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# Trails for tourism and outdoor recreation: A systematic literature review

## Abstract

Trails are important elements in the natural and cultural landscape, and many ancient pathways have developed into routes of great significance for recreation and tourism in contemporary societies. By conducting a systematic quantitative literature review, this paper reports on the status of international trail research and analyzes some of the key content with focus on trails for tourism and outdoor recreation in non-urban settings. For this purpose, we reviewed 195 research papers published in peer-reviewed academic journals. Results show that research on trails for tourism and outdoor recreation is primarily from English-speaking Western countries. The most studied trail-based activity is hiking, but there has been an increase in the number of studies researching multiple activities. Results also show that international trail research to a large extent is based on the natural sciences, and focus on environmental and managerial aspects of trail use. This review identifies gaps in trail research, especially in a socio-cultural context on topics such as heritage and public health. Research on conflicts between different recreational trail-based activities is also relatively scarce, as well as studies concerning conflicts between trail-based recreation interests and other land-use interests. We also identify a need for an exploration of the trail concept, as research has not yet articulated a clear definition of what a trail is. The paper also includes analyses of changes in trail-related research over time.

**Key words:** recreational trails; tourism; outdoor recreation; literature review; trail research over time

## Introduction

Over the centuries, trails have helped form the basis of human mobility patterns and have been essential to travel and tourism. Many ancient pathways have developed into routes still used today, serving as important passageways for recreationists and tourists. Such paths, trails, scenic routes etc. can also function as tourist attractions in themselves (Moore & Shafer, 2001). Thus, trails do play a significant role for tourism and the tourism attraction system (Leiper, 1990; Travis, 2011). Despite this relatively little attention has been given to their role in the context of tourism and recreation research and there is a lack of comprehensive studies synthesizing knowledge on this matter (Timothy & Boyd, 2015). Moore and Shafer (2001) recognize that even though trails and trail-related topics have been studied within different fields of research, there are still important gaps in the literature that need to be addressed in order for this area of research to better meet its potential. More recently, Timothy and Boyd (2015) provided an extensive examination of various aspects of trails in tourism including different types of trails, demand for trails, impacts on trails, as well as planning, development and management of trails. Their inquiry focused on "*natural and or human-made linear corridors in rural or urban areas*

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*designated as trails, paths or routes for the use of recreationists, tourists or travelers regardless of their mode of transportation"* (ibid, p. 4).

In the current study, we take Timothy and Boyd (2015) as a point of departure for our inquiry, but limit the study to trails in natural settings beyond the urban context. The number of recreational trails are increasing on a global scale. In outdoor recreation and nature based tourism, trails can be seen both as resources that add value to the tourism experience and a tool to manage people (Ballantyne & Pickering, 2015; Timothy & Boyd, 2015). For example, Moore and Shafer (2001, p. 2) state that *"to users, trails are travel routes and settings for activities and experience. Many users visit trails purely for recreation. Others use them more as a means to get from one place to another, perhaps trailhead to alpine lake or home to subway station. Either way, there is no doubt that trails are extremely popular settings for recreation and valuable for transportation"*. Hence, trails are used by people for a number of purposes, such as exercise, self-renewal, relaxation, wildlife viewing, visiting cultural features, travel to a scenic viewpoint and inspiration. Trails also function as guides through the landscape. They provide access into nature areas, a route visitors can follow to reduce risks of becoming lost, confronting physical dangers or damaging sensitive places (Lekies & Whitworth, 2011). Trails are also excellent tools for nature interpretation and other educational purposes.

Recreational trails are often classified and managed based upon the type of activity they are used for – such as hiking, backpacking, horseback riding, mountain biking or the use of off-road vehicles – or by their geographical location or type of environment they are located in. For example, Timothy and Boyd (2015) identified trails in national parks, rainforest walks, wilderness tracks and desert trails. Moore and Ross (1998) identify five trail types: traditional backcountry trails, recreational greenways (mainly found in urban areas), multiple-use recreation trails, rail-trails and water trails. The multiple-use trail is designed to facilitate many different activities, such as bicycling, walking, running and other non-motorized uses. Rail-trails are constructed on abandoned railroad corridors that have been converted to recreational use. The traditional backcountry trail is generally an unsurfaced natural route that can range from narrow pathways to carefully planned, natural-looking passages (Moore & Driver, 2005). Such trails are often found deep inside recreation areas and the outer perimeters. Timothy and Boyd (2015) extends the concept of natural trails to also include wilderness tracks, ski and snowmobile trails, forest canopy walks, geology trails and long distance, multi-day trails. Wilderness tracks are different from the traditional backcountry trail in the sense that they are the most natural and the most remote type of trails. They are primarily used by hikers and horseback riders, and feature isolation from human-modified landscapes. However, even though many recreational trails are located in exceptional nature areas they are also closely linked with cultural traditions or features. All trails reflects a cultural expression of some sort, even those created in the post-modernistic era (Figure 1). Trodden tracks in natural environments are signs of human influences and cultural values are placed in the landscape. In a trail context the nature-culture dichotomy is inseparable (Timothy & Boyd, 2015).

The aim of this study is to provide an overview of the scientific (peer reviewed) literature on trails used for outdoor recreation and tourism in non-urban settings. The purpose is to report on the status of international trail research and to analyze some of the key content. To do this, a systematic quantitative literature study was undertaken to review scientific publications on trails for tourism and outdoor recreation. More specifically, this review provides insights on (i) geographical location of trail research, (ii) methods and type of data used in trail research, (iii) trail activities and (iv) study topics. Publications reviewed cover the timeframe from 1970 to 2016, allowing us to also study how trail research has changed over time.

Figure 1  
Hiker on trail in the Swedish mountains



In the following sections, we provide a detailed description of the approach used for the systematic literature review as well as the methods used for data collection. This is then followed by a presentation of the results and the paper ends with a discussion of the most important findings.

## Systematic literature review

The literature review holds a special role within research as it provides researchers with the insights necessary to better structure and understand their topic of inquiry (Booth, Papaioannou & Sutton, 2016; Jesson, Matheson & Lacey, 2011). In the literature review, extensive reference to related research and theory in the field of interest is presented, and connections are made between the source texts and the positioning of the researcher. Hence, the literature review can therefore serve as a driving force and the jumping-off point for scientific inquiry. Without the literature review, it will not be possible to identify what has already been researched, and what knowledge gaps to be filled (Booth et al., 2016; Ridley, 2008). Machi and McEvoy (2016) suggest that the literature review provides the context and the background about the current knowledge of a topic, which then makes a logical case to answer the questions of the study.

Jesson et al. (2011) identify two broad categories of literature reviews: the traditional review and the systematic review. The major difference of these types is that the traditional review has a narrative

approach conducted without a prescribed methodology. Gough, Oliver and Thomas (2012) argue that the traditional literature review does not explain the criteria of identifying and including certain studies, and why other studies are excluded. It is thus not possible to assess the relevance of such a review or if the decisions regarding which studies to include or exclude were made following an accountable and explicit method. Hence, it is difficult to interpret the meaning of the results from the review (Gough et al., 2012). A systematic literature review, on the other hand, is a review "with a clear stated purpose, a question, a defined search approach, stating inclusion and exclusion criteria, producing a qualitative appraisal of articles" (Jesson et al., 2011, p. 12). Booth et al. (2016) argue that there is increasing recognition for all reviews to be systematic, as all research requires some sort of 'system'. Gough et al. (2012) suggest that a systematic literature review involves three key activities: identifying and mapping the research that is relevant for the study, evaluating the research in a critical and systematic manner, and bringing the results together in a coherent synthesis. Booth et al. (2016) identify three principal advantages in the systematic approach to reviewing the literature compared to the traditional, narrative literature review: clarity, validity and auditability.

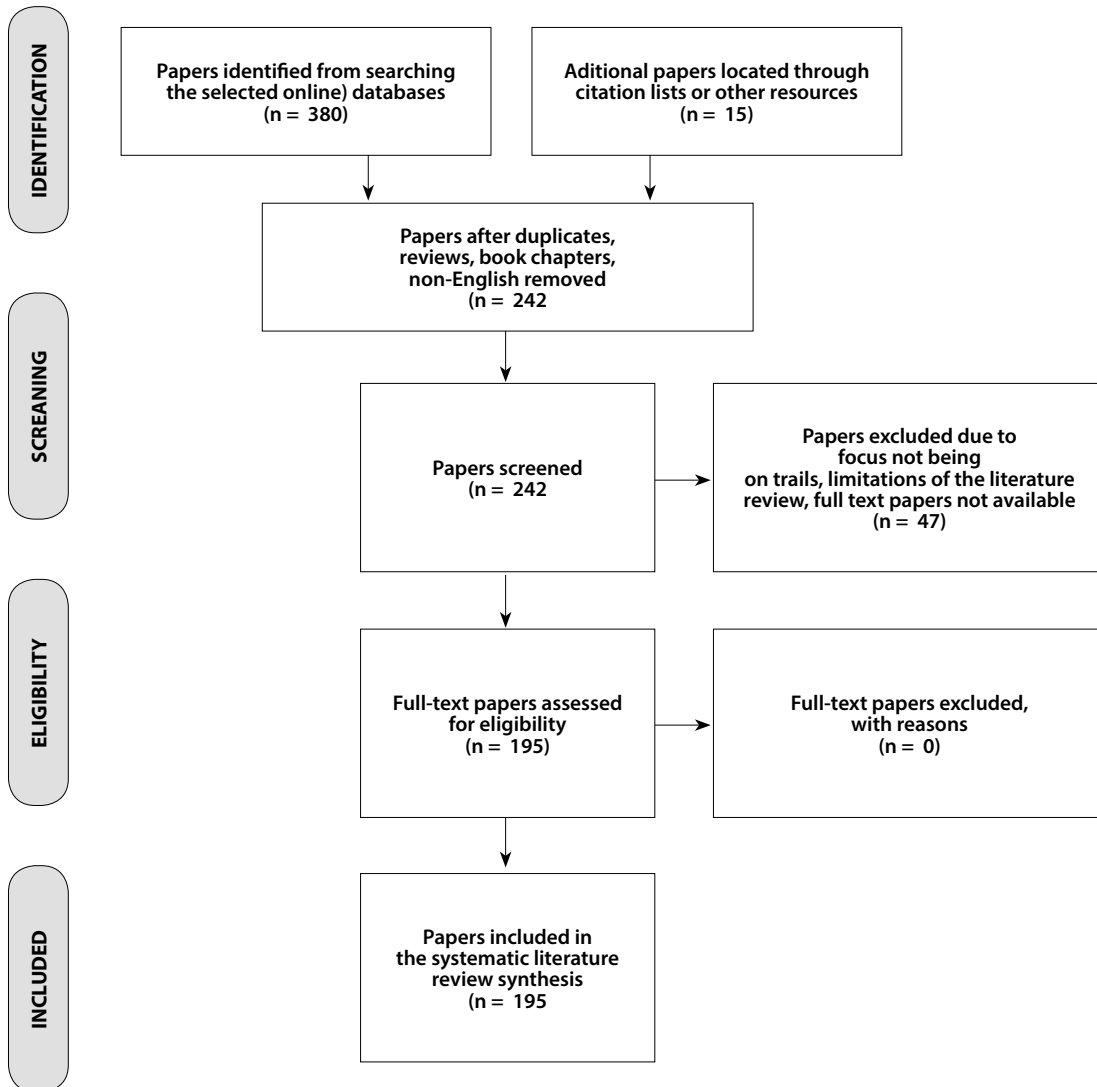
*Clarity* of scientific communication is the target for most systematic reviews (Booth et al., 2016). As the structure of a systematic review includes a clear methodology, navigation and interpretation is facilitated and it is easier to assess the work of the reviewers. The second advantage of the systematic literature review concerns internal *validity*. It is crucial that the outcome of the review is defensible against potential bias, such as selection bias where the reviewer selects research studies that support the beliefs she or he already has (Booth et al., 2016). In a systematic approach, the process of selecting which items to include in the review is based on the relevance of those items, not because the research results favor certain perceptions and beliefs Booth et al., 2016. The final advantage addresses issues of transparency and *auditability*. According to Booth et al. (2016), it is necessary that the reviewer is transparent when presenting conclusions from the review, so that it is obvious to the reader that the results are based on the data from the review process. By using flowcharts and graphical, textual and tabular features, the results can be revealed in a comprehensible manner.

For the purpose of the current study, a systematic review was judged as the most appropriate method given the aim to provide an overview of the scientific literature on trails used for outdoor recreation and tourism. The review was undertaken following the approaches suggested by Pickering, Grignon, Steven, Guitart and Byrne (2015) and Petticrew (2001).

## Data collection

The selection of academic publications followed the PRISMA protocol (Preferred Reporting Items for Systematic Review Recommendations) as described in Figure 2 (Moher, Liberati, Tetzlaff & Altman, 2009). To start with, 380 publications were identified based on the on-line database searches and an additional 15 publications were identified through an analysis of the reference lists of these publications. After removal of duplicates and literature beyond the scope of this study, 242 publications were screened. This screening resulted in the removal of another 40 publications due to lack of focus on trails. Seven articles were excluded because full-text version of these were not available, even though efforts to obtain them through alternative channels such as "Research Gate" and e-mailing the authors were made.

Figure 2  
Flow chart of the systematic quantitative literature review



Source: Adapted from PRISMA (2015).  
Note: "n" denotes the number of original papers.

Original research papers published in English language journals were obtained by searching the following electronic databases: Academic Search Elite, Scopus and Leisure Tourism. The search was done without any time limitation, and therefore all identified articles since the 1970s were reviewed. The literature search was undertaken from March to May 2016.

## Key words

Main keywords for the literature search were 'trail and recreation' and 'trail and tourism'. We also used a combination of the following terms: 'walk\*' 'hik\*', 'bik\*', 'ski\*', 'snowmobil\*', 'horse rid\*', 'informal', 'rail-trail', 'heritage', 'multi-use', 'public health', 'management', 'conflict', 'econom\* and impact', 'tourist attraction', 'sustainab\*', 'design and plan\*', 'interpret\*' and 'environment\* and protection'.

These keywords were chosen because they cover the human recreation activities that are typically trail-based in the context of outdoor recreation and tourism. Studies of trails used for industrial purpose, wildlife trails, urban trails and aquatic (water based) trails were not included. We also considered only original research publications for this study. This ensures that the results reported have been peer-reviewed and that the publication is a primary source (Pickering & Byrne, 2014). Book chapters, literature reviews, conference papers and reports were accordingly excluded, but reference lists of such publications were reviewed to search for additional publications to include.

## Processing and categorization

For each publication, information on the following items were recorded in a database: Title, author, journal, year, location, protected area, research design, type of data collected, main recreational activity, study topic and purpose of the study. Table 1 provides an overview of the categories used for each recorded item. In many cases, more than one category was applicable for a single publication, in which case the "main" or "most significant" category was recorded. Hence, the systematization of this study is made with exclusive categories, which should be kept in mind when reading the results.

Table 1  
Categorization of the reviewed publications

Item	Categories
Title of the publication	
Author(s) of the publication	
Name of journal	
Year of publication	
Geographic location of the study	North America; Europe; Oceania; Asia; South- and Central America; Africa
If the study was conducted in a protected area	Yes, No
Type of data	Quantitative; Qualitative; Mixed; GIS; Photographic
Main recreational activity	Hiking; Biking; Horseback riding; Skiing; Motorized use; Multiple use
Study topic	Environmental protection; Trail management; Trail planning and design; Economic impact; Conflict management; Heritage; Public health; Interpretation and education; Tourist attraction
Purpose of the study	

The *type of data* collected was recorded as quantitative, qualitative or mixed, as well if it was spatial (GIS) and/or photographic. The recreational activities of trail users were categorized as hiking (both long-distance hiking and shorter walks), biking (including mountain biking), horse riding, skiing and the use of motorized vehicles, such as ORV:s, ATV:s and snowmobiles, or a combination of multiple activities, categorized as multiple-use. *Study topic* refers to the purpose of the trail-study, i.e. what topic regarding trails for tourism and outdoor recreation the study aims to research. These categories emerged during the analysis of the selected academic articles and were then developed by the authors. As such, the categories were assessed to cover the study topics researched in the literature and provide a comprehensive basis for the analysis of trail research.

## Changes in trail research over time

In order to monitor how research on trails for tourism and outdoor recreation has changed over time we also divided the selected publications into three groups based on publication year: 1970-1999, 2000-2009 and 2010-2016. There were 29, 72 and 94 observations recorded in each period<sup>1</sup>. This is equivalent to 0.97, 7.2 and 13.4 publications per year on average in each period respectively, indicating an increasing interest for research on recreational trails among the scientific community over time.

## Results

Altogether there were 195 academic publications identified which examined trails in the context of outdoor recreation and tourism since year 1970. About half of all publications reviewed focused on various forms of backcountry trails. This type of trail is typically found in many different settings, for example the rural countryside (e.g. Buckley, van Rensburg & Hynes 2009; Clark, 1997), tropical rainforests (e.g. Aguirre, 2009; Farrell & Marion, 2001), deserts and shrub lands (e.g. Webb, Ragland, Godwin & Jenkins, 1978; White, Waskey, Brodehl & Foti, 2006), alpine areas (Ballantyne, Pickering, McDougall & Wright, 2014; Hill & Pickering, 2006) and temperate forests (e.g. Lynn & Brown, 2003; Siderelis, Naber & Leung, 2010; Wood, Lawson & Marion, 2006). It is difficult to distinguish specific features that characterizes a typical backcountry trail, other than the classification suggested by Moore and Driver (2005) that this type of trail is generally an unsurfaced natural route often found inside recreation areas and the outer perimeters (Timothy & Boyd, 2015). More remote trail types, such as wilderness tracks, were less common in the literature (13 % of the publications). Rail-trails and multiple-use trails, both used for a number of different activities with a paved or asphalted surface, were studied in 11 % of all publications. Only a few publications studied long-distance trails (e.g. (Zarnoch, Bowker & Cordell, 2011; Potter III & Manning, 1984) or cultural trails (e.g. Božić & Tomić, 2016; Horodnikova & Derco, 2015). Protected areas is, however, a common context for trail related research as we find that almost two thirds of the studies (62%) were conducted in national parks, national forests, UNESCO World Heritage Sites, nature reserves, national grasslands or Natura 2000-areas.

### Geographic location

Although trail related research was conducted in 36 countries, a majority of the studies were concentrated to a few countries and regions (Table 2). Just over 40 % of the studies were conducted in North America (73 papers in the USA, 8 papers in Canada), and 28 % of the studies were from Europe (57 papers). The Oceanian region accounted for 18 % of the studies (Australia 32 and New Zealand 5 papers respectively), while research in Asia only constituted 7 % of the studies and South- and Central America 5 %. The two papers from Africa represents 0.9 % of the studies reviewed. Hence, these results clearly show there is a geographical skewness in research on trails for tourism and outdoor recreation, with a predominant focus on English-speaking Western countries. This could reflect that trail systems are more developed in Western countries and that the tradition of outdoor recreation has a more prominent role in these societies.

Looking at the geographical distribution of publications over time, we find that trail related research has a wider distribution during the period 2010-2016 than during 1970-1999. Between 1970 and 1999, 50 % of the studies were conducted in North America – a number that decreased to 35 % for the 2010-2016 period. This could point at a stagnation in North American trail research, while for Europe and the Oceanian region the trend is the opposite. Between 1970 and 1999, Australia and New Zealand constituted 13 % of the studies, a number that increased to approximately 19 % in the two following time-periods. For Europe, the proportion increased from 20 % during 1970-1999 to 36 % during 2010-2016, which is more than for North America. It is interesting to note that between 1970 and 1999, trail research was reported from only three European countries, while in the time-period 2000-2009 there were studies from nine European countries, and for 2010-2016 this number increased to include studies from 15 European countries. The first study recorded from an Asian country is from 2003 and dealt with trampling impacts on vegetation and soils, and how visitors perceive these impacts in a National Forest Park in China (Deng, Qiang, Walker & Zhang, 2003).

Table 2

**Geographic location of reviewed publications**

Region	Total		Time-period (%)		
	Publications	%	1970-1999	2000-2009	2010-2016
North America	81	40.3	50.0	42.8	35.1
Europe	57	28.4	19.9	22.1	36.2
Oceanian countries	37	18.4	13.3	19.3	19.1
Asia	14	7.0	0.0	9.9	6.4
South- and Central America	10	5.0	9.9	5.2	3.2
Africa	2	0.9	6.6	0.0	0.0
TOTAL	201	100.0	100.0	100.0	100.0

Note: Four studies examined trails in more than one country (Farrell & Marion (2001) studied trails in Costa Rica and Belize; Leung & Marion (1999) studied trails in Costa Rica and Ecuador; Symmonds et al., (2000) studied trails in the United Kingdom, USA, Australia and New Zealand; Vail & Heldt (2004) did studies in USA and Sweden).

## Type of data used

Methods used in the literature on trails for tourism and outdoor recreation originates from both the social sciences (e.g. interviews, surveys and focus groups) and natural sciences (e.g. point sampling and experimental simulators). Most studies (55.4%) used quantitative data, 21 % had a combination of quantitative and qualitative data and only 11 % used qualitative data. GIS (geographic information system) was used in about 9 % of the studies and 4 % of the studies reviewed applied a method that involved photographs.

Studies using *quantitative data* typically had an environmental focus and the data was often used to measure impacts on the environment surrounding the trails. For example, Wallin and Harden (1996) measured trail-related soil erosion in the humid tropics while Barros, Gonnet and Pickering (2014) studied the impacts of informal trails on vegetation and soils in protected area in the Southern hemisphere. Most studies concerning environmental aspects of trails for tourism and outdoor recreation also used quantitative data (62 studies, including three studies using GIS and two using photography) while only eight studies used mixed data. One example of a study using a mixed method approach is Goeft and Alder (2001) who measured environmental impacts (soil erosion, compaction and trail widening) in combination with a survey measuring preferences among mountain bikers. Trail management and economic impact are other topics primarily researched through quantitative data (29 and 11 studies respectively). Quantitative data was also mainly used in the studies with an experimental research design (22 of 29 studies) and in the comparative studies (8 of 11 studies). The remaining studies in these three categories all used mixed data.

Studies using *qualitative data* mainly researched social science oriented topics, such as heritage (e.g. Wrede & Mügge-Bartolovic', 2012), interpretation and education (e.g. Lekies & Whitworth, 2011). Most qualitative studies were cross-sectional and used interviews (12 studies) as the primary source of data (e.g. Deyo et al., 2014; Hayes & MacLeod, 2008). We also found several studies with qualitative data that had an exploratory approach (6 studies) and in the form of case studies (5 studies).

Studies using *mixed methods* were mainly cross-sectional, but both case studies and experimental studies were present in this category. One example being Beeton (1999) who used self-completion questionnaires in combination with secondary and tertiary information on management practices and regulations of national parks in Australia. Reis, Lovelock, and Jellum (2014) conducted a survey of rail-trail visitors combined with interviews with key tourism and community stakeholders. Mixed method data was used to study several different topics, such as "trail management" (14 studies), "public health" (6 studies) and "conflict management" (5 studies).



We were also able to observe some trends over time in the use of different data types in trail research. Table 3 shows that the most obvious trend is a decrease in use of qualitative methods. While 21 % of the studies used this type of data in 1970-1999, this proportion decreased to 11 % in 2000-2009 and less than 9 % in the 2010-2016 period. We observed the opposite trend for studies using GIS data. In this case, the first study was from 2002 and studied the susceptibility to environmental damage in relation to elevation (Arrowsmith & Inbakaran, 2002). Between 2010 and 2016 there were 12 % of the studies that used GIS data. The use of photography-based data is also a more recent phenomenon in this context. One should observe, however, that a majority of the studies using GIS and photography-based data often did so in combination with quantitative data. Hence, if all these studies would have been classified as quantitative data, this category would also have increased over time.

Table 3  
Data type in reviewed publications

Data type	Total		Time-period (%)		
	Publications	%	1970-1999	2000-2009	2010-2016
Quantitative	108	55.4	58.6	52.7	56.4
Mixed	41	21	20.7	22.2	20.2
Qualitative	22	11.3	20.7	11.1	8.5
GIS	17	8.7	0	8.3	11.7
Photography	7	3.6	0	5.5	3.2

GIS data was mainly used to study means to reduce negative impacts and providing information about trail conditions (Beeco, Hallo, English & Giumetti, 2013; Hawes, Dixon & Ling, 2013; Newsome & Davies, 2009), but also for assessing suitability of trail locations (e.g. Martínez & Ocana, 2014; Snyder, Whitmore, Schneider & Becker, 2008; Yang, Coillie, Hens, Wulf, Ou & Zhang, 2014). Trail planning and design is a topic where GIS data is often used, one example being how GIS can be used to plan for reduced conflicts between recreation groups (Shilling, Boggs & Reed, 2012). Photographs were used to visualize when interviewing visitors and managers about recreation impacts on the ground (Vistad, 2003), and for measuring erosion from rainfalls (Tarolli, Calligaro, Cazorzi & Dalla Fontana, 2013). One study used qualitative data in combination with photographs. In this case participants were given a camera and instructed to take pictures of the surroundings at given times in order to study hikers' and mountain bikers' modes of experience (Walker & Shafer, 2011). All but two of the studies using photography did so in combination with quantitative data.

## Recreational activities

Hiking is the most studied trail related recreation activity with 51 % of the publications examined (Table 4). The concept "hiking" is broad and includes both shorter walks and long-distance hikes. It also concerns several different social science topics, such as nature interpretation and visitor behavior (e.g. Bradford & McIntyre, 2007; Hughes & Morrison-Saunders, 2002; Littlefair & Buckley, 2008), trail planning and design (Hugo, 1999), economic values (Cook, 2008) and methods for assessment of services provided (Chen & Liaw, 2012). Hiking was also studied in the context of impacts on vegetation and soil (e.g. Ballantyne et al., 2014; Bright, 1986; Nepal & Way, 2007), and how hiking on trails for tourism and outdoor recreation affect wildlife (e.g. Longshore & Thompson, 2013; Rodríguez-Prieto, Bennett, Zollner, Mycroft, List & Fernández-Juricic, 2014; Wiedmann & Bleich, 2014).

Table 4

**Recreational activities in reviewed publications**

Recreational activity	Total		Time-period (%)		
	Publications	%	1970-1999	2000-2009	2010-2016
Hiking	100	51.3	51.7	47.2	55.3
Multiple-use	47	24.1	24.1	25	23.4
Biking	18	9.2	10.3	11.1	7.4
Motorized vs. non-motorized	14	7.2	6.9	6.9	7.4
Motorized	8	4.1	6.9	8.3	0.0
Horseback riding	7	3.6	0.0	1.4	5.3
Skiing	1	0.5	0.0	0	1.1

Multiple-use is the second most common "activity" being observed. This includes combinations of activities such as walking, biking, jogging and horseback riding. This category also include studies where interactions between two specific activities are studied, namely hiking vs. biking, hiking vs. horseback riding and biking vs. horseback riding.

Of the 18 studies researching the activity biking, seven studies focused on trail management and four studies focused on trail planning and design. These studies mainly concerned how biking trails can be planned and managed to avoid ecological and environmental problems (e.g. Figueras, Farrés & Pérez, 2011; Newsome & Davies, 2009; Symmonds, Hammitt & Quisenberry, 2000). Even though we did not record any studies with a primary focus on conflicts between recreational interests in the biking category, studies concerning management of biking on trails also included this topic (e.g. Chiu & Kriwoken, 2003; Morey, Buchanan & Waldman, 2002; Schuett, 1997; Hendricks, Ramthun & Chavez, 2001). Hence, considering recreational conflicts is an important topic when managing trails for biking. Of the eight studies concerning motorized activities, three focused on snowmobiles, and five examined off-road vehicles or all-terrain vehicles. All five studies on off-road vehicles were from the USA, while studies on snowmobiling came from the USA and Sweden.

Looking at changes in activities over time, there seems to be an increased interest in horseback riding more recently, while motorized activities has become less common to study. We also observe an increase in the number of publications studying three or more activities simultaneously. When separating out these studies from those studying only two activities (e.g. hiking vs. biking, hiking vs. horseback riding and biking vs. horseback riding), it becomes clear that "multiple-use" (where more than two activities are researched in the same study) has increased over time: from 7% in the time period 1970-1999 to 17% in the time period 2010-2016. This could point to an increase in the number of trail-based activities, and a diversification of trail activities.

### Study topic

Nine different topics were identified from studies in the publications reviewed (Table 5). The most studied topic is environmental protection, with 36 % of the publications reviewed. This topic covers broad environmental and ecological issues such as impacts from trampling (Deluca, Patterson, Freimund & Cole, 1998; Kellomaki, 1977; Mason, Newsome, Moore & Admiraal, 2015) and erosion (Eagleston & Rubin, 2013; Gager & Conacher, 2001), but also more specific topics such as how visitors and host communities can prevent waste being left on trails (Kuniyal, 2005) and impacts of snowmobiles on air quality (Musselman & Korfmacher, 2007).

Table 5  
Study topics of the reviewed publications

Study topic	Total		Time-period (%)		
	Publications	%	1970-1999	2000-2009	2010-2016
Environmental protection	70	35.9	41.4	29.2	39.4
Trail management	47	24.1	13.8	34.7	19.1
Planning and design	22	11.3	10.3	4.2	17.0
Economic impact	17	8.7	6.9	11.1	7.4
Conflict management	11	5.6	10.3	5.5	4.3
Heritage	10	5.1	6.9	2.8	6.4
Public health	10	5.1	6.9	5.5	4.3
Interpretation, education	7	3.6	3.4	5.5	2.1
Tourist attraction	1	0.5	0.0	1.4	0.0

The second most researched topic is trail management, examined in 24 % of all publications (47 studies). This topic concerned topics such as how management of recreation use can control environmental impacts (Park, Manning, Marion, Lawson & Jacobi, 2008) and the evaluation of management actions to reduce environmental impacts (Vistad, 2003). Research also include socially oriented studies, for example how trails can be organized and managed to benefit the local community (Voda, Moldovan, Torpan & Henning, 2014) and if different managerial factors can determine responsible hiking behavior (Guo, Smith, Leung, Seekamp & Moore, 2015).

The third most researched topic is trail planning and design, identified in 22 papers. The academic articles in this category mostly concerned how trails for tourism and outdoor recreation can be developed in a sustainable manner to reduce negative environmental impacts from trail-users and how negative impacts caused by seasonality can be alleviated (e.g. Boers & Cottrell, 2007; Courtenay & Lookingbill, 2014; McNamara & Prideaux, 2011; Santarém, Silva & Santos, 2015).

It is difficult to identify any clear trends in the topics being studied since the 1970s. While studies focusing on environmental protection seem to be more common in the early period as well as more recently, studies on trail management are more common during the 2000-2009 period. Studies on conflict management do however show a decrease from 10 % in the time period 1970-1999 to 4 % in the period 2010-2016. With an increased diversity in trail use by different groups (e.g. hikers, bikers, runners, skiers, snowmobilers) one could expect an increase in studies researching conflict management, but this does not seem to be the case.

Several of the publications reviewed focused on more than one topic. Table 6 shows the major combinations of study topics identified in this study (combinations with at least three recordings) as well as the number of studies that exclusively focused on the topic in question. From this presentation, we can conclude that some topics are more common to research together than other topics. More than one quarter of the studies that had environmental protection as primary focus (18 of 70 studies) researched this topic in combination with trail management. In a similar manner, almost 13 % of the studies primarily researching trail management also studied environmental protection. This could indicate a need for a proper trail management to handle environmental impacts caused by trail-users in order to protect the environment surrounding trails for tourism and outdoor recreation.

Table 6

**Major combinations of study topics**

	Primary and secondary focus	Number of publications
Environmental protection	Exclusively environmental protection	49
	Environmental protection + Trail management	18
Trail management	Exclusively trail management	28
	Trail management + Trail planning and design	7
	Trail management + Conflict management	3
	Trail management + Environmental protection	6
Trail planning and design	Exclusively trail planning and design	12
	Trail planning and design; Trail management	4
Economic impact	Exclusively economic impact	14
Conflict management	Exclusively conflict management	8
Heritage	Exclusively heritage	3
Public health	Exclusively public health	10
Interpretation and education	Exclusively interpretation and education	4
Tourist attraction	Exclusively tourist attraction	1

Trail management is also a topic often studied in combination with trail planning and design (15 % of the trail management publications had this combination). Four studies with trail planning and design as primary focus also researched trail management, and another three studies researched trail management as a secondary focus in combination with a third topic. Hence, trail planning and design is studied together with trail management in 32 % of the papers reviewed on this topic. This could point to an awareness of careful planning and management of trails for tourism and outdoor recreation in order to minimize unwanted or unexpected effects of trail use. Of the ten studies primarily focusing on heritage, only three did so exclusively, while the other seven articles examined this topic in combination with e.g. environmental protection, trail planning and design, interpretation and education.

## Discussion

The aim of this paper is to provide an overview of international research on trails for tourism and outdoor recreation. The systematic literature review approach has provided valuable insights to the academic literature on this topic and highlighted what appears to be gaps in knowledge, thus setting an agenda for future research directions. Before discussing some of the main results, we would like to address the issue of defining the trail. Somewhat surprisingly, none of the 195 academic articles reviewed had a clear definition of what a trail actually is. Clark (1997) discussed trails as a form of fieldwork for educational purposes: "*a trail comprises a specially selected route around an area which takes students past sites or through areas which exemplify important types of geographical change*" (1997, p. 350). This is symptomatic for our review, as it does not bring clarity to what inherent properties characterize a trail, it only describes what a trail can be used for. Hugo (1999) discusses the differences between trails for tourism and outdoor recreation in Europe and South Africa, but readers are also here left without any clear definition or key features of the trail concept. Deyo et al. (2014) researched trails on American Indian land and the study recognized that trails are elements of the cultural landscape which can provide important benefits to users and communities, but neither do this study define the trail concept. Hence, from this literature review we must conclude that defining trails for tourism and outdoor recreation is of secondary importance. Given the volume of trail related research around the

world, it is interesting that understanding of such a central concept in outdoor recreation research seems to be somewhat taken for granted. An interesting inquiry would be to study if the meaning of trails for tourism and outdoor recreation differs between geographies and cultures. This discussion is largely absent in the academic articles reviewed here and consensus seems to be that the recreational trail concept is understood from a Western perspective.

## The geographic spread of trail research is uneven

It is also obvious that research on recreational trails published in English language journals is limited to a few countries and geographic regions. The majority of the studies included in the literature review (54%) were conducted in USA and Australia. Reviewing also non-English journals could have highlighted different issues and broaden the representation of research. However, Hamel (2007) recognizes that more than three quarters of all academic articles within the social sciences and humanities, and over 90 per cent of the academic articles within the natural sciences, are published in English. Hence, including papers written in other languages may not have produced a very different result from the one found in this review.

Another possible explanation to the uneven geographic distribution of academic literature on trails for tourism and outdoor recreation is that there are more academics studying recreational trails in the USA and Australia than elsewhere. King (2004) recognizes that there is a general dominance in research by the USA, and it can therefore be discussed if the geographically biased trail research is an expression of this dominance. However, as the USA is a very large country, comparable to the entire Europe, it should be no surprise if there is an overrepresentation of studies from the USA compared to single countries in Europe and elsewhere. One should also note that researchers from one country can conduct studies on trails in other countries, although this is not very common. Yet one reason for the US dominance to this field can probably be tracked to the early days of outdoor recreation research, dating back to the 1950s (Manning, 2011; Plummer, 2008). Some of the North American designated recreational trails were established even before that (Bayfield & Barrow, 1976), but this is when the interest in research on outdoor recreation started in the US, also reflecting the relative dominance of this region in the early time period of this study. As seen from Table 2, the geographic spread has since then shifted to other parts of the world. While Europe had the highest share during the 2010-2016 period, one region there are good reasons to keep an eye on in the future is Asia.

In China, there has been a rapid increase in tourism in protected areas and trail-based recreation (Li, Ge & Liu, 2005; Yang et al., 2014; Zhang, Xiang & Li, 2012). Many of the protected areas in China receive more than 500 000 visitors annually, of which a great number participate in trail-based activities (Zhong, Buckley, Wardle & Wang, 2015). Our review did however only identify five studies examining trails for tourism and outdoor recreation in China specifically. It is quite possible that there will be a future increase in studies analysing tourism and recreation in natural areas in China, reflecting the change in Chinese society where citizens increasingly have the possibility to travel and enjoy natural areas in the country (Zhong et al., 2015).

## Hiking is the most researched trail-activity

Although many different recreation activities on trails have been studied, hiking is clearly the most researched activity. There are 100 studies which solely focus on this activity, and another 46 studies which research hiking in combination with other activities, such as biking or horseback riding. In this context it is important to remember that hiking also includes shorter walks, and the setting is not necessarily

remote nature areas, as may be associated with the term hiking. One pattern we identified from the reviewed papers is that research on other activities than hiking, for example biking, has more focus on the activity as such including those practicing the activity. Studies on hiking have a more diverse focus on different study topics, such as environmental protection or trail management, and the activity itself and the people doing it is often of secondary interest. Hence, the impacts from hiking are sometimes more important than the actual activity. For example, studies on biking (including both mountain and downhill biking) often take social aspects in consideration, such as rider preferences (e.g. Chiu & Kriwoken, 2003; Goeft & Alder, 2001; Morey et al., 2002), while hikers' preferences are much less researched. Also, while studies researching hiking is geographically well spread (34 countries), studies on biking are concentrated to five countries only. Similarly, of the 14 studies researching horseback riding (by itself or together with another activity), 11 of those were from the USA and Australia.

There were 47 papers researching multiple activities, which makes it the second largest "activity category". This could potentially point to a diversification of trail-based activities, where several activities compete for the same space. Of the 47 articles researching multiple activities, 40 were published in the time-period 2000-2016 which indicates that multi-use trails is a rather recent phenomenon. At the same time, it is interesting to note that only six of the studies in this category focused on conflict management. One would expect that an increase in the number of trail-based activities and more diverse activities taking place on the same trail, should result in an increase of recreational conflicts between multiple activities. This study shows that conflict management research primarily focuses on two specific activities, for example hiking vs. horse riding and motorized vs. non-motorized activities.

There were few studies on snowmobiles, with only three studies researching snowmobiling exclusively and one looking at snowmobiling vs. cross-country skiing. In general, research on trails for winter use is scarce, which is expected given the limited number of countries where snow-based activities are possible. It is interesting to note however that even though there were only four studies on snowmobiling, two of these studies address the issue of governing common-pool resources. This implies that snowmobiling can cause conflicts with various stakeholders other than different types of trail-based recreation, for example private landowners (Anttila & Stern, 2005; Vail & Heldt, 2004).

## Under-researched topics

Research on trails for tourism and outdoor recreation is primary based on the natural sciences and focused on environmental and managerial aspects of trails to protect species and soils. We found that studies on environmental protection and trail management together constitute 60 % of the reviewed papers, while there is very little research on recreational trails in a socio-cultural or heritage context. Less than one third of the reviewed publications had a primary focus on economic impact, conflict management, heritage, public health, interpretation and/or trails as a tourist attraction. One reason for this could possibly be that the focus of this study is a non-urban context, and the large number of studies carried out in protected areas. As these areas often attract a great number of visitors, concerns are raised that they may have negative impact on the natural environment these areas are designated to protect (Newsome, Moore & Dowling, 2013; Siikamäki, Kangas, Paasivaara & Schroderus, 2015) Hence, if trails were to be studied in a more urban context, it is likely that studies with a social science approach would have been more common. It is also noteworthy that even though climate change is extensively being discussed among scholars in tourism research (e.g. Amelung & Nicholls, 2014; Kaján & Saarinen, 2013; Rosselló-Nadal, 2014), only three of the 195 reviewed articles addressed this issue. Ritter, Fiebig and Muhar (2012) discuss how global warming affects alpine trail networks, Tomczyk, White and Ewertowski (2016) recognize the importance of trail design when weather events become extreme, and Fernandes (2016) analyses the impacts on trail related tourism from heavy rainfalls.

Our literature review shows that research on conflicts between different trail users is rather limited, despite an increase in trail use which may cause crowding and other trail-related conflicts (Cessford, 2003; Dolesh, 2004). Only 11 papers primarily focused on conflict management, and these papers focused on conflicts between different recreational activities, such as hiking/biking or motorized/non-motorized use. There was, for example, no research on how trails can be a tool to handle conflicts between recreational activities and other land-use interests, such as local communities or extractive industries (e.g. forestry).

Research on trails' impact on public health is also quite limited, even though studies have shown that access to parks and trails are important for the physical activity of both youths and adults (e.g. Bedimo-Rung, Mowen & Cohen, 2005; Kaczynski & Henderson, 2007). This research is also geographically very uneven as all ten studies examining trails within the context of public health were done in the USA. Brown and Bell (2007) recognize that global governmental efforts to promote public health have come to include the therapeutic properties of nature, and nature is seen as an antidote to the stress and strains of modern life. Given such benefits, one could expect a larger number of articles focusing on the role of trails for public health on a recreation and tourism context. While public health issues are studied (and published) within many other contexts (e.g. physical activity, medicine etc.) without any specific connections to trails, our review points at the need to include also dimensions of accessibility to nature, where trails do play a major role.

## Conclusions

Trails for tourism and outdoor recreation constitute an essential element of infrastructure in the natural landscape, and trails have for quite some time been an acknowledged theme in the scientific literature. This systematic literature review represents an attempt to thoroughly investigate the research conducted on recreational trails, in order to synthesize knowledge on this matter as requested by Timothy and Boyd (2015). This review explored the geographical spread of trail research, how research has been conducted, what trail-related activities and topics have been examined within the scientific literature and what research gaps remain. Results show that research on recreational trails has been given increased attention within the academia, as the number of published papers on this topic has been growing more than the number of published papers in general, measured from 1980. Results from this study also reveal that research on trails is primarily concerned with different aspects of environmental protection and management, thus leading to the conclusion that less focus has been on trails from a social science perspective.

To conclude, there is a need for more studies in certain regions, such as Africa and Asia, as most trail research has been concentrated to the Western countries. Further research should also examine conflicts associated with trail use, as trails are increasingly being used for multiple activities and there is a greater diversity of recreation activities. In addition, an interesting topic for future research is what role trails can have in handling conflicts between different land-use interests, as natural areas are often used by diverse actors, not all of which use the landscape for touristic and recreational purposes.

Moreover, it is clear that the lack of definition within the academic literature of what constitutes a trail is a deficiency in trail research, as trails can have different meanings in various cultures and contexts. This leads to the conclusion that there is a need for more generic research on recreational trails, not only to elaborate on a definition but also to explore multiple meanings, perspectives and methodologies. Recreational trails are in many ways hugely important to tourists, as they often provide a number

of benefits, including safety, education, self-actualization, nature protection etc. By investigating what characterizes a recreational trail and what surrounding properties they possess, it is possible to gain a better understanding of the role of trails relating to various issues of tourism and outdoor recreation in the natural landscape. Finally, we think it is necessary to broaden the view on recreational trails in order for more holistic and inclusive approach to emerge, one that further extends the trail concept and recognizes various types of trails as key agents in tourism mobility. Increased knowledge on topics such as how tourists experience accessibility issues and infrastructure in natural areas, or enhanced performance of natural resource management agencies can be of great value for decision makers, planners, educators, and nature conservationists.

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## Note

<sup>1</sup> It should however be noted that in the category "geographical spread of trail research", four articles researched trails in more than one country. Therefore, in this particular category there was 30 observations in the time period 1970-1999 compared to the time period 2000-2009 when the number of observations was 77.

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## References

- Aguirre, J. A. (2009). Sustainable Trail Management in Costa Rica National Parks: the use of photography for trail surfacing decisions under tropical rainforest conditions. *PASOS: Revista de Turismo y Patrimonio Cultural*, 7(1), 29-42.
- Amelung, B. & Nicholls, S. (2014). Implications of climate change for tourism in Australia. *Tourism Management*, 41, 228-244. DOI: <http://dx.doi.org/10.1016/j.tourman.2013.10.002>.
- Anttila, S. & Stern, C. (2005). The voluntary provision of snowmobile trails on private land in Sweden. *Rationality and Society*, 17(4), 453-474. DOI: 10.1177/1043463105058318.
- Arrowsmith, C. & Inbakaran, R. (2002). Estimating environmental resiliency for the Grampians National Park, Victoria, Australia: a quantitative approach. *Tourism Management*, 23(3), 295-309. DOI:10.1016/S0261-5177(01)00088-7.
- Ballantyne, M. & Pickering, C. M. (2015). The impacts of trail infrastructure on vegetation and soils: Current literature and future directions. *Journal of Environmental Management*, 164, 53-64. doi: <http://dx.doi.org/10.1016/j.jenvman.2015.08.032>
- Ballantyne, M., Pickering, C. M., McDougall, K. L. & Wright, G. T. (2014). Sustained impacts of a hiking trail on changing Windswept Feldmark vegetation in the Australian Alps. *Australian Journal of Botany*, 62(4), 263-275. DOI: 10.1071/BT14114.
- Barros, A., Gonnet, J. & Pickering, C. (2013). Impacts of informal trails on vegetation and soils in the highest protected area in the Southern Hemisphere. *Journal of Environmental Management*, 127, 50-60. DOI: 10.1016/j.jenvman.2013.04.030.
- Bayfield, N. G. & Barrow, G. C. (1976). The use and attraction of nature trails in upland Britain. *Biological Conservation*, 9(4), 267-292. DOI: [http://dx.doi.org/10.1016/0006-3207\(76\)90050-1](http://dx.doi.org/10.1016/0006-3207(76)90050-1).
- Bedimo-Rung, A. L., Mowen, A. J. & Cohen, D. A. (2005). The significance of parks to physical activity and public health: A conceptual model. *American Journal of Preventive Medicine*, 28(2, Supplement 2), 159-168. DOI: <http://dx.doi.org/10.1016/j.amepre.2004.10.024>.
- Beeco, J. A., Hallo, J. C., English, W. R. & Giumetti, G. W. (2013). The importance of spatial nested data in understanding the relationship between visitor use and landscape impacts. *Applied Geography*, 45, 147-157. DOI: 10.1016/j.apgeog.2013.09.001.



- Beeton, S. (1999). Hoofing it - on four or two feet? Managing multi-use trails and sites. *Current Issues in Tourism*, 2(2-3), 211-225.
- Boers, B. & Cottrell, S. (2007). Sustainable Tourism Infrastructure Planning: A GIS-Supported Approach. *Tourism Geographies*, 9(1), 1-21. DOI: 10.1080/14616680601092824.
- Booth, A., Papaioannou, D. & Sutton, A. (2012). *Systematic approaches to a successful literature review*. London: Sage.
- Božić, S. & Tomić, N. (2016). Developing the Cultural Route Evaluation Model (CREM) and its application on the Trail of Roman Emperors, Serbia. *Tourism Management Perspectives*, 17, 26-35. DOI: 10.1016/j.tmp.2015.11.002.
- Bradford, L. E. A. & McIntyre, N. (2007). Off The Beaten Track: Messages As A Means Of Reducing Social Trail Use At St. Lawrence Islands National Park. *Journal of Park & Recreation Administration*, 25(1), 1-21.
- Bright, J. A. (1986). Hiker impact on herbaceous vegetation along trails in an evergreen woodland of Central Texas. *Biological Conservation*, 36(1), 53-69. DOI: 10.1016/0006-3207(86)90101-1.
- Brown, T. & Bell, M. (2007). Off the couch and on the move: Global public health and the medicalisation of nature. *Social Science & Medicine*, 64(6), 1343-1354. DOI: <http://dx.doi.org/10.1016/j.socscimed.2006.11.020>.
- Buckley, C., van Rensburg, T. M. & Hynes, S. (2009). Recreational demand for farm commonage in Ireland: A contingent valuation assessment. *Land Use Policy*, 26(3), 846-854. DOI: 10.1016/j.landusepol.2008.10.013.
- Cessford, G. (2003). Perception and reality of conflict: walkers and mountain bikes on the Queen Charlotte Track in New Zealand. *Journal for Nature Conservation*, 11(4), 310-316. DOI: <http://dx.doi.org/10.1078/1617-1381-00062>.
- Clark, G. (1997). The educational value of the rural trail: A short walk in. *Journal of Geography in Higher Education*, 21(3), 349.
- Chen, W. J. & Liaw, S. C. (2012). What is the value of eco-tourism? An evaluation of forested trails for community residents and visitors. *Tourism Economics*, 18(4), 871-885. DOI: 10.5367/te.2012.0146.
- Chiu, L. & Kriwoken, L. (2003). Managing recreational mountain biking in Wellington Park, Tasmania, Australia. *Annals of Leisure Research*, 6(4), 339-361.
- Cook, A. (2008). Recreation value of a new long-distance walking track. *Tourism Economics*, 14(2), 377-391.
- Courtenay, C. I. & Lookingbill, T. R. (2014). Designing a regional trail network of high conservation value using principles of green infrastructure. *Southeastern Geographer*, 54(3), 270-290. DOI: 10.1353/sgo.2014.0023.
- Deluca, T. H., Patterson, W. A., Freimund, W. A. & Cole, D. N. (1998). Influence of llamas, horses, and hikers on soil erosion from established recreation trails in western Montana, USA. *Environmental Management*, 22(2), 255-262. DOI: 10.1007/s002679900101.
- Deng, J., Qiang, S., Walker, G. J. & Zhang, Y. Q. (2003). Assessment on and perception of visitors' environmental impacts of nature tourism: a case study of Zhangjiajie National Forest Park, China. *Journal of Sustainable Tourism*, 11(6), 529-548. DOI:10.1080/09669580308667219.
- Deyo, N., Bohdan, M., Burke, R., Kelley, A., Van Der Werff, B., Blackmer, E. D., . . . Reo, N. J. (2014). Trails on tribal lands in the United States. *Landscape and Urban Planning*, 125, 130-139. DOI: 10.1016/j.landurbplan.2014.02.020.
- Dolesh, R. J. (2004). Tough terrain. (Cover story). *Parks & Recreation*, 39(10), 56-63.
- Eagleston, H. & Rubin, C. (2013). Non-motorized winter recreation impacts to snowmelt erosion, tronsen basin, eastern cascades, Washington. *Environmental Management*, 51(1), 167-181. DOI: 10.1007/s00267-012-9963-x.
- Farrell, T. A. & Marion, J. L. (2001). Identifying and assessing ecotourism visitor impacts at eight protected areas in Costa Rica and Belize. *Environmental Conservation*, 28(3), 215-225.
- Fernandes, F. (2016). Built heritage and flash floods: hiking trails and tourism on Madeira island. *Journal of Heritage Tourism*, 11(1), 88-95. DOI: 10.1080/1743873X.2015.1082574.
- Figueras, M. T. B., Farrés, M. C. P. & Pérez, G. R. (2011). The carrying capacity of cycling paths as a management instrument. The case of ebro delta (Spain). *Ekologia Bratislava*, 30(4), 438-452. DOI: 0.4149/ekol-2011-04-397.
- Gager, P. & Conacher, A. (2001). Erosion of Access Tracks in Kalamunda National Park, Western Australia: Causes and management implications. *Australian Geographer*, 32(3), 343-357. DOI: 10.1080/00049180120100068.

- Goeft, U. & Alder, J. (2001). Sustainable mountain biking: A case study from the Southwest of Western Australia. *Journal of Sustainable Tourism*, 4(2-4), 193-211.
- Gough, D., Oliver, S. & Thomas, J. (Eds.) (2012). *An introduction to systematic reviews*. Los Angeles, Ca: SAGE.
- Guo, T., Smith, J. W., Leung, Y. F., Seekamp, E. & Moore, R. L. (2015). Determinants of Responsible Hiking Behavior: Results from a Stated Choice Experiment. *Environmental Management*, 56(3), 765-776. DOI: 10.1007/s00267-015-0513-1.
- Hamel, R. E. (2007). The dominance of English in the international scientific periodical literature and the future of language use in science. *AILA Review*, 20(1), 53-71. DOI: 10.1075/aila.20.06ham.
- Hayes, D. & MacLeod, N. (2008). Putting down routes: an examination of local government cultural policy shaping the development of heritage trails. *Managing Leisure*, 13(2), 57-73. DOI: 10.1080/13606710801933420.
- Hawes, M., Dixon, G. & Ling, R. (2013). A GIS-based methodology for predicting walking track stability. *Journal of Environmental Management*, 115, 295-299. DOI: 10.1016/j.jenvman.2012.11.027.
- Hendricks, W. W., Ramthun, R. H. & Chavez, D. J. (2001). The Effects of Persuasive Message Source and Content on Mountain Bicyclists' Adherence to Trail Etiquette Guidelines. *Journal of Park & Recreation Administration*, 19(3), 38-61.
- Hill, W. & Pickering, C. M. (2006). Vegetation associated with different walking track types in the Kosciuszko alpine area, Australia. *Journal of Environmental Management*, 78(1), 24-34. DOI: 10.1016/j.jenvman.2005.04.007.
- Horodnikova, J. & Derco, J. (2015). Dark tourism, thematic routes and possibilities for innovation in the Slovak Republic. *Tourism*, 63(2), 241-246.
- Hughes, M. & Morrison-Saunders, A. (2002). Impact of trail-side interpretive signs on visitor knowledge. *Journal of Ecotourism*, 1(2-3), 122-132.
- Hugo, M. L. (1999). A comprehensive approach towards the planning, grading and auditing of hiking trails as ecotourism products. *Current Issues in Tourism*, 2(2-3), 138-173.
- Jesson, J., Matheson, L. & Lacey, F. M. (2011). *Doing your literature review : traditional and systematic techniques*. Los Angeles, Calif. ; London: SAGE.
- Kaczynski, A. T. & Henderson, K. A. (2007). Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation. *Leisure Sciences*, 29(4), 315-354. DOI: 10.1080/01490400701394865.
- Kaján, E. & Saarinen, J. (2013). Tourism, climate change and adaptation: a review. *Current Issues in Tourism*, 16(2), 167-195. DOI: 10.1080/13683500.2013.774323.
- Kellomaki, S. (1977). Deterioration of forest ground cover during trampling. *Silva Fennica*, 11(3), 153-161.
- King, D. A. (2004). The scientific impact of nations. *Nature*, 430(6997), 311-316. DOI: 10.1038/430311a.
- Kuniyal, J. C. (2005). Solid waste management in the Himalayan trails and expedition summits. *Journal of Sustainable Tourism*, 13(4), 391-410.
- Lekies, K. S. & Whitworth, B. (2011). Constructing the Nature Experience: A Semiotic Examination of Signs on the Trail. *American Sociologist*, 42(2), 249-260. DOI: 10.1007/s12108-011-9129-y.
- Leiper, N. (1990). Tourist attraction systems. *Annals of Tourism Research*, 17, 367-384.
- Li, W., Ge, X. & Liu, C. (2005). Hiking trails and tourism impact assessment in protected area: Jiuzhaigou Biosphere Reserve, China. *Environmental Monitoring and Assessment*, 108(1-3), 279-293. DOI: 10.1007/s10661-005-4327-0.
- Littlefair, C. & Buckley, R. (2008). Interpretation reduces ecological impacts of visitors to world heritage site. *Ambio*, 37(5), 338-341. DOI: 10.1579/07-R-393.1.
- Longshore, K. & Thompson, D. B. (2013). Detecting short-term responses to weekend recreation activity: Desert bighorn sheep avoidance of hiking trails. *Wildlife Society Bulletin*, 37(4), 698-706. DOI: 10.1002/wsb.349.
- Lynn, N. A. & Brown, R. D. (2003). Effects of recreational use impacts on hiking experiences in natural areas. *Landscape and Urban Planning*, 64(1-2), 77-87. DOI: 10.1016/S0169-2046(02)00202-5.
- Machi, L. A. & McEvoy, B. T. (2016). *The literature review : six steps to success*. Thousand Oaks: SAGE.
- Manning, R. E. (2011). *Studies in outdoor recreation : search and research for satisfaction*. Corvallis: Oregon State University Press.

- Martínez, J. V. & Ocana, C. O. (2014). Multicriteria evaluation by GIS to determine trail hiking suitability in a natural park. *Boletín de la Asociación de Geógrafos Españoles*(66), 323-339.
- Mason, S., Newsome, D., Moore, S. & Admiraal, R. (2015). Recreational trampling negatively impacts vegetation structure of an Australian biodiversity hotspot. *Biodiversity and Conservation*, 24(11), 2685-2707. DOI: 10.1007/s10531-015-0957-x.
- McNamara, K. E. & Prideaux, B. (2011). Planning nature-based hiking trails in a tropical rainforest setting. *Asia Pacific Journal of Tourism Research*, 16(3), 289-305. DOI: 10.1080/10941665.2011.572665.
- Moher, D., Liberati, A., Tetzlaff, J. & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Annals of Internal Medicine*, 151(4), 264-269.
- Moore, R. L. & Driver, B. L. (2005). *Introduction to outdoor recreation : providing and managing natural resource based opportunities*. State College, Pa.: Venture Pub.
- Moore, R. L. & Ross, D. T. (1998). Trails and recreational greenways. *Parks & Recreation*, 33(1), 68.
- Moore, R. L. & Shafer, C. S. (2001). Introduction to special issue trails and greenways: Opportunities for planners, managers, and scholars. *Journal of park and recreation administration*, 19(3), 1-16.
- Morey, E. R., Buchanan, T. & Waldman, D. M. (2002). Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: Choice experiments and benefits transfer. *Journal of Environmental Management*, 64(4), 411-422. DOI: 10.1006/jema.2001.0513.
- Musselman, R. C. & Korfmacher, J. L. (2007). Air quality at a snowmobile staging area and snow chemistry on and off trail in a Rocky Mountain subalpine forest, Snowy Range, Wyoming. *Environmental Monitoring and Assessment*, 133(1-3), 321-334. DOI: 10.1007/s10661-006-9587-9.
- Nepal, S. K. & Way, P. (2007). Comparison of vegetation conditions along two backcountry trails in Mount Robson Provincial Park, British Columbia (Canada). *Journal of Environmental Management*, 82(2), 240-249. DOI: 10.1016/j.jenvman.2005.12.016.
- Newsome, D. & Davies, C. (2009). A case study in estimating the area of informal trail development and associated impacts caused by mountain bike activity in John Forrest National Park, Western Australia. *Journal of Ecotourism*, 8(3), 237-253. DOI: 10.1080/14724040802538308.
- Newsome, D., Moore, S. A. & Dowling, R. K. (2013). *Natural area tourism : ecology, impacts and management*. Buffalo, NY: Channel View Publications.
- Park, L. O., Manning, R. E., Marion, J. L., Lawson, S. R. & Jacobi, C. (2008). Managing Visitor Impacts in Parks: A Multi-Method Study of the Effectiveness of Alternative Management Practices. *Journal of Park & Recreation Administration*, 26(1), 97-121.
- Petticrew, M. (2001). Systematic reviews from astronomy to zoology: myths and misconceptions. *BMJ*, 322(7278), 98-101. DOI: 10.1136/bmj.322.7278.98.
- Pickering, C. M. & Byrne, J. (2014). The benefits of publishing systematic quantitative literature reviews for PhD candidates and other early-career researchers. *Higher Education Research & Development*, 33(3), 534-548. DOI: 10.1080/07294360.2013.841651.
- Pickering, C. M., Grignon, J., Steven, R., Guitart, D. & Byrne, J. (2015). Publishing not perishing: how research students transition from novice to knowledgeable using systematic quantitative literature reviews. *Studies in Higher Education*, 40(10), 1756-1769. DOI: 10.1080/03075079.2014.914907.
- Plummer, R. (2008). *Outdoor recreation : an introduction*. New York, NY: Routledge.
- Potter III, F. I. & Manning, R. E. (1984). Application of the wilderness travel simulation model to the Appalachian Trail in Vermont. *Environmental Management*, 8(6), 543-550. DOI:10.1007/BF01871580.
- Reis, A. C., Lovelock, B. & Jellum, C. (2014). Linking tourism products to enhance cycle tourism: the case of the Taieri Gorge railway and the Otago Central rail trail, New Zealand. *Tourism Review International*, 18(1/2), 57-69. DOI: 10.3727/154427214X13990420684527.
- Ridley, D. (2008). *The literature review : a step-by-step guide for students*. London: SAGE.

- Ritter, F., Fiebig, M. & Muhar, A. (2012). Impacts of global warming on mountaineering: A classification of phenomena affecting the alpine trail network. *Mountain Research and Development*, 32(1), 4-15. DOI: 10.1659/MRD-JOURNAL-D-11-00036.1.
- Rodríguez-Prieto, I., Bennett, V. J., Zollner, P. A., Mycroft, M., List, M. & Fernández-Juricic, E. (2014). Simulating the responses of forest bird species to multi-use recreational trails. *Landscape and Urban Planning*, 127, 164-172. DOI: <http://dx.doi.org/10.1016/j.landurbplan.2014.03.008>.
- Rosselló-Nadal, J. (2014). How to evaluate the effects of climate change on tourism. *Tourism Management*, 42, 334-340. DOI: <http://dx.doi.org/10.1016/j.tourman.2013.11.006>.
- Santarém, F., Silva, R. & Santos, P. (2015). Assessing ecotourism potential of hiking trails: A framework to incorporate ecological and cultural features and seasonality. *Tourism Management Perspectives*, 16, 190-206. DOI: 10.1016/j.tmp.2015.07.019.
- Schuett, M. A. (1997). State park directors' perceptions of mountain biking. *Environmental Management*, 21(2), 239-246. DOI: 10.1007/s002679900023.
- Shilling, F., Boggs, J. & Reed, S. (2012). Recreational system optimization to reduce conflict on public lands. *Environmental Management*, 50(3), 381-395. DOI: 10.1007/s00267-012-9906-6.
- Siderelis, C., Naber, M. & Leung, Y. F. (2010). The influence of site design and resource conditions on outdoor recreation demand: A mountain biking case study. *Journal of Leisure Research*, 42(4), 573-590.
- Siikamäki, P., Kangas, K., Paasivaara, A. & Schroderus, S. (2015). Biodiversity attracts visitors to national parks. *Biodiversity and Conservation*, 24(10), 2521-2534. DOI: 10.1007/s10531-015-0941-5.
- Snyder, S. A., Whitmore, J. H., Schneider, I. E. & Becker, D. R. (2008). Ecological criteria, participant preferences and location models: A GIS approach toward ATV trail planning. *Applied Geography*, 28(4), 248-258. DOI: 10.1016/j.apgeog.2008.07.001.
- Symmonds, M. C., Hammitt, W. E. & Quisenberry, V. L. (2000). Managing recreational trail environments for mountain bike user preferences. *Environmental Management*, 25(5), 549-564. DOI: 10.1007/s002679910043.
- Tarolli, P., Calligaro, S., Cazorzi, F. & Dalla Fontana, G. (2013). Recognition of surface flow processes influenced by roads and trails in mountain areas using high-resolution topography. *European Journal of Remote Sensing*, 46(1), 176-197. DOI: 10.5721/EuJRS20134610.
- Timothy, D. J. & Boyd, S. W. (2015). *Tourism and trails : cultural, ecological and management issues*. Bristol: Channel View Publications.
- Tomczyk, A., White, P. C. L. & Ewertowski, M. W. (2016). Effects of extreme natural events on the provision of ecosystem services in a mountain environment: The importance of trail design in delivering system resilience and ecosystem service co-benefits. *Journal of Environmental Management*, 166, 156-167. DOI: 10.1016/j.jenvman.2015.10.016.
- Travis, A. S. (2011). Introduction to UK Upland planning for countryside conservation, recreation and tourism. In A. S. Travis (Ed.), *Planning for tourism, leisure and sustainability – international case studies* (pp. 122-128). Retrieved from <http://www.cabi.org/cabebooks/ebook/20113297699>.
- Vail, D. & Heldt, T. (2004). Governing snowmobilers in multiple-use landscapes: Swedish and Maine (USA) cases. *Ecological Economics*, 48(4), 469-483. DOI: 10.1016/j.ecolecon.2003.10.014.
- Walker, J. R. & Shafer, C. S. (2011). Mode of Experience on a Recreational Trail: An Examination of How Hikers and Mountain Bikers Focus Their Attention. *Journal of Park & Recreation Administration*, 29(2), 21-38.
- Wallin, T. R. & Harden, C. P. (1996). Estimating Trail-Related Soil Erosion in the Humid Tropics: Jatun Sacha, Ecuador, and La Selva, Costa Rica. *Ambio*, 25(8), 517-522.
- Webb, R. H., Ragland, H. C., Godwin, W. H. & Jenkins, O. (1978). Environmental effects of soil property changes with off-road vehicle use. *Environmental Management*, 2(3), 219-233. DOI: 10.1007/BF01866550.
- White, D. D., Waskey, M. T., Brodehl, G. P. & Foti, P. E. (2006). A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S. *Journal of Park & Recreation Administration*, 24(2), 21-41.
- Wiedmann, B. P. & Bleich, V. C. (2014). Demographic responses of bighorn sheep to recreational activities: A trial of a trail. *Wildlife Society Bulletin*, 38(4), 773-782. DOI: 10.1002/wsb.463.

- Vistad, O. I. (2003). Experience and management of recreational impact on the ground - A study among visitors and managers. *Journal for Nature Conservation*, 11(4), 363-369. DOI: 10.1078/1617-1381-00069.
- Voda, M., Moldovan, L., Torpan, A. & Henning, A. (2014). Using gis for mountain wild routes assessment in order to qualify them for tourism valorisation. *Geographia Technica*, 9(1), 101-108.
- Wood, K. T., Lawson, S. R. & Marion, J. L. (2006). Assessing Recreation Impacts to Cliffs in Shenandoah National Park: Integrating Visitor Observation with Trail and Recreation Site Measurements. *Journal of Park & Recreation Administration*, 24(4), 86-110.
- Wrede, V. & Mügge-Bartolović, V. (2012). GeoRoute Ruhr—a Network of Geotrails in the Ruhr Area National GeoPark, Germany. *Geoheritage*, 4(1), 109-114. DOI: 10.1007/s12371-012-0057-1.
- Yang, M., Coillie, F. v., Hens, L., Wulf, R. d., Ou, X. & Zhang, Z. (2014). Nature conservation versus scenic quality: a GIS approach towards optimized tourist tracks in a protected area of Northwest Yunnan, China. *Journal of Mountain Science*, 11(1), 142-155. DOI: 10.1007/s11629-012-2459-6.
- Zarnoch, S. J., Bowker, J. M. & Cordell, H. K. (2011). A mixed-modes approach for estimating hiking on trails through diverse forest landscapes: the case of the Appalachian Trail. *Canadian Journal of Forest Research*, 41(12), 2346-2358. DOI: 10.1139/x11-147.
- Zhang, J.-T., Xiang, C. & Li, M. (2012). Effects of Tourism and Topography on Vegetation Diversity in the Subalpine Meadows of the Dongling Mountains of Beijing, China. *Environmental Management*, 49(2), 403-411. DOI: 10.1007/s00267-011-9786-1.
- Zhong, L., Buckley, R. C., Wardle, C. & Wang, L. (2015). Environmental and visitor management in a thousand protected areas in China. *Biological Conservation*, 181, 219-225. DOI: <http://dx.doi.org/10.1016/j.biocon.2014.11.007>.

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