Nordia
Geographical Publications

Volume 47:4

A spatial perspective of visitor experiences in national parks – Investigating the potential of Public Participation GIS methods in outdoor recreation planning

Miisa Pietilä

ACADEMIC DISSERTATION

to be presented with the permission of the Doctoral Training Committee for Human Sciences of the University of Oulu Graduate School (UniOGS), for public discussion in the lecture hall L2, on the 3rd of October, 2018, at 12 noon.

Nordia
Geographical Publications

Volume 47:4

A spatial perspective of visitor experiences in national parks – Investigating the potential of Public Participation GIS methods in outdoor recreation planning

Miisa Pietilä

Nordia Geographical Publications

Publications of
The Geographical Society of Northern Finland
and
Geography Research Unit, University of Oulu

Address: Geography Research Unit
P.O. Box 3000
FIN-90014 University of Oulu
FINLAND
heikki.sirvio@oulu.fi

Editor: Teijo Klemettilä

Cover image: Laura Johansson / Metsähallitus

Nordia Geographical Publications
ISBN 978-952-62-2056-7
ISSN 1238-2086

Juvenes Print
Oulu 2018

A spatial perspective of visitor experiences in national parks – Investigating the potential of Public Participation GIS methods in outdoor recreation planning

Contents

Abstract

A spatial perspective of visitor experiences in national parks – Investigating the potential of Public Participation GIS methods in outdoor recreation planning

Pietilä, Miisa, Geography Research Unit, University of Oulu, 2018

Keywords: visitor experience, visitor planning, outdoor recreation, PPGIS, national park

The number of visitors and the diversity of users at national parks is increasing. To cope with this, national park management organizations must efficiently plan for the visitor use of these areas. This requires an understanding of visitors' experiences as well as methods to systematically monitor visitors in parks. Academics have recently proposed versatile spatial methods to improve visitor planning in parks. One such approach, potentially supporting the participatory and spatial paradigms of conservation area management, is Public Participation Geographic Information Systems (PPGIS). PPGIS methods are used to map people's experiences related to certain locations. However, these methods have only been trialed on a limited scale in relation to outdoor recreation planning frameworks and to address different visitor planning practices. In addition, there is lack of studies which incorporate managers' perspectives in the development of PPGIS methods.

This study investigates the potential of PPGIS methods in the context of planning for outdoor recreation in national parks. More specifically, the study aims to increase the understanding of the factors that influence visitor experiences, find out how PPGIS methods could serve different visitor planning practices and frameworks, as well as to review the opportunities and challenges related to implementing PPGIS methods.

The study is mainly based on two PPPGIS surveys that were conducted in Oulanka National Park in 2010 and 2014. The first study was carried out using paper maps on which visitors marked their most positive and negative experiences in the park and provided an explanation for this experience. The second study was conducted using a web-based PPGIS survey in which park visitors placed pre-defined markers on an electronic map representing experiences such as the outcomes of visiting certain sites and perceptions of the negative impacts of recreation. These two data sets were analyzed using spatial statistics, such as spatial discounting and chi-square statistics. In addition, interviews of managers representing the Finnish park organization, Metsähallitus, were conducted to increase the management perspective when outlining the needs for spatial data on visitors.

The study showed that there are different needs when developing PPGIS methods depending on whether they are applied to understand visitor experiences or to monitor them for practical management purposes. The study showed that the aesthetics of the encountered environment and adequate recreation infrastructure are important for a quality visitor experience. Furthermore, the study suggested that to understand visitor experiences, PPGIS methods should be utilized to capture how visitors perceive the

environment they encounter. To enhance practical visitor planning, the study suggested using PPGIS methods to define the acceptable amount of change in national parks and identify the recreation opportunities that parks provide. For monitoring the change, the study recommends to spatially measure visitors' perceptions towards the negative impacts of recreation, such as littering, crowding and erosion. To define recreation opportunities, mapping should focus on those environmental features which visitors consider important for their activities at certain locations. Moreover, the everyday management of national parks would benefit from spatial information concerning possible shortcomings in the recreation infrastructure.

Regarding the implementation of PPGIS practices into outdoor recreation planning of national parks, the study revealed that managers' attitudes towards social science and public participation support the integration of these methods. On the contrary, challenges for implementation are caused by (1) the technical complications related to PPGIS practices, (2) institutionalized monitoring practices that can hinder the adoption of new methods, and (3) the quality of PPGIS data. These issues could be facilitated by developing a mobile phone application enabling collection of visitors' experiences while they visit national parks and developing automatic processes which quantify the mapping outcomes and transfer the data into a format for use in GIS software and add it to databases used for planning purposes.

Supervisors

Professor Jarkko Saarinen
Geography Research Unit
University of Oulu, Finland

Adjunct Professor Nora Fagerholm
Department of Geography and Geology
University of Turku, Finland

Professor Jarmo Rusanen
Geography Research Unit
University of Oulu, Finland

Pre-examiners

Associate Professor Anton Stahl Olafsson
Section of Landscape Architecture and Planning
University of Copenhagen, Denmark

Doctor Isabelle Wolf
Office of Environment and Heritage
Department of Premier and Cabinet, Australia

Official opponent

Professor Tuuli Toivonen
Department of Geosciences and Geography
University of Helsinki, Finland

List of original articles

Article I — Pietilä, M.* & K. Kangas (2015). Examining the relationship between recreation settings and experiences in Oulanka National Park – A spatial approach. *Journal of Outdoor Recreation and Tourism* 9, 26–36.

Article II — Pietilä, M. (2017). Do visitor experiences differ across recreation settings? – utilizing geographical information systems to study the setting-experience relationship. *Visitor Studies* 20: 2, 187–201.

Article III — Pietilä, M.** & N. Fagerholm (2016). Visitors' place-based evaluations of unacceptable tourism impacts in Oulanka National Park, Finland. *Tourism Geographies* 18: 3, 258–279.

Article IV — Pietilä, M.** & N. Fagerholm (2018). A management perspective to using Public Participation GIS in planning the visitor use of national parks. *Journal of Environmental Planning and Management*. https://doi.org/10.1080/09640568.2018.1473757

* The author was responsible for analyzing the data. The article was written in collaboration with Katja Kangas.

** The author was responsible for collecting and analyzing the data. The article was written in collaboration with Nora Fagerholm.

Acknowledgements

This unbelievable journey started in Helsinki in early 2012. Right after handing in my master's thesis, I wrote down the initial idea for what my PhD would concern. However, life first took me to New Zealand and then to Kuusamo, where I developed the idea and met people who ended up playing large roles in my PhD process. After some years, I found myself in Oulu with funding that enabled me to realize my dream of becoming a PhD. This was the beginning of an intense process, which I both loved and hated. Luckily, I had a bunch of amazing people around me who pushed me forward and believed in my work, as well as lovely friends who were not that interested in what I was doing, and saved me from struggling to explain my research.

There are many people that I wish to thank for participating in this process. First, I want to thank my supervisors, Jarkko Saarinen and Nora Fagerholm, who have been great supporters. Jarkko, I'm grateful for your patience, trust and all the tips that you gave me. Some of those tips I think I understood, some of them I understood years later, and some – I guess – I didn't even understand that I was given. Nora, I am very pleased that you agreed to join my supervision team a bit later in the process. It was lovely to co-author articles with you, and I really enjoyed having a supervisor like you with such a practical grip on my work.

The things I enjoyed the most while doing my PhD were the conference trips and the research visits that I was able to conduct. These trips were a great source of motivation and enabled me to meet interesting scholars around the world. To name a few, I am very grateful that I met Greg Brown who was a great help and support in the early stage of my work. In addition, Susan Moore, you became my academic idol and mentor. I appreciate how sincerely interested you were in my work and how you hosted me during my research visit to Australia. I'm also honored that I got to know you as an amazing personality as well as a loving mom. Moreover, I am very grateful to the nominated pre-examiners, Isabelle Wolf and Anton Stahl Olafsson, for reviewing my thesis and giving very supportive comments and development suggestions. I also want to thank Tuuli Toivonen for accepting the invitation to be my opponent.

Two important institutions have been closely involved in this work. I am very thankful for my lovely colleagues at the Natural Resources Institute: Katja Kangas, Marjo Neuvonen, Tuija Sievänen and Liisa Tyrväinen. You helped me publish my first scientific articles, which was a very important start for my academic career. With the lessons that I learned from you, publishing the rest of the articles was relatively comfortable. Additionally, Metsähallitus has been an amazing partner organization. I am very grateful for all of you, especially Essi-Maaria Ala-Aho, who helped me collect my primary data set in Oulanka National Park. I would also like to express my gratitude to those colleagues who agreed to be interviewed for my research. I sincerely hope that you can benefit from my work.

The closest community in which this work has been conducted was our tourism research group. I'm very grateful to all the members of this group – Jarkko, Kaarina, Eva, Maaria, Vilhelmiina, Outi, Alix, Roger, Sini – our meetings have really brightened my working days and made this process enjoyable. I am thankful for the time you have put into reviewing my manuscripts. In addition, I appreciate that so many people have been

willing to proofread my texts. The past four years have been much about reading and writing. Having dyslexia hasn't helped much in this, and therefore knowing people who are willing to improve my texts has been precious.

The undeniably best side-effect of this process has been finding a bunch of very good friends. I am especially grateful for the special girls: Outi, Fredriika, Katharina, Gitte and Cadey. You really enjoyed and suffered through the process with me. I don't know how I would have survived the past five years without our WhatsApp group that provided 24/7 mental support on all possible issues in life. Furthermore, it has been lovely to work and spend time outside the office with an amazing international and dynamic group of friends. I really hope we will keep organizing the chaotic group trips even after we have all finished our PhDs.

Finally, many thanks to my family. My mom, Anne, has done an incredible job by organizing opportunities for me to advance my work, even when I was on maternity leave. Many thanks to dear Veikko for supporting me on this journey. I appreciate that, despite your great knowledge on the subject, you gave me space to do the thesis on my own, but still provided valuable and practical advice when I asked for it. I am also very thankful to our daughter, Milja, for putting this whole work into a wider perspective and showing me what is most valuable in life. Moreover, I'm grateful for our second – yet unborn – child for setting the final deadline for this work.

In Oulu, August 2018
Miisa Pietilä

1 Introduction

National parks are large natural or near natural areas that are set aside to protect ecological processes and the species and ecosystems characteristic of these areas. In addition, these areas are intended to provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities (IUCN 2018). Indeed, the element of recreation has been part of the creation of national parks and national park systems since the first parks were established (Frost & Hall 2009). Currently, national parks are facing an increasing demand in most parts of the world: the number of visitors to national parks is increasing and the diversity of users and interests within these areas are blossoming (Eagles 2014; Balmford *et al.* 2015; Ankre *et al.* 2016). Consequently, recreation has also an increased role in the planning and management of many national parks (Puhakka 2008; Puhakka & Saarinen 2013; Newsome & Hughes 2018). To illustrate this, such terms as *touristification*, *sportification* and *adventurescape* have been presented. Wall-Renius and Fredman (2007) have used the term *touristification* to emphasize that national parks have become tourism products that are promoted and sold by the industry, and that the status of national parks have started to act as a significant marker trigging people to visit parks. Newsome and Hughes (2018) have recently used the term *sportification* to highlight that the rationale for conservation reserves has reached a phase in the 21st century where nature conservation areas act as a backdrop for entertainment, including a range of adventure and competitive sport-oriented recreation and cultural events. Similarly, Saarinen (2018) has referred to *adventurescapes*, which are natural and wild environments increasingly utilized by new and evolving commercial forms of tourism. In this respect, national parks as *adventurescapes* have become a part of the tourism industry and its global imaginaries.

Recreation has also been present in Finnish national parks since the first parks were established in 1938. At that time aesthetic, touristic aspects, and the formation of national identity were important reasons for preserving nature (Sorsa 2004). Nevertheless, a major emphasis on tourism in Finnish national parks has been seen since the 1990s (Puhakka 2008; Puhakka & Saarinen 2013). From this point forward, a so-called 'new tourism' has increased the volume of tourists interested in traveling to nature (see Poon 1993). Meanwhile, nature-based tourism has become an important tool for regional development, especially in northern Finland (Saarinen 2005). The number of visits to parks has increased since this, receiving approximately three million visits in 2017 (Metsähallitus 2018). The way outdoor recreation is planned and managed in parks has also changed. Metsähallitus, the state state-run enterprise managing Finland's 40 national parks, is currently more interested in creating new possibilities for tourism entrepreneurs to operate in the parks (Puhakka 2007; 2008). Likewise, Metsähallitus has started to refer to visitors and hikers as tourists and clients, illustrating the change in the management thinking, orientation, and economic role of tourism (Puhakka & Saarinen 2013). On the whole, Metsähallitus has accepted "growth and profitability" as integral parts of governance which are realized in

the goals of increasing visitor numbers and economic impacts of nature-based tourism (Rytteri & Puhakka 2009). Compared to other Nordic countries, Finland is developing tourism within its parks more actively than its neighboring countries (see Higham & Vistad 2011).

The emphasis of tourism in national parks is said to reflect the wider phenomena of neoliberalization of nature (Castree 2008; Rytteri & Puhakka 2009; Puhakka & Saarinen 2013; Job *et al.* 2017). From this perspective, the central logic is to 'sell nature in order to save it', assuming that when nature is commercialized, its value rises, giving additional resources and incentives for nature conservation (McAfee 1999). Expanding the visitor use spectrum is considered to encourage visitation of parks, which in turn fosters public support for nature conservation (Weiler *et al.* 2013; Moyle & Weiler 2017). Moreover, tourism has been considered to contribute to socioeconomic development of rural areas (Machlis & Field 2000; Hall & Boyd 2005). In addition, the health and well-being benefits are increasingly documented to justify the financial and political support for conservation areas (e.g. Puhakka *et al.* 2017; Buckley & Brough 2017).

To cope with increasing visitation, park management organizations must efficiently plan and manage outdoor recreation within the parks. Along with the changes in the use of parks, the planning, management and governance of conservation areas has also shifted. The traditional top-down approaches have been replaced by participatory bottom-up approaches, because of recognizing that the top-down governance approaches are ineffective at addressing the underlying social and ecological system complexities and uncertainties faced especially by those protected areas that are also tourism destinations (Islam *et al.* 2017). Current approaches to natural resource management highlight the importance of integrating public opinion in the decision-making process (e.g. Reed 2008; Dinsdale 2009; Brown & Weber 2011; Risvoll *et al.* 2014; Su *et al.* 2014). Furthermore, the concept of *co-management* has been suggested to emphasize the importance of active participation and collaboration of diverse stakeholder groups as well as collaborative knowledge generation and learning (Berkes 2009; Plummer & Fennell 2009; Islam *et al.* 2017). Moreover, co-management can be considered a knowledge partnership between the government and local resource users (Berker 2009). Metsähallitus, like other park organizations around the world (see Ross *et al.* 2009; Thomlinson & Crouch 2012), has also an objective to involve citizens in planning and management of national parks; as quoted in the *principles of sustainable tourism*, "we cooperate and offer local residents and visitors the opportunity to take part in the management and development of the site" (Metsähallitus 2014a).

A second similar trend, which influences the management of especially those conservation areas that have a significant touristic role, is the increasing role of visitors in the production of experiences. Tourists are not anymore passive sightseers consuming tourism destinations or sights, but active and willing to participate in the design, production, and consumption of experiences. Due to this, there has been an increasing discussion around *co-creation* of tourism experiences and forming new kinds

of relationships between producers and consumers (see Binkhorst & Den Dekker 2009; Campos *et al.* 2015). Visitors' willingness to participate is also evident within protected areas, which have received a growing interest and participation in ecologically oriented volunteer tourism (Rattan *et al.* 2012; Wearing & McGehee 2013; Weaver 2015). Over all, this trend shows that visitors can also be seen as potential contributors to the conservation aims of national parks and enablers of the sustainability of these areas, rather than only as a distraction to the ecological mandate (Weaver 2015).

Yet another change in conservation area management has been related to the idea of *spatiality*. The emphasis on spatiality has received increasing attention in natural resource management and related research in recent decades (Kruger & Hall 2008; Stewart *et al.* 2013), with calls to take the concepts such as *place* and *scale* more seriously. Considering conservation areas as *places* means that they are understood as geographical areas that contain people's meanings, values and experiences (Cresswell 2004; Tuan 1974). Therefore, the use of *place* has started to be seen to assist the development of management strategies that are more responsive to people's experiences and needs (Manzo 2008). Especially in the era of high intensity use and activities taking place within conservation areas, a significant advantage of the concept of place is seen as its capability to help managers, for example to recognize that users form relationships with specific places as well as have expectations concerning appropriate use and management (Williams 2008). Moreover, *scale* is a critically important concept within geography, and is found at the center of methodological discussions within the discipline (Gibson *et al.* 2000; Marston *et al.* 2005). According to Gibson *et al.* (2000) the idea of *scale* refers to the spatial dimensions used to measure and study objects and processes, and the related term *level* refers to the location along this scale. In tourism, destination is an often-used level for researching and discussing issues such as sustainability (Saarinen 2006; 2013). National park planning and management is also implemented much on the park level (i.e. destination) (Kajala *et al.* 2004).

To plan outdoor recreation in national parks, in line with the trends presented above, there is an undoubtable need for methods that host the knowledge relationship between managers and visitors, and take advantage of visitors' willingness to contribute to the conservation of the parks. In addition, these methods should be sensitive to visitors' experiences in particular geographical locations and enable moving across different spatial levels. One such promising approach is Public Participation GIS (PPGIS).

PPGIS is an approach that has evolved along with the development from maps created by experts and state administration representatives towards geographic information that is created by people and their users (Panek 2016). The purpose of the approach has been to enhance public involvement to inform land use planning and management by systematically and geographically mapping people's experiences related to places (Sieber 2006; Dunn 2007; Panek 2016). Versatile methods have been utilized to carry out the mapping. The use of PPGIS methods has been found especially recommendable for areas that should be managed by integrating the range of values the public associates with lands like national forests and parks (Brown & Reed 2009; Brown & Weber 2011;

Brown & Kyttä 2014). PPGIS has indeed been actively used to map the variety of values, including recreation, that visitors attach to these areas to enhance land use planning, (e.g. van Riper *et al.* 2012; Brown *et al.* 2014a; Scolozzi *et al.* 2015; Strickland-Munro *et al.* 2016; Munro *et al.* 2017). However, the focus of most PPGIS studies so far has been a holistic management and consolidation of different kinds of land use values or ecosystem services (Brown & Kyttä 2014; Brown & Fagerholm 2016), while only some researchers have piloted or suggested that PPGIS could be integrated also into outdoor recreation planning frameworks (Brown & Weber 2011; Beeco & Brown 2013). In addition, the decision-support potential of PPGIS has been mostly described in academic literature, and there is only little evidence of formal agency adoption beyond preliminary PPGIS trials (Brown 2012; Brown & Kyttä 2014; Kahila-Tani *et al.* 2016; Brown & Kyttä 2018). Further, there has been a lack of studies investigating managers' willingness and readiness to adopt these methods. This justifies the need to investigate how PPGIS could enhance the planning of outdoor recreation in national parks and how managers see its role in outdoor recreation planning practices.

2 Research aim and objectives

The aim of this study is to investigate the potential of PPGIS methods in planning for outdoor recreation (i.e. visitor planning) in national parks, in the Nordic and Finnish context more specifically. Visitor planning is considered here to be one aspect of a more holistic concept of *national park management*, which includes also the management of the ecological and cultural values of the parks, for example (Newsome *et al.* 2013). The aspect of visitor planning includes more specifically those practices that managers carry out as a means to manage visitors and their impacts. These planning practices depend on the park organization and can include such matters as opportunity zoning, defining the limits of acceptable use, coordinating visitors across and within the parks, as well as planning which management actions to take to achieve the goals that are set for the visitor use.

The overall aim of the study is approached through three research questions. The first question: *How does the encountered environment influence visitor experiences in national parks?* aims to increase our understanding of the factors that influence visitors' experiences, and to find out how the PPGIS methods should be applied to understand visitor experiences. The second question: *How could PPGIS enhance planning for the visitor use of national parks?* explores what kind of spatial data could serve visitor planning practices, as defined by the park managers. The third research question: *What are the opportunities and challenges in implementing PPGIS methods into visitor planning?* evaluates what these are in the Finnish context and how the possible challenges could be overcome.

The research questions are answered by the four research articles that this compilation dissertation is based on. Table 1 provides a summary of the focus and method used in each research article and illustrates how the research articles contribute to answering the research questions presented above. Shortly, Article I examines the factors that affect the quality of visitors' experiences. This is based on a PPGIS survey that was conducted using paper-maps in Oulanka National Park. Article II focuses more specifically on the relationship between recreation opportunities and visitor experiences. This Article, as well as Article III, is based on a web-based PPGIS survey targeted to visitors of Oulanka National Park. Article III focuses on visitors' perceptions on the negative impacts of recreation. To supplement these studies, Article IV provides a management perspective to using PPGIS in visitor planning in the Finnish context. This Article is a study in which the managers of Metsähallitus are interviewed to examine their needs for spatial data on visitors and to bring up the challenges related to implementing PPGIS methods in practice.

The study begins with a literature review illustrating the aspects from which tourism and recreation in national parks has been studied (Chapter 3). This overview positions the study in the Nordic context and within the geographical tradition. Following this, the different approaches to study the relationship between the environment and visitor experiences are presented and discussed from a management perspective. Furthermore, the most commonly utilized concepts and frameworks in outdoor recreation planning are

reviewed to set a context in which the PPGIS methods are to be integrated. In addition, the state of visitor monitoring is discussed shortly to highlight the importance as well as the current state and practices to collect data on visitors to parks. Lastly, the management practices carried out in Finnish parks are introduced to narrow the study context to Finnish national park planning.

To set a methodological context for the study, Chapter 4 introduces spatial methods that have been used and developed to collect and analyze visitor use of natural areas. Shortcomings in these methods are raised to justify the potential need for a more experiential type of spatial data on visitors. Afterwards, a short review is provided on how PPGIS methods have been used for the purpose of planning outdoor recreation in national parks.

The empirical part of the study (Chapter 5) introduces first the case study area, Oulanka National Park, where the PPGIS surveys are carried out. After this, the data collection and analyses methods are presented. Following this, the main findings are discussed in chapter 6 in the order of the three research questions (Table 1). Lastly, conclusions based on the findings are summarized (Chapter 7).

Table 1. Summary of the research articles and illustration on the relationship between the articles and research questions.

Research article	**I**	**II**	**III**	**IV**
Focus of the article	Factors affecting the quality of visitor experiences	The relationship between recreation opportunities and visitor experiences	Perceptions of negative impacts of tourism	Managers' needs for spatial data Challenges related to implementing PPGIS methods
Method	Paper-map PPGIS survey	Web-based PPGIS survey	Web-based PPGIS survey	Interviews to park managers
RQ1: How does the encountered environment influence visitor experiences in national parks	X	X		
RQ2: How could PPGIS enhance planning for the visitor use of national parks?		X	X	X
RQ3: What are the opportunities and challenges in implementing PPGIS methods into visitor planning?				X

3 Visitor planning in national parks

3.1 Research on tourism and recreation in national parks

The planning of tourism and recreation in national parks and related areas have been internationally widely studied subjects (Frost & Hall 2009; Manning 2011; Newsome *et al.* 2013). Themes such as negative impacts of recreation, crowding, visitor satisfaction, carrying capacity, as well as the overall role of tourism in parks, have been frequently raised. In the Nordic countries, research that has focused on national park visitor use planning has covered national park visitations and visitor characteristics (e.g. Raadik *et al.* 2010; Haukeland *et al.* 2010; Neuvonen *et al.* 2010a; Sæþórsdóttir 2010a; Puhakka 2011; Sievänen *et al.* 2011; Wall-Reinius & Bäck 2011; Nerg *et al.* 2012; Puhakka & Siikamäki 2012; Veisten *et al.* 2015). Some researchers have also focused more directly on visitor experiences, for example how visitors experience wilderness (e.g. Saarinen 1998; Sæþórsdóttir 2010; Sæþórsdóttir & Saarinen 2016). In addition, researchers have studied the influence of park characteristics on park visitation to help in planning and management of existing parks and in the establishment of new parks (e.g. Neuvonen *et al.* 2010b; Lyon *et al.* 2011; Siikamäki *et al.* 2015; Schägner *et al.* 2016). To guarantee the sustainability of parks, the socio-cultural sustainability has been a key research interest focusing on the relationships between tourism, nature conservation and locality (e.g. Sandell 2005; Zachrisson 2006; Törn *et al.* 2008; Puhakka *et al.* 2009; Haukeland *et al.* 2011; Juutinen *et al.* 2011; Kalterborg *et al.* 2011; Sarkki *et al.* 2013; Puhakka *et al.* 2014).

Geographical research on recreation in national parks can be classified into three interests. Firstly, recreation ecology has aimed to increase the understanding and monitoring of the environmental impacts of nature-based tourism and recreation, as well as the effectiveness of various management tools in reducing those impacts. A key interest within this tradition has been the causal relationships between particular activities and various ecological factors (Marion & Cole 1989; Buckley 2005; Leung *et al.* 2008; Monz *et al.* 2010; Pickering *et al.* 2010; Hammit *et al.* 2015). Secondly, studies from the human geography perspective have focused on visitor behavior and visitors' experiences in national parks, especially through place-related concepts such as place attachment and place meanings. Here, a key interest has been the relationship between place attachment and variables considered important in outdoor recreation, such as sensitivity to resource and social conditions, motivations for visiting, support for management actions, social carrying capacity and potential conflicts with others, as well as visitors' likelihood of returning (e.g. Williams *et al.* 1992; Kaltenborn & Williams 2002; Moore & Scott 2003; Kyle *et al.* 2004; Hwang *et al.* 2005; White *et al.* 2008; Ramkissoon *et al.* 2013; Price *et al.* 2018). Attention has also been directed in developing a scale to measure place attachment through the dimensions of place identity and dependence (see Williams & Vaske 2003).

Moreover, in the Nordic context, the public right of access to national parks and its influences has been discussed (Kaltenborn *et al.* 2001; Sandell & Fredman 2010).

Thirdly, scholars in the field of Geographic Information Science (GIScience) have been interested in how different kinds of spatial tools and Geographic Information Systems (GIS) could be utilized in visitor planning of parks. This has led to a growing number of research efforts investigating how spatial methods could be used to capture and analyze visitor use patterns and factors affecting these patterns (Hallo *et al.* 2012; Orsi & Geneletti 2013; Beeco & Brown 2013; Meijles *et al.* 2014; Van Kirk *et al.* 2014; Levin *et al.* 2015; Sessions *et al.* 2016; Tenkanen *et al.* 2017; Korpilo *et al.* 2017; Walden-Schreiner *et al.* 2018). This approach has had its main focus on the technical development of spatial tools, but it inevitably touches contextually both the interests of recreation ecology and human geography. As this study concentrates on the development of PPGIS methods used to measure people's experiences and values as introduced later in the study, it contextually relates to human geography using its concepts, such as a visitor experience.

3.2 The relationship between visitor experiences and the environment

There are several ways that visitor experiences and their relationship with the environment can be understood and consequently studied and monitored. These paradigms can be categorized into four groups (1) inherent/aesthetic, (2) instrumental/goal-directed, (3) cultural/symbolic and (4) individual/expressive (Williams 2007).

The inherent/aesthetic paradigm has its premises on the fact that biological and psychological survival motivates behavior (Saegert & Winkel 1990). Research under this paradigm has looked for, for example, the direct "dose-response" linkages between specific environmental stimuli and psychological functioning and wellbeing (Williams 2004), containing the extensive literature on social carrying capacity and crowding (Manning 1985; Manning & Valliere 2001). The approach has also studied humans' landscape preferences and explored how environmental factors influence scenic quality, which are considered as objective and highly generalizable across time and place (Williams & Patterson 1999). In addition, this paradigm sees the natural environment as having an intrinsic capacity to promote healing and mental restoration (Kaplan & Kaplan 1989) and has received much attention lately (Hartig *et al.* 2014; Seymour 2016).

The instrumental/goal-directed paradigm suggests that visitors are motivated to seek out particular activities in specific settings in order to receive specific psychological outcomes (Williams 2007). Therefore, research representing this approach measures either the motivations, goals, and expectations (connoting what people seek or expect from the experience) or the outcomes, satisfactions and benefits which refer to what people receive from visiting a certain setting. Moreover, the visitor experience is considered to consist of "bundles" of outcomes, such as self-achievement, meeting new people, or learning.

Therefore, the aim is often to identify which components of the recreational experience are most important to participants (Driver 1983). In addition, the environment is evaluated based on its goal-fulfilling potential and, therefore, settings for experiences reflect tangible, and theoretically interchangeable, properties of the environment (Williams 2007). Studies representing this approach often refer to the environment using the term *setting*, which is considered as a combination of attributes of a real place that gives it recreational value (Clark & Stankey 1979).

The strength of the instrumental/goal-directed approach is that it shows, using an engineering-like approach, natural resources are tangible properties which can be manipulated and controlled to meet recreation needs (Williams *et al.* 1992). This rather simplistic view has evolved an extensive research tradition that has aimed to increase the understanding of how different types of setting attributes shape visitor experiences. Indeed, much research has been conducted to try to understand the link between settings and visitor experiences, but the link is still anything but clear. Studies comparing visited settings (excluding the ones focusing on hypothetical setting preferences) and realized experiences have commonly found no or only small differences in experiences across setting types (Pierskalla *et al.* 2004; Backlund & Stewart 2012; Fix *et al.* 2013; Kil *et al.* 2014).

Lastly, the cultural/symbolic paradigm aims to understand the symbolic meanings attached to the environment, while the individual/expressive is focused on the experience in terms of the role that it plays in the broader context of the individual's life (Williams *et al.* 1992; Patterson *et al.* 1998). Experiences are viewed as significant components of a person's identity, and perhaps relationship to place (Borrie & Birzell 2001). Therefore, it is not so much about making summary judgments at any particular time, but instead the interest is focused on an ongoing process of identity affirmation in which outdoor recreation activities, both on site and off site, become symbolic expressions of our identities (Haggard & Williams 1992). Experience is thus an unfolding story or narrative that organizes meaning and identity for the individual (Borrie & Birzell 2001). These paradigms have increased their dominance in outdoor recreation research (e.g. Williams *et al.* 1992; Mitchell *et al.* 1993; Manzo 2008; Brooks *et al.* 2006; Dvorak *et al.* 2013).

From a management perspective, the two last approaches have, however, been somewhat troublesome, as the key idea in these is that individuals play a large role in shaping the character and quality of the experience as a transaction between the person and the setting (Cole & Williams 2012). In fact, these approaches highlight the challenge of stewarding wilderness experiences, when experiences are considered highly idiosyncratic and personally constructed and given meaning (Cole & Williams 2012), while recreation settings are understood as "one-of-a-kind places that cannot be designed or engineered" (Williams *et al.* 1992: 30). To conclude, a goal-directed approach to understanding visitor experiences has been the most promising one, because it suggests that managers are able to modify the settings to construct recreation opportunities that lead to certain visitor experiences (Clark & Stankey 1979). Even though it is understood that these certain types of experiences cannot be controlled nor guaranteed, managers are considered to be able

to influence visitors' experiential outcomes by shaping the physical, social, and managerial attributes of a setting to provide opportunities for rewarding experiences (McCool 2006; McCool *et al.* 2007; Newsome *et al.* 2013).

3.3 Outdoor recreation planning concepts and frameworks

Outdoor recreation planning is much dominated by the ideology related to providing a *diversity* of setting opportunities. Early recreation researchers already brought up the notion that not all people visiting natural areas prefer similar settings, are looking for similar experiential outcomes, or desire equivalent facilities. Therefore, they proposed that in order to achieve quality recreational experiences, managers need to provide a variety of settings (Clark & Stankey 1979). Since this, the fundamental premise of visitor planning has been that quality experiences are best assured by providing a range or diversity of recreation settings (McCool 2006). To help recreation managers determine the existing supply of these settings, the framework of the Recreation Opportunity Spectrum (ROS) has been applied to map the continuum of settings ranging from primitive (i.e., remote, large, and undeveloped settings) to urban (i.e., easily accessible and developed settings) (Brown *et al.* 1978; Clark & Stankey 1979). In practice, this has been done by identifying attributes that represent specific types of opportunities and classifying specific sites into one of several categories along the continuum.

A major output of ROS is a map of a planning area displaying the spatial distribution of recreation opportunities (McCool *et al.* 2007). These maps are commonly generated manually and through digitization by analysts with an in-depth knowledge of the region (Joyce & Sutton 2009), but because GIS technology enables systematic classification of a recreation area, few studies have demonstrated how GIS software could also be used to create recreation opportunity classification or comparable management zones (e.g., Joyce & Sutton 2009; Kil *et al.* 2014; Orsi *et al.* 2013). These studies exemplify how information from geographical databases can be used to create layers describing the physical, social, or managerial features of the area. This kind of automatic generation has been said to have a great advantage over manual methods because of the removal of individual interpretations, and it is readily repeatable as new data are acquired (Joyce & Sutton 2009). The ROS framework has been mostly developed and utilized in North America, but it has also inspired development of so-called "Nordic methods" that have been developed aiming to support the provision of recreational opportunities in urban environments (see review by Lindholst *et al.* 2015). These methods have aimed to classify recreation areas into different ROS classes, even though different terminology is used.

The other widely used concept and framework in outdoor recreation is the Limits of Acceptable Change (LAC). This concept evolved gradually from the concept of *recreation carrying capacity*, which was developed in the 1960s when managers needed a framework that could help them cope with the increasing recreational use of natural areas and its

impacts. The concept of carrying capacity, referring originally to the maximum level of use that an area can sustain, as determined by natural factors, was found to serve this need (Stankey & McCool 1984). Managers hoped that this framework could help them in determining the visitor carrying capacity, below which the natural environment could be sustained. Some years later, Wagar (1964) expanded the concept to include also the social aspect, by recognizing that the amount of use impacts also visitors' experiences. However, the idea of determining a numerical capacity was criticized and it was understood that, e.g. visitor behavior is the principal cause of impacts to the environment, instead of the pure visitor number (McCool *et al.* 2007). Since determining a carrying capacity was noticed to be complex, Frissell and Stankey (1972) suggested that carrying capacity should be considered as the "amount of change in an area" that is permitted by an area's management objectives; LAC evolved from this idea. Thus, LAC was viewed as the amount of human-induced change that was acceptable in a wilderness setting (Stankey *et al.* 1985). Therefore, the central questions in outdoor recreation became: How much impact is acceptable, what strategies should be taken to avoid unacceptable impacts, and who should make the decisions regarding acceptability (McCool *et al.* 2007)?

LAC as a framework represent a management-by-objectives approach. The premise of this kind of framework is that management objectives and associated indicators and standards of quality are formulated for a park or site within a park. As described by Manning *et al.* (2011), management objectives define desired conditions: the level of resource protection and the type and quality of recreation experiences to be maintained. After this, associated indicators and standards of quality are defined. These are objectives in quantitative and measurable form which are then monitored to determine if standards of quality are met. Finally, if standards are violated, or are in danger of being violated, management action is required.

3.4 Visitor monitoring in national parks

In addition to research that aids planning the visitor use of national parks, monitoring is a vital procedure that should play a significant role in the planning and management of national parks. Monitoring is the systematic gathering and analysis of data over time (Newsome *et al.* 2013) required especially when the management-by-objectives frameworks such as LAC are applied (Manning *et al.* 2011).

For planning outdoor recreation in parks, data on the natural environment and its visitors are both needed. While monitoring of vegetation and wildlife in recreational and protected areas has a long tradition, the level of monitoring visitors to natural areas has raised concern among scholars (Muhar *et al.* 2002; Wardell & Moore 2004; Eagles 2014). For example, Eagles (2014: 529) noted that currently most park agencies undertake some level of visitor use monitoring "ranging from simple guesses to very sophisticated programs". Therefore, he lists visitor use monitoring as one of the key research priorities

in park tourism. In the Nordic context, the level of monitoring also varies. While, for example, Norway and Sweden lack a systematic tradition for monitoring visitors to their parks (Vistad 2006; Fredman & Sandell 2009), Finland is said to have high degrees of interest and competence in visitor monitoring (Foreword by Paul F. J. Eagles in Kajala *et al.* 2007).

Visitor monitoring involves the collection of data on important aspects of visitor use in parks. Among others, these include use volumes, the location and purposes of those uses, visitor and visit characteristics and visitation outcomes such as visitor satisfaction, and types of experiences (Muhar *et al.* 2002; Kajala *et al.* 2007; Newsome *et al.* 2013; Eagles 2014). There are a number of ways to monitor visitors to parks including interviews, questionnaire surveys, self-registration of visitors, direct and indirect observation (e.g. camera or video monitoring, mechanical and electronic counting devices) and indirect measures (e.g. environmental impact, number of cars, water/firewood consumption, etc.). A good visitor monitoring program includes data collected using several complementary methods (Muhar *et al.* 2002; Kajala *et al.* 2007).

Collecting quality data on visitors to nature areas is essential, for instance, to ensure quality recreation experiences, guarantee the sustainable use of the area (e.g. knowing and managing impacts on terrain, wildlife, etc.), develop tourism, and promote public health and well-being. In addition, monitoring provides managers with a systematic basis for allocating funds and resources (see Newsome *et al.* 2013; Kajala *et al.* 2007). Visitor information is important at different levels: monitoring is essential for implementing management actions at the local level, but it is also important when communicating with politicians and other decision makers at the regional, national and international levels (Kajala *et al.* 2007).

3.5 National park management in Finland

National parks in Finland are managed by the state-owned enterprise Metsähallitus. More specifically, the public administration duties, such as recreation services and protection of nature, are provided by the Parks and Wildlife Finland (former Natural Heritage Services). The first national parks in Finland were established in 1938 and currently the administration responsibility covers altogether 40 national parks. Visiting the parks is free for all citizens and tourists, since managing parks is still considered as a budget-funded public administration duty. The national parks in Finland have been assigned IUCN category II, with the exception of Lemmenjoki, which is in category Ib (Wilderness area). This means that the areas are "large natural or near natural areas that are set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities" (IUCN 2018).

Management of national parks in Finland is outlined to be based on (i) the best available information, (ii) goal-oriented management plans, (iii) stakeholder participation, (iv) systematic evaluations, and (v) the ongoing development of methods and services in accordance with the principles of adaptive management (Heinonen 2007). As the aim of public participation requires that stakeholders' opinions are actively sought and listened to, park visitors should also be involved in the planning and management of national parks. Related to this, visitor monitoring is considered as one means of carrying out participatory planning since it provides a channel for visitors to convey their wishes and viewpoints on the planning process and thus have an impact on the development of the area (Kajala *et al.* 2007).

Metsähallitus carries out spatial zoning in parks to direct visitor use to specific outdoor recreation and tourism zones by, e.g. planning recreation infrastructure for these locations (see e.g. Metsähallitus 2014b: 86). This type of zoning highlights the perspective of conservation and does not differentiate more precisely what kind of opportunities for recreation are offered within the parks, as done in ROS. Instead, the aim related to providing opportunities is stated in a very general manner as to "provide", "produce" and "offer" *quality* visitor experiences (Alatossava 2011). However, current intent to create profiles for national parks shows a somewhat corresponding ideology as to providing a diversity of recreation opportunities. The aim of profiling parks is to find out the ultimate strengths of each park and create services and stories around the defined assets. This way, a national park profile gives customers a general idea of what she/he will experience when entering the park. The profile is intended to help customers choose the park corresponding to her/his needs and thus to increase visitor satisfaction (see Erkkonen 2014). This can be seen as representing a market-driven approach in national park planning and management (see Puhakka & Saarinen 2013).

To continually evaluate the sustainability of all its actions, Metsähallitus uses the LAC planning framework as the basis of monitoring changes in the state of the area and in determining appropriate management actions to manage changes. The indicators for monitoring are derived from the nine principles that guide sustainable nature tourism in state-owned protected areas (Metsähallitus 2014a). Standards defining the limits of acceptable change are set for each indicator at the park level (Kajala *et al.* 2004). The LAC process includes also monitoring of the quality of visitors' experiences from several perspectives. In practice, visitor surveys have a key role in collecting information on the state of visitor experiences and these surveys are conducted in all national parks at intervals of about five years (Kajala *et al.* 2004).

4 Spatial methods to support visitor planning

4.1 Modeling use distribution

The main methods to collect social science data in the context of outdoor recreation are questionnaires and interviews, but there is an increasing interest towards using spatial technology for studying visitors' recreation behavior (Pickering *et al.* 2018). Global Positioning System (GPS) tracking has already become a rather established method for understanding visitors' spatial use patterns (e.g. Hallo *et al.* 2012; Beeco & Brown 2013; Meijles *et al.* 2014; Van Kirk *et al.* 2014; Korpilo *et al.* 2017). The use of smartphones for research purposes is also becoming increasingly common (Birenboim & Shoval 2016). For example, Doherty *et al.* (2014) explored the possibilities of smartphones to track human activity, perceived psychological health and well-being in natural environments. The advantage of smartphones compared to GPS trackers is that they enable collecting information beyond the simple movement pattern. The most recent interest has been directed towards piloting the use of social media; data continuously generated by the ubiquitous digital devices such as geographically and temporally tagged images (Orsi & Geneletti 2013; Levin *et al.* 2015; Sessions *et al.* 2016; Tenkanen *et al.* 2017; Walden-Schreiner *et al.* 2018). The trend of using these kinds of Volunteered Geographic Information (VGI) reflects the recent paradigm shift in GIScience that is created by citizens who are willing to devote their time and effort, or who unconsciously create "big data" by using different kinds of location-based services (Panek 2016; Goodchild *et al.* 2017).

Spatial data, especially data collected using GPS tracking, have been used to create *computer simulation models* to illustrate visitor use patterns within recreation areas, especially in North America (Cole 2005; Lawson 2006). The purpose of this has been to create replications of visitor use patterns in order to help managers determine, if the existing use pattern is sustainable and appropriate for the physical or biological resource and if it enhances the quality of recreational experiences (e.g. Wang & Manning 1999; Lawson *et al.* 2003; Van Kirk *et al.* 2014). From a management perspective, these computer simulation models have enabled predicting how distributions of visitor use are likely to change according to different scenarios (O'Connor *et al.* 2005). Therefore, the simulation models have helped to rationalize, where chosen management actions should be put in practice to obtain the best results overall. For instance, Lawson *et al.* (2003) used simulation modeling to estimate the daily social carrying capacity for Delicate Arch and Arches National Park, and to test how a public transportation system could increase the park's social carrying capacity. Van Kirk *et al.* (2014) used the simulation to achieve an informed redistribution of overnight visitor use that reduces the number of areas at overcapacity while still accommodating the same overall amount and the same temporal distribution of visitor use.

Computer simulation models are problematic because they rely on the assumption that accurate measures of use distribution would give insight into issues such as crowding,

conflicts between visitors, and resource degradation. However, as Manning (2011) highlights, there is a significant difference between concepts such as *use level*, which is a physical concept relating the number of people per unit of space, and *crowding* which is a subjective and negative evaluation of the use level. Therefore, to understand the social aspects of visitor use in parks, there is a need for a method that not only illustrates the spatial distribution of visitors, but also includes evaluative information about how visitors perceive the site conditions. Furthermore, methods that illustrate the spatial distribution of use, like simulation modeling, support best management that is based on so called "hard" regulatory management actions such as restricting use (see Ling Kuo 2002; Mason 2005). This is problematic in the context of managing outdoor recreation in the Nordic countries where the use of "hard" management actions is limited due to the long tradition of Right of Public Access to natural areas (Tuunanen 1999). Therefore, in Finland, where management actions rely on "soft" actions that stress education and interpretation, managers are more in need of experiential information that can help them understand visitor behavior and to modify this.

4.2 PPGIS methods in national park planning

PPGIS methods have developed since the mid-1990s, when the traditionally expert-driven Geographic Information Systems started to be utilized for social scientific purposes (Sieber 2006; Dunn 2007; Panek 2016). Since then, an extensive range of methods have been used to systematically capture and measure the spatial distribution of place values, activities, experiences, preferences and other perceptual attributes, described in an increasing number of published studies (Brown & Kyttä 2014; Brown & Fagerholm 2016). To highlight the difference between PPGIS methods and previously introduced VGI, Brown and Kyttä (2014) have emphasized that PPGIS should meet the scientific standards of data quality, especially if the data are to be used to support and justify decisions that are purported to have broad public support. Therefore, the dominant form of spatial data collection in PPGIS should involve probability sampling of individuals in contrary to VGI, which is typically citizen-initiated, produced passively and voluntarily.

Common to all PPGIS methods is the need to symbolically represent spatial attributes or spatial markers of interest on a map. In the context of national parks or related areas, researchers have most commonly mapped the landscape, social or place values that visitors attach to certain locations, including attributes like aesthetic/scenic, and therapeutic (e.g. van Riper *et al.* 2012; Brown *et al.* 2014a; Scolozzi *et al.* 2014; Strickland-Munro *et al.* 2016; Munro *et al.* 2017). Other mapped attributes include outdoor recreation experiences such as solitude and learning (Brown & Weber 2011), the health benefits of outdoor recreation (Brown *et al.* 2014b), activities in which visitors participate (Brown & Weber 2011; Munro *et al.* 2017), and the motives for undertaking a certain activity (Wolf *et al.* 2015). Researchers

have also been interested in mapping visitors' perceptions of the negative impacts of tourism (Brown & Weber 2011; Scolozzi *et al.* 2014; Barnett *et al.* 2016) as well as the conflict potential between users or different values (Wolf *et al.* 2017; Moore *et al.* 2017).

PPGIS data, in its simplest form, is used to identify distribution patterns of the mapped attributes. PPGIS data on social values can be integrated with biophysical landscape information to identify social-ecological hotspots (SES) where human and biophysical systems are closely linked (e.g. Alessa *et al.* 2008; Karimi *et al.* 2015). There are also more sophisticated processes and applications developed to integrate PPGIS data into land-use planning. For example, Brown and Reed (2012a) have developed a values compatibility analysis (VCA) which assesses the compatibility of forest values with prospective forest policies. Sherrouse *et al.* (2014) have established a Social Values for Ecosystem Services (SolVES) application to incorporate quantified and spatially explicit measures of social values into ecosystem service assessments (Sherrouse *et al.* 2014; van Riper *et al.* 2017). In addition, Brown and Reed (2012b) have introduced the concept of *social landscape metrics*, which represents the composition and configuration of PPGIS data, having become a common method for quantifying PPGIS data (e.g. Brown *et al.* 2014a; Hausner *et al.* 2015).

The benefit of the PPGIS methods is their capacity to capture the subjective values people associate with specific places (Seymour *et al.* 2010; van Riper & Kyle 2014), and thereby give management organizations insight into visitors' perspectives (Beeco & Brown 2013). However, the decision-support potential of PPGIS has mostly been described in academic literature, and there is only little evidence of formal agency adoption beyond preliminary PPGIS trials (Kyttä & Brown 2014; Brown and Kyttä 2018). Globally, Finland has been one of the leading countries in adopting PPGIS, and yet it has been evidenced that impediments to adopting these tools exist in Finland as well (Kahila-Tani *et al.* 2016). The explanations as to why regional and environmental planning agencies have not adopted PPGIS methods in their planning processes often point to a lack of government commitment to public participation and consultation in general, as well as to lacking skills and institutional motivation to use the data effectively (Brown 2012; Brown & Kyttä 2014; Kahila-Tani *et al.* 2016).

Even though PPGIS case studies have been conducted to support the planning of outdoor recreation within protected areas, the linkage between PPGIS methods and outdoor recreation planning frameworks has remained weak, even though it has been said that "incorporating spatial considerations into recreational planning frameworks is perhaps the most direct contribution spatial data can make to visitor management of parks and protected areas, particularly at a micro scale" (Beeco & Brown 2013: 81). In regard to this, Beeco and Brown (2013) have only suggested that mapped visitor experiences and perceived impacts could be used to identify park experience zones similar to the way that ROS classes are identified by managers. In addition, Brown and Weber (2011) discussed that where ROS maps exist, PPGIS analysis could determine whether the mapped experiences are consistent with the ROS classifications. In addition, there

is only little discussion about whether PPGIS methods could be extended from being a research method into becoming a monitoring tool that could be used to collect data on visitors to parks over time (see Brown & Weber 2011).

In Finland, Metsähallitus has not so far listed PPGIS as a visitor monitoring method, but it has piloted these methods as a means to support planning and management of state-owned lands. Metsähallitus has carried out several PPGIS surveys to support different planning purposes. The first PPGIS survey was used in Sipoonkorpi after it was nominated as a national park in 2011. The study was carried out to support the formation of the Park management plan, and therefore such issues as how people use the park and what kind of development they wish to be implemented were measured. A comparable PPGIS survey was recently carried out in Ärjänsaari (in Oulujärvi), after the state bought the island for protection in 2017. In this case, spatial information on issues, such as the activities that visitors were willing to participate in and the infrastructure visitors wished to have on the island, were collected. The information was used to form a development plan for the island (Metsähallitus 2017). Another type of PPGIS study was conducted around Saaristomeri National Park where the aim was to collect spatial information on visitors' and residents' landscape values to emphasize the concept of *landscape* in the Park's and Wildlife Finland's operations (Fagerholm *et al.* 2014). As these studies had an emphasis on outdoor recreation, PPGIS methods have also been piloted in studying how these methods succeed in involving different stakeholders (e.g. reindeer herders, Sami people, tourism actors) into larger-scale natural resource planning in Lapland (Heikkonen 2013).

5 Research design and methods

5.1 Case study area: Oulanka National Park

This study was carried out in one of the most well-known parks in Finland: Oulanka National Park and its nearby surrounding areas (Figure 1). Oulanka National Park 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 in the north. The region hosts a wide range of biotopes and species (Alatossava 2011). Having a long history of outdoor recreation, Oulanka National Park is currently the fourth most-visited national park in Finland with approximately 200,000 annual visits (Metsähallitus 2018). The park offers opportunities for outdoor activities including hiking, canoeing, skiing, snowshoeing, fishing and wildlife viewing. From the recreation perspective, Oulanka's main asset is its diversity: the park offers a lot to see within a relatively small area, attracting many different types of visitors. Well-marked trails lead visitors to the main attractions, many of which are in close proximity to each other and can be easily reached within a short hike (Alatossava 2011). The area is especially famous for its 80-kilometer 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 kilometers south from Oulanka National Park. Additionally, the park has five day-trip trails ranging from five to twelve kilometers. In addition to the marked trails, the park infrastructure includes visitor centers, campfire sites, camping grounds, wilderness huts and parking places.

Oulanka National Park was selected for a case area because it is one of the most-visited national parks in Finland, and because the number of visits to the park has already caused severe, visible impacts such as erosion and trampling (Lyon *et al.* 2011). For these reasons, the park is expected to host a high number of positive and negative visitor experiences, which makes it a suitable and interesting area to pilot PPGIS methods. Valtavaara Nature Reserve, on the south side of the park, was included in the study area because it is closely connected with Oulanka National Park being a starting or ending point for visitors walking the Bear's Trail. The reserve is also highly visited because it is located next to the Ruka tourist resort, requiring careful planning of this high-use area.

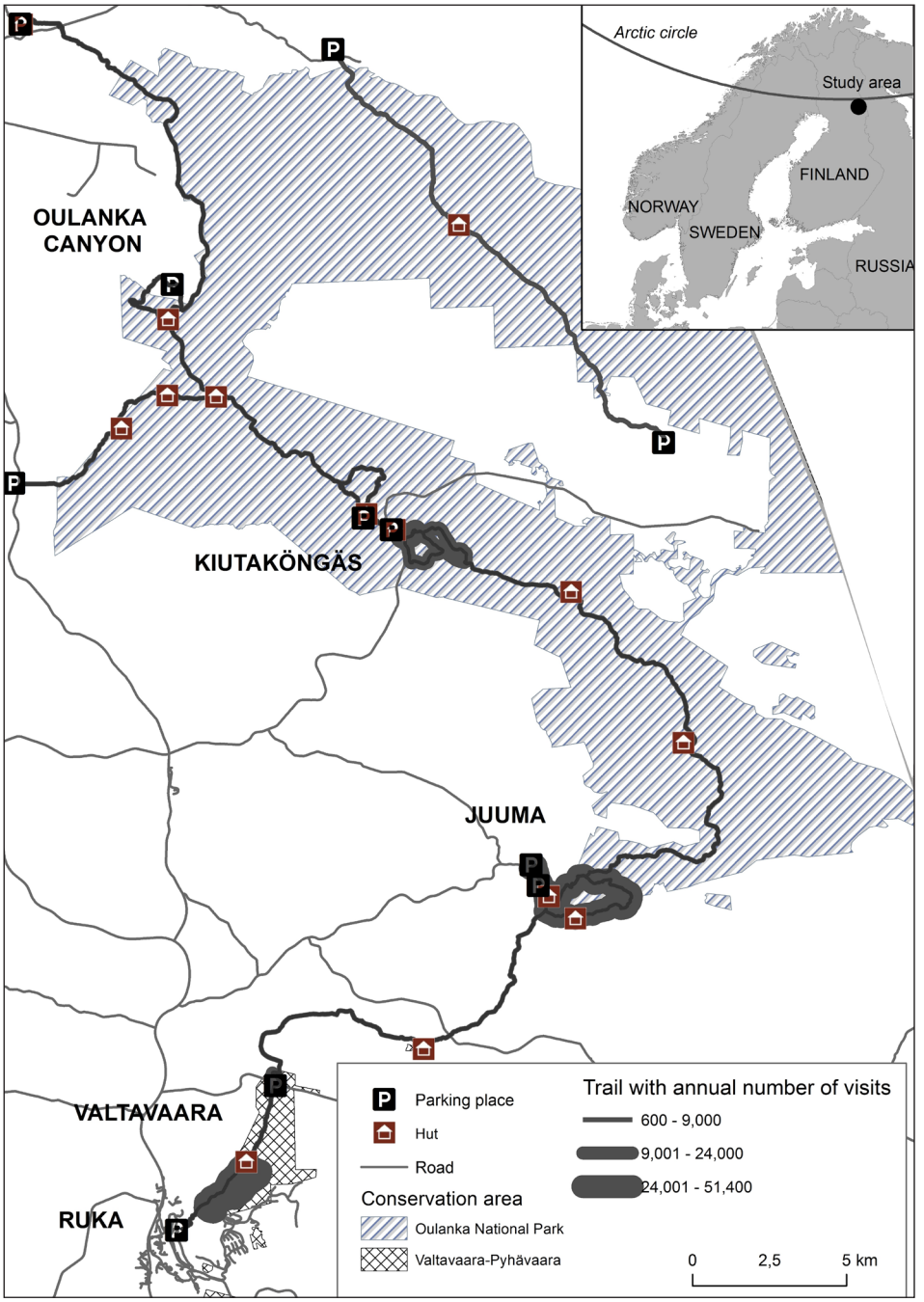

Figure 1. Oulanka National Park and Valtavaara Nature Reserve with main recreation infrastructure and estimation of annual number of visits.

5.2 Data collection methods

In this study, two different types of methods were used to investigate the potential of PPGIS methods in planning outdoor recreation in national parks. At first, two PPGIS surveys were conducted to pilot different PPGIS methods and to study how visitor experiences are related with the environment where they take place. A summary of the two data sets that these surveys produced are provided in Table 2. After the PPGIS surveys, semi-structured interviews were conducted to find out managers' perspectives towards the use of PPGIS methods.

5.2.1 PPGIS surveys in Oulanka National Park

At first, data set 1 was collected using paper maps and open-ended questions related to visitors' experiences. This data set was collected on site in Oulanka National Park in 2010. As a part of a more extensive questionnaire, based on random sampling, visitors were asked to identify the location of their high- and low-quality experiences. In this task, visitors were given an A4-size color-printed map of the national park (see Article I, Fig. 1) and asked: "Please circle on the map where you had the highest-quality nature experience. Explain why." and "Please indicate on the map with a cross where you had the lowest-quality nature experience, if any. Explain why". In contrast to many PPGIS studies that use predefined markers, respondents were allowed to freely describe their experiences by writing approximately one sentence. The spatial data was digitized from paper maps into ArcMap10.2 in point format. All digitized points were given the same visitor identification number to match non-spatial survey data stored in SPSS. Data set 1 was utilized to find out which environmental factors affect the quality of visitor experiences in Article I.

Data set 2 was collected using a web-based PPGIS survey which was attached to the Metsähallitus's standardized visitor survey in 2014. The spatial data were collected asking Oulanka National Park visitor survey participants to participate in a web-based PPGIS survey by providing their e-mail address at the end of the self-administrated visitor survey form. Those participants who provided their contact information received an e-mail invitation to complete the PPGIS survey. 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 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).

The two particular mapping tasks that were utilized in research Articles II and III are presented in figures 2 and 3. Figure 2 shows that when mapping positive experiences, respondents were asked to drag-and-drop a point marker labeled "I visited this place" on the map. After dropping the marker, a pop-up window opened and prompted participants to choose, from a predefined list, one or more positive experiences that they had in that particular location. Experience items were applied from the Recreation Experience Preference (REP) scale that has been developed to measure the dimensions or items of a visitor experience (Driver 1983). Even though the scale was initially developed to measure motives for engaging in recreation behavior, the scale has become a post-activity assessment tool for measuring the actual outcomes of recreation, assuming that the participants' motives for engaging in recreation behavior have been fulfilled (Backlund & Steward 2012). Due to limitations of the PPGIS survey interface the selection of the items was limited to physical wellbeing, relaxation, learning about nature, nostalgia, excitement, social bonding, independence, and escaping daily routine. These experience items were selected together with the representatives of the Metsähallitus and were operationalized for visitors as shown in Figure 2. Visitors were only asked to indicate whether or not they had a particular experience in the specific location instead of rating the importance of each experience item. This was again due to technical limitations of the PPGIS survey interface. In addition to predefined experiences, an open-ended space was offered to describe an experience outside the list. The data on the different experiences in Oulanka National Park are utilized in research Article II.

To find out those locations where visitors perceived that the impacts of recreation disturbed their visit, participants were asked to place a predefined marker on a map (Figure 3). These predefined markers were the same as the items used in the visitor survey: erosion caused by tramping, littering, treatment of the natural environment, too many visitors, and behavior of other visitors. Additionally, to get an impression of the severity of the impact in each mapped location, participants were asked 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. These data were used in research article III.

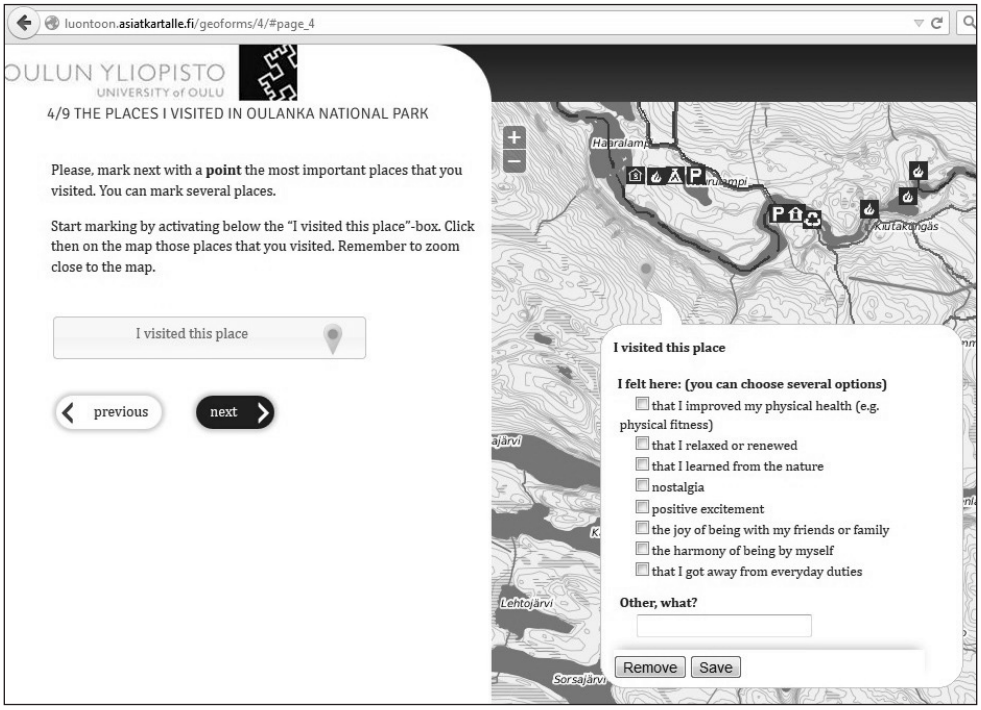

Figure 2. A web-based PPGIS survey interface asking visitors to map the positive outcomes of their visit to Oulanka National Park.

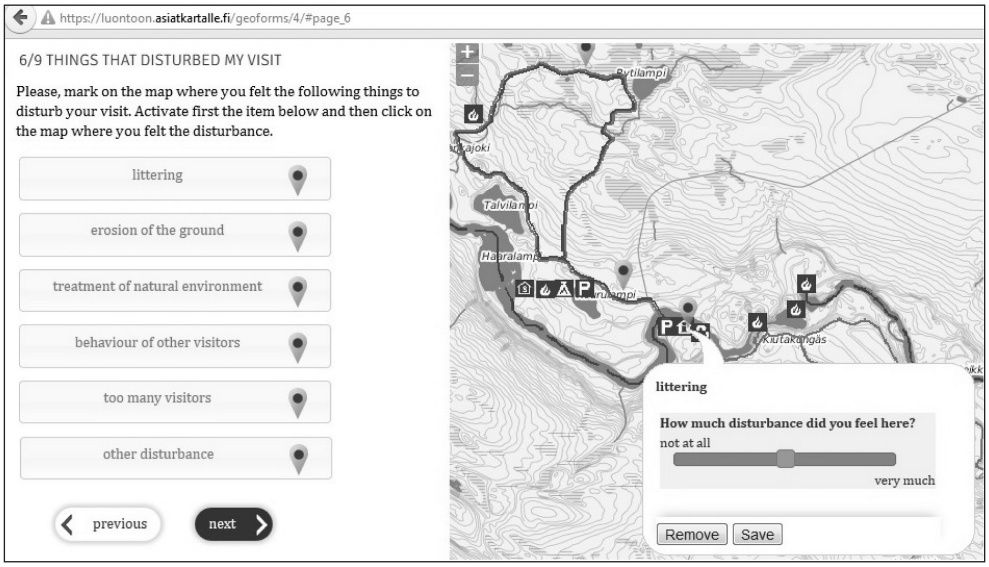

Figure 3. A web-based PPGIS survey interface asking visitors to map the item that disturbed their visit to Oulanka National Park.

Table 2. A summary of the data sets used in the research process.

	Data set 1	**Data set 2**
Data collection method	• Paper map • On-site	• Internet • After visit
Year	2010	2014
Spatial attributes	Open-ended markers: • High-quality experience • Low-quality experience	Predefined markers: • physical wellbeing • relaxation • learning about nature • nostalgia • excitement • social bonding independence • escaping daily routine • erosion caused by tramping • littering • treatment of the natural environment • too many visitors • behavior of other visitors
Form of mapping	Point	Point
Number of respondents	628	170
Additional information	Research article I	Research article II and III

5.2.2 Park manager interviews

In addition to PPGIS surveys, semi-structured interviews of representatives from Metsähallitus were conducted. These interviews were based on a purposive sampling and were used in research Article IV. Altogether, 10 interviews for persons working in management and planning were carried out in the area of the Ostrobothnia Regional Unit, which is one of the three regional units of Parks and Wildlife Finland. The interviews were conducted in September and October 2017 as face-to-face interviews, excluding two interviews which were conducted via telephone. The interviews were conducted in Finnish and lasted between 45 and 90 minutes.

The interviews focused on the following themes: quality of visitor experiences, opportunities for recreation, the characteristics and behavior of park visitors, challenges of managing visitors in parks, and the current state of information related to visits to parks. In addition, managers were asked to evaluate the usefulness and benefits of place-based information on visitor experiences, based on six thematic maps representing visitors' perceptions in Oulanka National Park. The maps were mailed to the interviewees before the interviews and they were provided paper copies during the interviews. The maps depicted the spatial distributions of use, visitor experiences, special places, visitor perceptions of the negative impacts of recreation (such as littering or crowding), sites where visitors felt unsafe, and development needs regarding the park's infrastructure (see Article IV Appx. 1). The maps were created based on the web-based PPGIS survey illustrated above (data set 2).

5.3 Analyses methods

The significance of certain setting attributes on the quality of the experience was explored in Article I using data set 1. This was done by applying the principle of spatial discounting (Brown *et al.* 2002); assuming that marked experiences within a shorter distance to a certain setting feature indicates the importance related to the experience. In practice, the straight-line distances from each experience point location to the nearest setting features was measured. The proximity to features representing the natural environment: bodies of water (river and lake polygons), cliffs (lines representing escarpments that prevent passage), and rapids (points representing parts of running water), was calculated using the General Map Dataset (1:100,000), which is a vector data set maintained by the National Land Survey of Finland. The proximity to recreation facilities (campfire sites and parking lots) was calculated from a vector dataset from Metsähallitus.

Article II further explored the relationship between recreation opportunities and realized visitor experiences using chi-square statistics. To be able to compare the mapped experience items against different types of recreation settings, the study area was classified into settings according to three criteria: on-site management, accessibility, and

social interaction which are commonly used condition criteria in ROS (Clark & Stankey 1979). The process was run in ArcGIS software based on scoring 250*250 meter pixels representing the study area (see Article II, Fig. 3). After the classification process, a chi-square statistic and an analysis of standardized residuals were completed to indicate whether any experience items mapped in the online survey were disproportionately represented within a given setting type. Standardized residuals greater than 1.96 (Brown & Weber 2011) were considered indicating that participants had mapped significantly more or fewer of certain experience items (e.g., relaxation) in a particular setting (e.g., developed) than would be expected, contributing thus to the overall relationship between experiences and settings.

In addition, in Article I, visitors' open-ended answers related to why a certain experience was positive or negative was analyzed to compare the answers provided by the participants against the objectively measured features of the environment. The text-based content of visitors' self-descriptions of mapped experiences was analyzed using quantitative content analysis. The relative frequency of the characteristics described by visitors was considered to estimate the relative importance of different setting characteristics.

To study visitors' perceptions on the negative impacts of recreation, Article III utilized *social landscape metrics* for the four most-visited areas of the park. These metrics presented the composition and configuration of perceived mapped impacts within each area. More specifically, boundary-based metrics were utilized to understand the type and mix of perceived mapped impacts of recreation within a certain subarea (see Brown & Reed 2012b). The following metrics were applied: Value sum absolute (P0), Value sum percent (P1), Value frequency index (F), Dominant value (D), Value dominance (D1), and Value diversity index (D2), Mean intensity index (I) (see Article III, Appx. 1).

The interview data were analyzed using thematic content analysis. The analysis was based on the original research question in Article IV coding the data into three themes: (1) the means of planning for the visitor use of parks and role of spatial information, (2) ways to implement spatial monitoring, and (3) the attitudes towards spatial planning practices.

5.4 Data representativeness and participant characteristics

The paper-map survey received a relatively high response rate. A total of 628 questionnaires were filled in, out of which 448 survey participants responded to the map-based questions by marking positive experiences, negative experiences, or both on the map. This corresponds to a response rate of 71% (Article I). The web-based survey ended up having a lower response rate: a total of 736 visitors responded to the visitor survey and out of these, 170 visitors responded to the PPGIS survey, the response rate being 23% (Articles II, III).

The participants of both surveys corresponded well to the overall visitor profile of the park. The majority of the respondents were Finnish. About half of the respondents were

female and the average age of respondents was around 45 years. The major differences in the participant profiles were that data set 1 included relatively more participants representing lower educational groups and data set 2 included a higher percentage of repeat visitors than other data sets. The characteristics of respondents in both data sets, as well as in the Oulanka National Park visitor survey, are presented in more detail in Table 3.

Table 3. The characteristics of PPGIS survey participants.

	Paper-map survey (data set 1) n=628	Web-based survey (data set 2) n=170	Oulanka National Park Visitor Survey 2014 n=756
	%	%	%
Gender			
Male	48	54	51
Female	52	46	49
Education			
No vocational education	19	5	7
Vocational education	32	41	47
Higher education	49	53	46
Nationality			
Finnish	84	86	85
Foreign	19	14	15
Previous park visits			
Repeat visitor	53	64	58
First-time visitor	47	36	42
Length of visit			
Day visitor	54	59	68
Overnight visitor	46	41	32

6 Results and discussion

6.1 Understanding visitor experiences in national parks

This study was novel in using PPGIS methods to study the factors affecting visitor experiences. It succeeded in revealing some aspects of the experience, but more importantly it contributed in outlining how the methods should be further developed to serve the purpose of understanding visitor experiences in national parks and related areas.

Overall, participants in the paper map survey placed most of the experience markers in the Kiutaköngäs area, followed by the Juuma area (Article I, Fig. 2). The less-visited and more remote parts of the park had the fewest marked locations. Most of the markings represented positive experiences (n=429) with only 54 markings indicating negative experiences. When using web-based PPGIS survey, participants mapped 430 markers representing the places they had visited. When these were split into separate types of experiences 1,162 markers represented those positive experiences that visitors gained when visiting Oulanka National Park (Article II, Fig. 4). The most commonly reported positive experiences were relaxation and physical wellbeing, followed by social bonding and learning about nature. Only 87 markers were placed to indicate locations where visitors felt that the negative impacts of recreation had disturbed their visit (Article III, Fig. 4). The most common mapped impact was littering, followed by erosion and evaluation of too many visitors.

The results from Article I confirmed that the aesthetics of the scenery (how pleasant and interesting visitors find the environment) have a key role in the quality of a visitor experience. The importance of aesthetics has also been noticed in many previous studies (e.g. Brown & Weber 2011; Hausner *et al.* 2015) as well as in the visitor surveys that are conducted in Finnish parks (e.g. Puska 2015). The results from Article I also suggested that shortcomings in recreation infrastructure are one of the main reasons lowering the quality of visitor experiences. Other scholars have also noticed that facilities and services play an increasing role in outdoor recreation (Fredman & Emmelin 2001; Wall-Reinius & Bäck 2011). Acknowledging these aspects is important when planning visitor use in parks, and can be done by, for example, planning trails that pass versatile sceneries.

From a research point of view, a more important finding was that visitor experiences can only poorly be explained by the physical features of the environment that are located close by. This is because the results from Article I showed that there were only small differences in the environmental factors (e.g. bodies of water, cliffs and campfire sites) that were located close to high- and low-quality experiences. This suggests that the objectively measured setting features explain mainly which locations are visited, instead of the quality of visitors' experiences. Therefore, the quality of a visitor experience should be studied by exploring visitors' perceptions of the environment instead of the objectively measured features of the physical environment. This conclusion is also supported by the results

from Article II, which suggested that visiting different kinds of recreation settings, when defined according ROS attributes (level of site management, access, and social interaction) do not necessarily cause differences in visitors' experiences such as solitude, physical wellbeing, or relaxation, as also noticed in previous studies (e.g. Backlund & Stewart 2012; Fix *et al.* 2013; Kil *et al.* 2014; Pierskalla *et al.* 2004). This also strengthens the view that recreation opportunities should be considered as something more than a collection of fungible (replaceable, substitutable) attributes of the environment (Williams 2008).

All in all, the study demonstrates that it is misleading to analyze human spatial behavior in relation to the objective, "real" environment, as people do not experience space in this way (Kirk 1963). Therefore, it is recommendable to be cautious when combining data on the physical landscape features with information on values as done in some PPGIS studies (e.g. Brown & Brabyn 2012; Brown *et al.* 2015). Furthermore, to develop PPGIS methods to serve the understanding of visitor experience, it is suggested to use the methods to study the reasons for having certain types of experiences in certain locations, which is done only in a few PPGIS studies (e.g. Bijker & Sijtsma 2017). For example, in relation to the importance of aesthetics, PPGIS methods could be more extensively used to study visitors' perceptions of what makes them appreciate certain sceneries. In addition, PPGIS could help in understanding what elements make certain places to be considered *natural* or *wilderness*, which are core concepts in outdoor recreation research but complex to study because of multiple interpretations (Fredman *et al.* 2012).

6.2 Using PPGIS to enhance outdoor recreation planning

Outdoor recreation planning involves many different tasks which can potentially benefit from spatial information related to visitors' experiences. According to the interviews of managers and planners of Finnish national parks, the most vital operations where spatial information would aid planning are measuring the negative impact of recreation, preventing conflicts among visitors and indicating shortages and development needs related to recreation infrastructure (Article IV). On the contrary, as the results from Article IV demonstrated, managers did not prioritize knowing where exactly certain types of experiences take place. Therefore, even thought it was evidenced in Article II that PPGIS is an adequate tool for collecting spatially detailed information on different types of experiences, the usefulness of this kind of spatially-bound information was questioned in Article IV. To conclude, based on this study, it seems that park-level data on the positive visitor experiences or wider benefits of recreation is adequate for communicating the importance of parks to a larger audience in a means to justify the existence of national parks and nature conservation (Weiler *et al.* 2013; Moyle & Weiler 2016) and that there is no need to collect spatially detailed information to support this purpose.

6.2.1 Measuring the negative impacts of recreation

As visitor use increases in national parks there is a likelihood that the negative impacts also grow, which increases the importance of monitoring the quality of visitor experiences and the environment. The finding in Article III showed that the number and type of recreation-related impacts did not follow the intensity of visitor use, as sometimes expected (D'Antonio 2010; Beeco 2013). This highlights the importance of using spatial methods which are able to reveal how visitors perceive certain situations, instead of making assumptions on visitors' experiences based on the absolute visitor use distribution. Furthermore, spatially detailed information on the negative impacts of recreation is advantageous, as the findings from Article IV confirmed that managers are concerned that conducting the park-level monitoring can cover the reality of the state of some heavily used parts of the parks. Therefore, as suggested in Article III, visitors' perceptions on recreation-related impacts should be measured and analyzed on the level of a park unit, at least in geographically large parks.

Based on articles III and IV it is recommendable that at least visitors' perceptions of littering, erosion and crowding should be measured spatially. Measuring these issues could be integrated into the LAC framework used by Metsähallitus. The spatial data could be integrated either to define the current values or standards for acceptable change (see Kajala *et al.* 2004). This depends how the measuring is conducted: whether visitors are asked to report, e.g., the pure amount of litter they perceive at a certain location, or whether they are asked to report an evaluation of the condition they encounter (e.g. how acceptable they consider the amount of litter they see). This type of spatial measuring of the impacts would increase the spatial accuracy of LAC but would not save managers from deciding whether it is enough that one visitor evaluates a location to be, e.g., too eroded, or whether it should be evaluated as eroded by hundred or thousand visitors before carrying out management actions.

Furthermore, conflicts between visitors can also be considered as one type of negative side impact resulting from the increasing and diversifying use of parks (Eagles 2014; Balmford *et al.* 2015; Ankre *et al.* 2016). The results in Article IV support that one important task of managers is to prevent conflicts among users. As proven by Wolf *et al.* (2017) PPGIS is suitable for mapping locations with conflict potential. However, more piloting on using PPGIS methods for this purpose is needed because the conflict between users depends heavily on the specific contexts, e.g. the scale of commercial tourism activities in parks, or the regulations related to motorized activities. When using PPGIS methods for this purpose, it should be acknowledged that in addition to mapping where conflicts between users take place, information on the reasons behind the conflicts should be studied to enable planning suitable management actions to prevent these conflicts (Article IV).

Using PPGIS methods to measure the negative impact of tourism would be advantageous, as this can increase managers' awareness of how park visitors view the

conditions they encounter and to furthermore facilitate the communication between visitors and managers concerning site conditions. As previous research efforts have shown, there can be notable differences in the sensitivity of managers and visitors towards, e.g. various recreation-related impacts (e.g. Martin & McCool 1989; Brown &Weber 2011) and therefore there is a need for methods that enable sharing these views. The advantage of spatially-bound information on visitors' evaluations on site conditions is that it specifically shows where the shortcomings in conditions take place and where management actions are needed, from the visitors' point of view. Using visitors as informants for site conditions could be especially useful in the current situation where many park management organizations are short on financial resources and understaffed (Hadwen *et al.* 2007) and when visitors are increasingly willing to participate in the development and conservation of national parks (Rattan *et al.* 2012; Wearing & McGehee 2013; Weaver 2015).

Moreover, the results from Article III suggest that visitors can experience high levels of satisfaction in places where they encounter conditions that are not evaluated as optimal. This has also been shown in several previous studies (Kuentzel & Heberlein 1992; White *et al.* 2001; Hall & Cole 2007; Dorwart *et al.* 2009). This highlights that managers must be cautious when using visitors' perceptions of the negative impacts of recreation as indicators of experiential quality. Moreover, the same caution is needed when using visitors' evaluation on recreation-related impacts as indicators of resource conditions, because visitors' evaluations on the resource conditions may not reflect the sustainability of the physical environment. To conclude, when using PPGIS methods, or any other method, to measure the negative impacts of recreation, it is important to underline whether visitors are asked to reflect the acceptability of recreation-related impacts against the quality of their own experience, or against what they consider appropriate for the wellbeing of the physical environment. Future studies must be clearer on this aspect.

6.2.2 Developing PPGIS methods to define recreation opportunities

Defining what kinds of recreation opportunities national parks offer is an important management task helping direct visitors to locations that correspond to their particular needs and wishes. Therefore, article II studied how the environment, when defined as a combination of different setting features using GIS methods, affects what kinds of experiences visitors report while visiting Oulanka National Park. The results showed that conventional GIS methods are technically functional methods in creating recreation opportunity zones. However, as opportunities, when defined this way, were not shown to be related with the realized visitor experiences, the usefulness of this kind of opportunity zoning can be questioned. GIS-based opportunity zoning also turned out to be contradictory to managers' views on recreation opportunities regarding the spatial level and the utilized attributes. First, the results from Article IV highlighted that park managers in Finland consider recreation opportunities at the park level; parks are perceived

to differ from each other by the opportunities they provide. This conforms to the idea in park profiling (Erkkonen 2014). Secondly, managers did not differentiate among the parks according to ROS attributes (such as social interaction and on-site management) but stressed more the environmental qualities as a set up for a certain type of recreation opportunity (Article IV).

To support recreation opportunity zoning that equals managers' ideologies, PPGIS methods could be well-suited to studying the elements of the environment that visitors value and consider important for their activities, and further to define recreation opportunities. For this purpose, the concept of place dependency, referring to the importance of a place in providing features and conditions that support specific goals or desired activities (Williams & Vaske 2003) could provide good premises, if applied in a spatial manner. The strength of the concept is that it considers that visitors select certain types of settings because these include unique features that promote their participation in a certain activity. Another strength of using the concept is that it could increase the understanding of those factors that make visitors dependent on particular parks (or certain parts of the parks), because it seems that visitors to Finnish parks are somehow dependent on certain types of opportunities as the share of those frequently visiting the same park is high (e.g. Puska 2015).

Furthermore, the use of PPGIS methods in defining recreation opportunities would have advantages. First, involving customers in defining recreation opportunities and thus creating these destinations is valuable, as Young (1999) presents that the success of a tourist place, such as a national park, depends on the level of consensus on meanings negotiated between place production (how managers communicate the destination) and place consumption (how tourist view or value the destination). On a practical level, this means that visitors should be intensively involved in defining the opportunities, or park profiles, so that they correspond with how they perceive these places. Secondly, PPGIS, as spatially accurate methods, could also help in assessing whether visitors perceive the parks to present a homogeneous recreation opportunity or whether it would be useful to define recreation opportunities at a smaller spatial level.

6.3 Implementing PPGIS methods into visitor planning

Integrating new methods, such as PPGIS, into existing planning procedures can face different kinds of impediments. In the broad picture, one possible impediment to adopting PPGIS methods in a park organization could be the organizational attitude towards social science. This is because academics worldwide have been concerned that outdoor recreation remains more of a secondary management task and a field of competence in itself, when conservation areas are managed by ecologically trained managers (Stenseke & Hansen 2014; Eagles *et al.* 2014; Cole, 2006; Hadwen *et al.* 2007). Therefore, concerns about outdoor recreation have generally been addressed by biologists, lacking professionals

in outdoor recreation, social science and/or human behavior (Stenseke & Hansen 2014). However, the extensive work that Finland has done to develop visitor monitoring, as well as the attitudes of the interviewed managers' (Article IV), may suggest that Parks and Wildlife Finland employees are more commonly educated in social sciences and have a higher appreciation of this kind of knowledge compared to employees in park organizations worldwide, in general. This creates an opportunity for implementing PPGIS methods into the management practices of Finnish national parks.

Managers' attitudes towards public participation could also hinder the implementation of PPGIS methods. Nevertheless, the results from Article IV suggested that park managers in Finland were eager to understand visitors' experiences and wish to include visitor perspectives into, e.g., the planning of new national parks. Therefore, this study does not support the previous notification that regional and environmental planning agencies have not adopted PPGIS methods into their planning processes because of a lack of government commitment to public participation and consultation in general (Brown 2012; Brown & Kyttä 2014). The fact that managers appreciated visitors' views on the development encourages using PPGIS methods for park-users' participation in designing park facilities. Along with the trend of *sportification* of parks (Newsome & Hughes 2018), it can be assumed that an increasing share of park visitors are highly specialized in the activities they carry out in the parks and are willing to participate in the planning of park facilities, as an example.

Despite managers' positive attitudes towards public participation, one rather fundamental question related to enhancing the planning processes, even though not the focus of the study, is: How well does the use of PPGIS methods support the involvement or participation of park users into planning? From a critical point of view, the way PPGIS surveys were conducted in this study does not fully support the idea of co-management, which highlights *active* participation and institutionalized arrangement for *intensive* user participation in decision-making (Berkes 2009; Plummer & Fennell 2009; Islam *et al.* 2017). The PPGIS surveys that were part of this study utilized visitors merely as consultants in a similar way that the traditional visitor surveys involve the user in producing information on their behavior and experiences. Yet, mere consultation or ad hoc public participation is not considered as true co-management (Berkes 2009). Therefore, if wishing to use PPGIS methods to foster real co-management of national parks, the methods should be carried out in a way which promotes more intense participation.

From the challenges point of view, it was noticed in Article IV that technical difficulties could become an acute issue when integrating PPGIS data into planning processes. This is connected to the previously mentioned lack of skills to effectively use the PPGIS data, which has been recognized as another organizational barrier for adapting PPGIS methods (Kahila-Tani *et al.* 2016). Although researchers have developed promising tools and methods, such as SolVES (Sherrouse *et al.* 2014) and social landscape metrics (Brown & Reed 2012b), to help quantify mapped social or landscape values in a place-based manner, these tools are primarily developed for analyzing how different landscape values or land

use types are spatially related, there is a need to develop tools which would serve more specifically the purposes of outdoor recreation planning. Social landscape metrics, such as those piloted in Article III, provide a good premise for quantifying visitors' perceptions on negative impacts of recreation, but there is indeed a need to develop professional analysis interfaces that can automatically quantify also those spatial attributes that are important in visitor planning. In addition to developing the needed tools, training managers and planners to use these tools cannot be overstressed. This is because training-related issues are the most significant factors impeding the use of GIS in planning (Göcmen & Ventura 2010). It is also important that the use of PPGIS and GIS is not left for specialized GIS departments, but cooperation between GIS specialists and planners within the organization must be encouraged in order to increase the use of any GIS tools in recreational planning (Olafsson & Skov-Petersen 2014).

Moreover, the results from Article IV showed that Finland's advanced procedures for collecting and storing data on conservation area visitors can also act as a hindering factor for adopting new methods. As the article showed, managers felt that they have a great deal of information on visitors due to the visitor surveys that are carried out in the parks. Therefore, even though the potential of using PPGIS methods for monitoring purposes was acknowledged, challenges seemed to relate to integrating this "new" type of data with the existing monitoring processes that already have an institutionalized status (Article IV). This reflects the challenge of *path dependency*, which explains how the set of decisions faced in any given circumstance are limited by decisions made in the past (Arthur 1989; David 1993). From this perspective, the investments that have been made to establish the current visitor monitoring and data management systems to compare the data in temporal bases can be viewed as a structural "lock-in" (Grabher 1993) that hinders the adaptation of new monitoring methods. There is an understandable anxiety that the value of the existing data will be lost if the format of data collection is changed. From an international perspective, this challenge is most likely less significant as the global state of visitor monitoring is underdeveloped (Muhar *et al.* 2002; Wardell & Moore 2005; Eagles 2014), causing possibly different kinds of challenges that did not arise in the Finnish context.

Finally, there is a concern and a challenge related to the reliability of PPGIS data which can work as an obstacle for implementing PPGIS methods. As Article III showed, visitors mapped surprisingly few recreation-related impacts on the environment, even though it has been said that the number of visits to Oulanka National Parks is so high that its impacts are visible (Lyon *et al.* 2011). One explanation for this can be related to the difficulty to specifically remember experiences after a visit (Borrie *et al.* 1998; Stewart & Cole 1999), especially when asked in a location-specific manner. Therefore, it is recommendable to ask visitors to map their experiences while visiting the parks. Smartphone applications represent a high potential for carrying out PPGIS surveys. The advantage of using smartphones, which utilize GPS, would be increased spatial preciseness of the data. Smartphone applications would also allow storing evidence reinforcing the perceived condition, e.g. a picture of the place evaluated as too crowded. This could further help

managers to understand visitors' perceptions of the site conditions. To conclude, to overcome the challenge related to the possible difficulty related to mapping exercises, it is recommendable to continue developing applications which allow collecting visitor experiences in the field using mobile phones (Doherty *et al.* 2014; Kangas *et al.* 2015; Birenboim 2016).

7 Conclusions

Planning for outdoor recreation in national parks is a growing concern under the current trend of increasing use pressure. Therefore, there is a call for methods that help to involve visitors in the management of these areas, as well as to increase the spatial understanding of how these areas are experienced. Different kinds of spatial methods have indeed been suggested to enhance the planning of visitor use in parks. Despite the common aspect of spatiality, the nature of information that these methods produce differs. The use of GPS and geo-referenced social media produces information that is mainly limited to informing visitors' use distribution, while PPGIS methods can also produce explanatory information. This is important in order to also understand visitors' spatial behavior, such as why people choose to visit certain parks or sites. This is particularly significant in Finnish and Nordic contexts where communication plays an important role in, for example, coordinating visitors across and within the parks, compared to other contexts where use restrictions, such as use quotas, can be defined to limit the use of certain trails or campsites.

The decision on which methods to use to monitor visitors depends, undeniably, also on other facts than the quality of the information. When concerning the cost-effectiveness of PPGIS methods, it must be acknowledged that the data collection and analyses of PPGIS data are rather resource intense and expensive (Levin *et al.* 2017). As evidenced also in this study, the percentage of those visitors participating in PPGIS surveys can remain low despite the high effort in recruiting participants. Low response rate has been noticed to be characteristic of PPGIS surveys that apply random sampling (Brown 2017). Therefore, retrieving spatial data on park usage from social media can be considered attractive; it is embraced because these new methods replace and compensate for the former laborious and costly means of collecting information (Tenkanen *et al.* 2017). However, Instagram images, as an example, include very limited information on who has posted the data (Levin *et al.* 2017), and therefore PPGIS methods are superior from the perspective of having the possibility to evaluate the representativeness of the data. These are example issues that need to be considered before adopting "trendy" spatial methods for visitor monitoring. Fortunately, researchers have started to conduct studies comparing different spatial methods (e.g. Tang & Liu 2016; Levin *et al.* 2017; Norman & Pickering 2017), which help managers when deciding which methods to apply, if any.

The contribution of this study is that it increased the knowledge how PPGIS methods could be more extensively used to meet the academic and practical interests in the field of outdoor recreation, as summarized in Figure 4. The study showed that there are different needs when developing PPGIS methods depending on whether they are applied to *understand* visitor experiences or to *monitor* them for practical management purposes. To answer the first research question related to understanding visitor experiences and their relationship with the environment, the findings highlighted that it is important to capture visitors' perceptions of the environment they encounter, such as evaluations of

the scenery. PPGIS methods could naturally be used for this purpose. The increased understanding of how visitors perceive the environment could also indirectly benefit managers when deciding on management actions in national parks.

To answer the second research question concerning how PPGIS could enhance the practical interest of visitor planning, the study suggested that PPGIS methods could be integrated into outdoor recreation management frameworks through using it to define the acceptable amount of change in national parks and the recreation opportunities that the parks provide (Figure 4). For the purpose of defining LAC, the recommended spatial attributes that should at least be measured are littering, crowding and erosion. To define recreation opportunities, mapping should focus on revealing those environmental features which visitors consider important for their activities at certain locations. Finally, the findings highlighted managers' needs for spatial information on where visitors find shortcomings in recreation infrastructure or other development needs as well as where conflicts between users take place and why. Spatial information covering visitors' perspectives on these issues would facilitate the planning of management actions.

In regard to the third research question, focusing on the implementation of PPGIS methods, the study revealed that managers' attitudes towards social science and towards public participation support the integration of PPGIS methods (Figure 5). Conversely, challenges are cause by the technical complications related to PPGIS practices, institutionalized monitoring practices that can be impediments for adopting new methods, as well as issues related to the quality of PPGIS data. In order to increase the quality of PPGIS data it is recommended to develop a mobile phone application which enables collection of visitors' experiences while they visit national parks. Moreover, to overcome the technical difficulties related to the use of PPGIS, it is recommended to develop automatic processes which quantify the mapping outcomes and transfer the data into GIS format for software and databases used for planning purposes. Besides, there is a need to strengthen managers and planners' know-how related to new types of GIS practices.

The results of this study are naturally context dependent to some extent. As the means of managing visitors and state of available information on visitors differ across park organizations, there are some limitations to how the results of the study can be generalized. For example, in case the park organization is lacking basic knowledge on the spatial distribution of visitor use of parks the need for this type of information would probably arise. Managers' attitudes towards using PPGIS methods and the obstacles for applying PPGIS approaches are also restricted to the Finnish park organization, because each park organization has its own organizational culture and practices to monitor park visitors, causing differences in how the potential of the PPGIS methods is seen. Therefore, to be able to compare and discuss possible differences in the needs and attitudes towards PPGIS data, it is recommendable to study managers' attitudes towards the PPGIS approach also in other contexts.

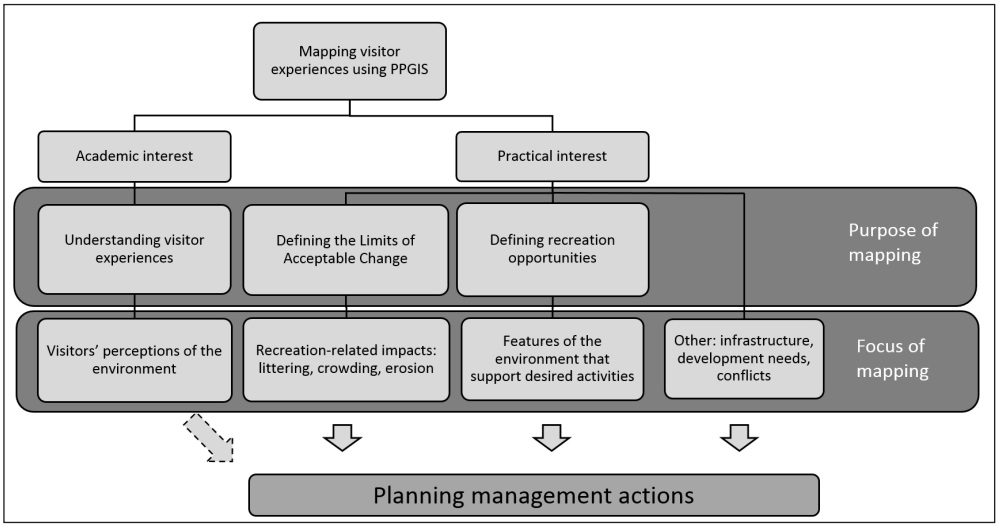

Figure 4. A summary illustrating how mapping visitor experiences could enhance the understanding of visitor experiences and planning the visitor use of parks.

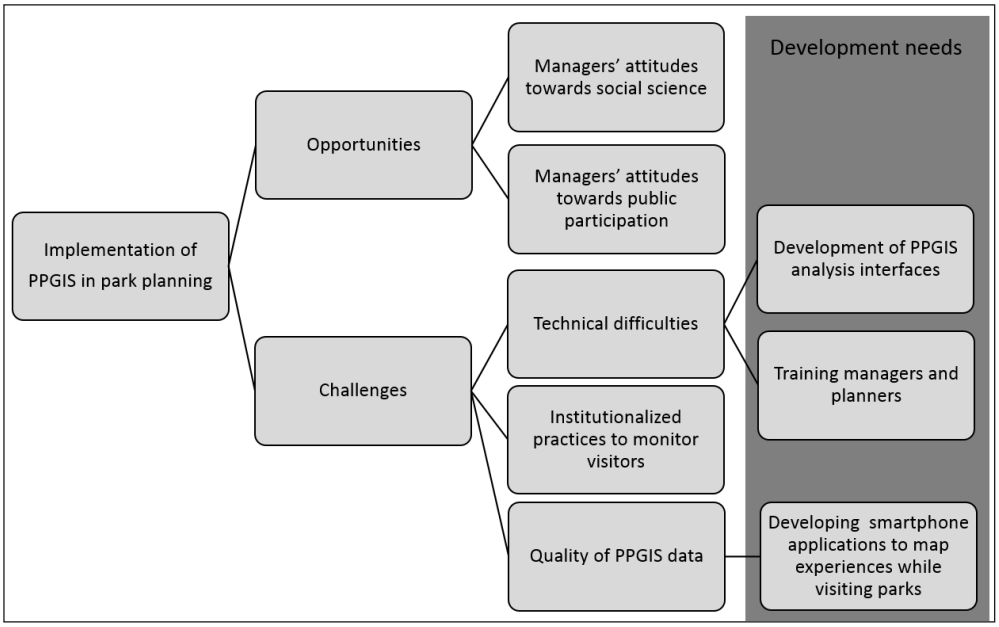

Figure 5. A summary of the opportunities and challenges related to implementing PPGIS methods into national park visitor planning.

References

Alatossava, S. (2011). Oulangan kansallispuiston luontomatkailusuunnitelma 2011 [Sustainable Tourism Development Strategy for Oulanka National Park 2011]. Nature Protection Publications of Metsähallitus. Serie C. No. 99. <https://julkaisut.metsa.fi/assets/pdf/lp/Csarja/c99.pdf> (accessed 10 Jan 2018).

Alessa, L, N., Kliskeya, A. & G. Brown (2008). Social–ecological hotspots mapping: a spatial approach for identifying coupled social–ecological space. *Landscape and urban planning* 85: 1, 27–39.

Ankre, R., Fredman, P. & A. Lindhagen (2016). Managers' experiences of visitor monitoring in Swedish outdoor recreational areas. *Journal of Outdoor Recreation and Tourism* 14, 35–40.

Arthur, W.B. (1989). Competing technologies, increasing returns, and "lock–in" by historical events. *Economic Journal* 99, 116–131.

Backlund, E. A. & W. P. Stewart (2012). Effects of setting–based management on visitor experience outcomes: Differences across a management continuum. *Journal of Leisure Research* 44: 3, 392–415.

Balmford, A., Green, J. M., Anderson, M., Beresford, J., Huang, C., Naidoo, R. & A. Manica (2015). Walk on the wild side: estimating the global magnitude of visits to protected areas. *PLoS biology* 13: 2 e1002074.

Barnett, A. J., Wiber, M. G., Rooney, M. P. & D. G. Maillet (2016). The role of public participation GIS (PPGIS) and fishermen's perceptions of risk in marine debris mitigation in the Bay of Fundy, Canada. *Ocean & Coastal Management* 133, 85–94.

Beeco, J. A. (2013). Integrating spatial modeling into recreational planning in parks and protected areas. All Dissertations. Paper 1080. 131p. <https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=2080&context=all_dissertations> (accessed 2 Jan 2018).

Beeco, J. A. & G. Brown (2013). Integrating space, spatial tools, and spatial analysis into the human dimensions of parks and outdoor recreation. *Applied Geography* 38, 76–85.

Berkes, F. (2009). Evolution of co–management: role of knowledge generation, bridging organizations and social learning. *Journal of environmental management* 90: 5, 1692–1702.

Bijker, R. A. & F. J. Sijtsma (2017). A portfolio of natural places: Using a participatory GIS tool to compare the appreciation and use of green spaces inside and outside urban areas by urban residents. *Landscape and Urban Planning* 158, 155–165.

Binkhorst, E. & T. Den Dekker (2009). Agenda for co–creation tourism experience research. *Journal of Hospitality Marketing & Management* 18: 2–3, 311–327.

Birenboim, A. & Shoval, N. (2016). Mobility research in the age of the smartphone. *Annals of the American Association of Geographers* 106: 2, 283–291.

Borrie, W. T. & R. M. Birzell (2001). Approaches to measuring quality of the wilderness experience. *In* Freimund, W. A. & Cole, D. N. (eds.): *Visitor use density and wilderness experience*, 29–38. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Ogden, UT.

Borrie, W.T., Roggenbuck, J.W. & R. B. Hull (1998). The problem of verbal reports in recreation research: review, recommendations, and new directions. *Tourism Analysis* 2, 175–184.

Brooks, J. J., Wallace, G. N. & D. R. Williams (2006). Place as relationship partner: An alternative metaphor for understanding the quality of visitor experience in a backcountry setting. *Leisure Sciences* 28: 4, 331–349.

Brown, G. (2012). Public Participation GIS (PPGIS) for regional and environmental planning: Reflections on a decade of empirical research. *Journal of Urban and Regional Information Systems Associatio*n 25: 2, 7–18.

Brown, G. (2017). A review of sampling effects and response bias in internet participatory mapping (PPGIS/PGIS/VGI). I 21: 1, 39–56.

Brown, G. & L. Brabyn (2012). An analysis of the relationships between multiple values and physical landscapes at a regional scale using public participation GIS and landscape character classification. *Landscape and urban planning* 107: 3, 317–331.

Brown, G. & N. Fagerholm (2015). Empirical PPGIS/PGIS mapping of ecosystem services: a review and evaluation. *Ecosystem Services* 13, 119–133.

Brown, G., Hausner, V. H. & E. Lægreid (2015). Physical landscape associations with mapped ecosystem values with implications for spatial value transfer: An empirical study from Norway. *Ecosystem Services* 15, 19–34.

Brown, G. & M. Kyttä (2014). Key issues and research priorities for public participation GIS (PPGIS): A synthesis based on empirical research. *Applied Geography* 46, 122–136.
Brown, G. & M. Kyttä (2018). Key issues and priorities in participatory mapping: Toward integration or increased specialization? *Applied Geography* 95: 1–8.
Brown, G. & P. Reed (2009). Public participation GIS: a new method for use in national forest planning. *Forest Science* 55: 2, 166–182.
Brown, G. G., Reed, P. & C. C. Harris (2002). Testing a place–based theory for environmental evaluation: an Alaska case study. *Applied Geography* 22: 1, 49–76.
Brown, G, & P. Reed (2012a). Values compatibility analysis: integrating public values in a forest planning decision support system. *Applied spatial analysis and policy* 5 :4, 317–332.
Brown, G. & P. Reed (2012b). Social landscape metrics: measures for understanding place values from public participation geographic information systems (PPGIS). *Landscape Research* 37: 1, 73–90.
Brown, G., Schebella, M. F. & D Weber (2014b). Using participatory GIS to measure physical activity and urban park benefits. *Landscape and Urban Planning* 121, 34–44.
Brown, G. & D. Weber (2011). Public participation GIS: A new method for national park planning. *Landscape and Urban Planning* 102: 1, 1–15.
Brown, G., Weber, D. & K. De Bie (2014a). Assessing the value of public lands using public participation GIS (PPGIS) and social landscape metrics. *Applied Geography* 53, 77–89.
Brown, P. J., Driver, B. L. & C. McConnell (1978). The opportunity spectrum concept in outdoor recreation supply inventories: Background and application. Forest Management Faculty Publications. 31. <https://pdfs.semanticscholar.org/6cd6/b0874625e486e07089f3f64a5ddf34e7425e.pdf> (accessed 24 Jan 2018)
Buckley, R. (2005). Recreation ecology research effort: an international comparison. *Tourism Recreation Research* 30: 1, 99–101.
Buckley, R. C. & P. Brough (2017). Economic value of parks via human mental health: an analytical framework. *Frontiers in Ecology and Evolution* 5, 1–9.
Campos, A. C., Mendes, J., Valle, P. O. D. & N. Scott (2015). Co–creation of tourist experiences: A literature review. *Current Issues in Tourism* 21:4, 1–32.
Castree, N. (2008). Neoliberalising nature: the logics of deregulation and reregulation. *Environment and planning* A 40: 1, 131–152.
Clark, R. N. & G. H. Stankey (1979). *The recreation opportunity spectrum: a framework for planning, management, and research*. General Technical Report. PNW–GTR–098. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 31 p. Portland, OR: U.S.
Cole, D. N. (2005; eds.). *Computer simulation modeling of recreation use: current status, case studies, and future directions*. General Technical Report. RMRS–GTR–143. 75 p. Rocky Mountain Research Station, USDA Forest Service. Fort Collins, CO: U.S.
Cole, D. N. (2006). Visitor and recreation impact monitoring: is it lost in the gulf between science and management? *The George Wright Forum* 23: 2, 11–16.
Cole, D. & D. Williams (2012). Wilderness visitor experiences: Lessons from 50 years of research. *In* Cole, N. (ed.): *Wilderness visitor experiences: Progress in research and management*, 3–20. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins, CO: U.S.
Cresswell, T. (2004). *Place: A short introduction*. 168 p. Blackwell, Oxford.
D' Antonio, A., Monz, C., Lawson, S., Newman, P., Pettebone, D. & A. Courtemanch (2010). GPS–based measurements of backcountry visitors in parks and protected areas: Examples of methods and applications from three case studies. *Journal of Park and Recreation Administration* 28: 3, 42–60.
David, P.A. (1993). Path dependence and predictability in dynamic systems with local network externalities: A paradigm for historical economics. *In* Foray D. & C. Freeman (eds.): *Technology and the wealth of nations*, 187–216. Pinter, London.
Dinsdale, E. A. (2009). Linking ecological and perceptual assessments for environmental management: A coral reef case study. *Ecology and Society* 14: 2, 1–17.
Doherty, S. T., Lemieux, C. J. & C. Canally (2014). Tracking human activity and well–being in natural environments using wearable sensors and experience sampling. *Social Science & Medicine* 106, 83–92.
Dorwart, C. E., Moore, R. L. & Y. F. Leung (2009). Visitors' perceptions of a trail environment and effects on experiences: A model for nature–based recreation experiences. *Leisure Sciences* 32: 1, 33–54.
Driver, B. L. (1983). *Master list of items for recreation experience preference scales and domains.* Unpublished document. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Dunn, C. E. (2007). Participatory GIS—a people's GIS?. *Progress in human geography* 31: 5, 616–637.
Dvorak, R. G., Borrie, W. T. & A. E. Watson (2013). Personal wilderness relationships: building on a transactional approach. *Environmental management* 52: 6, 1518–1532.
Eagles, P. F. (2014). Research priorities in park tourism. *Journal of Sustainable Tourism* 22: 4, 528–549.
Eagles, P. F., Coburn, J. & B. Swartman (2014). Plan quality and plan detail of visitor and tourism policies in Ontario Provincial Park management plans. *Journal of Outdoor Recreation and Tourism* 7, 44–54.
Erkkonen, J. (2014). Kansallispuistojen profilointi [The profiling of national parks]. Presentation for cooperation meetings. <http://www.metsa.fi/documents/10739/1522571/Puistojen+profilointi+MH+luontopalvelut+Lappi+2014.pdf/5389a6e8–8f45–4c71–b85d–15cc6a59314b> (accessed 24 Feb 2018)
Fagerholm, N., T. Koistinen, H. Jansson, & N. Käyhkö (2014). *Minun Saaristomereni: Saaristomeren maisemapalveluiden kartoitus osallistavin menetelmin*. [My Saaristomeri: Inventory of landscape services using participatory methods]. 119 pp. Metsähallitus.
Fix, P. J., Carroll, J. & A. M. Harrington (2013). Visitor experiences across recreation settings: A management or measurement issue?*Journal of Outdoor Recreation and Tourism* 3, 28–35.
Fredman, P. & L. Emmelin (2001). Wilderness purism, willingness to pay and management preferences. A study of Swedish mountain tourists. *Tourism Economics* 7: 1, 5–20.
Fredman, P. & Sandell, K. (2009). 'Protect, preserve, present'. *In* Frost W. & C. M. Hall (eds.): *Tourism and National Parks: International Perspectives on Development, Histories, and Change* 197–207. Routledge, London.
Fredman, P., Wall–Reinius, S. & A. Grundén (2012). The nature of nature in nature–based tourism. *Scandinavian Journal of Hospitality and Tourism* 12: 4, 289–309.
Frissell, S. S. & G. H. Stankey (1972). Wilderness environmental quality: Search for social and ecological harmony. Proceedings, Society of American Foresters Annual Meeting, Hot Springs, Arkansas October, 1972. <https://www.fs.fed.us/cdt/carrying_capacity/wilderness_environmental_quality_search_for_social_ecological_harmony_frissell_stankey_1972.pdf> (accessed 10 Dec 2017).
Frost, W. & Hall, C. M. (2009; eds.). *Tourism and national parks: International perspectives on development, histories, and change*. 357 p. Routledge. London.
Gibson, C. C., Ostrom, E. & T. K. Ahn (2000). The concept of scale and the human dimensions of global change: a survey. *Ecological economics* 32: 2, 217–239.
Goodchild, M. F., Aubrecht, C. & B. Bhaduri (2017). New questions and a changing focus in advanced VGI research. *Transactions in GIS* 21: 2, 189–190.
Grabher, G. (1993). The weakness of strong ties: The lock–in of regional development in the Ruhr area. *In* G. Grabher (ed.): *The embedded firm: On the socio–economics of industrial networks*, 255–277. Routledge. London.
Göçmen, Z. A. & S. J. Ventura (2010). Barriers to GIS use in planning. J*ournal of the American Planning Association* 76: 2, 172–183.
Hadwen, W. L., Hill, W. & C. M. Pickering (2007). Icons under threat: Why monitoring visitors and their ecological impacts in protected areas matters. *Ecological Management & Restoration* 8: 3, 177–181.
Hadwen, W. L., Hill, W. & C. M. Pickering (2008). Linking visitor impact research to visitor impact monitoring in protected areas. *Journal of Ecotourism* 7: 1, 87–93.
Haggard, L. M. & D. R. Williams (1992). Identity affirmation through leisure activities: Leisure symbols of the self. *Journal of Leisure Research* 24: 1, 1–18.
Hall, C. M. & S. W. Boyd (2005: eds.). *Nature–based tourism in peripheral areas: Development or disaster?* 281p. Channel View Publications.
Hall, T. E. & D. N. Cole (2007). *Changes in the motivations, perceptions and behaviours of recreation users: Displacement and coping in wilderness.* Report RMRS–RP–63. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins, CO: U.S.
Hallo, J. C., Beeco, J. A., Goetcheus, C., McGee, J., McGehee, N. G. & W. C. Norman (2012). GPS as a method for assessing spatial and temporal use distributions of nature–based tourists. *Journal of Travel Research* 51: 5, 591–606.
Hammitt, W. E., Cole, D. N. & C. A. Monz (2015). *Wildland recreation: ecology and management*. 334 p. John Wiley & Sons.
Hartig, T., Mitchell, R., De Vries, S. & H. Frumkin (2014). *Nature and health. Annual review of public health* 35: 207–228.

Haukeland, J. V., Daugstad, K. & O. I. Vistad (2011). Harmony or conflict? A focus group study on traditional use and tourism development in and around Rondane and Jotunheimen National Parks in Norway. *Scandinavian Journal of Hospitality and Tourism* 11, 13–37.

Haukeland, J. V., Grue, B. & K. Veisten (2010). Turning national parks into tourist attractions: Nature orientation and quest for facilities. *Scandinavian Journal of Hospitality and Tourism* 10: 3, 248–271.

Hausner, V. H., Brown, G. & E. Lægreid (2015). Effects of land tenure and protected areas on ecosystem services and land use preferences in Norway. *Land Use Policy* 49, 446–461.

Heikkonen, A. (2013). Paikkatietojärjestelmä osallistamisen tukena Metsähallituksen luonnonvarasuunnittelussa Lapissa. [Geographic Information System as a support for participatory Natural Resource Planning in Lapland]. Master's Thesis. Rovaniemi University of Applied Sciences. 95p. <http://urn.fi/URN:NBN:fi:amk–2013092615573> (accessed 15 Jan 2018).

Heinonen, M. (2007: ed). State of the parks in Finland – Finnish protected areas and their management from 2000 to 2005. *Nature Protection Publications of Metsähallitus. Series A* 170. 313 p. Metsähallitus, Vantaa.

Higham, J. & O. I. Vistad, (2011). Tourism in protected natural areas: The Nordic–Baltic context. Scandinavian *Journal of Hospitality and Tourism* 11, 1–12.

Hwang, S. N., Lee, C. & H. J. Chen (2005). The relationship among tourists' involvement, place attachment and interpretation satisfaction in Taiwan's national parks. *Tourism Management* 26: 2, 143–156.

Islam, M. W., Ruhanen, L. & B. W. Ritchie (2017). Adaptive co–management: A novel approach to tourism destination governance? J*ournal of Hospitality and Tourism Management* (in press).

IUCN (2018). Protected Area Categories. <https://www.iucn.org/theme/protected–areas/about/protected–area–categories> (accessed 10 May 2018).

Job, H., Becken, S. & B. Lane (2017). Protected Areas in a neoliberal world and the role of tourism in supporting conservation and sustainable development: an assessment of strategic planning, zoning, impact monitoring, and tourism management at natural World Heritage Sites. *Journal of Sustainable Tourism* 25: 12, 1697–1718.

Joyce, K. & S. Sutton (2009). A method for automatic generation of the Recreation Opportunity Spectrum in New Zealand. *Applied Geography* 29: 3, 409–418.

Juutinen, A., Mitani, Y., Mäntymaa, E., Shoji, Y., Siikamäki, P. & R. Svento (2011). Combining ecological and recreational aspects in national park management: A choice experiment application. *Ecological economics* 70: 6, 1231–1239.

Kahila–Tani, M., Broberg, A. Kyttä, M. & T. Tyger (2016). Let the citizens map—public participation GIS as a planning support system in the Helsinki master plan process. *Planning Practice & Research* 31: 2, 195–214.

Kajala, L., Almik, A., Dahl, R., Dikšaitė, L, Erkkonen, J., Fredman, P., Jensen, F. Søndergaard, Karoles, K., Sievänen, T., Skov–Petersen, H., Vistad, O. I. & P. Wallsten (2007). *Visitor monitoring in nature areas – a manual based on experiences from the Nordic and Baltic countries*. 534 p Swedish Environmental Protection Agency. Stockholm, Sweden.

Kajala, L., Erkkonen, J. & M. Perttula (2004). Measures for developing sustainability of nature tourism in protected areas. *In* Sievänen, T., Erkkonen, J., Jokimäki, J., Saarinen, J., Tuulentie, S. & E. Virtanen (eds.): *Policies, methods and tools for visitor management* 241–246. Working Papers of the Finnish Forest Research Institute. Vantaa.

Kaltenborn, B. P. & D. R. Williams (2002). The meaning of place: Attachments to Femundsmarka National Park, Norway, among tourists and locals. *Norsk Geografisk Tidsskrift* 56: 3, 189–198.

Kaltenborn, B. P., Haaland, H. & K. Sandell (2001). The public right of access–some challenges to sustainable tourism development in Scandinavia. *Journal of Sustainable Tourism* 9: 5, 417–433.

Kaltenborn, B. P., Qvenild, M. & C. Nellemann (2011). Local governance of national parks: the perception of tourism operators in Dovre–Sunndalsfjella National Park, Norway. Norsk Geografisk Tidsskrift–Norwegian *Journal of Geography* 65: 2, 83–92.

Kangas, A., Rasinmäki, J., Eyvindson, K. & Chambers, P. (2015). A mobile phone application for the collection of opinion data for forest planning purposes. *Environmental management* 55: 4, 961–971.

Kaplan, R. & Kaplan, S. (1989). *The experience of nature: A psychological perspective.* 360p. Cambridge University Press.

Karimi, A, Brown, G. & M. Hockings (2015). Methods and participatory approaches for identifying social–ecological hotspots. *Applied Geography* 63: 9–20.

Kil, N., Stein, T. V. & S. M. Holland (2014). Influences of wildland–urban interface and wildland hiking areas on experiential recreation outcomes and environmental setting preferences. *Landscape and Urban Planning* 127, 1–12.
Kirk, W., Lösch, A. & I. Berlin (1963). Problems of geography. *Geography* 48: 4, 357–371.
Korpilo, S., Virtanen, T. & S. Lehvävirta (2017). Smartphone GPS tracking—Inexpensive and efficient data collection on recreational movement. *Landscape and Urban Planning* 157, 608–617.
Kruger, L. E. & Hall, T. E. (2008). Introduction: gathering to discuss place. *In* Kruger, L. E., Hall, T. E. & M. C. Stiefel (eds.): *Understanding concepts of place in recreation research and management*, 1–6. General Technical Report PNW– GTR–744. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR: U.S.
Kuentzel, W. F. & T. A. Heberlein (2003). More visitors, less crowding: Change and stability of norms over time at the Apostle Islands. *Journal of Leisure Research* 35: 4, 349–371.
Kyle, G., Graefe, A., Manning, R. & J. Bacon (2004). Effects of place attachment on users' perceptions of social and environmental conditions in a natural setting. *Journal of environmental psychology* 24: 2, 213–225.
Lawson, S. R. (2006). Computer simulation as a tool for planning and management of visitor use in protected natural areas. *Journal of Sustainable Tourism* 14: 6, 600–617.
Lawson, S. R., Manning, R. E., Valliere, W. A. & B. Wang (2003). Proactive monitoring and adaptive management of social carrying capacity in Arches National Park: an application of computer simulation modeling. *Journal of Environmental Management* 68: 3, 305–313.
Lechner, A. M., Raymond, C. M., Adams, V. M., Polyakov, M., Gordon, A., Rhodes, J. R. & E. C. Lefroy (2014). Characterizing spatial uncertainty when integrating social data in conservation planning. *Conservation Biology* 28: 6, 1497–1511.
Leung, Y. F., Marion, J. L. & Farrell, T. A. (2008). Recreation ecology in sustainable tourism and ecotourism; A strengthening role. *In* McCool, S.F. & R. N. Moisey (eds.): T*ourism Recreation and Sustainability 2nd Edition Linking Culture and the Environment*, 19–37. Cromwell Press, Trowbridge.
Levin, N., Kark, S. & D. Crandall (2015). Where have all the people gone? Enhancing global conservation using night lights and social media. *Ecological Applications* 25: 8, 2153–2167.
Levin, N., Lechner, A. M. & G. Brown (2017). An evaluation of crowdsourced information for assessing the visitation and perceived importance of protected areas. *Applied geography* 79, 115–126.
Lindholst, A. C., Caspersen, O. H. & C. C. K. van den Bosch (2015). Methods for mapping recreational and social values in urban green spaces in the nordic countries and their comparative merits for urban planning. *Journal of outdoor recreation and tourism* 12, 71–81.
Ling Kuo, I. (2002). The effectiveness of environmental interpretation at resource–sensitive tourism destinations. *International Journal of Tourism Research* 4: 2, 87–101.
Lyon, K., Cottrell, S. P., Siikamäki, P. & R. Van Marwijk (2011). Biodiversity hotspots and visitor flows in Oulanka National Park, Finland. *Scandinavian Journal of Hospitality and Tourism* 11, 100–111.
Machlis, G. E. & Field, D. (Eds.). (2000). *National parks and rural development: Practice and policy in the United States*. Island Press.
Manning, R. E. (1985). Crowding norms in backcountry settings: a review and synthesis. *Journal of Leisure Research* 17: 2, 75–89.
Manning, R. E. (2011). *Studies in Outdoor Recreation: Search and research for satisfaction*. 468 p. Oregon State University Press. Corvallis, OR.
Manning, R. E. & W. A. Valliere (2001). Coping in outdoor recreation: Causes and consequences of crowding and conflict among community residents. *Journal of Leisure Research* 33: 4, 410–426.
Manning, R., W. Valliere, L. Anderson, R. S. McCown, P. Pettengill, N. Reigner, S. Lawson, P. Newman, M. Budruk, D. Laven, J. Hallo, L. Park, J. Bacon, D. Abbe, C. van Riper & K. Goonan (2011). Defining, measuring, monitoring, and managing the sustainability of parks for outdoor recreation. *Journal of Park and Recreation Administration* 29: 24–37.
Manzo, L.C. (2008). Understanding human relationships to place and their significance for outdoor recreation and tourism. *In* L. E. Kruger, T. E. Hall & M. C. Stiefel (eds.): *Understanding concepts of place in recreation research and management*, 135–173. Department of Agriculture, Forest Service, Pacific Northwest Research Station PNW–GTR–744. Portland, OR: U.S.
Marion, J. L. & D. N. Cole (1989). Evaluating recreation impacts: A multi–faceted research design. *Park Science* 9: 2, 23–24.

Marston, S. A., Jones, J. P. & K. Woodward (2005). Human geography without scale. *Transactions of the Institute of British Geographers* 30: 4, 416–432.
Martin, S. R., McCool, S. F. & R. C. Lucas (1989). Wilderness campsite impacts: Do managers and visitors see them the same? *Environmental management* 13: 5, 623–629
Mason, P. (2005). Visitor management in protected areas: From 'hard' to 'soft'approaches? *Current Issues in Tourism* 8: 2–3, 181–194.
McAfee, K. (1999). Selling nature to save it? Biodiversity and green developmentalism. *Environment and planning D: society and space* 17: 2, 133–154.
McCool, S. F., Clark, R. N. & G. H. Stankey (2007). *An assessment of frameworks useful for public land recreation planning*. 125 p. General Technical Report PNW–GTR–705. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR: U.S
McCool, S.F. (2006). Managing for visitor experiences in protected areas: promising opportunities and fundamental challenges. *Parks: The International Journal for Protected Areas Managers* 16, 3–9.
Meijles, E. W., De Bakker, M., Groote, P. D. & R. Barske (2014). Analysing hiker movement patterns using GPS data: Implications for park management. *Computers, Environment and Urban Systems* 47, 44–57.
Metsähallitus (2014a). Suojelualueiden hoidon ja käytön periaatteet [Principles of Protected Area Management in Finland]. *Nature Protection Publications of Metsähallitus. Series B* 203. 134p. <https://julkaisut.metsa.fi/assets/pdf/lp/Bsarja/b203.pdf> (accessed 3 March 2018).
Metsähallitus (2014b) Oulangan hoito– ja käyttösuunnitelma 2012–2026 [Management plan for Oulanka National Park 2012–2026]. *Nature Protection Publications of Metsähallitus. Series C* 130. 163p. <https://julkaisut.metsa.fi/assets/pdf/lp/Csarja/c130.pdf> (accessed 5 Dec 2018).
Metsähallitus (2017). Ärjänsaaren kehittämisohjelma 2018–2024.[Development plan for Ärjänsaari]. *Nature Protection Publications of Metsähallitus. Series C* 160. 47p. <https://julkaisut.metsa.fi/assets/pdf/lp/Csarja/c160.pdf> (accessed 25 Jan 2018).
Metsähallitus (2018). Kansallispuistojen, valtion retkeilyalueiden ja muiden virkistyskäytöllisesti merkittävimpien Metsähallituksen hallinnoimien suojelualueiden ja retkeilykohteiden käyntimäärät vuonna 2017. [Visitation Numbers in Protected Areas of Finland in 2017] <http://www.metsa.fi/documents/10739/3335805/kayntimaarat2017.pdf/d4414a36–b10d–428c–aa90–c5b50f25e4e5> (accessed 4 Feb 2018)
Mitchell, M. Y., Force, J. E., Carroll, M. S. & W. J. McLaughlin (1993). Forest places of the heart: incorporating special spaces into public management. *Journal of forestry* 91: 4, 32–37.
Monz, C. A., Cole, D. N., Leung, Y. F. & J. L Marion (2010). Sustaining visitor use in protected areas: future opportunities in recreation ecology research based on the USA experience. *Environmental management* 45: 3, 551–562.
Moore, R. L. & D. Scott (2003). Place attachment and context: Comparing a park and a trail within. *Forest science* 49: 6, 877–884.
Moore, S. A., Brown, G., Kobryn, H. & J. Strickland–Munro (2017). Identifying conflict potential in a coastal and marine environment using participatory mapping. *Journal of environmental management* 197, 706–718.
Moyle, B. D. & Weiler, B. (2017). Revisiting the importance of visitation: Public perceptions of park benefits. *Tourism and Hospitality Research* 17: 1, 91–105.
Muhar, A., Arnberger, A. & C. Brandenburg (2002). Methods for visitor monitoring in recreational and protected areas: An overview. *In* Arnberger, A; Brandenburg, C. & A. Muhar (eds.): *Monitoring and Management of Visitor Flows in Recreational and Protected Areas Conference Proceedings*, 1–6.
Munro, J., Kobryn, H., Palmer, D., Bayley, S. & S. A. Moore (2017). Charting the coast: spatial planning for tourism using public participation GIS. *Current Issues in Tourism* 1–19.
Nerg, A., Uusivuori, J., Mikkola, J., Neuvonen, M. & T. Sievänen (2012). Visits to national parks and hiking areas: a panel data analysis of their socio–demographic, economic and site quality determinants. *Tourism Economics* 18: 1, 77–93.
Neuvonen, M., Pouta, E. & Sievänen, T. (2010a). Intention to revisit a National Park and its vicinity: effect of place attachment and quality perceptions. *International Journal of Sociology* 40: 3, 51–70
Neuvonen, M., Pouta, E., Puustinen, J. & T. Sievänen (2010b). Visits to national parks: Effects of park characteristics and spatial demand. *Journal for Nature Conservation* 18: 3, 224–229
Newsome, D., & M. Hughes (2018). The contemporary conservation reserve visitor phenomenon! *Biodiversity and Conservation* 27: 2, 521–529.

Newsome, D., Moore, S. A. & R. K. Dowling (2013). *Natural area tourism: Ecology, impacts and management.* (2th ed.) 457 p. Channel View Books.
Norman, P. & C. M. Pickering (2017). Using volunteered geographic information to assess park visitation: Comparing three on–line platforms. *Applied Geography* 89, 163–172.
O'Connor, A., Zerger, A. & B. Itami (2005). Geo–temporal tracking and analysis of tourist movement. *Mathematics and Computers in Simulation* 69: 1–2, 135–150.
Olafsson, A. S. & H. Skov-Petersen (2014). The use of GIS-based support of recreational trail planning by local governments. *Applied Spatial Analysis and Policy* 7: 2, 149–168.
Orsi, F. & D. Geneletti (2013). Using geotagged photographs and GIS analysis to estimate visitor flows in natural areas. *Journal for nature conservation* 21:5, 359–368.
Orsi, F., Geneletti, D. & A. Borsdorf (2013). Mapping wildness for protected area management: A methodological approach and application to the Dolomites UNESCO World Heritage Site (Italy). *Landscape and Urban Planning* 120, 1–15.
Pánek, J. (2016). From mental maps to GeoParticipation. *The Cartographic Journal* 53: 4, 300–307.
Patterson, M. E., Watson, A. E., Williams, D. R. & J. R. Roggenbuck, (1998). An hermeneutic approach to studying the nature of wilderness experiences. *Journal of Leisure Research* 30:4, 423–452.
Pickering, C. M., Hill, W., Newsome, D. & Y. F. Leung (2010). Comparing hiking, mountain biking and horse riding impacts on vegetation and soils in Australia and the United States of America. *Journal of environmental management* 91: 3, 551–562.
Pickering, C., Rossi, S. D., Hernando, A. & A. Barros (2018). Current knowledge and future research directions for the monitoring and management of visitors in recreational and protected areas. J*ournal of Outdoor Recreation and Tourism* 21, 10–18.
Pierskalla, C. D., Lee, M. E., Stein, T. V., Anderson, D. H. & R. Nickerson (2004). Understanding relationships among recreation opportunities: A meta–analysis of nine studies. *Leisure Sciences* 26: 2, 163–180.
Plummer, R. & D. A Fennell (2009). Managing protected areas for sustainable tourism: prospects for adaptive co–management. *Journal of Sustainable Tourism* 17: 2, 149–168.
Poon A. (1993). *Tourism, technology and competitive strategies.* 370 p. CAB International, Wallingford.
Price, S., Blacketer, M. & M. Brownlee (2018). The influence of place attachment on campers' evaluations of ecological impacts due to recreation use. *Journal of Outdoor Recreation and Tourism* 21, 30–38.
Puhakka, R. (2007) *Kansallispuistot murroksessa. Tutkimus luonnonsuojelun ja matkailun tavoitteiden kohtaamisesta* [National Parks in Transition. A Study of the Interaction between Nature Conservation and Tourism] (English summary) Doctoral dissertation. University of Joensuu. Publications in Social Sciences.
Puhakka, R. (2008). Increasing role of tourism in Finnish national parks. *Fennia–International Journal of Geography* 186: 1, 47–58.
Puhakka, R. (2011). Environmental concern and responsibility among nature tourists in Oulanka PAN Park, Finland. *Scandinavian Journal of Hospitality and Tourism* 11: 1, 76–96.
Puhakka, R. & J. Saarinen (2013). New role of tourism in national park planning in Finland. *The Journal of Environment & Development* 22: 4, 411–434.
Puhakka, R. & P. Siikamäki (2012). Nature tourists' response to ecolabels in Oulanka PAN Park, Finland. *Journal of Ecotourism* 11: 1, 56–73.
Puhakka, R., Cottrell, S. P. & P. Siikamäki (2014). Sustainability perspectives on Oulanka National Park, Finland: Mixed methods in tourism research. *Journal of Sustainable Tourism* 22: 3, 480–505.
Puhakka, R., Pitkänen, K. & P. Siikamäki (2017). The health and well–being impacts of protected areas in Finland. *Journal of Sustainable Tourism* 25: 12, 1830–1847.
Puhakka, R., Sarkki, S., Cottrell, S. P. & P. Siikamäki (2009). Local discourses and international initiatives: sociocultural sustainability of tourism in Oulanka National Park, Finland. *Journal of Sustainable Tourism* 17: 5, 529–549.
Puska, E.–M. (2015). *Oulangan kansallispuiston kävijätutkimus 2014*. [Oulanka National Park Visitor Survey 2014]. Nature Protection Publications of Metsä– hallitus. Serie B. No. 210. <https://julkaisut.metsa.fi/assets/pdf/lp/Bsarja/b210.pdf> (accessed 3 Jan 2018).
Raadik, J., Cottrell, S. P., Fredman, P., Ritter, P. & P. Newman (2010). Understanding recreational experience preferences: application at fulufjället national park, Sweden. *Scandinavian Journal of Hospitality and Tourism* 10: 3, 231–247.
Ramkissoon, H., Smith, L. D. G. & B. Weiler (2013). Relationships between place attachment, place satisfaction and pro–environmental behaviour in an Australian national park. *Journal of Sustainable Tourism* 21: 3, 434–457.

Rattan, J. K., Eagles, P. F. & H. L. Mair (2012). Volunteer tourism: its role in creating conservation awareness. *Journal of Ecotourism* 11: 1, 1–15.
Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. *Biological conservation* 141: 10, 2417–2431.
Risvoll, C., Fedreheim, G. E., Sandberg, A. & S. BurnSilver (2014). Does Pastoralists' participation in the management of national parks in northern Norway contribute to adaptive governance? *Ecology and Society* 19: 2, 71 http://dx.doi.org/10.5751/ES–06658–190271.
Ross, H., Grant, C., Robinson, C. J., Izurieta, A., Smyth, D. & P. Rist (2009). Co–management and Indigenous protected areas in Australia: achievements and ways forward. *Australasian Journal of Environmental Management* 16: 4, 242–252.
Rytteri, T. & R. Puhakka (2009). Formation of Finland's national parks as a political issue. *Ethics Place and Environment* 12: 1, 91–106.
Saarinen, J. (1998). Cultural influences on wilderness encounter responses. *International Journal of Wilderness* 4: 1, 28-32.
Saarinen, J. (2005). Tourism in the northern wildernesses: wilderness discourses and the development of nature–based tourism in northern Finland. *In* Hall C. M. & S. Boyd (eds.): *Nature–based tourism in peripheral areas. Development or disaster*, 36–49. Channel View Publications, Clevedon.
Saarinen, J. (2006). Traditions of sustainability in tourism studies. *Annals of tourism research* 33: 4, 1121–1140.
Saarinen, J. (2013). Critical sustainability: Setting the limits to growth and responsibility in tourism. *Sustainability* 6: 1, 1–17.
Saarinen, J. (2018). What are wilderness areas for? Tourism and political ecologies of wilderness uses and management in the Anthropocene. *Journal of Sustainable Tourism* 1–16.
Saegert, S. & Winkel, G. H. (1990). Environmental psychology. *Annual review of psychology* 41: 1, 441–477.
Sæþórsdóttir, A. D. (2010a). Planning nature tourism in Iceland based on tourist attitudes. *Tourism Geographies* 12: 1, 25-52.
Sæþórsdóttir, A. D. (2010b). Tourism struggling as the Icelandic wilderness is developed. *Scandinavian Journal of Hospitality and Tourism* 10: 3, 334-357.
Sæþórsdóttir, A. D. & J. Saarinen (2016). Changing ideas about natural resources: tourists' perspectives on the wilderness and power production in Iceland. *Scandinavian Journal of Hospitality and Tourism* 16: 4, 404-421.
Sandell, K. (2005). Access, tourism and democracy: A conceptual framework and the non-establishment of a proposed national park in Sweden. *Scandinavian Journal of Hospitality and Tourism* 5: 1, 63-75.
Sandell, K. & P. Fredman (2010). The right of public access–opportunity or obstacle for nature tourism in Sweden? *Scandinavian Journal of Hospitality and Tourism* 10: 3, 291–309.
Sarkki, S., Heikkinen, H. I. & R. Puhakka (2013). Boundary organisations between conservation and development: insights from Oulanka National Park, Finland. *World Review of Entrepreneurship, Management and Sustainable Development* 9: 1, 37–63.
Schägner, J. P., Brander, L., Maes, J., Paracchini, M. L. & V. Hartje (2016). Mapping recreational visits and values of European National Parks by combining statistical modelling and unit value transfer. *Journal for nature conservation* 31, 71–84.
Scolozzi, R., Schirpke, U., Detassis, C., Abdullah, S. & A. Gretter (2015). Mapping alpine landscape values and related threats as perceived by tourists. *Landscape research* 40: 4, 451–465.
Sessions, C., Wood, S. A., Rabotyagov, S. & D. M. Fisher (2016). Measuring recreational visitation at US National Parks with crowd–sourced photographs. *Journal of environmental management* 183, 703–711.
Seymour, E., Curtis, A., Pannell, D., Allan, C. & A. Roberts (2010). Understanding the role of assigned values in natural resource management. *Australasian Journal of Environmental Management* 17: 3, 142–153.
Seymour, V. (2016). The human–nature relationship and its impact on health: a critical review. *Frontiers in public health* 4, 260.
Sherrouse, B. C., Semmens, D. J. & J. M. Clement (2014). An application of Social Values for Ecosystem Services (SolVES) to three national forests in Colorado and Wyoming. *Ecological Indicators* 36, 68–79.
Sieber, R. (2006). Public participation geographic information systems: A literature review and framework. *Annals of the Association of American Geographers* 96: 3, 491–507.
Sievänen, T., Neuvonen, M. & E. Pouta (2011). National park visitor segments and their interest in rural tourism services and intention to revisit. *Scandinavian Journal of Hospitality and Tourism* 11, 54–73.

Siikamäki, P., Kangas, K., Paasivaara, A. & S. Schroderus (2015). Biodiversity attracts visitors to national parks. *Biodiversity and conservation* 24: 10, 2521–2534.
Sorsa, R. (2004). The role of tourism in Finnish nature conservation from the Nineteenth Century to the present. *In* Saarinen J. & C. M. Hall (eds.): *Nature–based tourism research in Finland: local contexts, global issues*, 33–46. Finnish Forest Research Institute, Research Papers 916.
Stankey, G. H. & S. F. McCool (1984). Carrying capacity in recreational settings: evolution, appraisal, and application. *Leisure Sciences* 6: 4, 453–473.
Stankey, G. H., Cole, D. N., Lucas, R. C., Petersen, M. E. & S. S. Frissell (1985). *The limits of acceptable change (LAC) system for wilderness planning*. 39 p. General Technical Report INT–176. Intermountain Forest and Range Experiment Station Ogden.
Stenseke, M. & A. S. Hansen (2014). From rhetoric to knowledge based actions–Challenges for outdoor recreation management in Sweden. *Journal of Outdoor Recreation and Tourism* 7, 26–34.
Stewart P. & N. Cole (1999). In search of situational effects in outdoor recreation: Different methods, different results. *Leisure Sciences* 21: 4, 269–286.
Stewart, W. P., Williams, D. R. & L. E. Kruger (2013: eds). *Place–based conservation: Perspectives from the social sciences*. 264 p. Springer Science & Business Media.
Strickland–Munro, J., Kobryn, H., Brown, G. & S. A. Moore (2016). Marine spatial planning for the future: Using Public Participation GIS (PPGIS) to inform the human dimension for large marine parks. *Marine Policy* 73, 15–26.
Su, M. M., Wall, G. & Z. Ma (2014). Assessing ecotourism from a multi–stakeholder perspective: Xingkai Lake National Nature Reserve, China. *Environmental management* 54: 5, 1190–1207.
Tang, Z. & T. Liu (2016). Evaluating Internet–based public participation GIS (PPGIS) and volunteered geographic information (VGI) in environmental planning and management. *Journal of Environmental Planning and Management* 59: 6, 1073–1090.
Tenkanen, H., Di Minin, E., Heikinheimo, V., Hausmann, A., Herbst, M., Kajala, L. & T. Toivonen (2017). Instagram, Flickr, or Twitter: Assessing the usability of social media data for visitor monitoring in protected areas. *Scientific reports* 7: 1, 17615.
Thomlinson, E. & G. Crouch (2012). Aboriginal peoples, Parks Canada, and protected spaces: a case study in co–management at Gwaii Haanas National Park Reserve. *Annals of Leisure Research* 15: 1, 69–86.
Törn, A., Siikamäki, P., Tolvanen, A., Kauppila, P. & J. Rämet (2008). Local people, nature conservation, and tourism in northeastern Finland. *Ecology and Society* 13: 1. Available at <http://www.ecologyandsociety.org/vol13/iss1/art8/>
Tuan,Y. (1974). Space and place: Humanistic perspective. *Progress in Geography* 6, 211–252.
Tuunanen (1999). Everyman's right in Finland Public access to the countryside: rights and responsibilities. The Finnish Ministry of the Environment. Edita Ltd.
Van Kirk, R., Martin, S., Ross, K. & M. Douglas (2014). Computer simulation modeling to determine trailhead quotas for overnight wilderness visitor use. *Journal of Park and Recreation Administration* 32: 3, 29–48.
Van Riper, C. J. & G. T. Kyle (2014). Capturing multiple values of ecosystem services shaped by environmental worldviews: a spatial analysis. *Journal of environmental management* 145, 374–384.
Van Riper, C. J., Kyle, G. T., Sherrouse, B. C., Bagstad, K. J. & S. G. Sutton (2017). Toward an integrated understanding of perceived biodiversity values and environmental conditions in a national park. *Ecological indicators* 72, 278–287.
Van Riper, C. J., Kyle, G. T., Sutton, S. G., Barnes, M. & B. C. Sherrouse (2012). Mapping outdoor recreationists' perceived social values for ecosystem services at Hinchinbrook Island National Park, Australia. *Applied Geography* 35: 1–2, 164–173.
Veisten, K., Haukeland, J. V., Baardsen, S., Degnes–Ødemark, H. & B. Grue (2015). Tourist segments for new facilities in national park areas: Profiling tourists in Norway based on psychographics and demographics. *Journal of Hospitality Marketing & Management* 24: 5, 486–510.
Vistad, O. I. (2006). Visitor monitoring in Norwegian national parks. *In* D. Siegrist, C. Clivaz, M. Hunziker & S. Iten (eds.): *Proceedings of the Third International Conference on Monitoring and Management of Visitor Flows in Recreational and Protected Areas*, Rapperswil, Switzerland, 80–82.
Wagar, J. A. (1964). The carrying capacity of wild lands for recreation. *Forest Science* 10: 3.
Walden–Schreiner, C., Leung, Y. F. & L. Tateosian (2018). Digital footprints: Incorporating crowdsourced geographic information for protected area management. *Applied Geography* 90, 44–54.
Wall–Reinius, S. W. & P. Fredman (2007). Protected areas as attractions. *Annals of tourism research* 34: 4, 839–854.

Wall–Reinius, S. & L. Bäck (2011). Changes in Visitor Demand: Inter–year Comparisons of Swedish Hikers' Characteristics, Preferences and Experiences. *Scandinavian Journal of Hospitality and Tourism* 11: 38–53.

Wang, B. & R. E. Manning (1999). Computer simulation modeling for recreation management: A study on carriage road use in Acadia National Park, Maine, USA. *Environmental Management* 23: 2, 193–203.

Wardell, M. J. & S. A. Moore (2004). Collection, storage and application of visitor use data in protected areas: guiding principles and case studies. Technical Report, 94 p. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.659.2268&rep=rep1&type=pdf> (accessed 4 Feb 2018).

Wearing, S. & N. G. McGehee (2013). Volunteer tourism: A review. *Tourism Management* 38, 120–130.

Weaver, D. (2015). Volunteer tourism and beyond: Motivations and barriers to participation in protected area enhancement. *Journal of Sustainable Tourism* 23: 5, 683–705.

Weiler, B., Moore, S. A. & B. D. Moyle (2013). Building and sustaining support for national parks in the 21st century: why and how to save the national park experience from extinction. *Journal of Park and Recreation Administration* 31: 2, 110 –126.

White, D. D., Hall, T. E. & T. A. Farrell (2001). Influence of ecological impacts and other campsite characteristics on wilderness visitors' campsite choices. *Journal of Park and Recreation Administration* 19: 2, 83–97.

White, D. D., Virden, R. J. & C. J. Van Riper (2008). Effects of place identity, place dependence, and experience–use history on perceptions of recreation impacts in a natural setting. *Environmental Management* 42: 4, 647–657.

Williams, D. R. (2004). Environmental psychology: Human responses and relationships to natural landscapes. *In* Manfredo, M. J., Vaske, J. J., Field, D.R.; Brown, P. J.& B. L. Bruyere (eds.): *Society and natural resources: A summary of knowledge*, 337–348. Modern Litho, Jefferson City, MO.

Williams, D. R. (2007). Recreation settings, scenery, and visitor experiences: a research assessment. *In* Kruger, L., Mazza R. & K. Lawrence (eds.): *Proceedings: national workshop on recreation research and management*, 29–41. General Technical Report. PNW–GTR–698. Department of Agriculture, Forest Service, Pacific. Portland, OR.

Williams, D. R. (2008). Pluralities of place: A user's guide to place concepts, theories, and philosophies in natural resource management. *In* Kruger, L. Hall, T. & Stiefel, M. (eds.): *Understanding Concepts of Place in Recreation Research and Management*, 7–30. General Technical Report. PNW–GTR–744. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR.

Williams, D. R. & J. J. Vaske (2003). The measurement of place attachment: Validity and generalizability of a psychometric approach. *Forest science* 49: 6, 830–840.

Williams, D. R. & M. E. Patterson (1999). Environmental psychology: Mapping landscape meanings for ecosystem management. *In* Cordell, H.K. & J.C. Bergstrom (eds.): *Integrating social sciences and ecosystem management: Human dimensions in assessment, policy and management*, 141–160. Sagamore Press. Champaign, IL.

Williams, D. R., Patterson, M. E., Roggenbuck, J. W. & A. E. Watson (1992). Beyond the commodity metaphor: Examining emotional and symbolic attachment to place. *Leisure sciences* 14: 1, 29–46.

Wolf, I. D., Brown, G. & T. Wohlfart (2018). Applying public participation GIS (PPGIS) to inform and manage visitor conflict along multi–use trails. *Journal of Sustainable Tourism* 26: 3, 470–495.

Wolf, I. D., Wohlfart, T., Brown, G. & A. B. Lasa (2015). The use of public participation GIS (PPGIS) for park visitor management: A case study of mountain biking. *Tourism Management* 51, 112–130.

Young, M. (1999). The social construction of tourist places. *Australian Geographer* 30: 3, 373–389.

Zachrisson, A., K. Sandell, K., Fredman, P. & K. Eckerberg (2006). Tourism and protected areas: motives, actors and processes. *The International Journal of Biodiversity Science and Management* 2: 4, 350–358.