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Current knowledge and future research directions for the monitoring and management of visitors in recreational and protected areas

Catherine Pickering[a,*], Sebastian Dario Rossi[a], Ana Hernando[b], Agustina Barros[b]

[a] Environment Futures Research Institute, Griffith University, Australia
[b] Instituto Argentino de Nivología y Glaciología y Ciencias Ambientales (IANIGLA), Centro Científico Tecnológico (CCT) CONICET, Mendoza, Argentina

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ABSTRACT

Visitation to recreation and protected areas is increasing globally and in many regions, including Europe, so is research on visitation. But who, where, what and how is the research done and what are the trends and key research gaps? The systematic quantitative review of 758 oral abstracts from the first seven conferences on Monitoring and Management of Visitors in Recreation and Protected Areas answers research questions on methods, goals and locations presented in the last decade as well as discussing trends and recommendations for the future. These major multi-disciplinary conferences are held every two years in different countries in Europe. Most (72%) of the research was from Europe, predominantly from countries where English is not the dominant language. Nearly every abstract was from terrestrial natural areas, often terrestrial protected areas (56%), with only three marine studies. Most abstracts (85%) were in the social sciences, either assessing visitor profile data along with motivations, satisfaction and experiences or focused on psychological aspects such as the attitudes, perceptions and behavior of visitors. Environmental research (32% abstracts) was mostly on vegetation, wildlife and landscape features with limited research on aquatic systems. Technology is driving research, with the analysis of big data from social media transforming where and how visitors can be monitored. Important gaps remain including research from countries and regions with large protected area systems and high levels of visitation including in Asia, South America and Africa, as well as some countries in Europe such as France.

Management implications: The article describes the previous trends in this conference series on outdoor recreation. The findings suggest that future conferences could:

- enhance the attendance and representation of researchers from parts of Europe so far under represented and different parts of the world such as Asia, the Russian Federation and Africa to make the conference truly international,
- strengthen the relevance of the conference for practitioners and managers, and
- communicate the value of research, including how new methods and technologies can enhance sustainable decision making.

1. Introduction

Nature-based tourism and recreation is increasing and diversifying worldwide, with protected areas and other natural sites key destinations for a range of activities (Ankre, Fredman, & Lindhagen, 2016; Balmford et al., 2015; Eagles, 2014; Newsome, Moore, & Dowling, 2012). This is in part driven by the well-recognized social benefits of visitor use of natural areas including improving human health and wellbeing (Berman, Jonides, & Kaplan, 2008; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Byrne, Wolch, & Zhang, 2009; Li et al., 2011; Maller, Townsend, Pryor, Brown, & St Leger, 2006; Morita et al., 2007; Pretty, Peacock, Sellens, & Griffin, 2005; Rossi, Byrne, & Pickering, 2015; Wells & Lekies, 2006). Nature-based activities can also generate economic revenues for protected areas and local communities through visitor expenditures and commercial concessions (Balmford et al., 2015). Unfortunately, these activities can also have detrimental impacts on the natural environment (Liddle, 1997; Monz, Cole, Leung, & Marion, 2010; Monz, Pickering, & Hadwen, 2013; Pickering & Hill, 2007), as well as resulting in social conflict among different users and with other stakeholders, when not properly managed (Arnberger &

* Corresponding author.
E-mail addresses: c.pickering@griffith.edu.au (C. Pickering), sebastian.rossi@griffithuni.edu.au (S.D. Rossi), ana.hernando.j@gmail.com (A. Hernando), abarros@conicet-mendoza.gov.ar, anaagustinabarros@gmail.com (A. Barros).

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Brandenburg, 2007; Carothers, Vaske, & Donnelly, 2001; Jacob & Schreyer, 1980; Rossi, Pickering, & Byrne, 2016; Vaske, Needham, & Cline, 2007).

To respond to the challenges and opportunities from nature-based tourism and recreation, there is an increasing focus on research into visitor management and monitoring (Buckley, Robinson, Carmody, & King, 2008; Lockwood, Worboys, & Kothari, 2012; Newsome et al., 2012; Worboys, Lockwood, Kothari, Feary, & Pulsford, 2015). This includes collecting information about visitors such as when, where and how many people use protected areas and for what purposes. This type of data is critical for protected area managers and other land use agencies (Andersen, Gundersen, Wold, & Stange, 2014; Buckley et al., 2008; Cessford & Muhar, 2003; Eagles, 2014; Worboys et al., 2015). Such data can help improve recreation opportunities while reducing the risk of social conflict as well as mitigate some environmental impacts (Ankre et al., 2016; Hadwen, Hill, & Pickering, 2007; Santos, Nogueira Mendes, & Vasco, 2016). The implementation of monitoring programs can also provide information about the state of conservation resources, the severity of threats, and the success of management responses (Buckley et al., 2008; Lockwood et al., 2012; Newsome et al., 2012; Worboys et al., 2015).

Recognizing the increasing interest in these issues, multidisciplinary conferences on Monitoring and Management of Visitors in Recreational and Protected Areas have been run every two years from 2002 to 2016 in Europe (Arnberger, Brandenburg, & Muhar, 2002; Đorđije, Miroslav, Lazar, & Vladimir, 2016; Fredman, Stenseke, Mossing, Liljendahl, & Laven, 2012; Goossen, Birgit, & van Marwijk, 2010; Raschi & Trampetti, 2008; Reimann, Sepp, Pärna, & Tuula, 2014; Siegrist, Clivaz, Hunziker, & Iten, 2006; Sievänen et al., 2004). These conferences bring together academics and practitioners to exchange information about the latest research, to identify emerging issues and foster better practices. The first conference was held in Vienna, Austria in 2002, with subsequent conferences in Rovaniemi, Finland in 2004, Rapperswil, Switzerland in 2006, Montecatini Terme, Italy in 2008, Wageningen, the Netherlands in 2010, Stockholm, Sweden in 2012, Tallinn, Estonia in 2014, and in Novi Sad, Serbia in 2016 (Fig. 1). The proceedings of the first seven conferences are published online, providing snapshots over time, allowing major themes, research outcomes, trends and gaps to be elucidated.

In this paper we review the proceedings of the first seven Monitoring and Management of Visitors Conferences (2002–2014) to assess: (1) who does research on this topic, and where, (2) what type of visitor data was collected and for which activities, (3) what are the main research themes/approaches, (4) what are the main methods used, (5) what was the role of technology in shaping research, and (6) where are key research gaps that should be addressed in future research on managing and monitoring visitors.

2. Methods

2.1. Quantifying the literature

We used a Systematic Quantitative Literature Review methodology (Pickering & Byrne, 2014; Pickering, Grignon, Steven, Guitart, & Byrne, 2015) to review the topic using the proceedings of the first seven conferences. To maintain consistency in the level of detail provided, while ensuring a wide diversity of topics were analyzed, we assessed the 758 abstracts for oral presentations, but excluded posters and keynote speaker abstracts. For each oral abstract, information was coded into a customized database for the review including: (1) *who did the research* such as the names of authors and their country of affiliation, (2) *where was the research conducted* including the region, country and location of the study, including if it was conducted in a protected area or other type of land use, and (3) on the type of *visitor data* collected (i.e. number of visitors, spatial and temporal use patterns). To determine (4) *what was the main approach/themes of the research* we recorded if it was original research, a case study, new methodology, a concept or a review abstract. We also coded if the research was primarily in the social sciences, environmental sciences, or both, or if it focused on technological developments, and what the major themes of the research were. We recorded data on (5) the *general methods* used for data collection, and (6) the *type(s) of technology* used (if any) for data collection such as GIS, traffic counters, GPS trackers or GPS tracking via smartphones. For abstracts in the social sciences, additional information was recorded including if the methods used were only quantitative (i.e. structured questionnaires, mailed questionnaires and/or desktop analysis), only qualitative (some individual or focus group interviews, document analysis, and/or participant observation) or 'mixed' studies using both quantitative and qualitative methods (Veal, 2011). In addition, the types of methods used were recorded including if they were formal structure questionnaires (e.g. used structured-designed question forms), visitor interviews (from semi-structured to unstructured interviews recording words, images and sounds), document analysis, direct observations (where the researcher watches the subject without interacting or altering the environment), participant observations (where the researcher was part of the social environment being studied) and intervention experiments (Veal, 2011). We also recorded who was assessed (e.g. visitors, communities, other stakeholders). For environmental studies, additional data about the type of impacts were recorded including if there were impacts on wildlife, vegetation, soils and/or aquatic systems. The coding procedures were cross-checked within the team, including the criteria used prior to assigning any abstracts, and then the coding of a sample of abstracts was compared between two of the authors to check for consistency.

2.2. Data analyses

The data for each abstract were initially entered into Survey Monkey using standardized categories/options to minimize entry errors and then transferred into SPSS (version 22.0). The geographic location (region, country and location) of each study was included in a GIS database to visually represent where research was conducted, with some abstracts including research from more than one location.

To identify research gaps (seventh aim) along with patterns and trends, the numbers of abstracts per category were examined through descriptive analysis and Chi-square tests. This included if there were differences in the field of research, components assessed and methods used among the seven conferences, including variation in quantitative and qualitative research in the social sciences abstracts. To identify more general patterns in the social science abstracts a Categorical Principal Component Analysis (CATPCA) was also used. The CATPCA is analogous to Linear Principal Component Analysis (PCA), except that it is suitable for the analysis of categorical variables (i.e. nominal or ordinal) and non-linear relationships (Linting, Meulman, Groenen, & van der Koojj, 2007).

3. Results

3.1. Who does the research and where?

Across the seven proceedings there were 758 oral abstracts by 1124 authors from 57 countries (Table 1). Some authors have multiple abstracts, but most (731) only appeared once as the author of an abstract at the conferences. Most of the research at the conferences was from authors affiliated with institutions located in non-English speaking countries (834, 74%), mainly Germany (86), Austria (81), Switzerland (72), the Netherlands (64), Finland (62), Italy (50), Sweden (45) and Japan (44). For authors affiliated with institutions in English speaking countries, the major contributions were by authors from the USA (125), followed by Australia (62), Canada (50), the United Kingdom (41) and New Zealand (12).

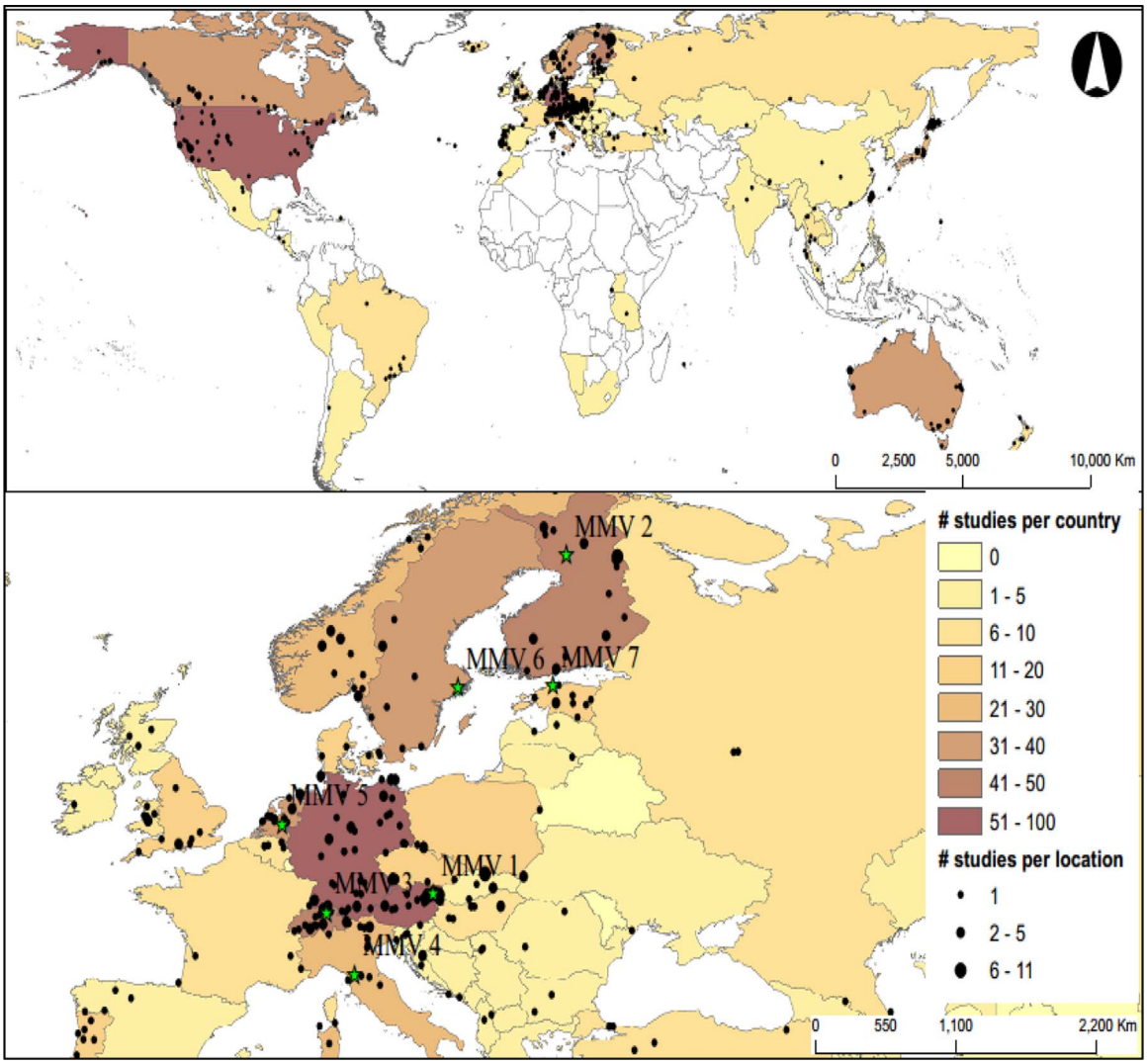


Fig. 1. Distribution of research presented in 758 abstracts for the first seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences. *The specific location of the research (i.e. city, national park, ski areas) is only shown when such information was provided in the text of the abstract.

3.2. Where was the research conducted?

The conferences were diverse, with abstracts presenting research conducted in 79 different countries (Fig. 1). As would be expected for conferences held in Europe, most of the research was from Europe (73% abstracts). Within Europe, interesting geographical patterns were found, with many abstracts presenting research conducted in Germany, Austria, Switzerland and Finland (Fig. 1, Table 1). As would be expected, a strong association was found between the location of a conference and the number of abstracts outlining research from that country (Fig. 1, Table 1). Countries in Europe that were poorly represented across the conferences with no or very limited research included Belarus, Cyprus, Luxembourg, Malta and Moldova with no abstracts, and only one or two abstracts for Bosnia and Herzegovina, Bulgaria, Greece, Kosovo, Liechtenstein, Lithuania, Ireland, Macedonia, Montenegro, Morocco, Romania and Scotland (Fig. 1).

The country with the most abstracts (10%) was outside of Europe, with 75 abstracts from the USA, mostly from popular protected areas (Fig. 1). Research from some other parts of the world were less common than expected including research from Asia (9.1%), Australia and New Zealand (6.1%), South and Central America (2.1%) and Africa (1.3%). Although many abstracts were from countries where English is a common or official language (183), the vast majority of abstracts (76%) were from countries where other languages are dominant, particularly German.

Although most of the research was conducted in protected areas (57%) (Table 1), there was also research from other types of natural areas, such as forests outside of protected areas (7%), other types of recreation areas (4%), urban green spaces (6%), tourist towns (2%) and ski resorts (2%). Within Europe, hotspots for research included the Danube Flood Plains National Park (11 abstracts), Oulanka National Park in Finland (10), Tatra National Park in Poland, (7) and Harz National Park in Germany (4) (Fig. 1). Outside Europe, there were several abstracts from Daisetsuzan National Park in Japan (7).

The number of abstracts was not proportional to the extent of protected areas within a country, with many abstracts from some countries without extensive protected areas (Table 1). When the numbers of abstracts were normalized by the expanse (1000 km^2) of protected areas, countries in Europe, such as Switzerland, the Netherlands, Austria and Turkey, were relatively well represented by abstracts at the conferences. In contrast, these normalized values were small for other countries in Europe such as Denmark, Poland, France, Russia and Spain (Fig. 1, Table 1).

Other important geographical gaps included freshwater and marine protected areas, which were very poorly represented with only 15 abstracts. The three abstracts from marine protected areas at the conferences were from Kosterhavet National Park in Sweden, Marine Protected Areas in general in Australia and the Marine Reserve in

Table 1
Geographical patterns in the location of research presented in the 758 oral abstracts from the first seven conferences. Protected Area data from http://www.protectedplanet.net/.

	Location of research	Author affiliations	In Protected Area	Protected Area (km^2)	Abstract per 1000 km^2 PA
Total	758	1124	438	20,600,000	0.037
Regions					
Europe	551 (73%)	752 (67%)	285 (65%)		
North America	115 (15%)	177 (16%)	83 (19%)		
Asia	69 (9.1%)	87 (7.7%)	47 (11%)		
Oceania (Australia and New Zealand)	46 (6.1%)	74 (6.6%)	31 (7.1%)		
South & Central America	16 (2.1%)	20 (1.8%)	15 (3.4%)		
Africa	10 (1.3%)	5 (0.4%)	7 (1.6%)		
English language	183 (24%)	294 (26%)	121 (28%)		
Countries in Europe					
Germany	70 (9.2%)	85 (7.6%)	39 (8.9%)	135,031	0.29
Austria	55 (7.3%)	81 (10.7%)	31 (7.1%)	23,018	1.35
Switzerland	53 (7.0%)	72 (9.5%)	15 (3.4%)	3986	3.76
Finland	45 (5.9%)	62 (8.2%)	27 (6.6%)	50,303	0.54
Netherlands	39 (5.1%)	64 (8.4%)	16 (3.7%)	3989	4.01
Sweden	32 (4.2%)	45 (5.9%)	7 (1.6%)	66,530	0.11
Norway	27 (3.6%)	41 (5.4%)	15 (3.4%)	55,443	0.27
Italy	26 (3.4%)	50 (6.6%)	11 (2.5%)	64,792	0.17
United Kingdom	22 (2.9%)	26 (3.4%)	11 (2.5%)	69,946	0.16
Estonia	15 (2.0%)	20 (2.6%)	9 (2.1%)	9168	0.98
Czech Republic	14 (1.8%)	17 (2.2%)	11 (2.5%)	17,263	0.64
Portugal	13 (1.7%)	25 (3.3%)	12 (2.7%)	21,101	0.57
Denmark	12 (1.6%)	14 (1.8%)	1 (0.2%)	11,830	0.08
Poland	12 (1.6%)	19 (2.5%)	11 (2.5%)	123,529	0.09
Hungary	10 (1.3%)	9 (1.2%)	8 (1.8%)	21,013	0.38
Turkey	9 (1.2%)	15 (1.3%)	5 (1.1%)	1709	2.93
Belgium	8 (1.1%)	15 (1.3%)	3 (0.7%)	7137	0.42
France	8 (1.1%)	14 (1.2%)	1 (0.2%)	141,369	0.01
Russia	8 (1.1%)	8 (0.7%)	5 (1.1%)	1,637,678	< 0.01
Iceland	7 (0.9%)	7 (0.6%)	5 (1.1%)	17,845	0.28
Croatia	5 (0.7%)	6 (0.5%)	4 (0.9%)	21,703	0.18
Slovakia	5 (0.7%)	1 (0.1%)	2 (0.5%)	18,245	0.11
Slovenia	5 (0.7%)	11 (1.0%)	2 (0.5%)	10,894	0.18
Spain	5 (0.7%)	14 (1.2%)	5 (1.1%)	142,141	0.04
Albania	4 (0.5%)	2 (0.2%)	2 (0.5%)	4913	0.41
Latvia	4 (0.5%)	3 (0.3%)	3 (0.7%)	11,720	0.26
Serbia	4 (0.5%)	6 (0.5%)	3 (0.7%)	5848	0.51

Reunion Island.

The number of abstracts, authors, counties they represent and locations for research varied over the conferences, reflecting patterns such as the popularity of the conference, but also where it was held. The 2012 conference in Stockholm, Sweden had the largest number of abstracts and authors (Table 2), but not the greatest range of affiliations of authors.

3.3. What types of visitor data were collected and for which activities?

Almost half of the research at the conferences included data on visitors (354 abstracts), including visitor numbers (52%), temporal and spatial patterns of usage (40%), visitor infrastructure data (i.e. trails, camps, visitor centers) (21%), frequency of visits (15%) and more recently, visitor tracking (8%) (Table 2). The type of visitor data collected varied over time, with proportionally more abstracts assessing visitor numbers and temporal and spatial use in the 2002 conference but fewer in 2012 (Table 2). In contrast, data about visitor infrastructure were more popular in the 2004, 2006 and 2008 conferences than in the earlier and later conferences (Table 2). Around a quarter of the research utilizes technology (198, 26%) such as traffic counters, computer simulation models, GIS mapping and/or video cameras for visitor monitoring (Tables 3 and 4).

Most studies looked at recreation and tourism in general (64%, 486), while others focused on popular activities such as hiking (20%), mountain biking (9%), skiing (4%) and camping (3%) (Table 3). For hiking, most of the research was in protected areas (71%), and much of it was in the social sciences. However, 20 abstracts assessed

Table 2
Numbers and types of abstracts and those with visitor data for the seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences. Only those with several abstracts in each Conference were statically compared.

All abstracts	# abstracts	2002	2004	2006	2008	2010	2012	2014	χ^2
Total abstracts	758	80	57	127	101	124	153	116	
Number of authors	1106	135	118	231	211	262	310	259	
Author affiliations (number of countries)	57	27	22	30	35	32	34	34	
Locations of research (number of countries)	92	34	21	44	40	40	44	42	
Abstracts with visitor data	354								
Numbers	185 (52%)	43	15	26	35	23	17	26	< **0.001**
Temporal & spatial usage	140 (40%)	27	13	23	22	20	15	20	**0.006**
Visitor infrastructure data	75 (21%)	7	13	18	16	9	2	10	
Frequency of visit	54 (15%)	1	4	2	8	8	13	18	
Visitor movement	28 (8%)	2	3		4	1	5	13	
Distance travelled	28 (8%)	3		4	7	5	5	4	

Table 3
Number of abstracts assessing different recreational activities in the first seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences.

Focus of research	# abstracts	In Protected Area	Social Science	Mixed	Environment	Technology
Recreation & tourism general	486					
Hiking	151	107	96	25	20	10
Biking	69	44	45	12	10	2
Skiing	27	9	12	9	5	1
Camping	24	20	11	4	9	

environmental impacts and 25 involved both social and environmental sciences, with only 10 focusing on technology. For the 69 abstracts presenting research on mountain biking, 64% were from protected areas, and again, social science research was the most common (45 abstracts). For skiing (27 abstracts) only nine abstracts were from protected areas, 12 were in the social sciences, nine were mixed, and five looked at environmental impacts. In contrast, for camping (24 studies, 20 in protected areas), there were nearly equal numbers of abstracts presenting social science (11) as environmental (9) research, with four mixed studies.

3.4. What were the main research themes/approaches?

Most abstracts presented the results of original research (64%), with some presenting case studies/reports (15%), reviews (11%), concept papers (4%) and some abstracts focused predominantly on developments in methodology (6%). Most of the research was in the social sciences (644), some of which also assessed environmental components (159), while 86 abstracts were on the environment alone (Fig. 2, Tables 4 and 5). Some of the presentations were solely focused on technology (28), including those examining new software or equipment that can be used to record and monitor visitors (Fig. 2, Tables 4 and 5).

There were few patterns in the proportion of abstracts from the social sciences, environment and technology among different geographical regions and countries, beyond the dominance of some locations overall. For example, there were the same proportions of abstracts in social versus environmental sciences versus technology for Europe, North America, Asia, for English language countries and for the USA (Chi-squared test for each comparison $p > 0.05$). Therefore, it appears that many regions do not specialize in social, environmental or technological research on visitors. The only exception was Germany, where there were more environmental only abstracts, but slightly fewer mixed and technology abstracts that would be expected based on the overall ratios of abstracts for each of these fields (Chi-squared test, $p = 0.0253$).

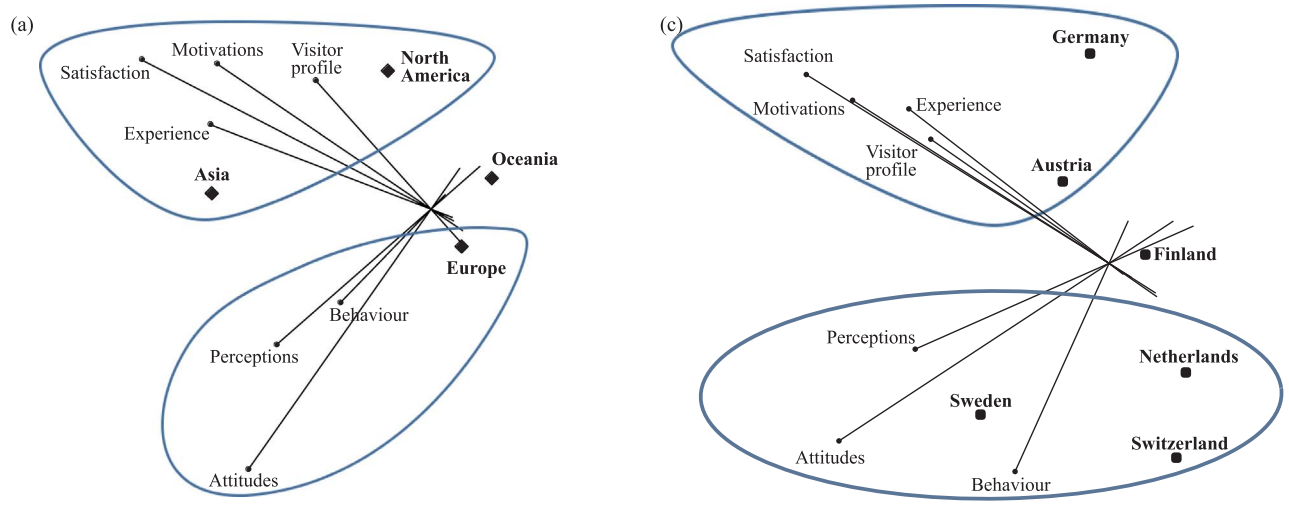
3.5. What approaches, methods and technology were used for social science research?

Social science research (644 abstracts including 159 mixed abstracts) is popular and has been so across all the conferences (Table 4). As expected, research on visitor profile data was popular (24%), including socio-demographic characteristics such as sex, age, and visitor activities in protected areas and other recreation areas. Research on the psychological aspects of visitors was covered at the conferences, with abstracts on visitors' perceptions (32%), attitudes (20%), behavior

Table 4
Main themes/approaches and methods used in social science abstracts in the first seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences. Only those categories with several abstracts in each conference were statistically compared to see if there were differences among years in the popularity of given topics.

	# abstracts[a]	2002	2004	2006	2008	2010	2012	2014	χ^2
Social	644	61	48	106	84	104	138	103	0.959
Topics									
Perceptions	207 (32%)	9	15	32	24	44	40	43	**0.017**
Attitudes	128 (20%)	3	6	13	17	31	27	31	**< 0.001**
Profile	155 (24%)	26	18	28	23	22	24	15	**0.022**
Behavior	100 (16%)	10	5	7	14	9	30	25	**0.002**
Motivations	93 (14%)	4	7	9	16	12	22	23	
Willingness to pay	78 (12%)	8	4	13	16	12	14	11	
Experiences	64 (10%)		1	6	5	20	22	10	
Satisfaction	50 (7.8%)	4		6	9	3	13	15	
Social values	42 (6.5%)	2	4	6	6	7	12	5	
Economic benefits of tourism	23 (3.6%)		1	5	6	7	3	1	
Social carrying capacity	16 (2.5%)		2	7	2	1	3	1	
Expectations	14 (2.2%)	2	1	3	1	5	2		
Methods									
Only quantitative	274 (43%)	27	25	52	28	37	58	47	0.427
Only qualitative	89 (14%)	6	4	46	12	18	23	10	
Mixed qualitative and quantitative	62 (10%)	7	7	6	10	9	12	11	0.702
Questionnaires	286 (44%)	28	26	52	36	43	50	51	0.664
Visitor interviews	147 (23%)	14	8	18	23	32	34	18	**< 0.001**
Document analysis	28 (4.3%)			2	2	1	7	16	
Direct observations	27 (4.2%)	6	1	1	7	4	6	2	
Intervention experiments	9 (1.4%)			4	2	1	1	1	
Participant observations	7 (1.1%)		1	3	1		2		
Technology									
GIS analysis & simulation models	78 (12%)	13	11	16	14	7	8	9	**0.012**
GIS mapping	76 (12%)	28	26	52	36	43	50	51	0.664
Traffic counters	34 (5.1%)	5	6	4	2	2	11	4	
GPS trackers	32 (4.8%)	1	1	2	4	1	12	11	
GPS smartphones	16 (2.4%)		1	1	3	2	3	6	

[a] * Number of abstracts can sum up more than 644 as many of them included more than one topic and methodology.



(b)

	Experience	Motivations	Attitudes	Perceptions	Visitor profile	Satisfaction	Behaviour
Motivations	0.124						
Attitudes	0.055	0.049					
Perceptions	0.122	0.025	0.298				
Visitor profile	-0.023	0.258	0.013	0.024			
Satisfaction	0.130	0.143	0.003	0.129	0.062		
Behaviour	-0.018	0.076	0.177	0.005	0.046	0.021	
Country	0.107	0.076	0.034	0.110	0.081	0.164	-0.018

(d)

	Experience	Motivations	Attitudes	Perceptions	Visitor profile	Satisfaction	Behaviour
Motivations	0.146						
Attitudes	0.029	0.171					
Perceptions	0.029	0.067	0.400				
Visitor profile	0.016	0.197	0.107	0.089			
Satisfaction	0.112	0.178	0.021	0.183	0.045		
Behaviour	-0.036	0.036	0.145	0.015	0.068	0.039	
Country	0.070	0.067	0.066	0.080	0.177	0.016	-0.031

Fig. 2. Results of a Multivariate Categorical Principal Components Analysis of 644 social science abstracts from the first seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences. Data are for global regions (a-b) and countries in Europe (c-d) with more than 30 abstracts. Vector lines indicate the strength and direction of the variable in explaining variation among the abstracts, with lines close together indicating a cluster of abstracts assessing similar combinations of variables.

(16%), motivations (14%), willingness to pay (12%), and experiences (10%) among others. These topics have become increasingly popular with only nine abstracts on visitor perceptions in 2002, but 43 in 2014 (Table 4). Research on people's willingness to pay to visit a protected area (12%) was also a common topic across all the conferences (Table 4). Other research included assessing the economic benefits of tourism (3.6%), social carrying capacity (2.5%) and expectations (2.2%). Although most of the research was on visitors (426, 66%), there were also studies assessing local communities (16%), government organizations (6%), protected areas (4%) and other land managers (3%), including their opinions and attitudes about a range of topics such as social conflict, environmental impacts and management practices in protected areas. Very few studies assessed visitor perceptions and awareness about climate change effects (1%). Those that did, looked at

Table 5
Main topics and methods used for environmental science abstracts in the first seven Managing and Monitoring Visitors in Recreational and Protected Areas conferences. Only those categories with several abstracts in each Conference were statistically compared to see if there were differences among years in the popularity of given topics. veg. = vegetation, exp. = experimental.

	#	2002	2004	2006	2008	2010	2012	2014	χ^2
Environment	245	26	15	51	45	34	40	34	0.095
Topics									
Wildlife	69 (28%)	14	2	14	11	11	7	10	0.052
Vegetation	73 (30%)	9	7	13	13	9	15	7	0.667
Soils	50 (20%)	1	3	9	5	7	17	8	
Landscape features	43 (18%)	11	4	9	6	5	6	2	
Environmental planning	56 (23%)	6	1	12	9	12	8	8	
Park management & biodiversity conservation	48 (20%)	5	3	12	11	11	3	3	
Environmental impacts	111 (45%)	9	6	30	17	15	24	10	**0.041**
Trail degradation	32 (13%)	1	2	6	4	4	11	4	
Tourism threats to the nature	30 (12%)	4	2	4	4	7	7	2	
Disturbance to wildlife	21 (8.6%)	3		7	2	2	4	3	
Trampling impacts on veg. & soils	12 (4.9%)		1	4		1	4	2	
Campsite impacts on veg. & soils	10 (4.1%)			6	1	2	1		
Weeds introduction & dispersal	6 (2.4%)					2	3	1	
Landscape fragmentation from trail networks	5 (2.0%)						4	1	
Noise impacts	4 (1.6%)			1			3		
Methods									
Secondary information	68 (28%)	3	4	12	14	14	15	6	
Field surveys with exp. Design	51 (21%)	6	3	8	4	7	12	11	
Desktop analysis	46 (19%)	10	2	7	15	1	5	6	
Park inventories	38 (16%)	6	4	12	5	5	5	1	
Technology									
GIS analysis & modeling	64 (26%)	6	4	11	12	8	11	12	
GIS mapping	52 (21%)	6	3	8	10	4	11	10	
Video camera monitoring	9 (3.7%)			4	2		2	1	

climate change impacts on recreation activities, natural risks and land cover changes.

The main methods used to collect social science data were questionnaires (43%), and interviews (23%), with few studies using intervention experiments (1.4%) and participant observation (1.1%) (Table 4). More of the social science abstracts used quantitative methods (43%), than qualitative (14%), or a mixture of quantitative and qualitative (10%). Although the popularity of quantitative vs qualitative methods varied among conferences, no consistent trends were found over time other than a slightly greater emphasis on qualitative analysis in the 2006 conference compared to the others (Table 4). Research using a range of technologies (22%) to map and predict visitor patterns and behavior, was popular including using Computer Simulation Models (12%), GIS mapping (12%), traffic counters (5%) and more recently, GPS trackers (4.8%), smartphones (2.4%) or Apps (1%) (Table 4).

When the topics for the social science abstracts globally were assessed together, two main clusters were identified using a CATPCA analysis (Fig. 2a). Many abstracts focused on socio-demographic and psychological variables about visitors including visitor profiles, motivations, satisfaction and experience (top left of Fig. 2a), particularly studies in Asia and North America. Other studies focused on psychological aspects of visitation including attitudes, perceptions and behavior (bottom left of Fig. 2a). Within Europe there were some differences in the social topics assessed. Research in Germany and Austria focused on motivations, satisfaction, experience and visitor profile (top left of Fig. 2c) while research in Sweden, Netherlands and Switzerland was more likely to assess perceptions, attitudes and behavior (bottom left of Fig. 2c).

4. Discussion

The first seven conferences present a wide range of research from a great diversity of authors mostly from non-English speaking countries. The popularity of technology and social media to monitor visitors is increasing, however, there were gaps in the research from certain regions and on certain themes.

4.1. Geographical patterns potentially reflect the effects of supply and demand

Clear patterns in the geography of the research were found. Some of these patterns are similar to those in other reviews of research using similar methodology, including a dominance of research from the USA and some countries in Europe. For example, similar geographical patterns were found for research on different aspects of tourism (Ruhanen et al., 2015), including environmental impacts of tourism globally (Ballantyne & Pickering, 2015; Steven, Morrison, & Castley, 2015; Steven, Pickering, & Castley, 2011), and for specific regions (Barros, Monz, & Pickering, 2014), including within Europe (Ballantyne & Pickering, 2013).

These geographic patterns can be seen in terms of factors that shape the demand for research on visitors, and factors that affect the supply of research. In terms of the demand for research, research gaps are apparent when the amount of research for regions and countries at the conferences is compared to the extent of the protected area systems and levels of visitation in each country/region. For instance, the six countries with the largest extent of terrestrial protected areas globally (Table 6), were not well represented at the conferences, particularly Brazil, China and the Russian Federation. Similarly, research from South and Central America (16 abstracts) and Africa (10 abstracts) was limited. Although some individual countries in Europe were well represented, such as Germany, Austria, Switzerland and the Netherlands, overall the continent was still poorly represented considering its total protected area system.

When visibility at the conferences is compared with levels of park visitation we also find research gaps. For Africa, with 10 abstracts and an estimated 69 million visits per year (Balmford et al., 2015), the research ratio is 0.145 abstracts per million visits per year. This is similar to the value for Europe of 0.143, and slightly above that of Asia/Australia (0.111) and Latin America (0.108). In contrast, for North America the ratio of abstracts to visitors was 0.035 with 115 abstracts at the conferences (Table 1), but an estimated 3303 million visits per year (Balmford et al., 2015).

Table 6
Comparing the total area (km^2) of Protected Areas (PA) with the number of abstracts in the first seven conferences for Europe, and then globally for countries with close to, or over a million km^2 of Protected Area systems. Protected area data are from http://www.protectedplanet.net/ using information from the World Database on Protected Areas. * = Russia – also part of European data.

	Location of research	Total (km^2) of terrestrial PA	% of area of terrestrial PA globally	Abstract per 1000 km^2 PA
Total	758	~20,600,000		0.0368
Europe	551 (72%)	2,915,790	14.15	0.00019
Countries with large PA systems				
Brazil	10 (1.3%)	2,468,479	11.98	0.0041
China	4 (0.5%)	1,598,471	7.76	0.0025
Russian Federation	7* (0.9%)	1,640,125	7.96	0.0043
Australia	38 (5%)	1,311,945	6.37	0.0290
USA	76 (10%)	1,247,228	6.05	0.0609
Canada	34 (4.5%)	926,034	4.50	0.0367

In terms of the supply factors, explanations for geographical biases in research in general include: (1) more researchers and research funding in the USA and wealthy parts of Europe (Pasgaard & Strange, 2013), (2) the dominance of the English language in academic publishing (Hamel, 2007; Muresan & Pérez-Llantada, 2014), (3) often higher rates of citation/impact for American journals (Anderson-Levitt, 2014), but also (4) social biases affecting perceptions regarding the importance of research from different regions/languages (Anderson-Levitt, 2014; Liddicoat, 2016; Muresan & Pérez-Llantada, 2014; Pérez-Llantada, Plo, & Ferguson, 2011). All four of these factors are important and their impacts on academia in general are increasingly recognized.

Whatever the reasons, the implications from this and similar reviews are important. It affects the context and interpretation of research by under representing some countries and regions despite their importance in terms of conservation, extent of protected area and levels of visitation. Addressing these issues involves: (1) recognition that it occurs so any interpretation of the literature is cognizant of the biases, (2) funding and supporting research and researchers in areas currently poorly represented in the literature, as well as (3) supporting the publication and presentation at conferences of work beyond the USA and wealthy parts of Europe. Doing so will foster a more geographical, social and political balance to our understanding, including of the management and monitoring of visitors.

One current benefit of these conferences is the strong representation of research beyond that of English speaking countries. Although the abstracts and conferences were in English, most of the presenting authors and study sites were from/in countries where English is not a dominant language. This includes many countries where academics are encouraged to publish their research in English, even when it is not a dominant local language, to make their work available to a broader audience (Muresan & Pérez-Llantada, 2014; Pérez-Llantada et al., 2011). The conferences provide them with this opportunity. Also, by often holding the conference in countries that have not always been very visible in the international academic literature, the conferences provide a platform for researchers from these sometimes less academically visible places to showcase their work to a broader audience on their 'home ground'.

The Monitoring and Management of Visitors conferences, do not

occur in isolation, but are one of several conferences where researchers can present this type of research. Other related conferences include the International Symposium on Society and Resource Management (ISSRM) with strong representation from the USA, the George Wright Society Conference on Parks, Protected Areas and the Cultural Sites and the Northeastern Recreation Research Conference, both held in the United States. The conference itself has changed its title slightly from Monitoring and Management of Visitor Flows in Recreational and Protected Areas in 2012 by removing the term flow to reflect the increasingly broader emphasis of research (Peter Fredman, pers. com., 2017).

Although the conference focus is not limited to terrestrial protected areas, nearly no research was presented from marine protected areas. This is despite the increasing size of marine protected areas globally (Boonzaier & Pauly, 2016; Butchart et al., 2015), and the very high levels of visitation to some of these parks such as the Great Barrier Reef Marine Park with 42.8 million visits annually (Deloitte Access Economics, 2013). Addressing this gap by targeting presentations on marine visitation is one solution, although it may be that much of research on this topic is already well represented at more marine-specific conferences such as the International Congress on Coastal and Marine Tourism.

4.2. Social science versus environmental science research

Research in social science was very popular in all the conferences, but the types of information collected have changed through time. The earlier conferences were more focused on collecting data on visitor numbers and locations while more recent conferences have shifted to assessing psychological aspects of visitation, such as visitor perceptions, attitudes, motivations, experiences and social values. This pattern is observed in the leisure science in general, where there is an increasing emphasis on research assessing values and attitudes (Byrne & Wolch, 2009; Dorwart, Moore, & Leung, 2009; Larson, De Freitas, & Hicks, 2013; Rossi, Byrne, Pickering, & Reser, 2015).

Although monitoring is critical for the management of visitor impacts on the environment (Hadwen, Hill, & Pickering, 2008; Pickering, 2010), research directly focused on recreation ecology assessing the impacts of tourism activities on the environment was not always a strong focus at the conferences. Recreation ecology has waxed and waned in the abstracts depending on factors such as the attendance of key researchers in the field, and session themes. Much of the research focused on wildlife, vegetation and soils, which is similar to the more general recreation ecology literature where these have been the major research focus for decades (Liddle, 1997; Newsome et al., 2012). What has changed in the recreation ecology literature at the conferences, and more generally, is the increasing interest in landscape level impacts, and the use of GIS methodology to undertake such studies (Ballantyne & Pickering, 2015; Barros et al., 2014; Leung, 2012; Newsome et al., 2012; Pickering & Hill, 2007).

4.3. Big data, social media and the impact of technology

Technology, including smartphones and other units with photography and GIS capacity, combined with social media, is revolutionizing how data about people in protected areas are collected (Levin, Kark, & Crandall, 2015; Wood, Guerry, Silver, & Lacayo, 2013). This is reflected in the conference abstracts with increasing numbers of presentations utilizing volunteer GPS data, images from online share sources and other types of social media to monitor visitation.

A step change in visitor monitoring is occurring as big data methodology is combined with publicly available data that are geographically and temporally tagged including images (Levin et al., 2015; Wood et al., 2013), along with volunteer GIS (Goodchild, 2013) and public participatory GIS data (Brown & Weber, 2011; Wolf, Wohlfart, Brown, & Lasa, 2015). The issue then becomes how to deal with the amount of data that is now available including how to process it effectively, how to display data and how to deal with the inherent biases of such datasets (Elwood, Goodchild, & Sui, 2012; Goodchild, 2013; Levin et al., 2015; Wood et al., 2013). A major source of bias remains because access to technology affects who posts what. Although access to smart phones and the internet and the use of social media is increasing in developing countries, it still lags behind that of developed countries (Poushter, 2016). Even within countries, factors such as gender, age, education and wealth affect rates of internet usage and smartphone ownership (Poushter, 2016).

When assessing specific types of social media data to assess visitation, additional issues arise. For example, geo and temporally tagged images on websites such as Flickr reflect numbers of visitors to a protected area, but also how far visitors travelled and their wealth (Levin et al., 2015; Wood et al., 2013). It also reflects the desirability of certain images including the attractiveness, iconic nature and/or rarity of specific topographical features (Levin et al., 2015). Certain animals are also far more likely to appear in images reflecting factors such as how easy they are to see, their rarity, charismatic status and if it is the visitors first time in the region (Willemen, Cottam, Drakou, & Burgess, 2015). As a result, image hotspots within protected areas are influenced by a range of factors, only one of which is the number of visits (Willemen et al., 2015). Similar types of issues are found regarding the extent to which other types of social data are representative of actual visitation on ground including using volunteer GPS data from tracking apps uploaded onto the web (Campelo & Mendes, 2016).

5. Conclusions

The conferences have presented a diversity of research, particularly in the social sciences, addressing a range of important themes and trends, including the effects of technology, social data and big data on visitation. They have provided the opportunity for researchers from non-English speaking countries, often in Europe, to present their research to a broad audience of academics and practitioners. Future conferences, and the broader academic literature on this topic, need to start considering research gaps, including the under representation of research from some countries in Europe including France, and more broadly from regions such as Asia, South America and Africa, and to potentially include more research on environmental impacts of visitation and the use of big data and social media.

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