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Preface

The admission of this master's thesis is the end of a long period of studying sports science at the University of Stavanger. My student years have been fun and challenging, but most of all rich in learning. The process of writing this master's thesis has been very rewarding, but also a long and hard endeavor, and I would like to give thanks to the people who contributed to making it possible.

First, I would like to thank my supervisor, Åge Vigane, for all your support and guidance through the process of writing this master thesis. Your contributions have provided both insight and knowledge into the writing process. Without your direct contribution, guidance and enthusiasm, this research project would not have been possible.

Furthermore, I would like to thank my fiancé Kristin Skjæveland for always being encouraging and always being there for support. When writing has been tiresome, I have taken comfort in you being there to cheer me on. Thanks to my close family as well, for their general support and help.

Finally, I would like to thank the people participating in the study. Your participation has not only allowed me to conduct my research, but hopefully also contributed to filling a knowledge gap in the current literature.

Norwegian abstract

Lysefjorden er en av de mest populære naturattraksjonene i Norge med godt over seks hundre tusen besøkende hvert år. Det har tidligere blitt uttrykt bekymring for at naturattraksjoner i Norge ikke er rustet for å møte et stigende antall besøkende, og at besøkende ofte har uansvarlig atferd. Norge opplever for tiden lignende problemer som på Island, hvor store antall besøkende til naturattraksjoner fører til overbelastning og påfølgende behov for regulering. Sporløs ferdsel er en viktig norm innen friluftsliv og handler om at naturen skal være like fin når vi forlater den, som da vi kom. Det finnes imidlertid ingen tidligere forskning som undersøker holdninger til sporløs ferdsel. Hensikten med denne forskningen var å måle og sammenligne holdninger til sporløs ferdsel blant turgåere i Lysefjorden i Norge og Laugavegur på Island. Data ble samlet inn gjennom spørreundersøkelser, og utforsket gjennom deskriptiv analyse. Forskjeller ble utforsket gjennom Mann-Whitney U test. Resultatene indikerte at holdninger til turgåere ved begge destinasjoner generelt var i tråd med sporløs ferdsel. Det ble imidlertid funnet flere signifikante forskjeller mellom de to destinasjonene, hvor turgåerne fra Lysefjorden viste holdninger mindre i tråd med sporløs ferdsel sammenlignet med turgåere fra Laugavegur. Denne studien antyder at fordi Laugavegur er mindre tilgjengelig og mer regulert, i tillegg til få begrensninger til allemannsretten i Lysefjorden kan forklare hvorfor holdningene til turgåere fra Laugavegur virker mer i tråd med sporløs ferdsel sammenlignet med turgåere fra Lysefjord.

Norwegian keywords

Sporløs ferdsel; Friluftsliv; Holdninger; Atferd; Allemannsretten;

Contents

Definitions

Outdoor recreation may be defined as "To stay or engage in physical activity in the outdoors during leisure time to experience diverse natural environments and foster experiences of nature" (Meld. St. 18 (2015 –2016)).

Traceless travel is a Norwegian norm of outdoor recreation which "involves leaving nature as beautiful as it was when first arriving" (Jakhelln, 2021).

Right to roam is the public rights of access to the countryside found in several of the Nordic countries (Øian et al., 2018).

Note to examiner

The research article is written using the guide for authors for the Journal of Outdoor Recreation and Tourism (JORT), which publishes original, empirical or conceptual/theoretical research on important international and regional issues in outdoor recreation and nature based tourism, with an emphasis on managerially and management relevant work. The following link may be copy pasted to access the guide for authors:

https://www.sciencedirect.com/journal/journal-of-outdoor-recreation-and-tourism/publish/guide-for-authors

Hiker's attitudes towards traceless travel – a comparative study from Lysefjorden in Norway and Laugavegur in Iceland

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Abstract

Lysefjord is one of the most popular nature destinations in Norway with well over six hundred thousand visitors coming to hike and enjoy the nature each year. However, recent concerns have been made that nature destinations in Norway are not equipped to deal with increasingly large visitor numbers, and that visitors often have irresponsible behavior. Norway is currently experiencing similar issues to Iceland, as vast visitor numbers to nature attractions leads congestion and subsequent need for regulation. Traceless travel is an important norm in outdoor recreation and involves leaving nature as beautiful as it was when first arriving. However, there seems to be no previous research examining attitudes towards traceless travel in the current literature. The purpose of this research was to measure and compare attitudes towards traceless travel among hikers visiting Lysefjord in Norway and Laugavegur in Iceland. Results indicate that attitudes of hikers at both destinations were generally in line with traceless travel. However, several significant differences between the two destinations were revealed, as the hikers from Lysefjord generally displayed attitudes less in line with traceless travel compared to hikers from Laugavegur. This study suggests that the Laugavegur being less accessible and more regulated, as well as limited restrictions to right to roam in Lysefjord may explain why attitudes of hikers from Laugavegur seem more in line with traceless travel compared to hikers from Lysefjord.

Keywords

Traceless travel; Outdoor recreation; Attitudes; Behavior; Right to roam;

Management implications

This study suggests that while hikers may generally display attitudes in line with the norm of traceless travel, site managers should apply proper restrictions where it is likely to happen that perceived benefits of engaging in behaviors with negative effects outweighs the perception of the negative effects. In addition, this study suggests that proper restrictions, such as limiting hiking off trail, and proper communication, such as signage of possible environmental consequences of inappropriate behaviors and positives of appropriate behavior may positively influence traceless travel attitudes.

1. Introduction

In the last decade, Norway has experienced a dramatic increase in visits to iconic nature attractions (Øian et al., 2018). Lysefjord is one of these nature attractions, being among the most visited hiking destinations in Norway with well over six hundred thousand visitors annually since 2019 (Lysefjorden Utvikling AS, n.d-b). Since 2018, Lysefjord has received and held the "Sustainable Destination" accreditation, indicating that Lysefjord is systematically working to reduce the negative effects of tourism including environmental impacts (Innovation Norway, n.d). At the current time however, there exists no research on whether the visitors to Lysefjord holds desirable attitudes in line with the idea of maintaining a sustainable destination. Rather, concerns have been raised that tourists often act irresponsibly, and that destinations such as Lysefjord have not been equipped to deal with the increasing number of tourists and their associated effects of trampling damage to soil and vegetation, littering, and other pollution (Heslinga, Hartman, & Wielenga, 2021; Øian et al., 2018)

Norway and Lysefjord is currently experiencing similar issues to Iceland, as vast numbers of visitors to nature attractions lead to congestion, with the subsequent need to regulate scales of visitation (Øian et al., 2018). Tourism has been among the fastest-growing industries in Iceland in recent years (OECD, 2017) and in 2017 the number of international visitors to Iceland was approximately 2.3 million, almost seven times more than the entire Icelandic population (Øian et al., 2018). The Icelandic highlands ecosystems is extremely fragile, and the impacts of tourists coming to hike and enjoy the nature can easily lead to soil erosion and land degradation (Ólafsdóttir & Runnström, 2009) As the access to the protected areas

of the Icelandic highlands continues to increase, regulation and infrastructure is needed to sustain the large visitor numbers and their associated environmental pressure (Tverijonaite, Ólafsdóttir, & Thorsteinsson, 2018). The Laugavegur trail, one of Iceland's most popular hiking trails residing in the highlands are currently subject to many protective regulations, such as not putting up fireplaces, no hiking off trail, and no camping outside of designated areas (Ferðafélag Íslands, n.d). By comparing the attitudes of hikers travelling the Laugavegur trail to the attitudes of hikers in Lysefjord, this paper hopes to provide useful information for management purposes at both hiking sites.

Traditionally, respect for nature and environmentally friendly behavior are important ideas of outdoor recreation in Norway, especially if we consider the norm of traceless travel (Nerland & Aadland, 2022). Traceless travel is an important ethical norm in outdoor recreation and involves leaving nature as beautiful as it was when first arriving. Previously, there have been some attempts at researching environmentally conscious behavior related to outdoor recreation in Norway (Bjerke, And, & Kleiven, 2006; Høyem, 2020). Yet even though it has been a norm in Norwegian outdoor recreation for decades, there seems to be no previous attempts to explore and measure attitudes towards traceless travel. However, several studies from the United States and Canada have investigated attitudes towards the comparable pro-environmental principles of Leave No Trace (Blye & Halpenny, 2020; Coulson et al., 2021; Vagias, Powell, Moore, & Wright, 2012). This paper attempts to adapt the quantitative measures used in the previous mentioned studies on the LNT principles to examine attitudes towards traceless travel.

Currently, there is still much to be learned about the attitudes of people coming to Norway and Iceland to hike and enjoy nature attractions. Providing data to fill this knowledge gap may not only lead to insight into hiker's attitudes at the examined study sites but may also help to predict behaviors and encourage proper behavior in the future (Ajzen, 1991). In addition, comparing attitudes may provide useful information for management purposes for both sites. To this end, the purpose of this research is to measure and compare attitudes towards traceless travel among hikers in Lysefjord in Norway and Laugavegur in Iceland.

2. Literature review

2.1 Right to roam Norway and Iceland

Practitioners of outdoor recreation in Norway and Iceland make use of right-to-roam, which not only secures free movement almost anywhere with few restrictions, but also include additional rights such as overnight camping and the right to forage for mushrooms and berries (Norwegian Environment Agency, n.d; The Environment Agency of Iceland, n.d). Right to roam has been associated with having roots as far back as the middle ages in both Iceland and Norway, but the right as it is practiced today was developed during the middle parts of the 1900s, and fully cemented into Icelandic law with the Nature Conservation Act of 1956 and Norwegian law with the Outdoor Recreation Act of 1957 (European Commission for Democracy through Law, 2020; Taraldrud, 2016).

The purpose of the Norwegian Outdoor Recreation act is “to protect the natural basis for outdoor recreation and to safeguard the public right of access to and passage through the countryside and the right to spend time there, etc, so that opportunities for outdoor recreation as a leisure activity that is healthy, environmentally sound and gives a sense of well-being are maintained and promoted” (Outdoor Recreation Act, 1957). The purpose of the Icelandic Nature Conservation Act implies more than facilitating for outdoor recreation, but states that the law is meant to “guarantee the public's right to move around the country and enjoy nature and thus promote general outdoor recreation in harmony with nature, for the health and well-being of citizens” (Nature Conservation Act, 2013).

A key part of right to roam in the Norwegian Outdoor Recreation Act and Iceland’s Nature Conservation Act is that it does not only apply to the local population, but also foreign visitors (Lovdata, 2023; The Environment Agency of Iceland, n.d). This means that tourists are free to explore and experience Norwegian and Icelandic nature with equal rights as Norwegians and Icelanders. Nature is the most important reason why tourists choose to visit Norway, a great share of tourists arriving in Norway can be characterized as active tourists, and the majority come to take part in outdoor activities and experience Norway’s nature (Innovation Norway, 2017; Meld. St. 19 (2016 –2017)) Similar tendencies is true for Iceland, where natural and cultural heritage sites are among the main tourist attractions, and a main factor in the rapid increase in foreign travelers (Ministry of the Environment Energy and

Climate, n.d-b). However, recent concerns have also been made of tourists enjoying the freedoms of right to roam while not fully complying with its principles when it comes to littering, respecting nature and wildlife, and respecting the local population (Heslinga et al., 2021). To address these concerns, it is important to understand the possible negative impacts of outdoor recreation.

2.2 Outdoor recreation and impacts on the natural environment.

All outdoor recreation activities disturb the natural environment in some way, and has the ability to negatively impact soil, water, wildlife and vegetation (Hammitt, 2015). One of the more widespread impacts of outdoor recreation, and perhaps the most noticeable, is human trampling, which may lead to devegatation, soil compaction and loss of organic matter (Mingyu, Hens, Xiaokun, & Wulf, 2009; Yaşar Korkanç, 2014; Yuejin, Kelong, Zhifeng, & Guangchao, 2022). In addition, hiking in forested areas has been shown as one of the main factors affecting the condition of tree growth along hiking trails, with trampling causing exposure of roots and a negative impact on radial growth (Ciapała, Adamski, & Zielonka, 2014; Matulewski et al., 2021) When larger numbers of hikers deviate from using formal trails, it may lead to the development of informal trail networks which may damage plant communities and lead to further deterioration of the natural environment. These informal trail networks may typically develop where there is limited regulation, limited formal or established trails and where vegetation is slow to recover once disturbed (Barros & Marina Pickering, 2017).

The creation and use of hiking trails itself may impact both soil and vegetation, but research on the enviromental effects of trail infrastructure itself is still limited (Ballantyne & Pickering, 2015) However, hiking trails may also contribute to lessen the environmental impacts of hiking. In addition to serving the purpose of making hiking more appealing, hiking trails may also play an important role in protecting natural and cultural resources (Daoutis, Kantartzis, Stathi, & Arabatzis, 2022). By concentrating traffic to formal hiking trails, both the extent of trampling damage and its associated environmental impacts to vegetation and soils may be minimized (Wimpey & Marion, 2010).

Wildlife has also been found to be affected in varying degrees by outdoor recreation. In fact, nearly any level of human activity in a protected area may alter wildlife behavior (Sytsma,

Lewis, Gardner, & Prugh, 2022). In Canada, recreational activities were found to be the most common threat to species at risk, affecting more species than any other threat category, with the second-most common recreational threat after off-road vehicle use being hiking (Rosenthal et al., 2022). Additionally, activities such as mountain biking, hiking and backcountry skiing has been associated with both spatial and temporal displacement and a loss of habitat for larger mammal species such as reindeer, bobcats, coyotes, moose and grizzly bears (George & Crooks, 2006; Lesmerises, Déry, Johnson, & St-Laurent, 2018; Naidoo & Burton, 2020). However, in addition to mitigating trampling damage and its associated negative effects on vegetation and soils, staying on established trails while hiking may help lessen the impacts on local wildlife. Westekemper et al. (2018) found that red deer can cope with recreational activity on trails as well as with the presence of trails in general, but that off-trail hiking has a greater disturbance potential.

2.3 Traceless travel

Environmentally conscious behavior and respect for nature are important ideals of outdoor recreation in Norway, which becomes evident when considering the tenet and norm of traceless travel, which outdoor recreationists are supposed to follow (Nerland & Aadland, 2022). The face value of the norm is quite simple and can be interpreted as simply cleaning up after making camp, not leave trash behind when hiking, and generally just leave as little evidence as possible of one’s presence in nature. According to Nerland and Aadland (2022) the norm of traceless travel can be seen as a derivation of the Norwegian Outdoor Recreation Act, and it is from this legislation we find the environmental responsibilities cemented in law.

The responsibilities related to traceless travel in the Outdoor Recreation Act is mostly found in paragraph § 9. (Picnicking and camping) and § 11. (Proper conduct and the owner's right to expel persons). On camping and picnicking the legislation states that “picnicking and camping must not take place if this may cause significant damage to young forest or to regenerating forest” (Outdoor Recreation Act, 1957, § 9). Regarding the access to and passing through other people’s property the legislation states that proper conduct is to “behave considerately and with due care in order not to cause damage or inconvenience for the owner, user or others or damage to the environment …. ensure that they do not leave

the place in a condition that may be unsightly or lead to damage or inconvenience for any other person. (Outdoor Recreation Act, 1957, § 11).

Another influence on the norm of traceless travel in Norwegian outdoor recreation can be found in the works of Norwegian philosopher and climber Arne Næss. During his time, Næss founded the environmental philosophy of deep ecology, developed guidelines for deep ecological practice in various areas of life, and also tried to develop an ecologically sound (Breivik, 2021). Some of his contributions to the norm of traceless travel can be found in Ecology, Community and Lifestyle (1989). Here Næss presents guidelines for ecologically responsible and ethical outdoor recreation, such as minimizing the strain upon the natural environment, maintaining respect for all life and landscapes and perhaps most important: “Traceless passage through the wilderness” (Naess, 1989, p. 179).

2.4 The Theory of Planned Behavior

One of the established behavioral theories used in understanding human decisions is the Theory of Planned Behavior (TPB) which assumes that people make a cost-benefit calculation out of self-interest, favoring behaviors with desirable consequences and forming unfavorable attitudes toward behaviors associated with undesirable consequences (Ajzen, 1991). Furthermore, Ajzen (1991) TPB states that human behavior is influenced by three factors; attitude towards behavior (the evaluative judgment of the behavior), subjective norms (perceived opinion of others performing the behavior) and perceived behavioral control (the perceived difficulty of performing the behavior).

The Theory of Planned Behaviour has previously been used in research related to outdoor recreation in a variety of ways, such as predicting visitor off-trail behavioral intentions at national parks (Goh, 2023), discussing a negative linkage between recreation specialization and pro-environmental behavior (Lee & Lee, 2021), predicting the intention to engage in personal protective behaviors to prevent the risk of tick exposure and tick-borne diseases (Omodior, Pennington-Gray, & Donohoe, 2015), and developing communication strategies for reducing human-wildlife conflict (Miller, 2019).

3. Methods

3.1 Study sites

The two examined sites were Lysefjord in Norway and the Laugavegur trail in Iceland. Both sites are important parts of nature-based tourism in their respective countries and characterized by high visitation numbers, thus creating ample opportunities for comparisons. Lysefjord is one of the leading hiking destinations in Norway with well over six hundred thousand visitors annually (Lysefjorden Utvikling AS, n.d-b). Perhaps most known for Preikestolen (Pulpit Rock) which attracts more than 300 000 visitors each year (Lysefjorden Utvikling AS, n.d-c; Stavanger Turistforening, n.d), Lysefjord also features popular hikes such as Kjerag, the Flørli stairs and a hiking trail all the way around Lysefjord. In addition to Lysefjord being surrounded by nature reserves and protected areas, the area around Preikestolen was in 2021 found to have natural values making it qualified to become a national park. However, due to opposition from the local government and community, the Norwegian Environment Agency decided not to pursue a further investigation into making the area around Preikestolen a national park (Rogaland fylkeskommune, n.d).

Figure 1. Lysefjord with surrounding trail. Map data from © OpenStreetMap, 2024 (https://www.openstreetmap.org/copyright) and © Den Norske Turistforening, 2024 (https://ut.no/tur/116245/signatur-lysefjorden-rundt/kart#10.16/59.0161/6.3897)

Laugavegur is one of Iceland's most popular hiking trails and runs from Landmannalaugar to Þórsmörk with estimations of 8000 hikers travelling the trail each year (Ólafsdóttir & Runnström, 2013). Both Landmannalaugar and Þórsmörk are popular hiking destinations on their own, with roughly 20% and 25% of international visitors travelling there during summertime (Óladóttir, 2017). The Laugavegur trail moves through the Fjallabaki Nature Reserve and ends in Þórsmörk Nature Reserve, meaning large sections of the trail resides in protected areas. There are also current plans in place to establish a national park in in the highlands where the Laugavegur trail moves through by amending the Act on Vatnajökull National Park (Ministry of the Environment Energy and Climate, n.d-a; Sæþórsdóttir, Wendt, & Ólafsdóttir, 2022).

Figure 2. Laugavegur. Map data from © OpenStreetMap, 2024 (https://www.openstreetmap.org/copyright)

3.2 Comparison of the two study sites

One of the main similarities between Lysefjord and Laugavegur is the high annual amount of both international and national hiking visitors. While it is hard to find accurate statistics of how many people hike the Laugavegur trail each year, Ólafsdóttir and Runnström (2013) reported an estimation of 8000 hikers moving between Landmannalaugar and Þórsmörk

annually, and a estimation of around 120 000 visitors to the Fjallabaki Nature Reserve during the summer of 2011. Similarly, there is no accurate statistics for how many visitors hike the whole trail around Lysefjord each year. However, estimations exists for parts of the trail, with roughly 300 000 visitors hiking Preikestolen (Stavanger Turistforening, n.d), and 70 000 visitors hiking Kjerag each year (Lysefjorden Utvikling AS, n.d-a). The visitor numbers are considerably higher in Lysefjord compared to the Laugavegur trail, yet this is mostly due to the Icelandic highlands being harder to access. Access to the Laugavegur trail vary from year to year depending on factors such as weather and snow conditions, and it is generally only open between June 25 and September 15 (Ferðafélag Íslands, n.d). In contrast, Lysefjord can be reached quite easily all year, and hiking opportunities exists almost year-round. In addition to high visitation numbers, both study sites contain beautiful and unique nature of noteworthy conservation value. Large parts of the Laugavegur trail through nature reserves and protected areas, while the surrounding areas of Lysefjord contains several nature reserves and conservation areas and both sites have been part of proposed national parks (Ministry of the Environment Energy and Climate, n.d-a; Rogaland fylkeskommune, n.d). The high visitation numbers for each hiking destination along with the need to protect the surrounding protected areas highlights the importance of proper behavior as a mitigating factor in reducing the environmental impacts of hiking.

3.3 Survey design

A survey questionnaire was used to collect data. Due to a lack of previous research, there is no current tool for measuring attitudes towards traceless travel. However, several studies have investigated attitudes towards the comparable pro-environmental principles of Leave No Trace (Blye & Halpenny, 2020; Coulson et al., 2021; Vagias, Powell, More, & Wright, 2012). The survey instrument used in the current study drew inspirations from the measures used in the studies mentioned above. The questionnaire consisted of 14 variables of Likert-type statements ranging from 1 = very inappropriate to 7 = very appropriate. The variables were designed with guidelines to traceless travel in mind to reflect common hiking and camping behaviors with possible negative impacts, and respondents were asked to indicate the “appropriateness” of each behavior. Lower scores are associated with better attitudes towards traceless travel. Examples of included behaviors were “Hike off trail to experience scenic views” and “Bury used toilet paper”. Some of the attitude measures were drawn from

the previous mentioned studies (Blye & Halpenny, 2020; Coulson et al., 2021; Vagias, Powell, More, & Wright, 2012) and slightly modified to fit traceless travel, while others were created as part of this study.

3.4 Survey deployment

The questionnaire was developed and administered to hiking visitors to both Lysefjord and Laugavegur. Surveys in Lysefjord were conducted between July 24th, 2023 and August 6th, 2023. Surveys in Laugavegur were conducted between August 16th, 2023 and August 19th, 2023. In Lysefjord, hiking visitors were approached on both the 560 Lauvvik-Lysebotn and 560 Lysebotn-Lauvvik ferry routes. This ferry route provides access to almost all of the hiking opportunities in Lysefjord. At the Laugavegur trail, hiking visitors were approached at trail heads, campsites, Ferðafélag Íslands cabins and on the bus to Landmannalaugar and from Þórsmörk. Through this systematic intercepting of individuals and groups, a total sample of n=266 were collected (127 in Lysefjord and 139 in Laugavegur). The questionnaires were completed on-site and returned to the project leader upon completion. Data was collected using paper-based questionnaires.

3.5 Participants characteristics

Participants from both Laugavegur and Lysefjord were predominantly international visitors (87.5% and 71.2% respectively). Male participants (N=65) outnumbered females (N=60) in Lysefjord, while the opposite was the case for Laugavegur where the females (N=76) outnumbered the males (N=60). Most of the participants from Lysefjorden were between the ages of 21-29 (26.40 %) and 30-39 (26.40 %). Participants from Laugavegur were in general slightly older, with most of the participants ranging between the ages of 30-39 (27.94%) and 40-49 (22,79%). A large number of participants from Laugavegur (52.94 %) were hiking for 5 or more days. Conversely, most of the participants from Lysefjorden (65.60%) were only hiking between 1-2 days.

3.6 Scale assessment

A reliability analysis of the model scale was conducted using the data collected from both Lysefjord and Laugavegur. A Cronbach's alpha score of $\alpha = 0.820$ suggested a good internal consistency of the 14-item scale (Pallant, 2020). Principal components analysis (PCA) using IBM SPSS Statistics Version 28 were employed to examine the scale´s factor structure. The

scale was designed to measure two factors, one trail specific behavior factor and one camp and wildlife behavior factor. PCA revealed the possibility for a 4-component solution, however, after assessing eigenvalues, examining the scree plot and conducting a parallel analysis as suggested by Pallant (2020, pp. 190-191) it was decided to retain a 2-component solution with factors subsequently named 1. Trail specific behavior and 2. Camp and wildlife behavior based on an examination of the items belonging to each factor. Item 5 of the scale: "Walk around eroded/muddy parts of a trail" were originally designed to fit with the trail specific behavior factor, however, PCA revealed it to fit better with the items in the camp and wildlife behavior factor. In addition to the principal components analysis, the 14 items of the scale were subjected to confirmatory factor analysis (CFA) using IBM SPSS Amos 29 Graphics. CFA revealed all but one factor loading as reasonably strong of > 0.4 and stronger (Pituch & Stevens, 2015). A CFI value of 0.904 indicated an acceptable goodness-of-fit of the model scale (Hu & Bentler, 1998).

3.7 Data analysis

Data was analyzed using IBM SPSS Statistics Version 28. Prior to analysis the data was cleaned using Microsoft Excel and checked for errors and missing data. No data was found outside of the possible values for any of the variables. Due to missing data, 2 cases from Lysefjord, and 3 cases from Laugavegur were deleted. Data was then assessed for normality and outliers. The primary focus of this study was to explore attitudes towards traceless travel among hiking visitors to both Lysefjord and Laugavegur. The data analysis consisted of exploring the mean and median scores of hiker's attitudes regarding specific hiking and camping behaviors related to traceless travel as well as measuring the variability through standard deviations. Due to groups failing the assumption of normality, exploring the median is the appropriate statistic method. However, the mean was also included in the analysis for easier interpretation and better understanding of the results. The appropriateness of the specific hiking and camping behaviors were measured using 14 Likert-type statements ranging from 1 = very inappropriate to 7 = very appropriate. The secondary focus of this study was to compare attitudes towards traceless travel between hiking visitors of both hiking destinations. Because both groups failed the assumption of normality, Mann Whitney U tests were used to determine if there were statistical differences between the two groups with regard towards traceless travel attitudes. Mann Whitney U test is considered the most

appropriate non-parametric test to measure differences between two independent samples when groups are determined as not being normally distributed. Effect size was determined as suggested by Field (2013) by calculating r values ((r = z/sqrt(N)) and using Cohen's measure of effect size where 0.1 is small, 0.3 is medium, and 0.5 is large (Cohen, 1988).

4. Results

4.1 Main results

The results showed that overall, both groups displayed generally low support for most of the hiking behaviors. However, visitors to Lysefjord did not hold the same attitudes towards traceless travel as hikers travelling the Laugavegur trail. Hiking visitors to Lysefjord displayed higher attitudinal support for most of the behaviors in the questionnaire compared to the hikers travelling the Laugavegur trail. The difference was most noticeable in the trail specific behavior factor, where all behaviors were viewed more favorably by hikers visiting Lysefjord than hikers travelling the Laugavegur trail, and the magnitude of differences were greatest. However, while many of the differences between the two groups were deemed to be statistically significant, effect sizes were generally small.

Table 1. Perceived appropriateness of common hiking behaviours among hikers from Laugavegur in Iceland and Lysefjord in Norway

		All hikers N = 261			Laugavegur n = 136			Lysefjord n = 125					
Item ID	Items	M	Md	SD	M	Md	SD	M	Md	SD	*z*	*p*	*r*
Trail specific behaviour													
B1	Hike off trail to experience the natural environment	3.8	3	2.0	3.3	3	1.9	4.4	5	2.0	-4.39	**.001**	-.27
B2	Hike off trail to get away from other hikers	3.3	3	2.0	2.6	2	1.6	4.1	4	2.0	-5.98	**.001**	-.37
B3	Hike off trail to experience scenic views	4.1	4	1.9	3.6	3	1.2	4.6	5	1.9	-4.16	**.001**	-.26
B4	Hike off trail to explore hidden areas	3.8	4	1.9	3.4	3	1.8	4.4	4	1.8	-4.39	**.001**	-.27
Camp and wildlife behaviour													
B5	Walk around eroded/muddy parts of a trail	4.2	4	1.7	3.8	4	1.7	4.6	5	1.6	-3.48	**.001**	-.22
B6	Placing a tent in an undisturbed spot, when camping in heavily used areas	3.4	3	1.9	2.9	2	1.7	4.0	4	1.9	-4.45	**.001**	-.28
B7	Dispose of waste in a campfire	2.2	1	1.7	2.0	1	1.5	2.4	1	1.9	-1.29	.198	-.08
B8	Bury used toilet paper	3.3	3	2.0	3.1	3	2.0	3.6	3	1.9	-2.32	**.020**	-.14
B9	Move rocks away from where I plan to place my tent	4.0	4	1.7	4.2	4	1.8	3.8	4	1.7	-2.12	**.034**	-.13
B10	Alter a campsite so that it is more desirable	3.3	3	1.7	3.3	3	1.7	3.4	3	1.6	-0.27	.786	-.02
B11	Have a campfire where there is no existing fire pit	2.4	2	1.4	2.0	2	1.3	2.7	2	1.6	-3.62	**.001**	-.22
B12	Leave pieces of partly burned wood behind when having a campfire	3.2	3	1.6	3.1	3	1.6	3.3	3	1.6	-1.04	.300	-.06
B13	Allow your dog off leash	2.9	2	1.7	3.0	3	1.8	2.9	2	1.6	-0.48	.631	-.03
B14	Attempt to approach wildlife for photos	2.9	3	1.6	2.8	2	1.6	2.9	3	1.7	-0.66	.512	-.04

Note: Measured via 7-point scale; 1 = very inappropriate, 4 = neutral, 7 = very appropriate. P = 0.05

4.2 Trail specific behavior

The mean and median scores as well as standard deviations from the trail specific behavior items varied between the Lysefjord and Laugavegur groups. The items: “Hike off trail to experience the natural environment” and “Hike off trail to experience scenic views” were viewed as slightly inappropriate by the Laugavegur participants, while the Lysefjord participants viewed them as slightly appropriate. The items “Hike off trail to explore hidden areas” and “Hike off trail to get away from other hikers” were viewed as slightly inappropriate and inappropriate respectively by the participants from Laugavegur. The same items were viewed neutrally by participants from Lysefjord. However, standard deviations were generally quite high for all items in both groups, indicating a widespread variability among the respondents.

4.3 Camp and wildlife behavior

In general, both the participants from Laugavegur and Lysefjord tended to view the camp and wildlife behavior items as different levels of inappropriate. The items: “Walk around muddy/eroded parts of a trail”, “Bury used toilet paper” and “Alter a campsite so that it is more desirable” were all viewed as slightly inappropriate by the Laugavegur participants. The same results were true for the Lysefjord participants except for “Walk around muddy/eroded parts of a trail”, which was viewed neutrally.

The item: “Dispose of waste in a campfire” received the lowest mean score for both groups with Laugavegur participants viewing the item as very inappropriate, and Lysefjord participants viewing it as inappropriate. The only item viewed neutrally by the Laugavegur participants were “Placing a tent in an undisturbed spot when camping in heavily used areas”. The same item was viewed as slightly inappropriate by the Lysefjord participants. The item: “Move rocks away from where I plan to place my tent” were viewed as inappropriate by the Laugavegur participants and as slightly inappropriate by the participants from Lysefjord. SD for all the items varied widely with many high scores, indicating large variability among respondents on the perception of appropriateness of the different behaviors.

The items “Have a campfire where there is no existing fire pit” and “Attempt to approach wildlife for photos” were both viewed as inappropriate by the Laugavegur and Lysefjord participants. The two groups were also in agreement on the item: “Leave pieces of partly

burned wood behind when having a campfire", viewing it as slightly inappropriate. The only item with a difference in scores between the two groups were: "Allow your dog off leash" which the Laugavegur participants viewed as slightly inappropriate, and Lysefjord participants viewed as inappropriate. However, much like the rest of the questionnaire, most of the items related to campfire and wildlife behavior displayed quite high standard deviations among both groups, meaning that there was a large variability in the answers of the participants connected to the perception of appropriateness of the campfire and wildlife behaviors.

4.5 Comparison between the study sites

Significant differences (with small and medium effect sizes) were found for several of the hiking behaviors between the study sites. Laugavegur participants were found to be significantly less inn agreement with 8 of the 14 hiking behaviors compared to the Lysefjord participants. This difference was especially evident in the trail specific behavior factor, where the Laugavegur participants were significantly less in agreement with all the hiking behaviors compared to the Lysefjord participants. In fact, in the whole questionnaire, the only behavior that the Laugavegur participants were significantly more in agreement with compared to the Lysefjord participants were: “Move rocks away from where I plan to place my tent”. However, while the difference was found to be statistically significant, the effect size was small. Similarly, almost all the items demonstrating a statistically significant difference between the two groups, only displayed small effect sizes. The only difference between the two study sites which displayed a noteworthy medium size effect was: “Hike off trail to get away from other hikers”. A medium size effect signals an elevated substantive difference between the groups from Laugavegur and Lysefjord related to trail behavior, as the Laugavegur group displayed a stronger disagreement with hiking off trail to get away from other hikers.

5. Discussion

5.1 Management implications

The purpose of this research was to measure and compare attitudes towards traceless travel among hikers in Lysefjord in Norway and Laugavegur in Iceland. Identifying and understanding attitudes towards traceless travel among hikers may play an important part in maintaining a sustainable hiking destination. The results showed that overall, both groups displayed generally low support for most of the hiking behaviors in the questionnaire, indicating attitudes generally in line with traceless travel. However, hiking visitors to Lysefjorden did not hold the same attitudes as hikers on the Laugavegur trail. Overall, hikers on the Laugavegur trail displayed slightly better attitudes than hiking visitors to Lysefjord. While both hiking destinations generally displayed attitudes mostly in line with the norm of traceless travel, there was still a noticeable difference. We discuss the results up against the Theory of Planned Behavior (TPB) and whether the results can be explained by the freedoms of right to roam, and the characteristics of the two hiking destinations.

First, the attitudinal response of the hiking visitors to Lysefjord were slightly less in line with the norm of traceless travel compared to the hikers travelling the Laugavegur trail. The differences were most profound in behaviors regarding leaving trails and some campsite related behaviors. Traditionally the right to passage through and the right to spend time in the countryside while camping is very strong in both Norway and Iceland (Outdoor Recreation Act, 1957; The Environment Agency of Iceland, n.d). However, many restrictions are in place at the Laugavegur trail (Ferðafélag Íslands, n.d), and so the right to roam becomes more restricted. The freedom provided by right to roam may play a part in explaining why the hiking visitors to Lysefjord find leaving established trails and camp in undisturbed spots less inappropriate, as right to roam still faces little restrictions at the site. This would support previous made concerns that the freedoms of right to roam may be abused by visitors coming to Norway (Heslinga et al., 2021). However, it should be noted while this research did not analyze differences between international and national visitors to Lysefjord, the results overall does not seem to suggest inherently bad attitudes towards traceless travel in Lysefjord. Still, the results from Lysefjord regarding leaving trails should be noted, as it may lead to the development of informal trail networks (Barros & Marina Pickering, 2017) and cause further deterioration to the natural environment as a result of trampling (Mingyu et al., 2009; Yaşar Korkanç, 2014; Yuejin et al., 2022). Furthermore, differences between local, national and international visitors should be considered for future research, as it may help determine whether some groups need more attitudinal and behavioral guidance than others.

Another factor that may have influenced the attitudinal response in Lysefjord and Laugavegur is the difference in characteristics of the two hiking destinations. Firstly, the Icelandic highlands is hard to access, and extensive planning is generally required to hike the Laugavegur trail (Ferðafélag Íslands, n.d). Conversely, access to hiking opportunities in Lysefjord is generally quite easy. While this was not directly explored, the ease of access to Lysefjord may attract visitors less experienced in the field of outdoor recreation (Heslinga et al., 2021) while the planning required to hike the Laugavegur trail may attract more experienced hikers which holds attitudes more in line with traceless travel. However, it should be noted that outdoor recreation does not necessarily promote environmentally responsible behavior on its own (Høyem, 2020) and recreation specialization may even

negatively impact pro-environmental behavior (Lee & Lee, 2021). Even so, less prepared or experienced hikers may highlight the need for more restrictions and communication to facilitate for better attitudes in Lysefjord.

Furthermore, the regulations and communication in place at the Laugavegur trail, such as being asked to always hike on trail and only use designated campsites due to the fragility of the surrounding area (Ferðafélag Íslands, n.d) may have influenced the attitudinal response of people hiking the Laugavegur trail. As a whole, the Icelandic environment is extremely fragile, and the ecosystems where the Laugavegur trail is situated is very susceptible to land degradation and soil erosion (Ólafsdóttir & Runnström, 2009). Proper communication such as signage posts on environmental consequences of inappropriate behaviors or positives of appropriate behavior, as well as the restrictions on the Laugavegur trail in general may certainly have influenced the attitudinal response of hikers, as these techniques are often recommended in management of parks and nature destinations (Barros & Marina Pickering, 2017; Goh, 2023).

Figure 3. Signage at the Laugavegur trail. Photograph taken by author.

Unlike the Icelandic highlands and the Laugavegur, the enviromental impacts visitors hiking in Lysefjord seem to have received little attention in research, perhaps excluding works associated with the creation of conservation areas (Rogaland fylkeskommune, n.d). Future research should consider exploring the direct enviromental impacts visitors hiking in Lysefjord, as it may help determine whether more restrictions are needed. Results of the current research suggests while there is some presence of restrictions and communication of in Lysefjord, perhaps more is needed.

Finally, Theory of Planned Behavior (Ajzen, 1991) assumes that people make a cost-benefit calculation out of self-interest, weighing the possible negative effects against the possible positive effects associated with a behavior. Many of the higher scoring behaviors in the questionnaire (associated with negative attitudes towards traceless travel) may present a higher perceived benefit than the perceived negative effects of the behavior, thus influencing the attitudinal response. The behavior “Walk around eroded/muddy parts of a trail” displayed quite high scores for both groups, indicating that hikers find the perceived positive effects of engaging in the behavior (such as avoiding muddy and wet boots) to outweigh the perceived negative effects (further deterioration of the trail). While this behavior may appear innocent enough on its own, large numbers of hikers trampling off-trail may easily lead to landscape damage (Barros & Marina Pickering, 2017). An interesting difference was found between the two hiking destinations, as all the behaviors in the trail specific behavior factor were viewed more favorably by hikers visiting Lysefjord than hikers travelling the Laugavegur trail. The difference could indicate that not only does the Lysefjord group find the perceived benefits of hiking off trail to outweigh possible negative effects, but also that the response from other hikers could be to join in on the behavior. This would coincide with previous research, where hikers displayed a stronger likelihood to leave the trail if witnessing others walking off trail (Goh, 2023). The results suggest that site managers should apply proper restrictions, such as limiting hiking off trail, where it is likely to happen that perceived benefits of engaging in behaviors with negative effects outweighs the perception of the negative effects.

5.2 Limitations

Some limitations can be attributed to this study. First, time and resource constraints limited both the number of participants recruited for analysis and the amount of background

variables included in the data collection. As a result, generalization of the results is limited. In addition, providing useful statistics on the differences between foreign visitors and locals to each hiking site was not possible. This could have provided useful knowledge for managing each hiking site, and so should be considered for future research. Ideally, more background variables should have been included in the data collection and analysis such as education and income levels of participants, as this could have provided deeper insight into attitudinal responses. Due to a limited time window before data collection this research had to collect data without obtaining personal information as per the guidelines of the Norwegian Agency for Shared Services in Education and Research, and so these background variables had to be omitted from data collection.

Second, assessing attitudes towards traceless travel accurately proved a challenge, partly due to there being no previous attempts in current literature. Finding fitting behaviors to include in the questionnaire was difficult, as some behaviors may be acceptable in certain situations, and sometimes not. This challenge was considered during the development of the questionnaire, however some of the items may still have been less appropriate. The items “Have a campfire where there is no existing fire pit” and “Leave pieces of partly burned wood behind when having a campfire” could perhaps have been substituted as campfires in Iceland are prohibited unless an established campground has a permitted facility. However, while some of the behaviors may have been somewhat inappropriate in the context of the study site, they still provided useful information in a general setting.

5.3 Conclusion

In conclusion, this study has provided data on attitudes towards traceless travel among hikers in both Lysefjord and Laugavegur, adding knowledge to fill a gap in the current literature. While attitudes of hikers at both destinations were generally in line with traceless travel, the findings of this study indicate that there is a difference in attitudes between hikers in Lysefjord and Laugavegur, as the hikers in Lysefjord generally displayed attitudes less in line with the norm of traceless travel compared to hikers from Laugavegur. This study suggests that the Laugavegur being less accessible and more regulated, as well as limited restrictions to right to roam in Lysefjord may explain why attitudes of hikers from Laugavegur seem more in line with traceless travel compared to hikers from Lysefjord

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Supplement to the research article

This supplement to the research article provides more information on the choice of research design and methodology, development of the questionnaire used, as well as some parts left out of the research article due to word count restrictions.

7. Introduction

The Nordic countries have experienced a dramatic growth in tourism during the last decades the, causing challenges concerning sustainable development of tourism (Øian et al., 2018). At the same time, sustainable tourism has achieved the status of being the superior goal in Norwegian government tourism policy, and is attaining much attention in the international scientific and political discourse on tourism (Aall, 2014). With the large numbers of visitors coming to the Nordic countries, concerns have been raised that tourists often act irresponsibly, and that many nature destinations have not been equipped to deal with the increasing number of tourists and their associated effects of trampling damage to soil and vegetation, littering, and other pollution (Heslinga, Hartman, & Wielenga, 2021; Øian et al., 2018).

The Theory of Planned Behavior assumes that individuals act rationally, according to their attitudes, subjective norms, and perceived behavioral control (Ajzen, 1991). In social research, attitudes are considered important because they are thought to predispose behavior (Michael A. Tarrant, 1999). In the research field of outdoor recreation, attitudes and behavior are common research topics, often focused on the environmental attitudes of outdoor recreationists (Daigle, Hrubes, & Ajzen, 2002; Jackson, 1986; Thapa, 2010).

Increased understanding of attitudes may help to predict and encourage pro-environmental behaviors (Ajzen, 1991), and so research on attitudes have become the topic for many research efforts in nature-based tourism and park management internationally (Ghazvini, Timothy, & Sarmento, 2020; Kaltenborn, Nyahongo, & Kideghesho, 2011; Kil, Holland, & Stein, 2014). In the United States and Canada many studies related to park management have attempted to measure attitudes towards Leave No Trace, a set of ethics promoting

conservation of the outdoors (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon, Taff, Newman, Vagias, & Newton, 2017; Wade M. Vagias, Powell, Moore, & Wright, 2012).

A similar idea to the Leave No Trace principles of Northern America can be found in the Norwegian norm of traceless travel, which people partaking in outdoor recreation are supposed to follow (Nerland & Aadland, 2022). However, even though the norm of traceless travel has been a part of Norwegian outdoor recreation for decades, there are no previous attempts at measuring attitudes towards traceless travel in the current literature. In fact, while attitudes and behaviors in outdoor recreation seems to be widely researched internationally, only a few studies seems to touch in on the topic in Norway, such as Bjerke, And, and Kleiven (2006) and Høyem (2020).

By conducting this research, the hope is to fill a knowledge gap in the current literature by providing information about the attitudes of hikers vising popular hiking destinations in Norway and Iceland. Furthermore, increased knowledge and understanding of attitudes of the hikers at the examined study sites may help to predict and encourage pro-environmental behaviors in the future (Ajzen, 1991).

The research article is written using the guide for authors for the Journal of Outdoor Recreation and Tourism (JORT), which publishes original, empirical or conceptual/theoretical research on important international and regional issues in outdoor recreation and nature based tourism, with an emphasis on managerially and management relevant work (Journal of Outdoor Recreation and Tourism, n.d)

7.1 Research purpose

The purpose of this research is to measure and compare attitudes towards traceless travel among hikers in Lysefjord in Norway and Laugavegur in Iceland.

8. Literature review

8.1 Comparing traceless travel and the Leave No Trace principles

The research article drew inspirations from survey research previously used in several studies on the Leave No Trace principles (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon et al., 2017; Vagias et al., 2012). Drawing inspiration from these studies were deemed appropriate

and to serve the purpose of measuring attitudes towards traceless travel due to the comparable nature of the two ethics, as well as the comparable research settings where the Leave No Trace principles has been explored. In the following section, the comparable nature of traceless travel and the Leave No Trace principles is highlighted.

8.1.1 Traceless travel

The Norwegian Outdoor Recreation Act of 1957 was created in response to the surge of Norwegians leaving the cities to take part in outdoor recreation, a new phenomenon which increased during the interwar period (Taraldrud, 2016). The legislation secures the public right to access, spend time, and pass through the Norwegian countryside (Outdoor Recreation Act, 1957) The Norwegian norm of traceless travel can be seen as a derivation of the Norwegian Outdoor Recreation Act (Nerland & Aadland, 2022). The responsibilities to the environment required by law are detailed in Outdoor Recreation Act (1957) in paragraph § 9. (Picnicking and camping) and § 11. (Proper conduct and the owner's right to expel persons). Other influences on the norm of traceless travel include Arne Næss, who developed guidelines for ecologically responsible friluftsliv, with one of the main points being “Traceless passage through the wilderness” (Naess, 1989, p. 179). However, even though the norm of traceless travel has been a part of Norwegian outdoor recreation for decades, there are no previous attempts at measuring attitudes towards traceless travel in the current literature.

Excluding the responsibilities required by law there are no set rules of traceless travel. However, there are many guidelines, including the previously mentioned guidelines by Arne Næss. In a pamphlet on the Norwegian right to roam the countryside, Miljødirektoratet (2016) states the following guidelines related to traceless travel,

- respect the access rules that apply to recreational and nature conservation areas check and comply with local restrictions with regard to dogs and campfires
- use established sites for picnicking and camping wherever possible
- show due caution if lighting a campfire, and extinguish it completely before you leave the site
- never cause damage to trees when gathering firewood – pick dry twigs from the ground instead

- never light a campfire on bare bedrock as the rock may crack
- never intrude on birds and animals, especially in the breeding and nesting season
- put your tent up on a site where you will not intrude on animals or birds, especially during the breeding and nesting season
- never cause harm to vegetation, especially endangered and vulnerable species
- never intrude on grazing livestock, and close all gates behind you
- respect other people's wish for solitude and silence
- never leave a permanent trace in the vegetation or landscape (Miljødirektoratet, 2016, pp. 4-9).

Another set of guidelines is published by Norsk Friluftsliv, a joint organization consisting of 18 of the largest voluntary friluftsliv-organizations in Norway. In the published guide, Jakhelln (2021) states the following regarding traceless travel,

Regarding trash:

- A good rule of thumb is that all items brought out in nature, should also be brought back. Avoid single-use products to minimize trash, and plan to reduce packaging brought outdoors. Paper may be disposed of in a campfire, but generally all other items should be brought out of nature and be properly disposed of. Last but not least, campsites should be properly inspected before leaving to avoid trash and other items left behind (Jakhelln, 2021).

Regarding going to the toilet in nature:

- Be prepared, and bring what you need including toilet paper. Move some distance away from the nearest trail or campsite. Keep away from water sources to avoid contamination. Dig a hole in the ground if possible and cover it when finished. Bring the toilet paper home and dispose of it properly or burn it, as it takes a long time to fully degrade (Jakhelln, 2021).

Regarding campfires:

- Rember to abide by restrictions regarding campfires. Bring wood from home, or use dead branches, and never harm healthy trees to obtain fuel. Choose suitable places that will not do damage to nature, and ideally use already established campfire sites. Be aware of weather conditions to avoid the spread of wildfire. Only use paper and wood, and

remember to properly clean up the campfire site and ensure the fire is fully put out (Jakhelln, 2021).

Regarding camping:

- Set up camp where no damage is done to nature. Collect all trash from the campsite and bring it out of nature. Show respect for local wildlife, avoid disturbance, and be especially aware during mating season. Avoid disturbing other people. Clean up nature elements used when setting up camp and put them back where they were found (Jakhelln, 2021).

8.1.2 Leave No Trace

The Leave No Trace principles, often shortened to LNT, is a set of ethics promoting conservation of the outdoors which was originally developed in response to the rapid increase of outdoor recreation activities such as hiking, camping, and backpacking in the United States in the 1960's (Marion & Reid, 2001).

There are 7 current LNT principles. The Leave No Trace Center for Outdoor Ethics (n.d-a) declares the LNT principles as follows, with guidelines to each principle,

1. Plan ahead and prepare
    - Know the regulations and special concerns for the area you'll visit.
    - Prepare for extreme weather, hazards, and emergencies.
    - Schedule your trip to avoid times of high use.
    - Visit in small groups. Split larger parties into smaller groups.
    - Repackage food to minimize waste.
    - Use a map and compass to eliminate the use of rock cairns, flagging, or marking paint. (Leave No Trace Center for Outdoor Ethics, n.d-b)
2. Travel and camp on durable surfaces
    - Durable surfaces include established trails, campsites, rock, gravel, and dry grasses or snow.
    - Protect riparian areas by camping at least 200 feet from lakes and streams.
    - Good campsites are found, not made. Altering a site is not necessary.
    - Concentrate use on existing trails and campsites.
    - Walk single file in the middle of the trail, even when wet or muddy.
    - Keep campsites small. Focus activity in areas where vegetation is absent.

- Disperse use to prevent the creation of campsites and trails.
- Avoid places where impacts are just beginning. (Leave No Trace Center for Outdoor Ethics, n.d-c)

3. Dispose of waste properly
    - Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled food. Pack out all trash, leftover food, and litter. Burning trash is never recommended.
    - Deposit solid human waste in catholes dug 6-8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.
    - Bury toilet paper deep in a cathole or pack the toilet paper out along with hygiene products.
    - To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater. (Leave No Trace Center for Outdoor Ethics, n.d-d)
4. Leave what you find
    - Preserve the past: observe cultural or historic structures and artifacts, but do not touch them.
    - Leave rocks, plants, and other natural objects as you find them.
    - Avoid introducing or transporting non-native species.
    - Do not build structures, furniture, or dig trenches. (Leave No Trace Center for Outdoor Ethics, n.d-e).
5. Minimize campfire impacts
    - Campfires can cause lasting impacts on the environment. Use a lightweight stove for cooking and enjoy a candle lantern for light.
    - Use established fire rings, pans, or mound fires where fires are permitted.
    - Keep fires small. Use only sticks from the ground that can be broken by hand.
    - Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes. (Leave No Trace Center for Outdoor Ethics, n.d-f)
6. Respect wildlife
    - Observe wildlife from a distance. Do not follow or approach them.
    - Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.

- Control pets at all times, or leave them at home.
- Avoid wildlife during sensitive times: mating, nesting, raising young, or winter. (Leave No Trace Center for Outdoor Ethics, n.d-g)

7. Be considerate of other visitors
    - Respect others and protect the quality of their experience.
    - Be courteous. Yield to other users on the trail.
    - Greet riders and ask which side of the trail to move to when encountering pack stock.
    - Take breaks and camp away from trails and others.
    - Let nature's sounds prevail. Avoid loud voices and noises. (Leave No Trace Center for Outdoor Ethics, n.d-h).

The LNT principles has been the subject of a lot of research. Blye and Halpenny (2020) investigated the level of perceived LNT knowledge of Canadian provincial parks users as well as attitudes towards LNT practices. The study suggests that tailored communication from park staff focusing on consequences of inappropriate behaviors and benefits to the park may be an effective way of changing knowledge and attitudes (Blye & Halpenny, 2020).

Wade M Vagias and Powell (2010) measured Leave No Trace attitudes towards common backcountry behaviors with the goal of developing more effective visitor education strategies, to ultimately reduce visitor-induced recreation impacts. The results showed widespread variability in the perceived appropriateness of several behaviors, indicating that the practice of behaviors also vary (Wade M Vagias & Powell, 2010).

Lawhon et al. (2017) examined visitor attitudes toward Leave No Trace practices, and self-reported knowledge concerning Leave No Trace in three Wyoming state parks to determine factors that influenced their behavioral intent to practice LNT. The study suggests among other things that attitudes towards the appropriateness of Leave No Trace practices are significant predictors of behavioral intent (Lawhon et al., 2017).

8.1.3 Comparison

There are many similarities between Norway's norm of traceless travel and the Leave No Trace principles. The main idea behind both ethics is to protect the natural environment when partaking in recreational activities in the outdoors. Additionally, both the norm of

traceless travel and the Leave No Trace principles came to be during roughly the same period and was developed as a response to more and more people taking part in recreational activities in the outdoors (Marion & Reid, 2001; Taraldrud, 2016). Last but not least, the similarities becomes clear when inspecting the official Leave No Trace principles (Leave No Trace Center for Outdoor Ethics, n.d-a) and available guidelines for traceless travel (Jakhelln, 2021; Miljødirektoratet, 2016).

There is one key difference between the two ethics. The Leave No Trace principles are clearly defined and separated into seven distinct principles. Conversely, the norm of traceless travel is much more loosely defined, and what traceless travel entails is to a certain degree left up to the individual to interpret. Nerland and Aadland (2022) states traceless travel can be interpreted as simply cleaning up a campsite, but that "If we consider this component in a purely hypothetical sense and at its most profound, sporløs ferdsel could have the potential to solve some of the environmental problems the world faces today".

8.2 Impacts on the natural environment that didn't make the article

All outdoor recreation activities, such as hiking, consists of an interaction between humans and the natural environment, which can be beneficial for humans in form of mental, physical, and social health (Mygind et al., 2019). Unfortunately, this interaction does not necessarily provide benefits both ways. In fact, all outdoor recreation activities has the potential to disturb the natural environment in some way, and may leave negative impacts on soil, water, wildlife and vegetation (Hammitt, 2015). There are several ways to mitigate the environmental impacts of outdoor recreation activities in already impacted areas, such as hikers using already established trails and campsites. However, when hikers and other practitioners of outdoor recreation deviate from established trails, camp in unspoilt and remote areas, or leave little regard for their environmental impact, the negative effects on the natural environment can be devastating and not easily reversed (Buckley, 2004).

Furthermore, pressures from outdoor recreation may also affect bodies of water, possibly causing degradation or loss of habitat for freshwater organisms (Venohr et al., 2018). While there seems to be a lack of research concerning ecological impacts of recreational activities in and around inland water bodies, it has been suggested that shore based recreation in some situations may cause lasting ecological effects, particularly for plants (Meyer et al.,

2021). Even seemingly innocent activities such as bathing may affect the natural environment, causing marginal ecological effects yet measurable effects on water quality (Butler, Pearson, & Birtles, 2021). Additionally, a study from German waterways found paddling from recreational boating to impact diversity of and cause significant damage to aquatic plants (Wegner, Meyer, & Wolter, 2023).

9. Research design and methodology

9.1 Choice of method

The approach in this study is quantitative and descriptive in nature, based on the aim to acquire knowledge on the attitudes towards traceless travel of hikers in Norway and Iceland. The most common descriptive research method is the survey, usually employed to determine present practices or opinions of a population (Thomas, Silverman, & Nelson, 2015). Survey research has previously been used to explore associations between environmental attitudes and interest in outdoor recreation activities in Norway (Bjerke et al., 2006). Survey research has also been common methods in research on the Leave No Trace principles (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon et al., 2017; Wade M. Vagias et al., 2012). Due to the comparable nature of traceless travel and the Leave No Trace principles, as well as similar research settings, similar methods to the ones used in the previously mentioned studies were employed.

This study used paper-based questionnaires to measure attitudes towards traceless travel. This allowed the researchers to gather information at sites with limited network access, while also maintaining the anonymity of participants. The purpose of this research was to measure and compare attitudes towards traceless travel among hikers in Lysefjord in Norway and Laugavegur in Iceland. To achieve this goal, descriptive analysis was employed to examine the data. Descriptive statistics are often used to describe sample characteristics and checking variables, but may also be used to address specific research questions (Pallant, 2020). Analyzing the descriptive data for means and median were thus deemed to serve the purpose of measuring attitudes towards traceless travel. This method is also previously used when measuring attitudes towards Leave No Trace (Blye & Halpenny, 2020; Coulson et al., 2021; Wade M Vagias & Powell, 2010; Wade M. Vagias et al., 2012).

9.2 Ethical considerations

As a rule, all processing of personal data including acquiring and registering, processing and analysis, transfer and storage and publication and archiving requires reporting the research to the Norwegian Agency for Shared Services in Education and Research (SIKT, 2023). Due to time constraints prior to beginning data collection, it was decided to proceed without reporting the research. This act allowed for being able to proceed with data collection within the limited timeframe available, but also put restrictions on which data could be collected. To avoid any processing of personal data, only a few background variables were included in the data collection, such as gender, country of residence, age group, amount of days hiking and hiking accommodation.

A central demand in research when collecting data from human participants is the need for free and informed consent, which means that research shall not be conducted on people without their inexpressible consent, with them being free from pressure to participate, and that consent is given with sufficient knowledge of the research being conducted (Fossheim, 2015). During this research, free and informed consent was obtained by participants when the questionnaires was being carried out and collected. Participants were informed of research purpose, consent, and anonymity when participating on the cover page of the questionnaire in addition to the researchers being present for further questions. The cover page included a short description of the purpose of the study, the people responsible for conducting the research and the institution to which the researchers belonged. In addition, an anonymity statement was provided detailing consent and anonymity when participating in the study.

Before data collection in Iceland could commence, it was considered whether it was necessary to obtain a research permit. However, according to the Icelandic Centre for Research (n.d) it is allowed to conduct scientific research in Iceland without the need for official research permits, except for research on thermophilic microorganisms.

Due to the nature of the research, no other permits or approvals were deemed necessary to obtain before data collection.

9.3 Supplementary study site information that didn't make the article

In Lysefjord, many hikers choose to do the classical "Lysefjorden rundt", a trip spanning several days hiking around the edges of Lysefjord, while also passing by the iconic day-hikes of Lysefjord, such as the Pulpit rock, Kjerag, and Flørli . The area around Lysefjord is known for its spectacular scenic views along the fjord, going up and down and passing by old farmsteads, lush forests, mountain lakes, massive gorges, and towering cliffs. In the hills north of Lysefjord lies three nature reserves, Hesten (10 708 acres), Longavatn (7 915 acres) og Skurvedalen (5 629 acres), and to the south and east of Lysefjorden there are two landscape conservation areas, Frafjordheiane and Setesdal Vesthei Ryfylkeheiane (Rogaland fylkeskommune, n.d).

When travelling the Laugavegur, in addition to the main route, it is possible for hikers to continue the trek by hiking the Fimmvörðuháls route which moves between Eyjafjallajökull og Mýrdalsjökull and end up in Skógar (Ferðafélag Íslands, n.d). Plenty of day-hiking opportunities at both the start and end of the trail, as well as several along the route. The trail is noted for displaying beautiful and varied landscapes, including colorful rhyolite and basaltic mountains, black obsidian lava, hot springs, black sand plains, glaciers, rivers and lakes as well as a lush, forested area when ending in Þórsmörk (Ferðafélag Íslands, n.d).

9.4 Sample size

Determining the sample size for a research project is an important consideration, not only involving finding the appropriate size to adequately represent the population, but also taking into account the practical considerations of time and cost (Thomas et al., 2015, p. 287). Time and cost were of issue during data collection of this research project. First, there were only a few weeks available for the researcher to commit to data collection (one week on the Laugavegur and two weeks in Lysefjord respectively), meaning as large a sample as possible had to be collected in these weeks. Second, the data collection was quite costly due to several factors, including only being able to use paper-based questionnaires and thus incurring large printing costs, travelling to and from Iceland, and the cost of staying in Lysefjord for two weeks.

The two populations surveyed in this research (hikers travelling the Laugavegur trail and hikers visiting Lysefjord) were quite high (Lysefjorden Utvikling AS, n.d; Ólafsdóttir &

Runnström, 2013). Ideally, the sample size for both study sites should have been closer to 400 which would have given a precision level of ±5% with a confidence level of 95% and P=0.05 (Glenn, 1992). However, due to the practical considerations discussed above it was decided that obtaining a sample size of >100 participants from each study site would be satisfactory for this research. According to Glenn (1992), a sample size of 100 for the populations of both Lysefjord and Laugavegur would give a precision level of ±10% with a confidence level of 95% and P=0.05. The final sample size for each site ended up being 125 for Lysefjord and 136 for Laugavegur respectively.

9.5 Constructing the questionnaire

At the current time there seems to be no previous attempts at researching attitudes towards traceless travel. As such, there exists no single tool for measuring these attitudes. To achieve the goal of measuring attitudes towards traceless travel, this study looked for inspiration in previous studies from the United States and Canada on the Leave No Trace principles (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon et al., 2017; Wade M. Vagias et al., 2012). This study drew inspiration from the research design of these studies to measure attitudes towards the Norwegian norm of traceless travel.

The questionnaire consisted of 14 variables of Likert-type statements ranging between 1 = very inappropriate to 7 = very appropriate. While it is debated how many points to include in the Likert scale when constructing a questionnaire, Taherdoost (2019) suggests the use of a seven-point rating scale. Each item of the scale was designed to reflect common hiking behaviors with possible negative effects to the natural environment, thus conflicting with the norm of traceless travel. The behaviors included in the questionnaire was based on available guidelines to traceless travel (Jakhelln, 2021; Miljødirektoratet, 2016; Naess, 1989). While some of the behaviors in the scale may appear innocent enough on their own, they may present a much larger issue when large numbers of hikers engage in such behavior (Rosenthal et al., 2022; Westekemper et al., 2018; Yaşar Korkanç, 2014; Yuejin, Kelong, Zhifeng, & Guangchao, 2022).

The four first items of the scale in the trail specific behavior factor: “Hike off trail to experience the natural environment”, “Hike off trail to get away from other hikers”, “Hike off trail to experience scenic views” and “Hike off trail to explore hidden areas” were designed to

reflect the traceless travel idea of never leaving a permanent trace in the vegetation or landscape (Miljødirektoratet, 2016) and “traceless passage through the wilderness” (Naess, 1989). In addition, these behaviors were deemed interesting as to capture why hikers decide to leave the trail. Hiking off trail is associated with trampling damage, which can lead to devegatation, soil compaction and loss of organic matter (Mingyu, Hens, Xiaokun, & Wulf, 2009; Yaşar Korkanç, 2014; Yuejin et al., 2022) while the use of formal hiking trails may help mitigate both the extent of trampling damage and its associated environmental impacts to vegetation and soils (Wimpey & Marion, 2010).

The first item of the camp and wildlife factor: “Walk around eroded/muddy parts of a trail” were drawn from the measure used in Wade M. Vagias et al. (2012), and designed to reflect the same ideas as the items in the trail specific behavior factor. However, principal components analysis revealed it to fit better with the second factor, and so it was included in the second factor.

The items: “Placing a tent in an undisturbed spot, when camping in heavily used areas” and “Move rocks away from where I plan to place my tent” were also drawn from the measure in Wade M. Vagias et al. (2012) while the item: “Alter a campsite so that it is more desirable” were drawn from Blye and Halpenny (2020). The items were designed to reflect ideas such as using established sites for camping wherever possible (Miljødirektoratet, 2016) and tidying up the campsite and nature elements used when camping (Jakhelln, 2021; Nerland & Aadland, 2022).

The items: “Allow your dog off leash” and “Attempt to approach wildlife for photos” were designed to reflect the traceless travel ideas of respecting all life, not to intrude on birds and animals, especially in the breeding and nesting season, as well as abiding by local restrictions when it comes to dogs (Jakhelln, 2021; Miljødirektoratet, 2016; Naess, 1989). Outdoor recreation has been found to often negatively affect wildlife (George & Crooks, 2006; Naidoo & Burton, 2020; Westekemper et al., 2018), meaning interactions between humans and birds and animals and wildlife intrusion should be avoided,

The items: “Dispose of waste in a campfire” and “Bury used toilet paper” were designed to reflect the ideas of only burning wood and paper in campfires, properly disposing of toilet paper, and tidying up campsites when leaving (Jakhelln, 2021; Nerland & Aadland, 2022).

The item: “Have a campfire where there is no existing fire pit” were drawn from the measure used in Blye and Halpenny (2020) and was designed together with the item: “Leave pieces of partly burned wood behind when having a campfire” to reflect the traceless travel ideas of choosing established camp sites when possible, extinguishing properly and cleaning up the campsite before leaving (Jakhelln, 2021; Miljødirektoratet, 2016).

9.6 Pilot study

Two small pilot studies were conducted prior to the main data collection. The first trial consisted of asking a few friends and close family members to read over the questionnaire, after which some items in the questionnaire were slightly altered for easier interpretation for the reader. The second trial were conducted at the Pulpit rock, where a small sample of the intended population were asked to complete the questionnaire. A trial run of the descriptive analysis process was completed after the second pilot study. After the second pilot, the questionnaire was deemed ready to distribute to the intended population.

9.7 Reliability and validity

The reliability of a scale such as the one used in this research indicates how free it is from random errors with one way of assessing reliability being through internal consistency, which involves exploring to which degree the items of the scale in question are all measuring the same underlying attribute (Pallant, 2020). A reliability analysis of the model scale was conducted using the data collected from both Lysefjord and Laugavegur. A Cronbach's alpha score of $\alpha = 0.820$ suggested a good internal consistency of the 14-item scale (Pallant, 2020).

The validity of a scale refers to the degree to which it measures what it is supposed to measure (Pallant, 2020) There are three main types of validity usually being explored: content validity, criterion validity and construct validity (Pallant, 2020; Streiner, Norman, & Cairney, 2015), in addition to face validity, which is sometimes included (Taherdoost, 2016). The current research did not venture far into the work of validating the survey instrument used for measuring attitudes towards traceless travel, and further validation is required and should be explored in later research. The steps taken to ensure a degree of validity in the current research were mostly related to face, content and construct validity.

First, face validity refers to researchers’ subjective assessments of the presentation and relevance of the measuring instrument as to whether the items in the instrument appear to

be relevant, reasonable, unambiguous and clear (Taherdoost, 2016). The items included in the questionnaire were developed and included using available guidelines on traceless travel (Jakhelln, 2021; Miljødirektoratet, 2016; Naess, 1989) and should be considered to satisfy the criteria for face validity. However, face validity is usually considered a weak form of validity (Taherdoost, 2016) and so other forms of validity should be explored.

The second validity form considered in this study was content validity. Establishing content validity involves literature reviews and evaluation by expert judges to find the degree to which items in an instrument reflect the content universe to which the instrument will be generalized (Taherdoost, 2016). As previously mentioned, available guidelines on traceless travel were used in development of the questionnaire, and so the items in the questionnaire should reflect the content universe. In addition, an associate professor physical education, sport and friluftsliv assisted in the development of the questionnaire, providing insight and knowledge to the process and further adding to content validity. Still, more experts on the field should review the items included in the questionnaire to properly ensure content validity (Taherdoost, 2016).

Last, construct validity refers to how well a construct is transformed into a functioning and operating reality, and may be verified by conducting a factor analysis using principal component analysis (Taherdoost, 2016). The factor analysis involved in this research is described in the following paragraph.

9.8 Factor analysis

The 14 items of the scale were subjected to principal components analysis (PCA) as detailed by Pallant (2020) using IBM SPSS Statistics version 28 and data from both Lysefjord and Laugavegur. Before performing the PCA, data was assessed for suitability of performing factor analysis. When inspecting the correlation matrix, several coefficients of .3 and above were revealed. A Kaiser-Meyer-Olkin value of .84 were observed, thus exceeding the recommended value of .6 (Kaiser, 1970). Test of Sphericity (Bartlett, 1954) were of statistical significance, granting further support for proceeding with factor analysis. Principal components analysis showed four components with eigenvalues exceeding 1, accounting for 31.4%, 16.2%, 8.7% and 7.4% of the variance respectively. However, further inspection of the scree plot exposed a noticeable break between the second and third components and an

even clearer break between the third and fourth components. Using the scree test (Cattell, 1966), it was decided to keep only two components for further analysis. The decision was further supported by parallel analysis revealing only two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (14 variables x 261 respondents). The two-component solution explained a total of 47.6% of the variance, with component 1 contributing 31.4% and component 2 contributing 16.2% respectively. Oblim rotation was performed to aid in the interpretation of the two components. The rotated solution had both components showing several strong loadings, with all but one variable loading substantially on only one component. However, item 6 of the scale loaded moderately on both components, with the highest loading on component 2.

In addition to the principal components analysis, the 14 items of the scale were subjected to confirmatory factor analysis (CFA) using IBM SPSS Amos 29 Graphics. CFA is typically used later in the research process to confirm specific hypotheses concerning the structure underlying a set of variables (Pallant, 2020, p. 188), and the use of CFA fell a little outside of the scope of this research. However, CFA could still provide information for further development of the scale used in the current research and were included when assessing the scale. CFA revealed all but one factor loading as reasonably strong of > 0.4 and stronger (Pituch & Stevens, 2015). A CFI value of 0.904 indicated an acceptable goodness-of-fit of the model scale (Hu & Bentler, 1998). The results of both PCA and CFA indicate that while the scale has many qualities, it still requires further refining.

10. Results

The results showed that overall, both groups displayed generally low support for most of the hiking behaviors. However, visitors to Lysefjord did not hold the same attitudes towards traceless travel as hikers travelling the Laugavegur trail. Hiking visitors to Lysefjord displayed higher attitudinal support for most of the behaviors in the questionnaire compared to the hikers travelling the Laugavegur trail. The difference was most noticeable in the trail specific behavior factor, where all behaviors were viewed more favorably by hikers visiting Lysefjord than hikers travelling the Laugavegur trail, and the magnitude of differences were greatest. However, while many of the differences between the two groups were deemed to be statistically significant, effect sizes were generally small.

11. Summary

To summarize, this supplement to the research article has provided more information on the choice of research design and methodology, development of the questionnaire used, as well as some parts left out of the research article due to word count restrictions. Methods, including the survey instrument, was inspired by research on the Leave No Trace principles (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon et al., 2017; Wade M. Vagias et al., 2012) and thus a comparison of the two set of ethics, as well as some of the published research on the matter were included. While the results of studies on the Leave No Trace principles were not specifically discussed in the research article, they were helpful deciding both methods and data analysis and for interpreting the results.

The method section of this supplement to the research article described the steps involved in constructing the questionnaire, sample size, pilot study and statistical analyses. Some limitations can be attributed to the methodology of the study. First, the sample size for both study sites should ideally have been closer to 400 which would have given higher precision levels (Glenn, 1992). As a result, generalization of the results was impacted. Arguments could be made for treating the article as a pilot study for measuring traceless travel, but this requires further discussion. Furthermore, some limitations can be attributed to the survey instrument itself. At the current time there exists no single tool for measuring attitudes towards traceless travel. A questionnaire was developed inspired by measures used in researching attitudes towards Leave No Trace (Blye & Halpenny, 2020; Coulson et al., 2021; Lawhon et al., 2017; Wade M. Vagias et al., 2012) and using available guidelines on traceless travel (Jakhelln, 2021; Miljødirektoratet, 2016; Naess, 1989). New questionnaires normally require a substantial validation process, and while this study took some steps to ensure a degree of validity, more work is required to properly validate the measure.

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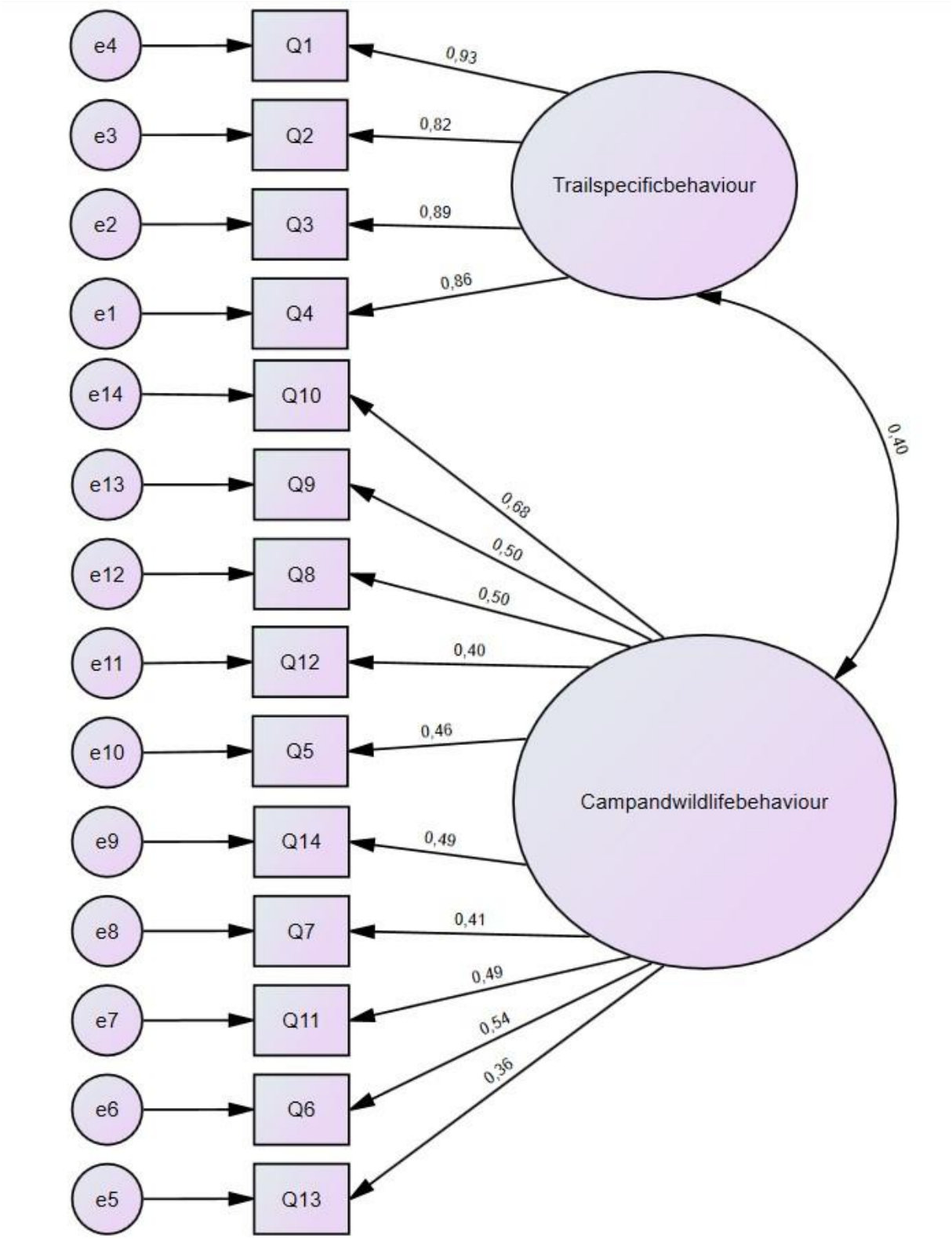
13. Attachments

Attachment 1: Confirmatory factor analysis



Attachment 2: Questionnaire

On a scale ranging from 1 = Very inappropriate to 7 = Very appropriate, indicate by checking of a box how appropriate it would be to:

1. Hike off trail to experience the natural environment						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
2. Hike off trail to experience scenic views						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
3. Hike off trail to explore hidden areas						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
4. Walk around muddy spots on the trail						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
5. Place a tent in an undisturbed spot, when camping in heavily used areas						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
6. Dispose of waste in a campfire						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
7. Bury used toilet paper						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
8. Move rocks away from where I plan to place my tent						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate

9. Alter a campsite so that it is more desirable						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
10. Have a campfire where there is no existing fire pit						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
11. Leave pieces of charred wood next to a fire pit						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
12. Allow your dog off leash						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate
13. Approach wildlife to take photos						
Very inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Very appropriate