas, Petersen, & Frissell, 1985), which are based on continuous monitoring of resource conditions and quality of experiences against set indicators.

From the tourism impact point of view, some impacts are consistently experienced more negatively by users than others. In addition to crowding (e.g. Kainzinger, Burns, & Arnberger, 2015; Manning et al., 2000; Tseng et al., 2009), impacts such as littering (Lynn & Brown, 2003; Verlič, Arnberger, Japelj, Simončič, & Pirnat, 2015; Whittaker, 1992), vegetation and soil impacts (Deng, Qiang, Walker, & Zhang, 2003), tree and plant damage (Lynn & Brown, 2003), fire rings (Lynn & Brown, 2003; Whittaker, 1992), trail extension and widening and trail erosion (Lynn & Brown, 2003), mud and standing water (Moore et al., 2012) have been reported to negatively influence visitor experiences. However, even though normative research has been used to form indicators of recreation experience quality, visitors have also demonstrated experiencing high levels of satisfaction despite evaluating visit conditions as not optimal (Dorwart, Moore, & Leung, 2009; Hall & Cole, 2007; Kuentzel & Heberlein, 1992; Shelby & Heberlein, 1986; White, Hall, & Farrell, 2001).

Spatializing normative research and new approaches

Outdoor recreation is inherently a geographical phenomenon. The uneven spatial distribution of recreation use has been a nearly universal finding especially across wilderness studies (Manning, 2011). In addition to recreational use, the impacts of tourism tend to be localized and concentrated on certain parts of recreation areas (D’Antonio, Monz, Newman, Lawson, & Taff, 2013; Hendee, Stankey, & Lucas, 1990; Leung & Marion, 2000). Nevertheless, visitor norms toward tourism impacts may not follow the same spatial patterns as the absolute use or the distribution of visitor impacts, because visitors can evaluate the same level of negative environmental impacts differently depending on how he or she experiences the setting. As evidenced by Hammitt and Cole (1998), visitors in wilderness areas may be more sensitive to evidence left behind by previous users than visitors in...
more developed areas. Similarly, the norms regarding the amount of visitors and the behavior of visitors depend on the recreation setting (Vaske et al., 2002; Vaske & Donnelly, 2001). In order to further explore the spatial aspects of how visitors perceive and evaluate tourism impacts, new approaches are needed.

One such tool having the potential to expand methods in spatially explicit mapping of tourism impacts is PPGIS. These tools have been progressively utilized in environmental planning to map landscape values and ecosystem services that people attach to particular places (see Brown & Fagerholm, 2015; Brown & Kyttä, 2014). PPGIS tools are considered to promote the understanding of a broad range of activities and values, including intangible values, derived from personal experience with a potential to result in more socially equitable planning decisions and to strengthen trust in park agencies (Brown, 2012). PPGIS tools have been implemented in various contexts, a major focus being on conservation area planning and management (e.g. Brown & Reed, 2009; Brown & Weber, 2011, 2012; Palomo et al., 2013; Sherrouse, Semmens, & Clement, 2014).

Even though PPGIS studies have aimed to encourage participation of visitors and residents in the planning and management of these areas, studies applying mapping to identify possible negative impacts related to tourism remain rare. The few exceptions are presented by Brown and Weber (2011), who mapped visitors’ perceptions of tourism impacts (e.g. degraded track condition, water quality, litter), Scolozzi, Schirpke, Detassis, and Gretter (2015), who focused on mapping tourists threats (e.g. pollution, overuse, and traffic) related to landscape values, and Pietilä and Kangas (2015), who mapped places where visitors had their worst experience(s).

**Methods**

**Study area – Oulanka National Park**

This study was conducted in Oulanka NP and its nearby surrounding areas (Figure 1). Oulanka NP is located in northeastern Finland, next to the border of Russia and near the Arctic Circle. The park is closely associated with extensive wilderness areas with landscapes varying from pine forests, to valleys of large rivers with sandy banks and rocky rapids, to extensive aapa mires (complex, cold-climate wetlands) in the north. The region hosts a wide range of biotopes and species (Alatossava, 2011). Having a long history of outdoor recreation, Oulanka NP is currently the fourth most visited national park in Finland with approximately 170,000 annual visits (Metsähallitus, 2015). The park offers opportunities for outdoor activities including hiking, canoeing, skiing, snowshoeing, fishing, and wildlife viewing. The park infrastructure includes visitor centers, campfire sites, camping grounds, wilderness huts, and parking places. Park entrance is free of charge for all visitors.

The study area is especially famous for its 80-km hiking trail called Karhunkierros (the Bear’s Trail) starting at the northernmost point of the park and ending at the Ruka tourist resort located 20 km south from Oulanka NP. Additionally, the park has five-day-trip trails ranging from 5–12 km. Recreational use is concentrated in Juuma, receiving the highest number of visitors (≈ 51,400 annual visits) in Kiutaköngäs (≈ 46,000) and in Valtavaara (≈ 46,000). The number of visits to the other parts of the park is notably smaller (<8000).

The park is managed by Parks and Wildlife Finland, which is a unit of the state-owned corporation: Metsähallitus. Parks and Wildlife Finland uses the planning framework of LAC
as the bases of monitoring change in the park's conditions and in determining appropriate management actions to manage the change. The indicators for monitoring are derived from nine principles, including ecological, sociocultural, and economic aspects of sustainability, that guide sustainable nature tourism in state-owned protected areas (Kajala, Erkkonen, & Perttula, 2004). Standards defining the LAC are set for each indicator by the park organization.

Data collection

In this study, we used two kinds of survey methods to collect data on visitors’ perceptions of tourism impacts. First, a self-administrated on-site visitor survey was conducted
according to Parks and Wildlife Finland’s standardized visitor survey conducted every five years (Erkkonen & Sievänen, 2001). The questionnaire was four pages in length and included mostly close-ended questions. Participants were asked in which activities they participated, what were their motives for visitation, how satisfied they were with the visit, which impacts of tourism they perceived to disturb their visit, etc. In addition, basic questions related to gender, age, education, and residency were asked. The survey questionnaire was available in Finnish, English, German, and Russian. Sampling was based on a developed and nationally applied process of collecting representative data on visitors to state-owned lands (Erkkonen & Sievänen, 2001). Nine sites of the park were selected for data collection, in which survey participants were selected in the order of arrival. Data were collected in two phases: winter sampling was collected during February and March 2014 and summer–autumn sampling was collected between June and October 2014.

In connection with the visitor survey we carried out an additional web-based PPGIS survey. The survey was conducted by asking Oulanka NP visitor survey participants to also participate in a web-based PPGIS survey by providing their email address at the end of the self-administrated visitor survey form. A web-based interface was chosen to complete the mapping, as this is currently recognized as the predominant method for conducting PPGIS surveys (Brown & Kyttä, 2014). Those participants who provided their contact information received an email invitation to complete the PPGIS survey within two weeks of their visit, including general instructions, an individual access code and a web link to the survey. Two reminders were sent to those visitors who had not logged into the PPGIS interface within two weeks of the sent invitation. Data collection finished in the end of October 2014.

The web-based survey was implemented using the Paikka application provided by Mapita Ltd. When completing the PPGIS survey, participants were asked to drag and drop certain predefined point- or line-shaped spatial markers on the map, as commonly done in PPGIS surveys (Brown & Kyttä, 2014). The survey was divided into five mapping tasks: visitors were asked to map the trails they had used; the main sites they had visited; issues that had disturbed their visit; features of the park that were found to be especially interesting or attractive; and the level of satisfaction with the park’s infrastructure. When conducting mapping, participants could zoom in and out between different map scales. The smallest scale map (1:200,000) showed the entire study area including the borders of conservation areas and names of the most visited sites. The ability of participants to drop markers on the map was restricted to the scale 1:25,000 or larger to control the precision of the spatial data (Brown & Kyttä, 2014; Lechner et al., 2014). All map layers included basic features of the physical environment such as roads, lakes, rivers, and contour lines. Maps from the scale 1:25,000 also included symbols of recreation infrastructure: trails, parking places, huts, and campsites, etc.

**Measures of perceived tourism impacts and satisfaction**

Visitor perception of tourism impacts was measured in two different ways. First, the visitor survey explored which impacts of tourism visitors found disturbing in general. Visitors were asked: *Did any of the following disturb you during this visit to Oulanka National Park?* The following predefined items were presented: erosion caused by tramping, littering, treatment of the natural environment, too many visitors, and behavior of other visitors
were rated on a five-point Likert scale (5 = not at all to 1 = very much, or no opinion). The selection of items is an outcome of a longer process aiming to define indicators of sustainability for Finnish national parks (see Kajala et al., 2004).

Additionally, we measured visitors’ perceptions of tourism impacts in the PPGIS survey to find out more precisely where visitors found the impacts of tourism as unacceptable reflecting on their quality of experience. In this mapping task, illustrated in Figure 2, participants were asked to place a predefined marker on a map to indicate the specific place where they had felt this particular impact disturbed their visit. These predefined markers were the same as the items used in the visitor survey. Additionally, to get an impression of the severity of the impact in each mapped location, we asked participants to evaluate the degree of disturbance that the impact had caused on a continuing scale (0 = not at all to 100 = very much) after placing the marker. If visitors did not think any of the presented items disturbed their visit, they could move on to the next mapping task in the survey.

Visitor satisfaction was measured in the standard visitor survey by asking visitors to rate how satisfied they were with different aspects of their visit. First, satisfaction with service quality was explored against several items (parking places, signposts at the trails, waste disposal, etc.) asking: What did you think about the quality of the services and facilities? Second, satisfaction with service quantity was measured asking: How satisfied were you with the amount of services and facilities? Satisfaction with the environment including items of general safety, general tidiness, and variability of landscapes was measured asking: What did you think about the quality of the environment? Fulfillment of expectations was measured against items of the natural environment, opportunities for outdoor activities, routes, and facilities by asking, Did this visit to Oulanka National Park fulfill your expectations regarding the following? Participants were asked to evaluate all items separately on a five-point Likert-scale (5 = very satisfied to 1 = very unsatisfied). Based on these

Figure 2. Web-based PPGIS survey interface used to map visitors’ evaluations of tourism impacts in Oulanka NP.
measures, we created a new variable ‘overall satisfaction’ to present the mean of satisfaction across all items.

**Analyses**

A total of 736 visitors responded to the visitor survey. From these respondents, altogether 257 visitors provided their email address for the additional PPGIS survey, and, finally, 170 responded to the PPGIS survey. The response rate of the study was thus 66% when comparing completed PPGIS surveys to the number of PPGIS survey invitations that were sent, and 23% when comparing completed PPGIS surveys to the number of visitor surveys conducted. Due to the relatively low response rate, we used chi-squared tests to evaluate the representativeness of our PPGIS subsample compared to all visitor survey respondents. In addition, using the same procedure, we compared the profile of those respondents who mapped negative tourism impacts to all visitor survey respondents. After these examinations, we tested the possible relationship between visitors’ individual characteristics against evaluated impacts of tourism and different aspects of satisfaction. We used Spearman’s correlation in these analyses, as it is also suitable for analyzing variables that are ordinal and discrete and not normally distributed.

The spatial analyses were conducted at destinations, park zone and site scales, illustrated in Figure 1. Perceived mapped impacts were analyzed for the collective spatial patterns of all participants (Brown & Reed, 2009; Brown & Weber, 2012). We first used descriptive statistics to present the content and spatial distribution of impacts at the destination scale. The spatial patterns of perceived mapped impacts were presented using nearest neighbor index ($R$) for a standardized measure of the study area (1145.1 km²). This index is a basic and widely used measure describing the nature of the spatial pattern of mapped attributes in PPGIS studies (e.g. Brown & Reed, 2009; Van Riper & Kyle, 2014). Then, we used Spearman’s correlation analysis, to explore the association between perceived impacts of tourism (compressed into a dichotomous variable) and different aspects of satisfaction.

For analyzing the perceived mapped impacts at the park zone scale, we extracted the four most-visited areas of the park as individual zones for examination. At this scale, we used social landscape metrics to present the composition and configuration of perceived mapped impacts of tourism, as these metrics have become a common method to quantify PPGIS data (e.g. Brown, Weber, & de Bie, 2014; Hausner, Brown, & Laegreid, 2015). We used boundary-based metrics to understand the type and mix of perceived mapped impacts of tourism within a certain subarea (see Brown & Reed, 2012). Several formulas were used for forming metrics, which are described in further detail in Appendix 1. The metrics applied were value sum absolute ($P_0$), value sum percent ($P_1$), value frequency index ($F$), dominant value ($D$), value dominance ($D_1$), and value diversity index ($D_2$). In addition, we calculated a new metric, mean intensity index ($I$), to reveal the mean intensity of impact disturbance within each park zone. The analysis on differences in visitors’ levels of satisfaction between different zones was conducted using a $T$-test for independent samples to compare whether the means of satisfaction differ across park zones based on the reported areas visited. However, due to the lack of spatial difference on visitor satisfaction, the relationship between perceived impacts and satisfaction could not be further explored at the park zone scale.
The smallest scale analysis was conducted at the site scale. Here, the content analysis of negative tourism impacts was based on a distribution map representing the locations of perceived mapped impacts. The spatial patterns of perceived mapped impacts were explored according to the intensity of impacts. For this purpose we formed impact hotspots using the kernel density function stressed with the evaluations of the severity of the perceived mapped impact. The kernel function calculates a smoothly curved circular surface of point density for each point summing the values in a raster grid cell (Silverman, 1986). A cell size of 500 m and threshold distance of 1500 m were applied reflecting the scale of data collection and uncertainty in point placement. Those pixels belonging to the highest quarter were considered as main impact hotspots. Finally, we analyzed the relationship between perceived mapped impacts and satisfaction using 500 m × 500 m pixels representing the sites of Oulanka NP. For this purposes we gave each pixel a value of one if it included one or more perceived mapped impacts, and a value of zero if there was no impact mapped intersecting that pixel. In addition, we calculated the level of satisfaction based on the average satisfaction that visitors had reported when they had visited that particular site. This was done using the point markers respondents had placed in the PPGIS survey representing the sites that they had visited, joined with the evaluation of satisfaction from the visitor survey. Finally, Spearman’s correlation analysis was conducted for all pixels that had been marked as a visited site.

Results

Survey participants

Altogether 44 participants out of 170 PPGIS survey respondents mapped tourism impacts that disturbed their visit, these participants placed 87 markers on the study area, leading to an average of two mapped impacts per respondent. The background profile of PPGIS survey respondents was similar to all visitor survey respondents. The profiles of the two groups only differed significantly by the length of visit. Overnight visitors (40% of PPGIS respondents) were overrepresented among PPGIS survey respondents ($\chi^2(1) = 4.9, p = 0.03$). In addition, the profiles between those who mapped negative impacts and all respondents significantly differed according to respondents’ level of education. Respondents with a university degree (66% of those who mapped negative impacts) were overrepresented among the ones who mapped negative impacts ($\chi^2(2) = 7.9, p = 0.019$). Otherwise, most of the study respondents were Finnish and had previously visited Oulanka NP. Approximately half of the respondents were female and about 50% of all respondents were over 45 years old.

Negative evaluations of tourism impacts were associated with visitors’ individual characteristics to some extent. Men, overnight visitors, and those participating in other activities than walking were shown to be sensitive to perceiving littering (Table 1). Satisfaction was more clearly related with visitors’ characteristics. Foreigners were more satisfied with the park’s services and facilities, women were overall more satisfied with their visit than men, younger visitors were more satisfied with services and facilities as well as with the environment, and those visiting the park alone were more satisfied with the park’s services and facilities compared to group visitors (Table 1).
Table 1. Spearman’s correlation between visitors’ characteristics, perceived impacts, and satisfaction.

<table>
<thead>
<tr>
<th>Erosion</th>
<th>Littering</th>
<th>Treatment of natural environment</th>
<th>Crowding</th>
<th>Behavior of other visitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.033</td>
<td>0.038</td>
<td>-0.061</td>
<td>0.036</td>
<td>0.027</td>
</tr>
<tr>
<td>0.111</td>
<td>0.190*</td>
<td>0.167*</td>
<td>0.104</td>
<td>0.15</td>
</tr>
<tr>
<td>-0.08</td>
<td>0.034</td>
<td>-0.06</td>
<td>-0.034</td>
<td>-0.085</td>
</tr>
<tr>
<td>-0.073</td>
<td>-0.071</td>
<td>-0.026</td>
<td>-0.044</td>
<td>-0.02</td>
</tr>
<tr>
<td>-0.088</td>
<td>-0.216**</td>
<td>-0.092</td>
<td>-0.073</td>
<td>-0.106</td>
</tr>
<tr>
<td>0.008</td>
<td>0.08</td>
<td>0.097</td>
<td>0.041</td>
<td>0.037</td>
</tr>
<tr>
<td>-0.018</td>
<td>0.044</td>
<td>0.027</td>
<td>-0.112</td>
<td>-0.142</td>
</tr>
<tr>
<td>0.074</td>
<td>0.165*</td>
<td>0.027</td>
<td>0.106</td>
<td>0.075</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Satisfaction (5 = satisfied to 1 = dissatisfied)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction with services and facilities</td>
</tr>
<tr>
<td>-0.175*</td>
</tr>
<tr>
<td>0.094</td>
</tr>
<tr>
<td>-0.190*</td>
</tr>
<tr>
<td>0.056</td>
</tr>
<tr>
<td>0.08</td>
</tr>
<tr>
<td>0.091</td>
</tr>
<tr>
<td>-0.200**</td>
</tr>
<tr>
<td>-0.09</td>
</tr>
<tr>
<td>Satisfaction with the environment</td>
</tr>
<tr>
<td>0.047</td>
</tr>
<tr>
<td>0.202**</td>
</tr>
<tr>
<td>-0.161*</td>
</tr>
<tr>
<td>-0.044</td>
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<tr>
<td>-0.066</td>
</tr>
<tr>
<td>0.012</td>
</tr>
<tr>
<td>-0.108</td>
</tr>
<tr>
<td>-0.005</td>
</tr>
<tr>
<td>Fulfillment of expectations</td>
</tr>
<tr>
<td>-0.068</td>
</tr>
<tr>
<td>0.189*</td>
</tr>
<tr>
<td>-0.072</td>
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<tr>
<td>-0.098</td>
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<tr>
<td>-0.088</td>
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<tr>
<td>-0.009</td>
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<tr>
<td>-0.044</td>
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<tr>
<td>-0.058</td>
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<tr>
<td>Overall satisfaction</td>
</tr>
<tr>
<td>-0.076</td>
</tr>
<tr>
<td>0.202**</td>
</tr>
<tr>
<td>-0.153</td>
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<tr>
<td>-0.033</td>
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<tr>
<td>-0.022</td>
</tr>
<tr>
<td>0.028</td>
</tr>
<tr>
<td>-0.147</td>
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<tr>
<td>-0.064</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.
Evaluator impacts and satisfaction

Destination
As Table 2 shows, visitors evaluated erosion to be the most distracting impact of tourism within Oulanka NP. Every fourth respondent evaluated this to disturb their visit very much, fairly much, or moderately. The second most distracting impact was too many visitors, which was considered disturbing by every fifth respondent. Treatment of natural environment, littering and behavior of other people were considered distracting by only around every 10th respondent. However, according to the mapped impacts, littering was the most unacceptable feature, covering 28% of all mapped impact markers. The second most often places mapped by visitors were places where they evaluated that erosion or too many visitors distracted their visit. Treatment of natural environment, mostly referring to the unaesthetic sights of clear-cut forests, was considered disturbing less frequently. All negatively evaluated impacts, especially erosion, located spatially clustered within the study area ($R < 1$) indicating that there are certain sites where visitors' acceptability towards the studied impacts deviates negatively from their norms.

Visitors were overall satisfied with their visit to Oulanka NP. The average of visitor satisfaction among study participants was 4.4 (on the scale 5 = satisfied to 1 = dissatisfied). Visitors were most satisfied against their expectations (mean 4.5) and with the environment (4.4), but less satisfied with the park’s services and facilities (4.2). Respondents that identified erosion as a negative impact also indicated a lower rate of satisfaction over all (Table 2). In addition, evaluation of too many visitors was negatively associated with overall satisfaction, satisfaction with service and facilities, and fulfillment of expectations. Behavior of other visitors was negatively associated with overall satisfaction, satisfaction with services and facilities, and satisfaction with the environment. Littering was only significantly associated with satisfaction with the environment.

Park zone
As Table 3 shows, the highest frequency of negative impacts located in Juuma, receiving 45% of all mapped impact markers ($P1$). This is in line with the popularity of the area, as...
almost half (45%) of the study participants had visited the Juuma area during their visit. The frequency of mapped impacts was much less within other zones \((F)\), even though a more popular place such as Kiutaköngäs was visited by an even bigger share of respondents (66%). The less visited areas received accordingly relatively few markings indicating that tourism impacts do not often exceed visitors’ norms in the more remote parts of the park. The diversity of negative tourism impacts was relatively high within all five park zones \((D2)\). However, littering was the most dominating impact \((D)\) within all zones except in Juuma, where crowding dominated the evaluation. The intensity of impacts was evaluated to be the highest in Valtavaara and in Juuma \((I)\). Visitor satisfaction did not differ significantly across park zones according to any aspects of satisfaction \((p > 1.28)\). The overall satisfaction of visitors yielded 4.4, regardless of the area visited by participants.

**Site scale**

The study area encompassed three impact hotspots where impacts were evaluated as unacceptable (Figure 3). The largest and most intense hotspot of tourism impacts followed the famous 12-km loop trail of Pieni Karhunkierros, starting from Juuma. This trail section was especially perceived to be crowded, eroded, and littered. The other hotspot evaluated to be littered and eroded was located along Valtavaara Hill. The third hotspot was located in the vicinity of Kiutaköngäs rapids, near the Oulanka Visitor Center. Erosion was most often evaluated to be the leading problem within this area. In addition, separate tourism impact markers, representing especially littering, were placed in the vicinity of wilderness huts as shown in Figure 4. No spatial relationship was found between mapped impacts and satisfaction. Those sites (500-m pixels) in which impacts were evaluated as exceeding visitors’ norms, did not yield a lower level of overall satisfaction \((\text{Rho} = 0.039, p = 0.686)\), nor with regard to any specific aspect of satisfaction: satisfaction with services \((\text{Rho} = 0.022, p = 0.825)\), satisfaction with the environment \((\text{Rho} = 0.020, p = 0.837)\), fulfillment of expectations \((\text{Rho} = 0.036, p = 0.711)\).

**Discussion**

In this study, we combined traditional survey methods with a PPGIS survey to identify where visitors perceived the impacts of tourism as unacceptable. We applied multiple scales of analyses to evaluate the usefulness of different scales of data collection and analyses for management purposes and to observe the effect of scale on the relationship between negative impacts and satisfaction. These analyses clearly indicated those

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**Table 3. Social landscape metrics for different park zones of Oulanka National Park based on mapped tourism impacts.**

<table>
<thead>
<tr>
<th></th>
<th>Kiutaköngäs</th>
<th>Juuma</th>
<th>Oulanka Canyon</th>
<th>Valtavaara</th>
<th>Other</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value sum absolute ((P0))</td>
<td>15</td>
<td>39</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>87</td>
</tr>
<tr>
<td>Value sum percent ((P1))</td>
<td>17</td>
<td>45</td>
<td>11</td>
<td>13</td>
<td>14</td>
<td>100</td>
</tr>
<tr>
<td>Value frequency index ((F))</td>
<td>0.9</td>
<td>2.2</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>–</td>
</tr>
<tr>
<td>Dominant impact ((D))</td>
<td>Littering/erosion/crowding</td>
<td>Crowding</td>
<td>Littering</td>
<td>Littering</td>
<td>Littering/erosion</td>
<td>Littering</td>
</tr>
<tr>
<td>Value dominance index ((D1))</td>
<td>0.0</td>
<td>0.4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Value diversity index ((D2))</td>
<td>1.8</td>
<td>1.5</td>
<td>1.6</td>
<td>1.4</td>
<td>1.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Mean intensity index ((I))</td>
<td>57.2</td>
<td>64.0</td>
<td>54.8</td>
<td>75.9</td>
<td>75.7</td>
<td>64.6</td>
</tr>
</tbody>
</table>

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Figure 3. Intensity of the negative impacts of tourism in Oulanka NP.

Figure 4. Types of and locations of tourism impacts disturbing visitor experiences in Oulanka NP.
locations in which tourism has already caused too apparent impacts from a visitor perspective, but showed no clear evidence that visitor satisfaction is lower at these particular locations.

**Perceived impacts and satisfaction across Oulanka NP**

At the destination scale, we found that visitors perceived erosion, crowding, and littering to negatively deviate from what they considered acceptable. These impacts, especially littering, are a common concern within areas where nature-based tourism is practiced (e.g. Deng et al., 2003; Lynn & Brown, 2003; Manning et al., 2000; Verlic et al., 2015; Whittaker, 1992). Both utilized methods provided complementary information about the types of impacts that were considered unpleasant in terms of the recreation experience, except in the case of littering, which participants tended to map relatively more often compared to how they evaluated its disturbance in the visitor survey.

At the park zone scale, we found that evaluations of tourism impacts did not follow the distribution of visitor use or the hypothesized spatial pattern of impact distribution. Unacceptable impacts of tourism were especially concentrated in the highly visited area of Juuma. Interestingly, the number of negatively evaluated impacts was much smaller in the other highly visited areas of Kiutaköngäs and Valtavaara. The most frequently reported impact differed among the highly visited places, as crowding was perceived as the most distracting impact in Juuma, whereas erosion was perceived to be the most frequently reported negative impact in Kiutaköngäs and Valtavaara. This may indicate that visitors heading to different areas of the park have different expectations, against which they evaluate the conditions they encounter. However, the study design could be improved to emphasize the dissimilarities between distribution patterns of absolute use levels, tourism impacts, and evaluations of impacts. First, using geographically even sampling design would help in comparing the frequencies of perceived negative impacts between zones, as in this study participants had most commonly visited the most popular places, Kiutaköngäs and Juuma, which may have emphasized that the mapped unacceptable impacts of tourism were concentrated in these zones. In addition, for this study we had no spatially accurate data on the ‘true’ distribution of tourism impacts (e.g. erosion), so the impacts were only assumed to follow the use distribution (e.g. more visitors meaning more erosion). Nevertheless, issues like terrain type and management actions, such as trail hardening, affect how severe and visible the impacts truly are.

At the site scale, we found that visitors especially considered the Pieni Karhunkierros loop trail located in Juuma to be problematic as visitors encountering this trail considered that the conditions they faced deviated negatively from their norms against the number of visitors and erosion. In addition, visitors considered the trail section following Valtavaara hill to be too eroded. As crowding and erosion were typical of certain trails, negative evaluations of littering seemed to concentrate in the vicinity of wilderness huts.

Considering visitor satisfaction, we found no uniform pattern of how unacceptable tourism impacts would result in visitors’ satisfaction levels. At the destination scale, some impacts such as erosion showed to be related to visitor satisfaction, being consistent with some previous studies (e.g. Deng et al., 2003; Lynn & Brown, 2003). However, the effect may be mediated through visitors’ characteristics, as we found some certain visitor groups, especially men, to be more sensitive to tourism impacts as well as more critical...
regarding their level of satisfaction with the visit. Nevertheless, at the park zone or site scale, the association between unacceptable tourism impacts and visitor satisfaction was invisible. This corresponds with previous studies that have evidenced that visitors can experience high levels of satisfaction despite evaluating visit conditions as not being optimal (Dorwart et al., 2009; Hall & Cole, 2007; Kuentzel & Heberlein, 1992; Shelby & Heberlein, 1986; White et al., 2001). Therefore, this study supports that visitors go through complex mental processes that affect how they cope with the negative impacts they perceive, allowing them to maintain high visitor satisfaction even though they encounter negative impacts during their visit (Hall & Cole, 2007; Manning, 2011).

Implications for planning place-based management action

From a practical perspective, this study suggests two kinds of management actions to be applied in Oulanka NP. To decrease the negative evaluations of tourism impacts, actions such as redirecting visitor flow, hardening trails, and educating visitors should be implemented. The site scale representation of tourism impacts provides a valuable tool for applying these actions, showing precisely those locations where certain tourism impacts deviate negatively from visitors’ norms and where management actions are thus to be directed. In response to Lyon et al.’s (2011) recommendation for constructing new protective structures (e.g. bridges, double width boardwalks, and trail reinforcement) in the Oulanka NP, this study identifies the exact locations where those structures would best mitigate the negative effects of tourism as identified by visitors. Thus, resources can be effectively allocated while simultaneously acknowledging visitor experiences. Moreover, negative evaluations can also be influenced through modifying visitors’ expectations, as evidenced especially in crowding-related studies (e.g. Kuentzel & Heberlein 2003; Manning, Valliere, Minteer, Wang, & Jacobi, 2009). This means that informing visitors of the realistic conditions that they will encounter can reduce visitors’ negative on-the-spot evaluations. In addition, using social marketing principles and techniques (see Hall, 2014) could help influence users to voluntarily modify their destructive behaviors. For example, ameliorating destructive behaviors like littering or wandering outside of designated trails will not only reduce visitors’ perceptions of impacts, but also improve the park’s conditions.

Our study clearly showed that measuring impacts at the destination scale can only provide a rough picture of visitors’ evaluations of which tourism impacts are considered problematic within a certain park area. Therefore, for a more discreet place-based management, we recommend collecting and analyzing evaluative information at least at the park zone scale. This approach enables the acknowledgment that standards against tourism impacts vary according to the locations of evaluations. Our study also demonstrated that PPGIS tools can be successfully used for place-based monitoring of tourism impacts, and therefore, more effort should be paid to extending PPGIS methods from fields of research into planning practices. Thus far, this has been found to be difficult as there are no standardized methods and models for collecting and integrating PPGIS data into decision-making processes (Brown 2012). For practical applications, monitoring protocols informing park management about issues of concern should be rather simple and repeatable, but the formation of, for example, social landscape metrics requires skills in analyzing social-science-based spatial data (Lechner et al. 2014).
We encountered some challenges in applying the PPGIS methods. An important aim of PPGIS studies is representativeness of participants; ensured through probability sampling of individuals (Brown & Kyttä, 2014). This study showed that those participants who replied to the additional PPGIS survey did not differ considerably from all of the people who responded to Oulanka National Park visitor survey. This is evidence that the new data collection method does not exclude any specific visitor groups. Respondents who mapped negative tourism impacts had a higher level of education than the average visitor survey respondent, suggesting that while visitors are becoming more conscious of environmental impacts they encounter (Moore et al., 2012; Van Riper, Manning, & Reigner, 2010), more highly educated visitors may have less tolerance for the same negative impacts. This supports the claim that environment-friendly tourists are typically more educated (Dolnicar, Crouch, & Long, 2008).

One explanation for the relatively small number of mapped unacceptable impacts of tourism was the low response rate of this study; which is typical of Internet-based PPGIS studies that use random sampling (e.g. Brown, Montag, & Lyon 2012; Brown & Reed, 2009). Another explanation, as outlined by Puhakka (2011) is that the number of Oulanka NP tourists that are especially environmentally responsible, and highly concerned about the environmental impact of tourism, is fairly low. Regardless, small data-sets are challenging in PPGIS studies because sufficient spatial data are required to identify spatial patterns with confidence (Brown & Kyttä, 2014). However, even the data from seven participants, who completed a mapping exercise, have resulted in a high quality of aggregated data and good results (Rohrbach, Anderson, & Laube, 2015). In our study, despite the fact that we had only 44 respondents who marked places of unacceptable impacts of tourism, these markings remain strong indicators of locations where management actions should be focused.

We also recommend conducting the mapping directly after visits, or even on the spot, to increase the number of mapped attributes and their accuracy. For this purpose, we see a high potential for using smartphone applications. These would also allow storing evidence of the condition, e.g. as text or photos, which led to the negative evaluation. Adding this descriptive component would improve the information value of spatial data remarkably, as it would enable analysis of visitors’ evaluations against the conditions under which the negative impact was realized.

In addition to technical challenges, we perceived the measuring approach we applied to be problematic as it provided only information about those impacts that had already deviated negatively from visitors’ norms towards tourism impacts. Therefore, the impacts rising inductively from the data cannot be interpreted to correspond with those features that exclusively determine visitors’ experience quality, as also other, still latent features can be important to experience quality even though visitors do not currently find these conditions unacceptable in Oulanka NP.

Finally, we recommend also measuring visitor satisfaction in a site-specific manner, as the satisfaction measures that compress the whole experience to an after-visit evaluation seem to lead to high levels of visitor satisfaction in Finnish parks (Metsähallitus, 2014), being also an international methodological concern. According to Manning (2011, p. 16), the satisfaction levels are consistently found to be high, having limited usefulness to recreation managers and researchers interested in relationships between outdoor recreation opportunities and experiences. Therefore, a geographically detailed view of visitors’
satisfaction levels could help in understanding more precisely the kinds of conditions which decrease the quality of visitor experiences.

Conclusions

Based on the results of this study we can conclude that evaluative information in park management would greatly benefit from a spatially explicit approach. Inclusion of different spatial scales in the tourism impact and satisfaction assessment provides a more multidimensional view of management needs. This study complements the previous ecologically oriented studies, which have emphasized the need for careful management planning to protect biodiversity in national parks that is threatened by recreational use: areas of high traffic and recreational use tend to spatially overlap with areas containing high biodiversity values (Lyon et al., 2011; Neuvonen, Pouta, Puustinen, & Sievänen, 2010; Siikamäki, Kangas, Paasivaara, & Schroderus, 2015). Using an experiential perspective, this study demonstrates how to add a layer of evaluation to management planning; stating spatially, explicitly, and effectively where further management practices should be implemented. This kind of spatially accurate data on visitors’ assessments provides a means to monitor tourism impacts, acknowledging that the acceptable level of impact can vary within parks.

In the future, we recommend conducting the mapping of impacts on the spot during the visit in order to increase the number of mapped attributes. The PPGIS approach, perhaps disseminated through mobile devices, should be encouraged as a method for collecting data on perceived tourism impacts and satisfaction related to specific places, sites, routes, and services in parks. In addition to parks, we recommend using the approach at more heavily trafficked tourism destinations to identify, in a customer-oriented manner, those place-specific issues needing management attention. However, the mapped attributes should not be limited to negative impacts of tourism, they should correspond to a destination’s characteristics and its specific development needs, including noise pollution, dangerous places, and landscape values, among others. Finally, in order to promote PPGIS to the status of a practical and institutionalized planning tool, we propose that applications and software with predefined functions for the most useful, reliable and meaningful metrics should be developed to decrease the managerial threshold for exploiting this new method in tourism planning.

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Disclosure statement

No potential conflict of interest was reported by the authors.
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References


### Appendix 1. Social landscape metrics used in the study.

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Explanation</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Sum Absolute</td>
<td>The number of impacts within one park zone.</td>
<td>$P_0 = \sum p_i$</td>
</tr>
<tr>
<td>Value Sum Percent</td>
<td>Relative distribution of impacts across all zones.</td>
<td>$P_1 = \sum p_i$</td>
</tr>
<tr>
<td>Value Frequency index</td>
<td>Relative frequency of impact within a zone compared to the frequency of all mapped impacts ($F &gt; 1.0$ greater relative frequency of impact than the average number of mapped impacts across all zones).</td>
<td>$F = \frac{\sum p_i}{\frac{1}{n} \sum j=1 X_j}$</td>
</tr>
<tr>
<td>Dominant value</td>
<td>The impact with the largest count of points in each zone.</td>
<td>$D = \max (\sum v_i)$</td>
</tr>
<tr>
<td>Value dominance index</td>
<td>Dominance of the relationship between the dominant impact on the next most common impact within one zone ($D_1 = 0$, no difference, $D_1 = 1$ only one impact type located in the park zone).</td>
<td>$D_1 = \frac{\max (\sum v_i) - \max (\sum v_i)^2}{\max (\sum v_i)}$</td>
</tr>
<tr>
<td>Value Diversity Index</td>
<td>Diversity of multiple impacts for the same zone.</td>
<td>$D_2 = - \sum_{i=1}^{\nu} p_i \ln p_i$</td>
</tr>
<tr>
<td>Mean Intensity Index</td>
<td>Mean intensity of tourism impacts within one park zone.</td>
<td>$I = \frac{\sum_{i} \bar{X}_i}{n}$</td>
</tr>
</tbody>
</table>

$p_i =$ number of tourism impact points mapped within a park zone  
$P =$ total number of mapped impact points  
$n =$ total number of park zones  
$X_j =$ mean number of impact points per park zone $j$  
$v_i =$ number of mapped impact points for a given value $v$ in a given park zone $i$  
$p_i =$ the proportional abundance of the $i$th landscape value $= (n_i/N)$.  
$n_i =$ the number of mapped landscape values in the $i$th landscape value category  
$N =$ the total number of all mapped landscape values  
$\ln =$ natural logarithm  
$\nu =$ the number of landscape value categories  
$k_i =$ evaluated intensity of impact point within park zone $i$

Source: Brown and Reed (2012) (excluding *mean intensity index*).