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NINA Report

# Testing visitor management strategies to reduce human waste in a highly visited national park in Norway

## Facilitating a new environmental norm for visitors to Lofotodden National Park

Rose Keller, Sigrid Engen, Sofie Selvaag





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# Testing visitor management strategies to reduce human waste in a highly visited national park in Norway

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Rose Keller  
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Member of the research team stands by the Biffy bag box and educational sign to intercept visitors to the national park © Signe Raft-evold Rue

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## Abstract

Keller, R., Engen, S. & Selvaag, S. 2023. Testing visitor management strategies to reduce human waste in a highly visited national park in Norway. NINA Report 2385. Norwegian Institute for Nature Research.

In 2021, the Norwegian Institute for Nature Research (NINA) carried out waste surveys (i.e., mapped the presence of different types of waste such as human fecal material and toilet paper, wet wipes, plastic, tobacco products, foil, and other litter) in Lofotodden National Park (NP). The background for the investigations was that the national park administration expressed concern about increased visitor numbers and the impact on the environment. The Lofotodden NP manager and protected area board also reported that the local population noticed more waste, including human feces, especially in the Kvalvika area. These investigations showed that human feces made up a large part of the waste, and that it impacted the water quality in the area. It was therefore decided that further investigations were needed to confirm the source of fecal pollution in surface water and understand the potential consequences of human waste on the visitor experience and the natural values of the area, including biodiversity in streams. We also determined we needed to understand the likelihood of visitors adopting future measures to deal with human feces. By the end of 2021 and throughout 2022 we developed a thorough protocol for assessing both the quantity of feces and the impact on water quality and visitors, along with a series of visitor surveys and interview questions to derive a tailored solution for reducing feces accumulation in highly popular areas in Kvalvika in Lofotodden NP.

In this report, we describe the final results from our mixed methods study on visitor impacts and behavior, along with the experience of visitors to the Kvalvika area using the Biffy bag portable toilet. We document how human feces and toilet paper left behind in the park can affect visitors' experience of nature, as well as impact the water quality and health of visitors. We also describe human health and environmental effects (i.e., water quality of local streams) from human waste during the control periods (no Biffy bags) compared to the improvement in water quality in the treatment periods (Biffy bags given to visitors). Finally, we conclude with recommendations for further measures, as well as the need for further research to understand the long-term effects of encouraging visitors to use toilet bags in Lofotodden National Park.

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## Sammendrag

Keller, R., Engen, S. & Selvaag, S. 2023. Testing visitor management strategies to reduce human waste in a highly visited national park in Norway. NINA Report 2385. Norwegian Institute for Nature Research.

I 2021 gjennomførte Norsk Institutt for Naturforskning (NINA) avfallsundersøkelser i Kvalvika i Lofotodden nasjonalpark. Blant undersøkelsene inngikk en kartlegging av mengden av ulike typer avfall som menneskelig avføring, toalettpapir, våtservietter, plast, sigarettneiper, snus og metall i et begrenset område. Undersøkelsene ble gjort med bakgrunn i at nasjonalparkforvaltningen uttrykte bekymring for økende besøksantall og påvirkningene dette kunne ha på naturen. Nasjonalparkforvalteren og nasjonalparkstyret rapporterte også at lokale ga uttrykk for en økning i mengde avfall, inkludert menneskelig avføring og toalettpapir, spesielt i Kvalvikaområdet. Avfallsundersøkelsene i 2021 viste at menneskelig avføring og toalettpapir utgjorde en stor andel av avfallet og at det påvirket vannkvaliteten i området. Det ble derfor bestemt at videre undersøkelser var nødvendige for å kunne vurdere omfanget av forurensningen og for å forstå konsekvensene menneskelig avføring kan ha for besøksopplevelsen og naturverdiene i området. Det ble også fokusert på tiltak som kunne gjennomføres for å redusere avfallet og på hva de besøkende mente om eksisterende do atferd og muligheten for å endre denne. I 2022 ferdigstilte vi en detaljert protokoll for å dokumentere mengde toalettavfall etterlatt i naturen og påvirkningen dette har på vannkvaliteten og besøksopplevelsen. Vi gjennomførte også en rekke brukerundersøkelser og intervjuer for å utvikle passende tiltak for å redusere toalettavfall på de mest brukte områdene i Kvalvika.

I denne rapporten beskriver vi resultater fra studien om menneskelige påvirkninger og atferd knyttet til toalettavfall ved Kvalvika og uttesting av toalettposer (Biffy bags) sommeren 2023. Dette er tilpassede poser som kan tas med på tur og kastes i avfallscontainere etter bruk. I rapporten viser vi hvordan dagens nivå av menneskelig avføring i området kan ha negativ effekt på vannkvalitet og påvirke folks helse. Avslutningsvis kommer vi med anbefalinger for videre tiltak, samt behov for ytterligere forskning for å forstå langtidseffektene av å oppfordre besøkende til å bruke toalettposer i Lofotodden nasjonalpark.

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## Foreword

In 2021, NINA investigated the extent of littering in parts of Lofotodden NP. The background for the investigations was that the national park administration expressed concern about increased visitor numbers and potential consequences on nature. The NP also received complaints from the local population about waste in the Kvalvika area. NINA's initial waste survey of the Kvalvika beach, Torsfjorden trail and Ryten area of Lofotodden NP revealed that soiled toilet paper and human feces made up the majority of waste occurrences registered, and that the water quality in the area was impacted by fecal pollution, possibly from humans. It was therefore decided that further investigations were necessary and that future measures should focus on reducing human feces. In this report, we review prior years' mapping of waste in Kvalvika. We describe how visitors perceive their waste behaviors and what effects human waste has on nature and human health in Kvalvika. In early 2023, we had a meeting with the local reference group in Lofoten to discuss possible management measures to test. The group explored different options, including toilets, and decided to trial portable toilet bags first. This gave us the opportunity to test a new Leave No Trace (Sporløs ferdsel) tool – the Biffy bag; a portable toilet bag people use, close and then bring it out again in their backpacks. In the report, we describe how we tested the effectiveness of this tool for reducing human waste in Kvalvika. Finally, we make recommendations for measures that can potentially influence people's behavior so that waste in natural areas is reduced. The methods used are visual mapping of waste and other littering in selected areas, water and soil samples, survey/interviews with visitors and behavioral observations.

This report culminates three years of fieldwork in Lofotodden NP. The work has been financially supported by Lofotodden NP, the Norwegian Environmental Agency, and the Norwegian Institute for Nature Research SATS grants. This work has benefitted a lot from advice from international scholars in leave no trace and recreation studies, specifically, Derrick Taff, Peter Newman, Ben Lawhon, Nathan Reigner, Vegard Gundersen, Bjørn Kaltenborn, and Todd Brinkmann. The team was also supported by many colleagues in NINA, including Annette Taugbøl, Yosra Zouhar and Jon Museth. We would like to thank Signe Raftevold Rue and Helena Slater for their fantastic help, hard work in the field and dedication to this work in 2023, and Hennie Lindøe og Eirik Sønstevoid for their dedication to the work in 2021. Despite long workdays they always remained positive. We thank Ingrid Engen for help during the first waste mapping in 2021, Mark Keller for help during field waste mapping in 2022 and Helena Slater for her invaluable work entering in survey data and conducting initial data analyses. Thanks to Leif and all the crew in Indresanden for their dedication to this project and for helping to keep us informed about the status of the bags, the surveys and the number of people. Thanks to Lofoten Avfallsselskap for their contribution to the project in donating time to place and empty the specially designed Biffy bag bins. A very big thank you all from the local reference group especially Line Samuelsen, Kristin Jensen, Signe Raftevold Rue, Ole-Jakob and Brit Grønmyr for their help with beach clean up. Thanks to BYRAA designers for their work designing the signs and bin covers. Karl-Henrik Kirksæther at the Visitor Centre for Lofotodden National Park saved the day and provided additional Biffy bags for our project, so thank you! The local reference group was instrumental to the design of this project and we are very grateful for all their insights and support, especially Lofoten Avfallsselskap, Lofoten Friluftsråd and Destination Lofoten. And as always, a big thank you to the national park manager, Ole-Jakob for his support, active fieldwork help, and contributions over the years for this work.

Rose Keller (project leader), Sigrid Engen and Sofie Selvaag  
15.12.2023 Lillehammer

# 1 Introduction

Research in the Nordic context (including Iceland, Norway, Sweden and Finland) has elucidated the increasing frequency of tension points between *allmannsretten* (the public right to roam) and conservation of nature within national park, or other natural attractions. Though commercialization of Norwegian nature and its related consequences have been noted by scholars for decades (see e.g. Kaltenborn et al. 2009), tensions have emerged in recent years due to the absolute number of tourists together with the expansion in activities offered within nature-based tourism, which can outpace the capacities of national park/protected area managers and communities (Fredman 2021; Fredman & Margaryan 2021; Haukeland et al. 2023). Waste is an issue faced in parks and protected areas around the world. Especially problematic is the growing problem of improper disposal of human feces and related toilet waste.

Lofotodden National Park (NP) administration expressed some concern about increased visitor numbers and the impact on the environment in 2021. The Lofotodden NP manager and Board also reported that the local population noticed more waste, including human feces, especially in the Kvalvika area. Pilot mapping in summer 2021, in addition to two masters students theses (Lindøe 2022; Sønstevold 2022) about visitor experience to the area, revealed a problem of human waste on the beach and negative impacts on overnight tourists. It was therefore decided that further investigations were needed to confirm the source of fecal pollution in surface water and understand the potential consequences of human waste on visitor experience of nature and the natural values of the area, including biodiversity in streams. We also determined we needed to understand the likelihood of visitors adopting future measures to deal with human feces. By the end of 2021 and throughout 2022 we developed a thorough protocol for assessing both quantity of feces, impact on water quality and visitors, and a series of visitor surveys and interview questions to derive a tailored solution for reducing feces accumulation in highly popular areas in Lofotodden NP.

The accumulation of human feces in quantities and in places that are unsustainable is not a problem unique to Norway. Research in human waste management systems in challenging and inaccessible places has a long history of documenting and testing effects on soils, water quality, and human health in backcountry settings (see e.g. Ells & Monz 2011). Likewise, effects of 'wild pooping' have been

documented and trialed against different leave behind, bury, or personal pack out systems. The science around fecal decomposition in alpine, sandy, high alkaline soils and cool climates has also converged on longer decomposition times than previously assumed (between 8 – 50 weeks), which allows for harmful (or alien) bacteria, protozoa and some parasites to reproduce for long periods (Cooke et al. 2020; Smart et al. 2022). The most visited places in Lofotodden NP are characterized by sandy or alkaline soils in cool climates which elongates the decomposition time of feces. Moreover, the human and economic resources needed to maintain disposal systems such as toilets can be prohibitively complicated in backcountry settings. Thus, human feces management in nature is highly context specific. One solution for human feces in wilderness settings in North America has been the use of a person pack-out toilet: a waste alleviation and gelling (WAG) bag. One type of WAG is a Biffy Bag — a double bag that contains chemicals to dry and neutralize the smell of the feces. After use it is triple sealed and packed into a person's backpack, to get thrown away at the end of the trip. Some parks have systems where the green (bio) inner bag is tossed into compost systems, and the outer (heavy duty triple seal plastic) is reused.

### **Sporløs Lofotturisme Project Aim:**

*Reduce amount of human fecal and toilet waste left behind in Lofotodden National Park through communication interventions targeted towards visitors to Kvalvika Beach.*

### **Project Milestones 2022 - 2023:**

- Map human feces and toilet waste
- Compare water quality in high use vs. low use areas
- Assess attitudes and preferences of visitors to Kvalvika
- Experimental testing of management interventions(2023)

This study's primary aim was to reduce the amount of human feces, toilet paper and wetwipes (**hereafter: toilet waste**) left behind at Kvalvika beach in Lofotodden NP. The management interventions (treatments) evaluated in this study included an array of site management actions compiled from prior literature and in collaboration with a local Lofoten reference group (see Table 9, pg 31). After consultation with the park manager, the national park board, and a local reference group for the Spørsløs Lofotturisme project (including Lofoten Waste Authority, Lofotrådet, Friluftsrådet, and Destination Lofoten (tourism)) the solution we determined to test was a personal toilet pack-out system, using the Biffy Bag. The communication interventions were two types of signs (educational sign and a promoter sign) and speaking with each incoming overnight visitor (personal contact) during our daily sample times (Table 1). Other solutions, such as toilets in the park were considered, but packing out waste was deemed the most feasible solution. Building and maintaining toilets would be costly and undesirable given that park regulations are strict when it comes to infrastructure development within park borders.

We set up a field experiment to test the effect of two different treatments on the toilet waste in Kvalvika in summer 2023. Treatment one included educational signs (passive communication) and free Biffy Bags, while for treatment two we also added active (personal contact) communication. This work builds on research and field activities carried out in 2021 and 2022 (for more details see Keller & Engen 2022; Selvaag et al. 2022). Waste mapping occurred between June 13 and July 27. The field experiment in 2023 occurred between July 7–27, comprising a control period with no signs and two experimental periods featuring the different sign/personal contact treatments (see figure 1). Between each period, we ensured that beach areas under investigation were cleaned up to maintain a zero-baseline at the start of each new experimental period. Importantly, the transition between experimental periods were coordinated to ensure no effects from one test period “spilled over” into a new test or control period (spill-over effects). For all statistical analyses we used the second control period for comparison.

June 13 – July 7		July 8 – 15		July 16 – 22		July 23 – 27	
Control	Map, clean	Passive	Map, clean	Active	Map, clean	Control	Map

Figure 1. Timeline for fieldwork summer 2023 in Kvalvika. Mapping and cleaning up of monitored hotspots 1 - 5 occurred the final day of each test period.

Two field workers used ArcGIS FieldMaps to survey all beach areas with known challenges (5 hotspots) in Kvalvika to determine the amount and distribution of toilet waste. Type of waste was based on simple categories: 1-human feces + toilet waste, 2-plastic, 3-other. The waste at each hotspot was systematically documented at the end/start of every new experimental period (4 rounds total).

Automatic trail counters (TrafX<sup>®</sup> with pyroelectric sensor) were used to measure daily visitor use. One counter was placed at each marked trail leading up to Kvalvika from Torsfjorden, and a second one was placed at the confluence of the Ryten/Kvalvika beach trail from the north side of the beach. Trail counters provided total visitor counts for the treatment and control periods. Total visitor counts were divided by total waste observed during each control and treatment period for a waste per capita measure. Ideally, we would have liked to capture daily variation in waste accumulation, but this would have required daily waste mapping, which would have required a lot more time dedicated to field work.

In this report, we describe the final results from our mixed methods study on visitor impacts and behavior, along with the experience of visitors to the Kvalvika area using the Biffy bag portable toilet. We also describe human health and environmental effects (water quality, degradation of vegetation in feces hotspots) of current levels of human waste and show how Biffy bags delivered

free-of-charge together with passive and active communication improve the situation. We also report how visitors experienced reading the educational signs or being personally talked to about using Biffy bags. Finally, we make recommendations for management trials and the need for future research to understand the longer-term effects of encouraging visitors to use Biffy bags for their toilet needs in Lofotodden NP.

## 1.1 Direct versus indirect behavior modification: encouraging compliance through communication

Management approaches can be considered on a spectrum of direct to indirect actions (Marion, 2016; Schwartz et al., 2018). Direct management targets visitor actions and their associated (negative) outcomes on the local environment (Manning, 2010). Typical direct management actions compel appropriate behavior through regulations or site management measures such as rope fencing to physically restrict behavior. Direct tactics are often effective in changing visitor behaviors due to enforcement but can be intrusive to the quality of visitor experiences (Ham et al., 2008). Indirect management actions, by contrast, leverage communication interventions to minimize depreciative behaviors by persuading visitors to make more environmentally friendly decisions (Brown et al., 2010; Howard et al., 2021; Schwartz et al., 2018). Early research has suggested that most depreciative behaviors are the result of unintentional behavior, not of malicious intent, and that such behaviors could be remedied through education-focused communication interventional messaging (Marion et al. 2023). By contrast, recent studies suggest depreciative behaviors are often a combination of (un-)awareness of consequences, ascription of responsibility on the management authority (“some park employee will tell me if I am doing something wrong”), and perceived difficulty in adopting an environmentally friendly/desired behavior (Selvaag et al., 2023). Persuasion therefore requires more than education and awareness building, such as appealing to ethics and moral norms. Common examples are the use of messages to inform visitor decisions and appeals to ethics as a persuasive technique for leave no trace (i.e. sporløs ferdsel) (Marion, 2014; Schwartz et al., 2018). Managers often prefer indirect tactics because they are less conspicuous in the visitor experience, though they are sometimes perceived by managers as less effective than direct tactics (Park et al., 2008), and in some cases have been empirically demonstrated to be less effective.

## 1.2 Additive effects of combining Passive and Active communication tactics

A degree of synergy may exist between direct and indirect tactics; combinations of direct and indirect tactics may be more effective in reducing noncompliant visitor behaviors. Research suggests that educational communication interventions may be effective in informing careless or unintentional behaviors, but also that direct and even obtrusive measures are appreciably more effective at curbing intentional depreciative behaviors (Howard et al., 2021). Our recent review (Selvaag et al., 2023) of changing visitor behaviors through communication reveals additive indirect (passive) and direct (active) communication interventions resulted in notable changes in observed behaviors, though this has been rarely addressed in the literature (a notable exception is Park et al., 2022).

## 1.3 Facilitating a new norm in visitor behavior in national parks based on the Theory of Planned Behavior and Communication theory

Several communication interventions have been formed based on the theory of planned behavior (TPB) to make visitors more aware and educated on the impact their behaviors have in national parks. TPB states that (changed) behaviors are indirect antecedents from individuals' attitudes, norms, and perceptions of difficulty in adopting a new behavior. TPB suggests we can alter people's behaviors if we understand how people think about an issue (**attitudes**), how they think they *should* behave (**norms**), and how easy or difficult it would be for them to change (**perceived behavior control**). Understanding these three factors means we can design communication interventions (e.g., signs) that are relevant to the problem and relevant to the people reading/hearing the message. Miller et al. (2020) looked at challenges of increasing visitor numbers in U.S.

national parks, especially amounts of generated waste, and how to communicate to visitors to reduce littering and improve recycling behaviors. The authors' findings suggest that most visitors' attitudes and norms were pro-environmental and reflected high individual knowledge about proper no-litter and recycling behavior. However, visitors perceived changing their habits to be difficult. Through indirect (signs) and direct (infrastructure) interventions that reminded visitors of their morals (pro-environmental attitudes and norms), littering was reduced by 70% over three years. They concluded that additive measures of communication interventions based on attitudes and norms, combined with strategically placed waste bins, re-affirmed the desired behavior and effectively reduced some negative impacts of high visitation to national parks.

Typically, TPB provides a start to understanding what needs to happen to change behavior and communication theory such as the **route to persuasion** (part of the Elaboration Likelihood model (ELM) is used to design a communication intervention linked to the desired behavioral change. A primary reason for combining the two theories is to minimize the notorious 'intention-observed behavior' gap, in other words, people tend to report higher likelihood of changing behaviors than actually doing so (Selvaag et al. 2023). Firstly, people evaluate messages based on the perceived merits of content (called the central route to persuasion). For example, we reinforced visitors existing attitudes by mentioning the unique and vulnerable coastal tundra landscape. We elicited attention to the un-natural amounts of feces in the beach area by pointing out *E. coli* risks. Secondly, people evaluate messages based on the mode of delivery (called the peripheral route to persuasion). We tested two ways of delivery, namely placing the educational sign prominently at the start of the trail, and personal contact (speaking) with each incoming visitor.

## 1.4 Research needs and hypotheses

This study extends previous research in encouraging leave no trace behavior for visitors in national parks via communication and behavior determinants theories. Specifically, we addressed three knowledge gaps identified in the literature. First, we measured the quality of the natural resource (water, visible environment) as well as assessed people's nature experience before and after onsite management treatments. Second, we tested an additive treatment effect of passive and active communication interventions to encourage visitors to change their behavior to be less impactful. Third, we tackled a particularly challenging behavior to change — going to the toilet in nature — whereas the scholarship on changing visitors' behaviors has primarily focused on 'electable' behaviors (such as travelling off-trail or littering) (Selvaag et al. 2023).

Our work was guided by the following hypotheses:

- (1) Treatments consisting of free Biffy bags and passive and/or active communication are more effective in reducing toilet waste and improving water quality than no treatment.
- (2) A treatment consisting of free Biffy bags, passive (signs) *and* active (personal contact) communication intervention is more effective in reducing toilet waste than a treatment consisting of free Biffy bags and passive intervention only.
- (3) The potential for change (people's *intentions* to change) will be greater than measured change (*observed* impact of people's behavior).

We test hypotheses 1 and 2 by launching two different trials of communication tactics of the same length and measure the quality of the environment and quantity of fecal sites between each trial period (refer to figure 1). The outcome measured is the average *waste per capita*, that is, the number of feces sites we register between each communication period divided by the number of overnight visitors to the beach during each trial period. We test hypothesis 3 with a GLM model based on the visitor survey results and descriptively compare visitors' intentions to use a biffy bag, with the waste per capita reduction measured by the mapping and tracking of visitors to the beach.

## 2 Methods

We tested several communication and determinants of behavior theory-derived educational messages and site management tactics in combination via an experimental onsite design. The practices applied and evaluated in this study were compiled based on a review of the communication for sustainable behavior literature (see Selvaag et al. 2023) and consultation with Lofotodden NP and a local reference group. Our interview guide and survey were developed using these theories and past research from North America and Australia which has focused on people's behavior when it comes to cleaning up pet waste (Romo 2018). To our knowledge, our study is the first to specifically address human feces, as well people's preferences for waste mitigation through field observations, quantitative surveys and qualitative interviews (i.e., a mixed methods design). We complement our visitor data with water quality and environmental DNA analyses to assess potential health hazard of human waste in the area. Environmental DNA samples are being analyzed and results are therefore not presented in this report. We analyzed the data using analysis of variance (ANOVA) and generalized linear models (GLMs) in addition to descriptive statistics.

### 2.1 Study area

Kvalvika is a 2 km stretch of beach that is reached by a 1.7 km trail from Torsfjorden trailhead or a 2.5 km trail from Indresanden trailhead. This is a popular natural attraction with accessible summits, a small beach for camping under the midnight sun, and cultural sites. There is parking lot access from Torsfjorden and Indresanden (figure 2). Torsfjorden is an informal parking area, whereas Indresanden provides services and more parking options for a fee. There are toilets established at both parking areas, but Torsfjorden is frequently closed due to insufficient water supply (during 2023, the toilet was closed from June through August, in 2022 the toilet was closed from mid-July through August). From Torsfjorden, the majority of visitors take the route in and out the same way; an average of 280-300 visitors per day in July. The visitation density (averaged visitors per hectare) in Lofotodden National Park is 6,5/ha which is near the density of visitors per hectare in two of the most visited national parks in the North America: Grand Canyon (9/ha) and Yosemite National Parks (7/ha).



Figure 2. Map of study area. Red dots are the formalized trailheads to Kvalvika and are also the survey, Biffy bag, and treatment sites where the team intercepted incoming and outgoing visitors.

Waste accumulation is a salient management concern because of the visitor density, but also due to the coastal tundra and dune vegetation as recovery rates and decomposition rates of fecal material and toilet paper are low in Lofotodden's shallow, sandy, anaerobic soils (GeoData Norge 2023; figure 3). This landscape contains a variety of trail environs: patchy dune grass, thick coastal meadow, scree and scarp, and beach (figure 4). The meadow area above the beach creates a natural camping area. Areas further away from the beach get too steep to camp. Large boulders and a depressed stream-bed function as toilet areas, as these features provide shelter.



*Figure 3. Sandy and aerobic soils contribute to slow decomposition as well as quantity and frequency of people using the same areas (hotspots) to leave feces and toilet related waste (Photo: Rose Keller).*



*Figure 4. Kvalvika beach with informal trails leading to different campsites and boulders for toilet activities.*





## Treatments

We tested two treatments, as already mentioned. Treatment 1 (T1) included free Biffy bag and an educational sign, whereas treatment 2 (T2) included free Biffy bag, educational sign and active communication (Table 1, figure 5).

Table 1. Description of the type of communication interventions the project tested during the period between July 7 – July 27. Treatment 1 included an educational sign and the Biffy bag box. Treatment 2 included one of the research team interacting with overnight visitors to tell them about the Biffy bag, and the Biffy bag box was in place.

INTERVENTION	PURPOSE	INTERVENTION TYPE
<b>EDUCATIONAL SIGN (TREATMENT 1)</b>	Communication, education about leave no trace and instruction for use of Biffy bag	Educational, Passive
<b>BIFFY BAG BOX PROMOTER SIGN (TREATMENTS 1, 2)</b>	Delivery of free Biffy bags to visitors	Site management, Direct
<b>PERSONAL CONTACT (TREATMENT 2)</b>	Communication and instruction for use of bag	Educational, Active


Please don't leave your toilet waste in the national park





**Bring along these custom-made toilet bags on your hike – for the sake of nature, your own health and the health of others.**

Ta med deg disse spesialtilpassede toalettposene på turen – av hensyn til naturen, din egen og andres helse.

1. Take one or more toilet bags for your trip. The bags are specially designed for human feces.
2. Each bag is easy to use and comes with instructions: poop directly into the bag and put toilet paper inside.
3. You must carry the used bag(s) out of the national park. Used bags are hygienic, odorless and safe to store in your backpack.
4. Throw away used bags in the designated waste containers, located at the trailhead parking areas (Torsfjorden or Indresand).

1. Ta med deg en eller flere toalettposer på turen din. Posene er spesialtilpasset for menneskelig avføring.
2. Posene er enkle å bruke og på hver pose står det beskrevet hvordan de skal brukes: bæsje rett i posen, og legg toalett papiret oppi.
3. Brukte poser kan trygt legges i sekken og skal bæres ut av nasjonalparken. Posene er hygieniske og luktfrie.
4. Kast posene i egne avfallscontainere på parkeringsplassene ved stistart (Torsfjorden eller Indresand).

**Caution! Water from the stream is unsafe to drink unless treated.**  
Due to high ecoli values from toilet waste, the water must be boiled or disinfected before use. Advarsel! Ikke drikk vann rett fra bekken, du kan bli syk. Grunnet høye ecoli-verdier fra toalettavfall, må vannet kokes eller desinifiseres på annen måte for bruk.

Figure 5. Educational sign used for testing effect of passive communication tactic to encourage visitors to use a Biffy bag for their trip into the national park.

Passive messaging (T1) using only signs took place from July 8–15 at the Torsfjorden and In-dresanden trailheads. During this period, the team observed people's engagement with the educational sign (figure 5) and Biffy bag box prompter sign, delivered visitor surveys, monitored the human waste hotspots on the beach, and took water samples.

Active messaging (T2) through personal contact took place from July 16–22 at the Torsfjorden trailhead. During this period, the team talked to overnight visitors to Kvalvika, observed people's engagement with the educational/information sign and Biffy bag box prompter sign, delivered visitor surveys, monitored the human waste hotspots on the beach, and took water samples.

During control periods, the team delivered visitor surveys, monitored the human waste hotspots on the beach, took water samples, and established or removed all experimental signs and Biffy bag boxes.

In-between treatment and control periods the hotspot areas were cleaned, and the amount of toilet waste was measured using ESRI FieldMaps to document each site of human feces and related toilet waste. The sites were recorded as "human feces, toilet waste" or "other." The "other" category (including food waste, plastic, clothing/equipment, among others) was explored post-survey for context, but not taken into analysis.

We know from previous reports and trail counter numbers that most visitors arrive/depart at the trailhead in Torsfjorden from 0900–1300, and 1800–2100. The team sampled visitors on average 10 hours per day from July 4–July 27. One team member sampled every returning group for a visitor experience survey. Another team member intercepted every ingoing overnight visitor to educate about the use of Biffy bags and deliver a bag to each member of the group, along with a QR code to take the survey afterward. A final team member conducted field observations, measured water quality, mapped waste, and sampled visitors the other team members could not reach. Due to visitors' having high environmental attitudes and general willingness to adopt to new rules to protect nature (Keller & Engen, 2022; Selvaag et al., 2022), these treatments were developed to evaluate the efficacy of various site management techniques along with their integration and possible synergistic effects.

The use of National Park symbols and onsite placement of signs for any given treatment were used to investigate theoretical rigor of COMM-B and TPB (described earlier) in encouraging desired behaviors. To corroborate the effectiveness of the message, the research team collected surveys from visitors about their reactions to the messages about human feces disposal and the mandate to use the Biffy bag they read on the sign or heard from others. The working causal models for this project are presented in Figures 6 & 7, where we assessed the effect of a particular treatment (in the figure, "sign" refers to treatment 1) on the outcome: feces/toilet waste per capita visitor to Kvalvika during July.

## 2.2 Causal model

To test hypothesis 1 and 2 we used an analysis of variance (ANOVA) model. This relationship is illustrated in Figure 6. Treatment refers to either passive or active communication period and the outcome is waste per capita. Treatments (the proportion of visitors receiving treatments) can be impacted by the weather, or general characteristic differences between visitor groups, such as age, gender, group size, and first time visit. The outcome can also be impacted by effects we did not measure in our survey or mapping, thus the 'unmeasured effects' is the standard error of the model. The data used to model this relationship is presented in table 2. The results of Model 1 (ANOVA) are presented in section 3.1 – 3.3.

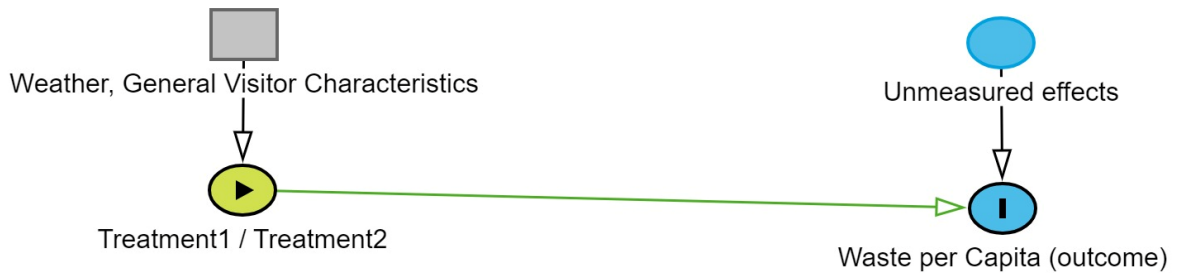


Figure 6. Model 1 (ANOVA). Green circle represents the communication treatments and control periods. Blue is the outcome waste per capita as measured at Kvalvika

To test hypothesis 3, we used a general linear model (regression). This relationship is illustrated in Figure 7. Treatment refers to either passive or active communication period and the outcome is waste per capita. General visitor characteristics refers to demographics such as age, gender, group size, residence, and experience. Visitor attitude and norms refer to specific visitor attributes we measured in our surveys relating to toilet waste and preferences. The outcome (Future Behavior) is the reported intention visitors had for using a Biffy bag during a future trip in nature. The outcome can also be impacted by effects we did not measure in our survey or mapping, thus the ‘unmeasured effects’ is the standard error of the model. The data used to model this relationship is presented in table 2. The results of Model 2 are presented in section 3.4. For future analyses, we will combine models 1 and 2 where we can directly model both the WPC and future intentions to directly compare effect size differences. In the present paper, we descriptively compare the estimates of likelihood to use a bag in the future (Model 2) with the estimates of WPC reduction from the ANOVA (Model 1).

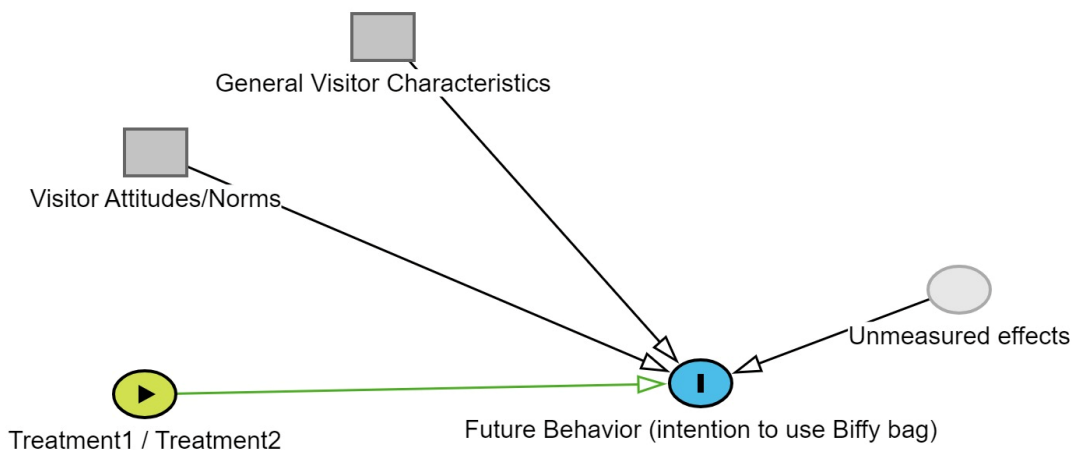


Figure 7. Model 2 (GLM). Green circle represents the communication treatments and control periods. Blue is the outcome future intention to use Biffy bag. Grey boxes are the visitor characteristics used to predict future intention (outcome), and grey circle represents the unmeasured effects on future behavior, standard error of the model.

Table 2. Model 1 and model 2 data elements. The input variables refer to the types of data we used to model the relationship between treatments and outcomes. The outcome variables are the data inputs we gathered to know if the treatments or visitor characteristics had any effect.

INPUT VARIABLES			OUTCOME VARIABLES	
Visitor counters	Visitor survey	Waste survey	Waste per Capita (M1)	Future Behavior (intention) (M2)
Variable distribution				
Continuous	Likert Scale (except where noted) 1 – 7, where 1 = highly disagree & 7 = highly agree	Continuous counts per hotspot	Continuous	Likert Scale 1 – 7, where 1 = highly unlikely to do in the future & 7 = highly likely
Data to generate waste per capita in 5 hotspots (M1)	<p>Investigate assumptions of continuity of visitor types affecting behavior and proportion receiving treatment (M2)</p> <p>How measured in visitor survey:</p> <p><b>Human waste Attitudes (C, T1, T2)</b></p> <p>Human feces decompose in nature quickly</p> <p>Burying waste is sufficient to protect nature</p> <p>Wet wipes decompose in nature quickly</p> <p>It is inappropriate if the park asks visitors to bring out their own feces<sup>1</sup></p> <p><b>Human waste Norms (C, T1, T2)</b></p> <p>I believe I should bury my feces</p> <p>I believe I should pack out my own feces using an appropriate bag</p> <p>I believe most people will leave their feces in the park</p> <p>Others expect me to take out my own feces using an appropriate bag</p> <p>I would prefer seeing toilets in this national park instead of packing out my own feces<sup>1</sup></p> <p><b>Individual items (C, T1, T2)</b></p> <p>I would prefer seeing toilets in this national park instead of packing out my own feces</p> <p>Did you see Biffy bags left behind by other visitors during your trip? •No • Not sure • Yes</p> <p>Have you noticed any human feces during your trip in Lofotodden National park? • No • Not sure • Yes</p> <p><b>Biffy bag use (T1, T2)</b></p> <p>Did you see the free Biffy bags at the start of the trail?</p> <p>Did you personally try to use the Biffy bag during your trip to Kvalvika?</p> <p>Difficult to take out my own feces and toilet paper in a Biffy bag?</p> <p>Difficult to carry Biffy bag(s) with me until I found a trash bin?</p>	Investigate distribution of feces and toilet waste, used to generate waste per capita in 5 hotspots (M1)	Measure of effectiveness of Treatments 1 or 2 as the sum of all waste mapped on the beach divided by the number of overnight visitors per week	<p>Assessment of visitors' intentions to use a Biffy bag or similar portable toilet bag for future visits to national parks in Norway, based on Visitor Survey when bag is free</p> <p>How measured in visitor survey:</p> <p><b>Future intention to use Biffy bag (C, T1, T2)</b></p> <p>Pack out my own feces &amp; toilet paper using an appropriate bag (e.g. Biffy bag) if they were readily available free of charge</p> <p>Pack out my own feces &amp; toilet paper using an appropriate bag (e.g. Biffy bag) if I could buy them for 30 NOK (approx. 3 Euros/dollars)<sup>2</sup></p>
Daily	Daily	1 x week	1 x week	Daily
<p>1. These items were reversed to match the positive direction of the other questions, so they could be made into an index of human waste attitudes or human waste norms.</p> <p>2. This item was used as an input variable in M2 by collapsing the likert scale to those who were highly sensitive to cost vs. those who were willing to pay for the bags (not sensitive to cost)</p>				

**Visitor characteristics as measured by visitor survey.** These characteristics are standard demographics in recreational studies such as: first time visitors, group size, age, gender. Assumptions here were that first time visitors, in smaller groups, older and female would take more time to read the educational sign about toilet waste and the Biffy bags. We recorded daily

weather and mosquito conditions as these could also affect visitors' time in reading a sign. From field observations we did not find that these had a significant pattern on sign-reading time, and weather and mosquito conditions were consistent for the entire study duration. Since the visitors at the different time periods were the same, the overall results should not be affected by first-time status, group size, age and gender.

**Visitor Attitudes and Norms.** These data include attitudes, preferences and intended behaviors (self-reported future use of Biffy bags). These characteristics were used in our GLM (M2) to predict people's intentions to use the Biffy bags in the future given their attitudes, norms, preferences, and willingness to pay for a bag on future trips. In M2 visitor characteristics were therefore used to predict intended behavior instead of waste per capita directly due to the mismatch of datapoints.

## 2.3 Mapping waste and water sampling

In summer 2022, we mapped the presence of human waste in June (baseline) and September (final). In June 2022 we examined the Torsfjorden trail and Kvalvika beach. After comparing our waste registrations with the waste mapping conducted by NINA in 2021 (Lindøe, 2022; Sønste-vold 2022), we identified five waste hotspots (green circles, figure 8) that we returned to and mapped in September the same year. Our team used the field mapping application, FieldMaps (Esri, 2023). In 2022 we registered all waste occurrences according to 10 categories. The main type of waste we recorded was toilet related (57% of all waste recorded: Keller & Engen, 2022).

Kvalvika map of hotspots A - E and water sampling site locations for fieldwork 2023: July - August

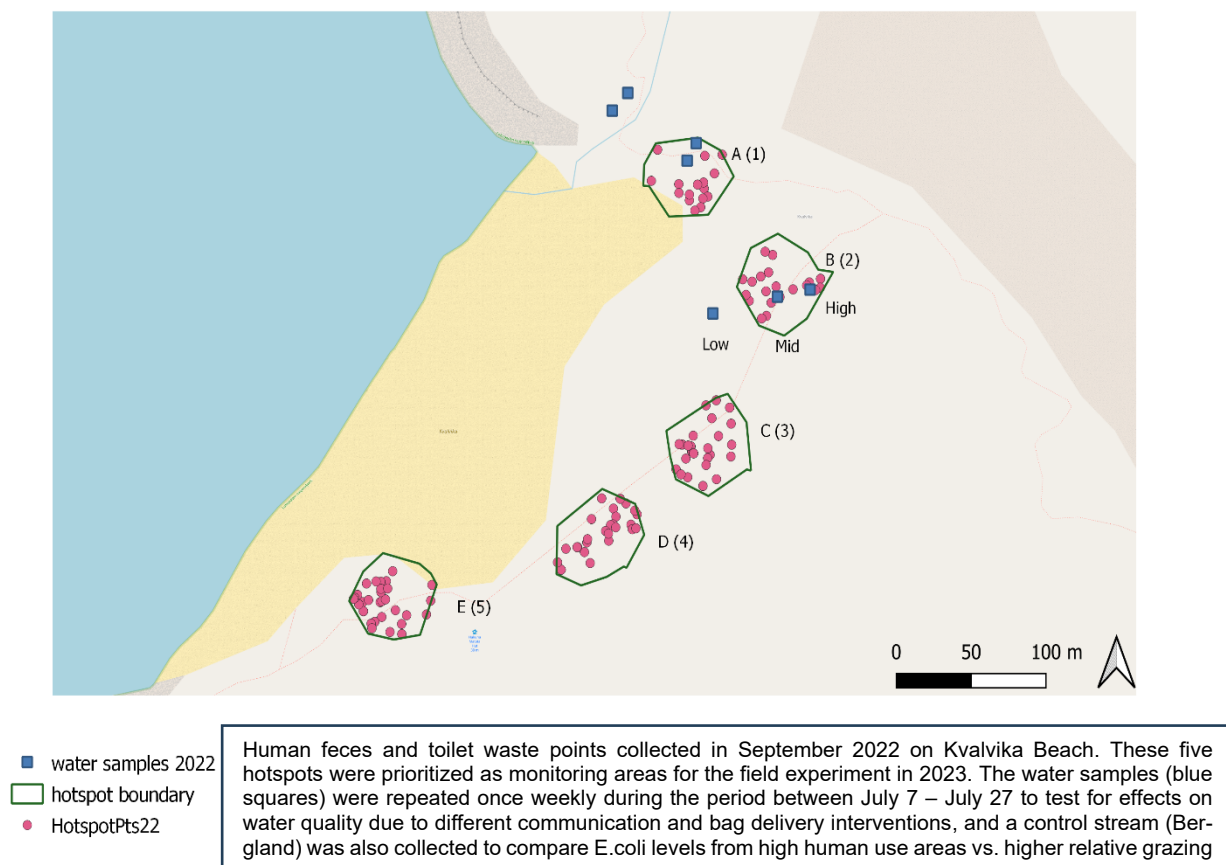


Figure 8. Map of human waste hotspots on Kvalvika Beach in Lofotodden National Park. Data presented here from 2022.

In July 2023, we mapped all five hotspots once per week, in accordance with the treatment/control plan.

We took water samples for water quality and environmental DNA (eDNA) analysis in July in two streams and 6 areas (figure 9) in Kvalvika. This was done because we observed toilet waste next to streams within the park that we also observed visitors utilizing for drinking water. We also took three samples from a control stream away from the highly visited area. The samples were sent for analysis to NINA's genetic laboratory, GenLab, for future environmental DNA analysis comparing 2022 and 2023 samples (results forthcoming). We took samples at the end of each treatment period to test effects of the three different test periods on the quality of water in Kvalvika. We took water samples before our clean up rounds and before launching a new study test period (i.e., between control and T1, between T1 and T2, and between T2 and a final control). These samples were sent to the local water quality testing station (EcoLab) in Sortland.



Figure 9a. Filtering water samples for environmental DNA analysis. (Photo: Rose Keller)



Figure 9b. Human waste sites directly next to stream at Kvalvika, with tents in the background. (Photo: Rose Keller)

## 2.4 Visitor surveys

Three surveys were developed for 2023 (See Supplement C for survey forms):

- A *control* survey targeting visitors' attitudes, preferences, future intentions to use a portable toilet bag, like the Biffy bag, and demographics (launched during the control phase of the project).
- A *treatment* survey targeting visitors' attitudes, preferences, experience with using the Biffy bag, future intentions to use the Biffy bag and demographics (launched during the treatment1 and treatment2 phase of the project).
- A *communication assessment* survey targeting visitors' experience of reading the information sign about the Biffy bags, or their experience during the active communication phase (treatment 2) of the project.

All three surveys were pilot tested on two groups of students (30 total) from the Norwegian Univ. of Life Sciences (NMBU) and University of Edinburgh. The treatment and control visitor surveys were developed according to a standard theory of behavior where individual behavior is found to be guided by general environmental attitudes, attitudes about a behavior, and the norms and perceptions of difficulty or ease of adopting a particular behavior (see table 6 for the mean visitor responses to these questions). We developed a short (2 pages) survey in both Norwegian and English (see Supplement C). We developed both an online and a paper version. This survey targeted visitors' perceptions of human feces in nature, appropriate behaviors according to their perception and perceptions of difficulty or ease in using the Biffy bags. The survey included assessments of visitors' knowledge of waste disposal, degree of concern about human waste in nature. The surveys were distributed in-person on site at Torsfjorden, or via QR code on the Biffy bags (figure 10). QR codes for the surveys were also distributed to local businesses and the visitor center in Reine and Ramberg.

The communication assessment survey (Supplement C) was developed according to standard communication surveys used in the national parks in North America in line with interpretation and persuasion theory (ELA). These short (1.5 page) surveys were distributed in person on site after an individual visitor or group of visitors read the sign or heard the message about using the Biffy bag. QR codes were not used for the communication survey due to potential recall (memory) bias. Our visitor survey measured characteristics which we presumed could impact visitors' cognition when deciding to take a bag or not. These characteristics encompassed visitors' own beliefs about proper waste disposal, their perceptions about using a Biffy bag for human feces disposal and preferences for non-bag solutions (i.e. toilets, or planning).



*Figure 10. QR code taped to each individual Biffy bag to encourage visitors to relate to us their experience of using the bag and connect actual bag use to visitor's response to use a Biffy bag during future visits to national parks in Norway.*

## 2.5 Field observations and trail counters

During the period of July 7–27, we made observations of visitors' time reading the information sign at the start of the Torsfjorden trail, visitor group size, estimated age, and language heard in order to corroborate survey findings. Field observation protocols also included counting tents on Kvalvika beach, and daily weather and mosquito reports. Observations were made according to standard observation sheets that were later digitized and entered into an excel file (later used in R software). Our research team also recorded the time spent reading the sign in T1, which was recorded every other day for a period of 1 hour during morning and evening. Trail counters were established in cooperation with Lofoten Friluftsråd at the start of Torsfjorden trail and the trail to Kvalvika from Ryten. These were in operation from May to October 2023, and have been repeatedly deployed during these months by Lofoten Friluftsråd since 2015.

## 3 Results

### 3.1 Passive, Active Treatments compared to Control conditions

Treatments incorporating a larger number of communication and site management techniques were compared against the control periods in deterring human feces accumulation on Kvalvika. To calculate reduction of feces, the team mapped each feces and toilet waste site within each hotspot. The total area was calculated and a buffer of 0.25 meter was established around each feces site. Where .25 m buffer radii overlapped, the overlapping areas were removed. In this way, we can estimate the area reduction of human feces and toilet waste per hotspots. Table 3 presents the total N toilet waste sites we recorded at the end of each test period together with the total overnight visitors in each period and the estimated WPC. It is the WPC that demonstrates the reduction of average toilet waste clearly for every visitor. The WPC for individuals in the control periods were 0.073 (baseline) and 0.066 (end). During T2, visitors left behind only 0.029 waste per person. These are small numbers, but with an average daily overnight visitor count of 74 in the month of July, these numbers add up.

**Table 3.** Efficacy of measures designed to encourage visitors to properly dispose of their feces in Kvalvika as determined by the percent of waste cover within each designated monitoring site (hotspot) on Kvalvika<sup>1</sup>

TREATMENT	% AREA WASTE IN HOTSPOT 1 (40M <sup>2</sup> )	% AREA WASTE IN HOTSPOT 2 (41M <sup>2</sup> )	% AREA WASTE IN HOTSPOT 3 (40M <sup>2</sup> )	% AREA WASTE IN HOTSPOT 4 (40M <sup>2</sup> )	% AREA WASTE IN HOTSPOT 5 (42M <sup>2</sup> )	TOTAL N WASTE <sup>1</sup>	TOTAL OVER-NIGHT <sup>2</sup>	WASTE PER CAPITA <sup>3</sup>
<b>0.CONTROL (BASELINE)</b>	23% n=9	23.5% n=10	24,1% n=10	16,9% n=7	25.2% n=11	47	642	0.073
<b>1. SIGN + BAG BOX (T1)</b>	14,4% n=6	7,1% n=3	16,9% n=7	14,4% n=6	11.5% n=5	27	639	0.042
<b>2. SIGN + PERSONAL CONTACT + BAG BOX (T2)</b>	7.2% n=3	9,5% n=4	12% n=5	7.2% n=3	9.1% n=4	19	651	0.029
<b>0.CONTROL (END)</b>	12% n=5	26% n=11	23% n=9	23% n=9	23% n=10	44	660	0.066

1. Waste mapped in June 2023 subtracted from waste mapped in July 2023 to adjust control period baseline waste
2. Estimated from our visitor survey sample: 32% of visitors surveyed were on an overnight trip into the park.
3. Harmonic mean  $n = .013$ ; Tukey's HSD post-hoc test applied to significance testing in ANOVA

Another way to examine the results is to look at the total waste coverage per hotspot. T1, incorporating one passive educational tactic (sign) and one site intervention (i.e., the box containing free Biffy bags) was significantly more effective than the control (no intervention) in deterring feces accumulation. For example, in hotspot 3, this amounted to a reduction of 8.5%. Specifically, from 25% human waste area in hotspot 3 during the control to 17,5% waste area in hotspot 3 during Treatment 1;  $\chi^2 = 64.17$   $p < 0.001$ , 1 df,  $n = 17$ , total overnight visitors T1 = 639).

T2 is descriptively more effective than the control period in reducing waste coverage. For example, in hotspot 3, this amounted to a reduction of 13% area covered by waste. Specifically, from 25% waste in hotspot 3 to 12% waste in hotspot 3 ( $\chi^2 = 122.0$ ,  $p < 0.001$ , 1 df,  $n = 15$ , total overnight visitors T2 = 651) (table 3).

The statistical analysis (ANOVA, table 4) showed that both treatments significantly reduced waste accumulation compared with control periods. The largest and most significant improvement was from the control period to T2 period (table 3). Evidence supports our hypothesis that treatments were effective in reducing human feces accumulation. We cannot say, however, that



the intervention with active (personal contact) was a significant improvement over the passive (sign) intervention (table 4, figure 11). General visitor characteristics were not significantly different from control and treatment periods, therefore visitor characteristics such as age and gender will likely not impact the results of the ANOVA (refer to table 5, sec. 3.4).

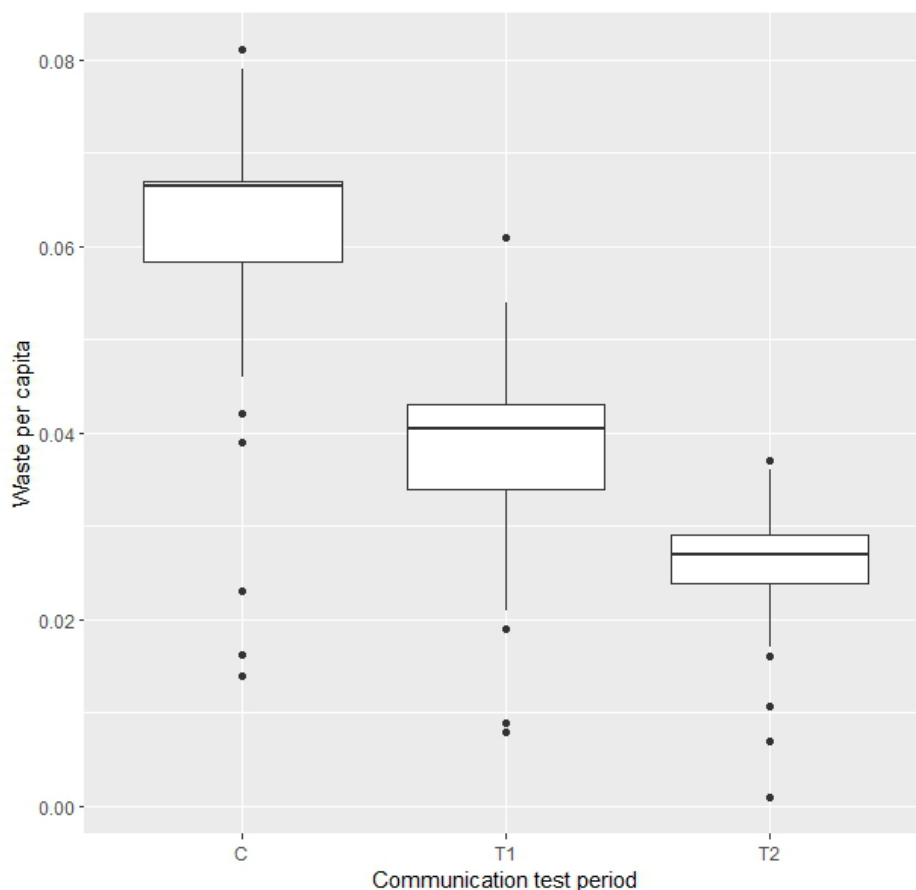


Figure 11. Box plot showing the distribution of total toilet waste per capita (total number of visitors in a test period / the number of registered toilet waste sites during that period) by Control, Treatment 1 and Treatment 2 groups.

Table 4. ANOVA (Model 1) results of communication intervention effectiveness in reducing waste per capita, with Tukey’s multiple comparisons of mean effectiveness with 95% conf. level.

TREATMENT	DIFFERENCE	LOWER	UPPER	P ADJ		
CONTROL (END) VS. TREATMENT1	-0.0214	-0.028	-0.015	0.001***		
CONTROL (END) VS. TREATMENT2	-0.0347	-0.042	-0.029	0.000***		
TREATMENT2 VS. TREATMENT1	-0.0132	-0.018	-0.007	0.01*	SumSQ	F-Value
GROUP					MeanSQ (DF)	pr(<.005)
RESIDUALS					.0268 (2) .0134 (2)	106.8***
					0.016 (129)	
					.0001 (129)	

### 3.2 Water quality: Rørholmen and Forsvatnet

There was a reduction in *E. coli* in both Rørholmen (the steam nearest to the hotspot with highest density of human feces) and Forsvatnet during the treatment periods as compared to the control period. There was no reduction in *E. coli* between treatments 1 & 2, but a large reduction from the initial control period. This is likely partly due to overall reducing fecal load after cleaning up the beach, but also due to the slower accumulation of feces during the treatment periods (see table 5). Intestinal coliphage are bacteria found in the guts of grazing livestock. The relatively low levels in Rørholmen and Forsvatnet compared to the control (Bergland) imply the *E. coli* stems from humans, rather than primarily from sheep grazing the area. Additionally, we tracked the visual status of vegetation in toilet waste hotspots and saw clear damage from high use in both trampling and pollution (figure 12), due to prior research that suggests that even limited visitor traffic can prevent recovery of disturbed areas (Ells and Monz, 2011), such as those plant communities destroyed by human feces accumulation.

**Table 5.** Water Quality Results for Rørholmen and Forsvatnet across the study periods: control, treatment 1, and treatment 2. All samples took place in Kvalvika in July 2023.

Location/Period	Rørholmen /Control	Rørholmen /Sign (T1)	Rørholmen /Active(T2)	Forsvatnet /Control	Forsvatnet /Sign (T1)	Forsvatnet /Active(T2)	Bergland (kontroll)
<i>E.coli</i> (cfu/100ml)	88	22	33	14	7	5	2
Intestinal coliphage	11	21	19	< 1	4	7	21



**Figure 12.** Evidence of vegetation damage in toilet hotspot on Kvalvika. Photo: Keller, July 2023

### 3.3 Visitor engagement with signs

From our amassed field observation sheet, we found the average time spent in front of the educational sign (T1) was 2 seconds. The median sign-reading time was 7 seconds, with a min of 0 seconds (43% of sample) and max of 2 minutes (> 1% of sample). We had another prompter sign directly on the box of Biffy bags at both trail starts. During our observation periods, 97% of visitors read this sign and responded by taking a bag (prompter sign read: If you are going to stay overnight on the beach: Take a Free Biffy Bag as your personal toilet).

### 3.4 Visitor characteristics: general demographics

In total, we collected n=363 visitor surveys, of which 99 were delivered in the control period, 104 delivered in treatment 1 period and 160 delivered in the treatment 2 period. Visitors were very similar across the control and treatment periods (see table 6). Thus, we assume that differences in WPC between control and treatment periods can be attributed to treatment effects and not differences in visitor characteristics (see table 4, ANOVA results). Additional visitor demographics are reported separately in Supplement B.

**Table 6.** Basic visitor demographics across control and treatment periods. There are no significant differences between the visitors in control and treatment periods.

Visitor Demographics	Control (n = 99)	Sign only (n= 104)	Sign & Personal Contact (n = 160)	T – test C v. T	T – test T1 v. T2
Mean Age	39	38.7	38.8	t(202) = 1.28 p<0.2	t(263) = 1.61 p<0.1
Gender (% Female)	58	52	54	t(202) = 1.29 p<0.3	t(263) = 1.65 p<0.2
Mean Group size (range: 1 – 29).	2.7	2.5	2.8	t(202) = 1.28 p<0.2	t(263) = 1.64 p<0.2
First time visitor (% of sample)	85.9	85	83.5	t(202) = 1.28 p<0.2	t(263) = 1.66 p<0.3

### 3.5 Visitor characteristics: attitudes and norms

These characteristics encompassed visitors' own beliefs about proper waste disposal, their perceptions about using a Biffy bag for human feces disposal and preferences for non-bag solutions (i.e. toilets, or planning). Visitors who report that burying feces is sufficient to protect nature were still on average compliant with the Biffy bag solution (see table 7). Visitors during the active treatment reported seeing less feces during their trip into the park, which corroborates our ANOVA and model findings. Those who subscribed to the notion that feces decomposed quickly, or that did not report seeing human waste as problematic reduced over the treatment periods, which may suggest the passive and active treatments were effective in conveying the message and improving compliance.

**Table 7.** The respondents were presented with a series of statements related to waste and were requested to assess each statement's alignment with their behavior during a trip in Lofotodden National Park. They rated each statement on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). Below are the averages for respondents from each test period. Note that the sample sizes vary due to the number of "NA" responses.

"human waste attitude" (mean values)	Control (n = 96)	Sign only (n= 102)	Sign & Personal Contact (n = 154)
Human feces decompose in nature quickly	5,7	4,1	3,3
Toilet paper decomposes in nature quickly	3,8	2,2	1,9
Burying human feces is sufficient to protect nature	5,5	4,5	3,7
Wet wipes decompose in nature quickly	0,2	0,8	0,1
Human feces left in nature do not negatively impact the environment	3,9	2,5	1,3
Human feces left in nature do not negatively impact the quality of people's nature experience	1,7	1,1	0,9
"human waste norm" (mean values)	Control (n = 99)	Sign only (n= 103)	Sign & Personal Contact (n = 159)
I should bury my own feces	6,4	5,5	5,7
I should take out my own feces using an appropriate bag	5,0	6,3	6,5
It is inappropriate if the park encourages visitors to take out their own feces using an appropriate bag*	4,7	5,3	6,0

I would prefer seeing toilets in the national park instead of being asked to take out my own feces*	3,9	4,6	3,1
Have you noticed human feces during your trip in the park? ( <b>proportion who answered Yes</b> )	,52	,31	,28
Have you seen Biffy bags left behind by others in the park? ( <b>proportion who answered Yes</b> )	NA	0	0

\*Reversed question when taken into composite variable so that direction of agreement is the same across all questions. Presented here in reversed form, higher means = higher disagreement with this statement.

Key takeaways for the **human waste attitude questions** (see Supplement A for graphical figures of visitor responses):

- Most respondents across control and both types of treatment survey selected “strongly disagree” for ‘Wet wipes left behind in nature decompose quickly’
- Responses to the statements “Burying human feces is sufficient to protect nature” and “Human feces decompose quickly” were more polarized (see Supplementary A). For example 29 to 38% agreed that burying waste is sufficient, 16- 18% neutral, and 48 – 54% disagreed.

Key takeaways for the **human waste norm questions** show that visitors were likely affected by the type of communication they received. We found that:

- During the passive and active treatments, a higher proportion of visitors believed they should pack out their own feces and toilet waste compared to the visitors sampled in the control periods.
- During the passive and active treatment periods, a higher proportion disagreed they should bury their own feces in the park compared to control respondents. However, still the majority of visitors agreed they believe they should bury their feces for appropriate waste management.
- During the passive treatment phase a higher proportion of visitors agreed with ‘I would prefer seeing toilets in this national park instead of packing out my own feces’, compared to the active phase, but overall this statement was contentious – with a wide spread of responses across both agree, disagree and not sure.

We can likely rule out that the differences were caused by differences in norms among visitors prior to interventions since the control survey norms were nearly the same as the norms reported by visitors in 2022.

See Supplement A for graphical figures of visitor responses to the human waste norm questions.

Our visitor survey measured characteristics we presumed would impact visitors’ actual use of the Biffy bag for their feces disposal. These variables we considered for measuring visitors’ intentions to use a Biffy bag in the future and were measured by a number of single statement variables (see table 8). For example, we included the averaged response per test period of visitors who stated they saw the free Biffy bags in the box at the start of the Torsfjorden or Indresanden trail. We assume those who did not see the free bags had higher potential to leave their feces behind in the park.

**Table 8.** Statements visitors responded to about using the Biffy bag during their trip into the national park.

Intentions to use a Biffy bag in the future ( <b>proportion who answered Yes</b> )	Control (n = 99)	Sign only (n= 105)	Sign & Personal Contact (n = 160)
Would you use a Biffy bag on a future trip in nature?	,80	,81	,82
Would you use a Biffy bag on a future trip in nature if you had to pay 30 NOK for each bag?	,36	,44	,55

"Biffy bag use" variables			
Did you see the free Biffy bags at the start of the trail?*	NA	,47	,77
Heard of a specially designed human feces bag before?	,11	,21	,20
Did you personally try to use the Biffy bag during your trip to Kvalvika?*	NA	,11	,26
Main reason you did not use the Biffy bag? (# visitors) †		<i>n</i>	<i>n</i>
I don't have one		28	48
I don't like using a Biffy bag		3	8
I haven't had the need to use one		53	61
No response		21	43

\*question for visitors during the treatment periods only

† frequencies shown for interest only, we did not include these items into the estimation

### 3.6 Model predicting visitors' intention to use Biffy bags in the future

Regarding hypothesis 3: *The potential for change (people's intentions to change) will be greater than measured change (observed impact of people's behavior)*, we developed a model to test intentions to use a Biffy bag in future trips to national parks in Norway and compare the effect sizes with the observed differences in estimated waste per capita in our earlier ANOVA model. As stated earlier, we will combine M1 and M2 to model the effect differences directly but can only compare the effect size differences between M1 and M2 in the present paper. We developed a generalized linear (logistic) model (M2) to test if visitor characteristics affect visitor behavior intentions to adopt bag use in the control vs. treatment periods as follows:

$$\begin{aligned}
 f(\text{intention to use biffy bag in future}) &= \delta + \beta(C, T1, T2) + \beta(\text{human waste attitude}) + \beta(\text{human waste norm}) \\
 &+ \beta(\text{noticed human feces}) + \beta(\text{biffybag cost}) + \beta(\text{age}) + \beta\varphi(\text{biffy use}) \\
 &+ \varepsilon
 \end{aligned}$$

Where  $\delta$  is the intercept of the model (intention to use Biffy bag at control),  $\beta(C, T1, T2)$  is the coefficient (effect) of the test period (T1: treatment 1; T2: treatment 2),  $\varphi$  are the individual survey items that relate to Biffy bag use variables (all three statements in table 3),  $\beta(\text{biffybag cost})$  is the variable of potential cost to visitors (30NOK) to use a Biffy bag, and  $\varepsilon$  is the error term (unobserved effects) on the outcome. The outcome — intention to use Biffy bag in the future — was made by collapsing the likert scale to a binary variable (disagree to neutral was coded — *will not use* and agree was coded — *will use*).

Table 8. Regression results from Model 2: Biffy bag use intentions based on visitors reporting attitudes, norms, and their demographic data.

Logistic Regression (M2) Results: model predicting likelihood of future Biffy bag use by visitors	Future Biffy bag use (intention) Results in logits	Standard error	z-value ( $p >  z $ ) * $p < 0.01$ *** $p < 0.001$
Treatment round (T1 – T2)	0.126	.531	.186(.12)
Human waste attitude	-0.191	.390	-.269(.438)
Human waste norm	4.098	1.32	2.86(.004)***
Noticed human feces	0.446	1.15	3.27(.231)
Biffy bag cost	-0.367	.701	2.84(.003)***
Age	0.441	.196	2.20(.027)*
Tried Biffy bag (yes)	2.87	1.65	1.73(.020)*
intercept	-12.26	5.018	-2.31(.003)***

Fischer iterations: 6. Adj  $R^2 = .58$ . AIC = 94.487; R code available

Results show the strongest predictor of intentions to use Biffy bags in the future is the human waste norm variable. The higher visitors scored on the 'norm' items presented in table 6, the more likely they reported they would use a Biffy bag in the future. This makes sense as norms are already 'usual behaviors,' so if people responded that 'I believe I should use a bag,' or that 'others expect me to use a bag,' the more likely they would report they would find it easy to use a Biffy bag in future visits to national parks in Norway. Conversely, the human waste attitude corresponded to a negative intention to use the bag. In other words, the more a visitor agreed that feces decompose quickly, and that they do not have a negative impact on the environment, the less likely they intended to use a Biffy bag in the future. However, this variable was insignificant which indicates attitudes in the composite variable we developed do not predict intention. However, this could be a consequence of making the attitudes items into a composite variable, instead of testing them individually. For example, a strong belief that feces harm the environment did have a strong positive correlation between this belief and intention to use a bag ( $p = .56$ ). In the present analysis, we did not test individual attitudes in M2 however for significance. If the individual was sensitive to the cost of a Biffy bag (reported disagreement to use if it cost 30 NOK), they were also less likely to report using a Biffy bag in the future if free. Higher ages also corresponded with higher likelihood to use the Biffy bag in the future, possibly due to more experience hiking, if we were to speculate. If a visitor noticed human feces, the likelihood of using a bag in the future was higher, however, this was non-significant and should not be taken as consequential.

Regarding hypothesis 3, the evidence presented here supports the assumption that visitors will exhibit stronger intentions to change behavior if human waste norms are strong. In other words, if a person tried the Biffy bag before, the likelihood is higher that the person would report intent to use the bag in the future. Likewise, if the human waste norm is strong, the likelihood of adopting the bag in the future is higher. Importantly, the effect of introducing a cost the visitor must pay to use a biffy bag in the future had a negative effect on the intention to use a biffy bag in the future for those visitors who are sensitive to cost. A likert plot (see figure 13 and Supplement A) demonstrates the variation in response to the cost variable (buy a bag), compared to the outcome variable (free biffy bag). The descriptive plots indicate:

- The majority agreed that it is easy to bring out own feces and toilet paper in a bag
- While most agreed easy to bring out feces and toilet paper using a bag if they were readily available free of charge, responses are much more spread when bags cost 30 NOK. The control respondents, who were making a judgement about their future behavior based on seeing/hearing no information about Biffy bags in Lofoten were the most spread: 36% agreed and 36% disagreed with easy when bags cost 30 NOK. Slightly higher proportion of active respondents agreed with easy when cost 30 NOK (55%), compared to passive treatment (44%) or control respondents (36%). This shows there is an effect on increasing willingness to try a Biffy bag if visitors are exposed to education about human feces issue in Lofotodden.

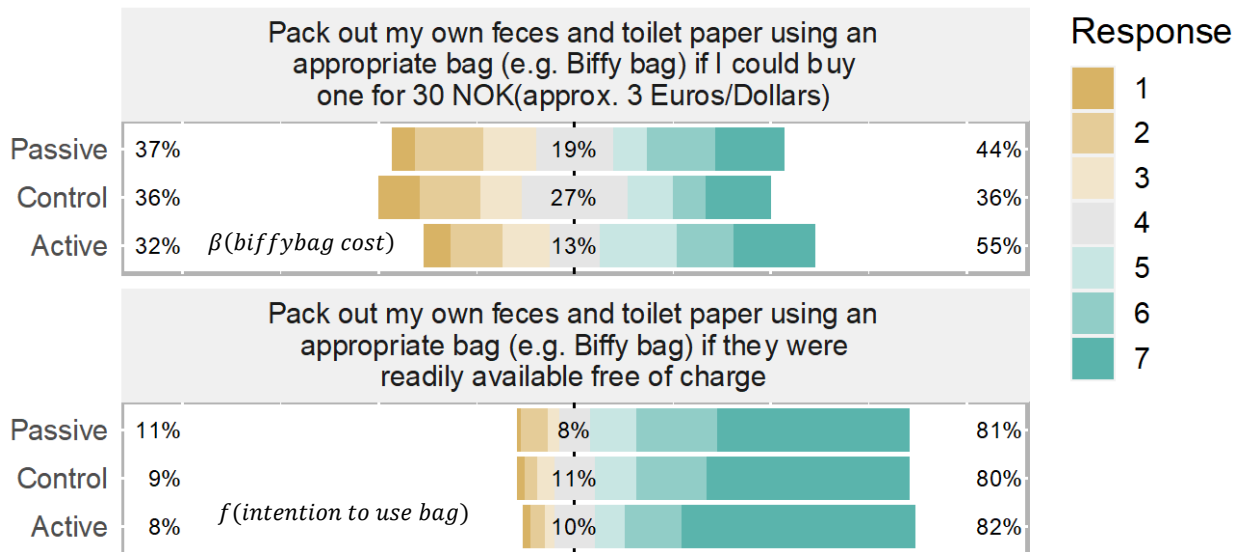


Figure 13. Plot describing the variation in responses to the survey question: How easy (7) or difficult (1) is it for you to use a Biffy bag in the future? Read the statements and answer on a scale of very difficult to do on a future trip (1) to very easy to do on a future trip (7).

### 3.7 Visitor responses to the communication interventions (passive vs. active)

The research team collected n= 110 surveys from visitors about their reactions to the messages about human feces disposal with a response rate of 74%. We calculated response rate from daily counts of visitors refusing to take the survey when asked compared to those who said yes (110). Figure 14 presents the range of responses visitors gave about how the information about feces in the park and being asked to not leave feces behind in the park impacted their experience. The full graphical representation of the visitor responses to the different messaging they received are presented in Supplement B. Responses were measured on a 7-point Likert scale: 1 = not at all personally impacted by message, and 7 = very much personally impacted by message.

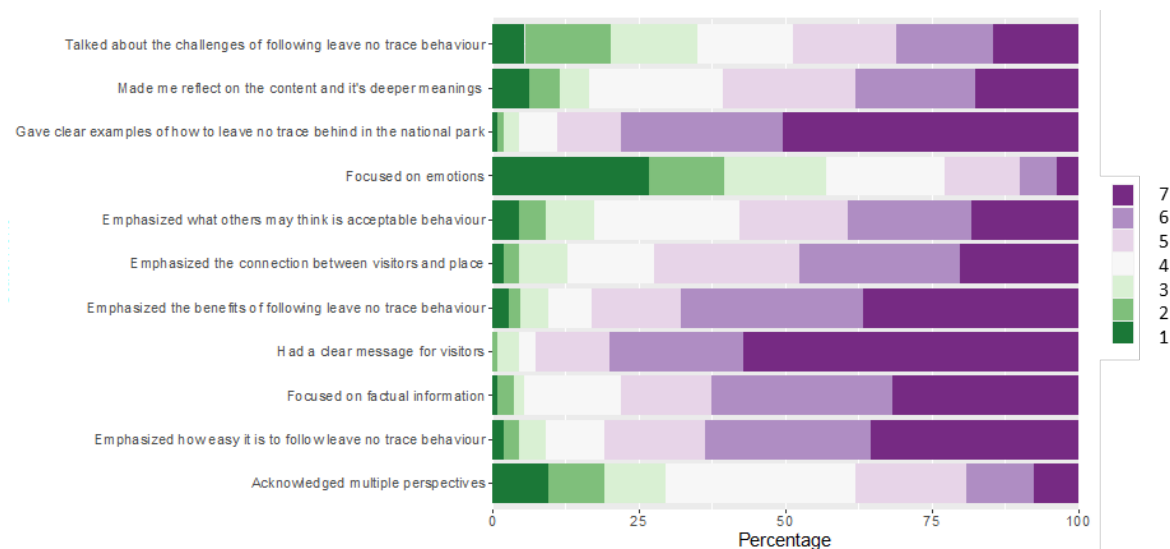


Figure 14. Likert plot of visitor responses to the survey about how communication was received and how it impacted visitors' nature experience.

Key takeaways are:

- 80% of respondents selected 1 or 2 (Not at all) in response to the statement 'Reduced my sense of freedom during this trip'
- 49% of respondents selected either 7 or 6 (Very much) in response to 'Made me care more about protected places like this'
- 46.5% of respondents selected either 7 or 6 (Very much) in response to 'Gave me an increased appreciation for the possible need for restrictions in this national park'

### **3.8 Visitor perspectives on toilets: visitor survey response and short interviews (2022- 2023)**

In 2022, we presented common themes related to motivations to visit Lofotodden, perspectives on waste management and preferences for toilets, burying, or bringing back out again one's own toilet waste from short interviews (Keller & Engen 2022). This year, we carried out 14 short interviews again focusing on the similar questions, but with additional questions about actual use of the Biffy bag. From our 2022 and 2023 visitor interviews, a total of 83% (n= 78) were motivated to visit for a "wild," "pristine," or "scenic" experience of nature. Some themes emerged that related to a negative experience if visitors were "reminded of human society, like toilets" (*interview 35 2022*). These themes were not pursued in depth, but they suggest that the visitor experience could be negatively impacted by a toilet on the beach. Our 2023 survey results reveal that only 35% would prefer toilets in Kvalvika rather than bringing out their own waste. Based on our survey responses about preferring toilets (35%) and open-ended survey responses, visitors seem less supportive of a toilet solution. From our visitor interviews, toilets were a divided issue. Some visitors deemed toilets inappropriate and a detriment to the park and nature experience for visitors if toilets *are visible* in the landscape. Furthermore, visitors who are motivated to visit the park based on wild camping and seeking a pristine nature experience may elect to not use a toilet even if available as that would "ruin the experience" (*interview 27, 2022*). However, toilets generally as understood as a potential positive and potential negative thing simultaneously in the majority of visitor interviews.



## 4 Discussion

### 4.1 Treatment efficacy

This research investigated combinations of passive and active communication treatments together with delivery of free personal toilet bags to reduce the accumulation of human feces and associated toilet waste in a popular tourist destination in Lofotodden National Park. As has been suggested in the literature, treatments that incorporate direct measures, like providing visitors with a Biffy bag, in combination with active communication tend to be more effective than only relying on passive communication. In this study, both our treatments (i.e., free Biffy bag + sign and free Biffy bag + sign + active communication) had a significant effect on toilet waste accumulation on the beach. We were unable to firmly establish that adding active communication was more effective than signs only. The effect size for active communication was higher than passive communication only, though the difference was not statistically significant.

Two hotspots (i.e., numbers 3 and 5), remained high use "toilet areas". The reduction in the amount of toilet waste here was lower compared to the other hotspots. These could be "the prime toilet areas" and should be prioritized as areas to monitor or establish interventions (such as making bags available, remind about leave no trace (promoter signs) and conduct regular water samples or warnings).

Relatively few people reported in the survey that they used the bag (i.e., 17,5%, n=124, visitors who reported seeing the free bags) while a larger proportion (38.7% n=124) reported 'not having the need'. The other visitors who took bags did not take our visitor survey, or did not answer these questions about "seeing the bags" or using the bags. The low proportion of people using the bags could be explained by us not capturing visitors who took bags, by visitors not needing to go to the toilet during their trip, or by people making a decision to wait to use a toilet instead of using the Biffy bags (598 total bags taken – 124 visitors reporting they saw the bags = 474 visitors who did not report or take the survey but took bags). Another, less likely alternative is that the treatment effect we observed was a result of people going to the toilet in areas of the park not monitored in the project, rather than using the bag. Fortunately, we found no left behind Biffy bags in the Kvalvika, Ryten, and Torsfjorden area.

### 4.2 Management recommendations

The delivery of free Biffy bags to visitors at the start of the trail and sharing information by sign or personal contact, **was effective in reducing feces on the beach and improved the quality of water in the most impacted and used streams.**

The Biffy bags were popular among visitors. In total, we distributed nearly 600 bags over a 2-week period, meaning 15% of visitors in these two weeks took a Biffy bag to use if needed (total n visitors in T1 + T2 periods = 4 032). Our findings suggest the bags could be effective in the future, given that visitors report high willingness to use bags if they are free (65–76% of visitors) or at a cost of 30 NOK (36–55% of visitors willing to use bag). The authors suggest an integrated additive management approach to reduce human waste accumulation on Kvalvika and the Torsfjorden and Ryten trail systems. Visitor behavior can be improved by combining communication targeted toward awareness of consequences and support strong moral norms of environmental care many visitors have already. Given visitors' desire to experience pristine Norwegian nature, freedom in exploring nature and camping, the park board could consider formalizing a bag-delivery system via subsidies and support/cooperation with the tourism sector.

Where degradation is most intense it is important to use direct site management, such as occasional clean up, instead of relying on informational signs alone. Our findings support a general principle that protected landscapes receiving heavy visitation should be more directly managed. The repercussions of degraded ecosystems are many, including potentially impacting local value creation in the long term.

Toilets could be however a solution that we have not tested in the field as a part of this project. The success of toilets in reducing human feces accumulation is debated in the literature about backcountry and remote camping areas, or areas facing a lack of resources to maintain or regularly check toilets. A number of factors affect the success of toilets, including soil type, climate, what visitors actually do around toilets, how far visitors need to walk to reach a toilet, and numerous maintenance issues that may arise for backcountry toilets (Williams 2016). If toilets are viewed as a solution it is prudent to conduct a cost benefit analysis of toilet installment together with experts such as environmental toxicologists and water system engineers. A key takeaway from our visitor surveys is the mixed support visitors have regarding toilets on Kvalvika beach *consistently* through all three years of this project (2021 – 2023). Toilets interfere with a visitors' experience of pristine nature. Degradation in perceptions of pristine nature has been shown to displace tourists to new prior 'untouched' nature areas (Priskin, 2003; Saarinen, 2004). Placement, perceptions of appropriateness in nature, actual intended use, and perceived difficulty all play key roles in determining toilet effectiveness.

An important point here is the density of visitation to Lofotodden NP. At 6,5 visitors per land hectare, this situates Lofotodden NP on the same level of visitation impact per land hectare as some large national parks in North America (NPS Visitation Statistics, 2022). The difference is national parks in North America (NA) operate on a different model that includes much more staffing to enforce rules of behavior to limit degradation of landscapes. These NA parks therefore have strict oversight over guiding activities that happen within the park boundaries. We note that many guiding businesses bring clients to Lofotodden NP. Although the numbers are not currently tracked, the direct experience of the park manager suggests that guiding is increasing. Our field observations over 3 years saw an increase in both frequency and group size (max reported group size was 24), though we cannot confirm the robustness of these observations because they were not quantified into a consistent monitoring protocol. The authors do not make an argument for adopting a North American model of governance. Rather, we suggest from our findings that it is important to provision sufficient support in the form of resources, staff, coordination, and research to national parks faced with this dense and seasonal visitation.

This study's findings regarding time spent reading the sign support findings in other national parks about visitor engagement with signs (Park et al., 2008; Weiler et al., 2013). Visitors' average 2 seconds at the information sign appear to function in conveying the basic message that leaving human feces in the park is problematic (likely due to the photo) and visitors made a judgement within those seconds if this statement applied to their situation and either took a bag or continued on without one. Substantive content can have a beneficial effect on resource preservation (Selvaag et al., 2023), but the short amount of time spent reading the signs and the decision to adopt a new behavior is a warning against information overkill – the "wall of text" effect (Selvaag et al. *unpublished field results 2023*).

### **4.3 Management implications from visitor survey results**

Our survey results confirm that visitors generally had high knowledge about the problems of leaving toilet paper and wetwipes behind in nature. The knowledge questions about burying human feces varied more in responses, and from our short post-survey interviews with visitors it is clear that visitors genuinely struggle with answering this question. Many wanted to know the 'proper' way to dispose waste. This underscores the importance of conveying a *clear* message about the desired behavior the park ultimately wishes to pursue. If this direction is human-feces bags, then all other information about waste disposal in Lofotodden should align to meet this goal. Additionally, general waste disposal information for all tourists to Lofoten should mention that specific areas require the use of human-feces bags. Clear directions and support for attaining bags needs to be in place as well. Future research or public/private sector efforts that explore how to get guides, businesses, and public authorities coordinated to manage such a system is needed.

People were not opposed to signs encouraging/telling them to change their behavior and adopt a new norm in Lofotodden, even if the message was a challenging or uncomfortable one. This

is further supported by the finding that visitors reported an increased appreciation for potential restrictions in the area (45.6% *very much* agreed), and that most visitors (63%) felt encouraged to tell others about toilet waste in Lofotodden. The preliminary results of this study may facilitate an understanding of type of visitors to Lofotodden based on their interpretation of the signs' content: those supportive of park interventions. We found that 80% of visitors felt that the sign and personal contact did not reduce their sense of freedom. Our survey is representative of the visitors that come to Kvalvika, based on the similarities in visitors across the test periods and the similarities from 2022 and 2018 visitor surveys, thus we can suggest that future visitors to the park will also be supportive of signs and personal contact.

Our 2023 survey results reveal that 35% would prefer toilets in Kvalvika rather than bringing out their own waste. We do not know what would actually happen if toilets existed on Kvalvika because we did not actively test this solution or model scenarios that could 'render' a toilet experience for visitors. However, based on our survey responses about preferring toilets (35%), our interview themes and open-ended survey responses, visitors are generally not supportive of a toilet solution *if it is visible*.

#### 4.4 Future research needs

More research is needed to account for sources of uncertainty regarding treatment efficacy. For instance, substantial media attention could have increased the compliance of visitors to take the bags for their trip during the passive communication phase, thus minimizing the difference between active and passive communication. Future research could combine more qualitative visitor experiences of being 'treated' to the outcome observed, for more in-depth understanding of the mechanisms behind the observed treatment effect (e.g., reduced WPC). Other studies in recreation ecology successfully combine field observations with measuring outcomes, but we could not ethically (nor did we desire to) 'track' people's toilet behavior directly. A workaround could be to color-code bags and encourage visitors subjected to different treatments to dispose of their bags in trash bins specific to the treatment period at hand.

Conducting experiments in the field as compared to lab settings always comes with latent variables (such as weather, changes in tourist services, and types of visitors). We did not find significant differences between visitors from our control to Treatment periods (see Supplement B for full descriptives), however, ideally this study would be repeated with the Treatments and controls occurring simultaneously to limit biases in the data. This would require a larger research team to specifically coordinate treatments so as not to contaminate visitors in the control group. Additionally, a future study should map waste sites each day, thus capturing daily variation and allowing for the influence of weather and other environmental conditions to be assessed in the amount of waste left behind by visitors.

Attention to the long-term effects of the Biffy bag solution is also warranted. Through repeated use of Biffy bags and communicating expected behavior (e.g., packing out waste) over time could result in increased efficacy of the treatment over time as the new norm of traceless tourism is established in Lofotodden. Furthermore, we underestimated the number of bags needed to cover the field season. As a result the study had to be modified (even after acquiring nearly 200 additional bags) We reduced the number of treatment days and limited the bag distribution to overnight visitors only. Estimates of bag use were derived from prior literature showing that indirect measures do not result in substantial behavior change, thus bags were ordered to meet a supposed demand for mainly the personal contact (active communication) treatment. Future research is needed to see if the effect of reducing human waste further improves when day-hikers are also given bags to use for their trips.

Future research could improve the findings from our study by including a qualitative assessment of visitors to understand the site-specific aesthetic impacts of a given treatment. This would improve our understanding of how some management tactics can better work in tandem or alone. Despite our delivery of (n = 110) visitor surveys targeted towards sign interpretation to try to

understand the cognitive processes behind behavioral choices, it did not include short interviews or lengthier surveys that would better address why some visitors pause to deeply engage with the treatments, while others try to avoid or only glance at a sign. However, for future analyses, we collected visitor surveys that can measure the effect of visitors characteristics on how they received / interpreted the communication treatment, and will model the effects of visitors in addition to the effects of treatment on two observed outcomes (waste per capita and intention to use the bag in the future).

We did not conduct a cost-benefit analysis of all potential forms of management options to reduce human feces and toilet waste in Lofotodden national park. Future research is needed in soil assessments and toxicology, and photo-elicitation visitor preference surveys (toilet scenarios) that would illuminate the factors that could support or undermine a toilet solution. While we do not have estimated costs associated with potential management solutions, we did compile pros and cons of management options for Kvalvika, based on field experience, our survey and mapping results, and in dialogues with the local reference group that included representatives from across Lofoten (see table 9).

## 4.5 Conclusion

The Norwegian Environment Agency's guide for visitor management in Norwegian protected areas is directed at the management authority for national parks and focuses on creating good experiences for visitors and the greatest possible local value creation, prioritizing implementing measures that increase understanding of protection and how to safeguard protected values. To facilitate local value creation, collaboration is encouraged between the interests of the tourism industry and the management authority (Lindøe, 2022). Conservation has success when solutions are tailored to the specific national park context, but similarities can be drawn across contexts. Top-down or bottom-up: managers rely on communication measures that encourage tourists to modify their outdoor habits towards desired, more sustainable behaviors (Selvaag et al., 2023).

The work presented here, we argue, is important for crafting a tailored visitor strategy for protecting the conservation values of Lofotodden NP. Many visitors to the park have strong environmental attitudes, but general messages intended to convey 'good behavior' are often not effective to prevent or mitigate negative impacts from high visitor use, the impacts of which could undermine conservation values and local value creation. In addition to conveying relevant, site-specific 'good behavior requests,' the delivery mode of the message is also important. We measured a reduction in feces accumulation and waste per capita when the message was simply stated, delivered to visitors in person, and clearly conveyed health risks to humans and nature. We distributed 598 Biffy bags over a 2-week trial period, testing two forms of communication: passive (sign) vs. active (personal contact). On the one hand, the amount of toilet waste left behind was reduced by over half (19 sites in T2 vs. 44 in C2) during active communication, compared to a 39% reduction in waste left behind during passive communication (27 sites in T1 vs. 44 in C2). On the other hand, our regression model did not show a large effect difference between T1 and T2 in people's intentions to use the bags in the future. Overall, visitors believed it would be easy to use a bag in the future if requested by the park, if the bags were available at the trail and free. Because there was generally high support for future bag use among visitors, this could explain why the effect size of the communication treatment in relation to the control period was small. This warrants future investigation into how intentions line up with observed behavior.

This report is an initial step in sharing knowledge across a diversity of actors in Lofoten connected to nature-based tourism that could collaborate in reducing impacts and improving a human-waste system in recreational settings. We conclude with a list of potential management options that we derived from extensive literature review of recreation studies and management, discussions with the project's local reference group, and national park managers in other countries including Sweden and USA (see table 9). Long-term effects will likely be different than the initial impact of this project. Therefore, the authors recommend cost-benefit analyses and local

workshops to discuss collectively how to bring a bag-delivery or other tailored systems to bear in Lofotodden national park and much of Lofoten’s highly prized and beautiful nature.

**Table 9.** List of potential management options to pursue in a future cost-benefit analysis. Strategies and estimated pros and cons of each option to reduce human feces and toilet waste in Lofotodden National Park.

Options	Anticipated outcome	Pros	Cons
Status quo with sign only advising to avoid drinking water from local streams	If sign is read by 30% of visitors (estimated from our sign observations in 2023), reduces some contamination	Simple, cheap. Low intervention and non park character changing. No maintenance needs	70% of visitors unlikely to read sign. Situation likely remains the same, growing worse with more visitation.
Bury waste and TP, inform against wetwipes with signs (5 or more) at strategic locations on trail and beach	Some surface waste is reduced. More care with ensuring good burial of TP	Simple, cheap. Low intervention, no maintenance needs	Surface waste still an issue. Toilet paper can still be obvious or dug up by dogs and humans. Hotspots still exist. People digging up other people's waste. Waste spread and health issues persist.
Bury waste, pack out TP and wetwipes with visitor’s own bags. Strategic signs (5 or more).	Some surface waste is reduced. TP is no longer visible and impacting experience or behavior	Lower waste with low intervention. A cleaner appearing landscape can encourage continuation of behavior	Hotspots still exist. People digging up other people's waste. Waste spread and health issues persist.
Bury waste, take out TP and wetwipes, provide zip-bag and trowel	Reduces obvious surface waste and waste nearest water sources	low barrier to adopt behavior. With enough information could be widely adopted	Hotspots still exist. People digging up other people's waste. Waste spread and health issues persist.
Direct to toilet at entrance, encourage bury waste, take out TP and wetwipes	Reduces some surface waste, especially near water	Simple, low intervention, low maintenance needs. Cleaner appearing landscape can encourage continuation of behavior	Hotspots still exist, infrastructure not ideally placed to reduce waste deposits along trail. Waste spread remains issue.
Inform visitors no toilets and plan accordingly	Sets expectations and could reduce some surface waste for people that plan.	Simple, low intervention, low maintenance needs.	Can only inform people at known entrance areas, too late to inform in many parts of the park. Toilets are far removed from most parking areas so visitors unlikely to drive to find one. Hotspots still exist, infrastructure not ideally placed to reduce waste deposits along trail. Waste spread remains issue.
Encourage Biffy bag (or similar bag) use (motivate only) via signs and at visitor centers	Reduces surface waste and reduces build up of buried waste <b>if adopted</b> widely	Simple, low intervention, all responsibility on visitors	Unlikely to just 'happen.' Need bins in park, or direct people to close-by disposal
Biffy bag (or similar bag), free of charge at trail with signs and/or personal contact from a ranger/nature-leader	Known to reduce surface waste and toilet waste left behind. Reduces E.coli in water and improves visitor experience and health. Hotspots are diminished.	Very low barrier to adopt behavior. With enough information could be widely adopted	(a). Need bins in park, or direct people to close-by disposal. Requires occasional checks to ensure disposal. In the near term, requires some personal contact with visitors, best if on site at trail starts, in cooperation with people who monitor parking areas.
Biffy bag (or similar bag), free of charge at visitor center, tourist info	Reduces surface waste if adopted widely. Hotspots are diminished	Low barrier to adopt behavior. With enough information could be widely adopted	Same as (a).
Biffy bag (or similar bag), reduced cost at X, X, X places	Reduces surface waste and reduces build up of buried waste if adopted	Known barrier to adopt behavior but not impossible. Majority of visitors still report	Same as (a).

	widely. Hotspots could dissipate.	willingness to purchase a bag and use it for trips into the park.	
Installing toilet(s) at the beach including fee to pay for toilet maintenance	Reduces surface waste if toilet(s) are used and signs informing of toilets are strategic. Could improve visitor experience for a type of visitor.	Low barrier to adopt behavior, requires no personal contact and strategic placed signs. waste spread still occurs with low maintenance of toilets, changes park character and could displace visitors	(b). Hard to test this and changes character of park and the free visitation experience of Norway NP. Toilets are difficult to move once established. Visitors may still elect not to use them for many reasons, including they are too far away from where they decide to camp or when they need to go. Could displace locals and others with a fee.
Multiple toilets at parking, trail, and beach. Possible fee for maintenance	Reduces surface waste if toilet(s) are used and signs informing of toilets are strategic. Could improve experience for a type of visitor.	Low barrier to adopt behavior, waste spread still occurs with low maintenance of toilets, changes park character and could displace visitors	Same as (b), and hard to test this and changes character of park

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## 6 Supplement A. Visitor Survey Graphs

### 6.1 Likert response plots for Treatment/Control Visitor Surveys (n=363)

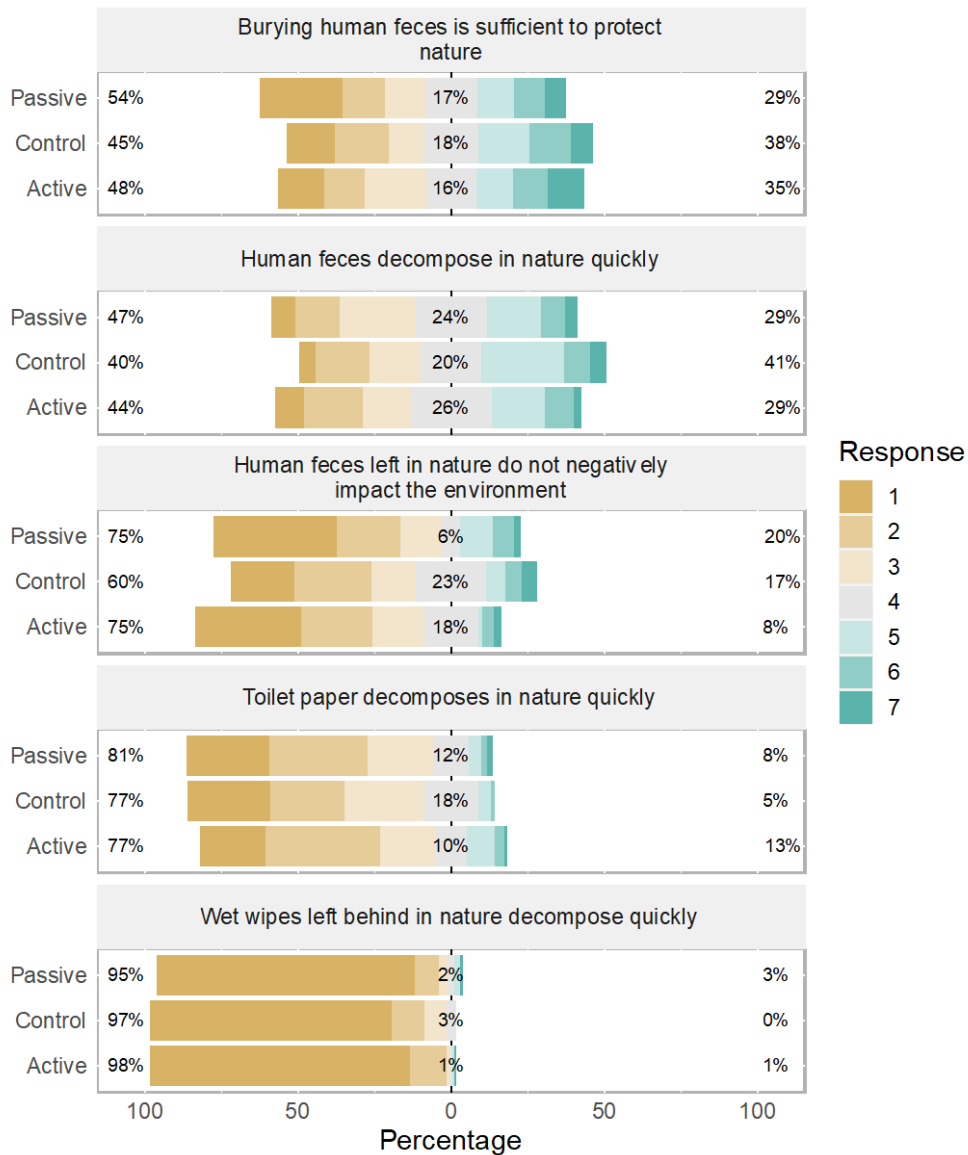


Figure 1. Visitor survey responses to question: How much do you agree or disagree with the following statements about human feces and toilet waste left in nature?

We consolidated six knowledge statements into a variable known as "human waste attitude" (see table 6). A 7-pt Likert scale of agreement: 1 = highly disagree, 7 = highly agree. Key takeaways for the human waste attitude questions:

- Most respondents across control and both types of treatment survey selected 1 (strong disagree) for 'Wet wipes left behind in nature decompose quickly'
- Higher range of responses to "Burying human feces is sufficient to protect nature" and "Human feces decompose quickly" statements. For example 29 to 38% agreed that burying waste is sufficient, 16- 18% neutral, and 48 – 54% disagreed.

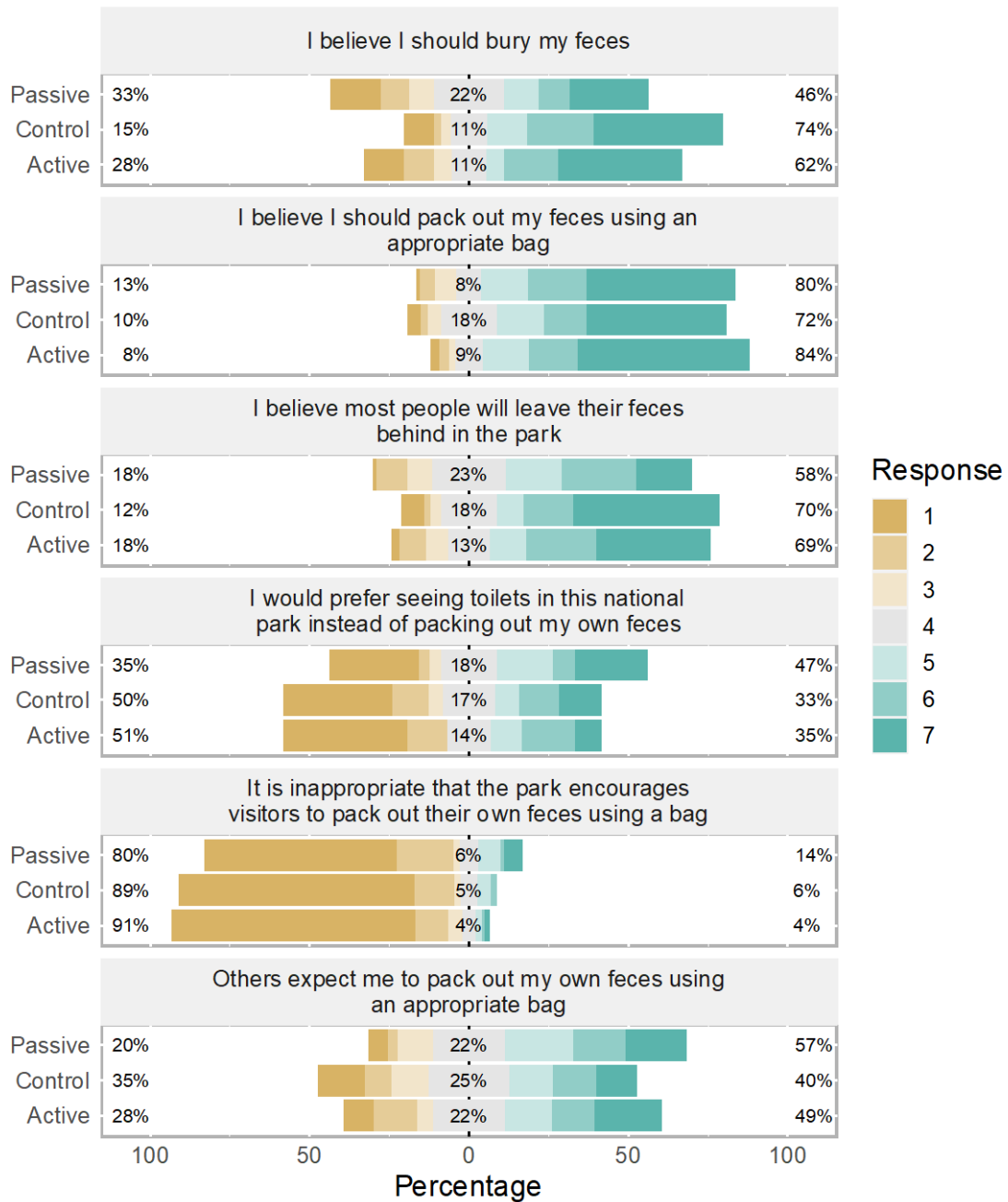


Figure 2. Visitor survey responses to question: how much do you agree or disagree with the following statements about going to the toilet in nature?

Key takeaways for the human waste norm questions (See Supplement A for graphical figures of visitor responses): A 7-pt Likert scale of agreement: 1 = highly disagree, 7 = highly agree.

- During the passive and active treatments, a higher proportion of visitors believed they should pack out their own feces and toilet waste compared to the visitors sampled in the control periods.
- During the passive and active treatment periods, a higher proportion disagreed they should bury their own feces in the part compared to control respondents. However, still

the majority of visitors agreed they believe they should bury their feces for appropriate waste management.

- During the passive treatment phase a higher proportion of visitors agreed with ‘I would prefer seeing toilets in this national park instead of packing out my own feces’, but overall this statement was contentious – with a wide spread of responses across both agree, disagree and not sure.
- Despite most agreeing that other people expect them to carry out their feces in a bag, the majority of respondents across treatment and control agreed with the statement ‘I believe most people will leave their feces behind in the park’

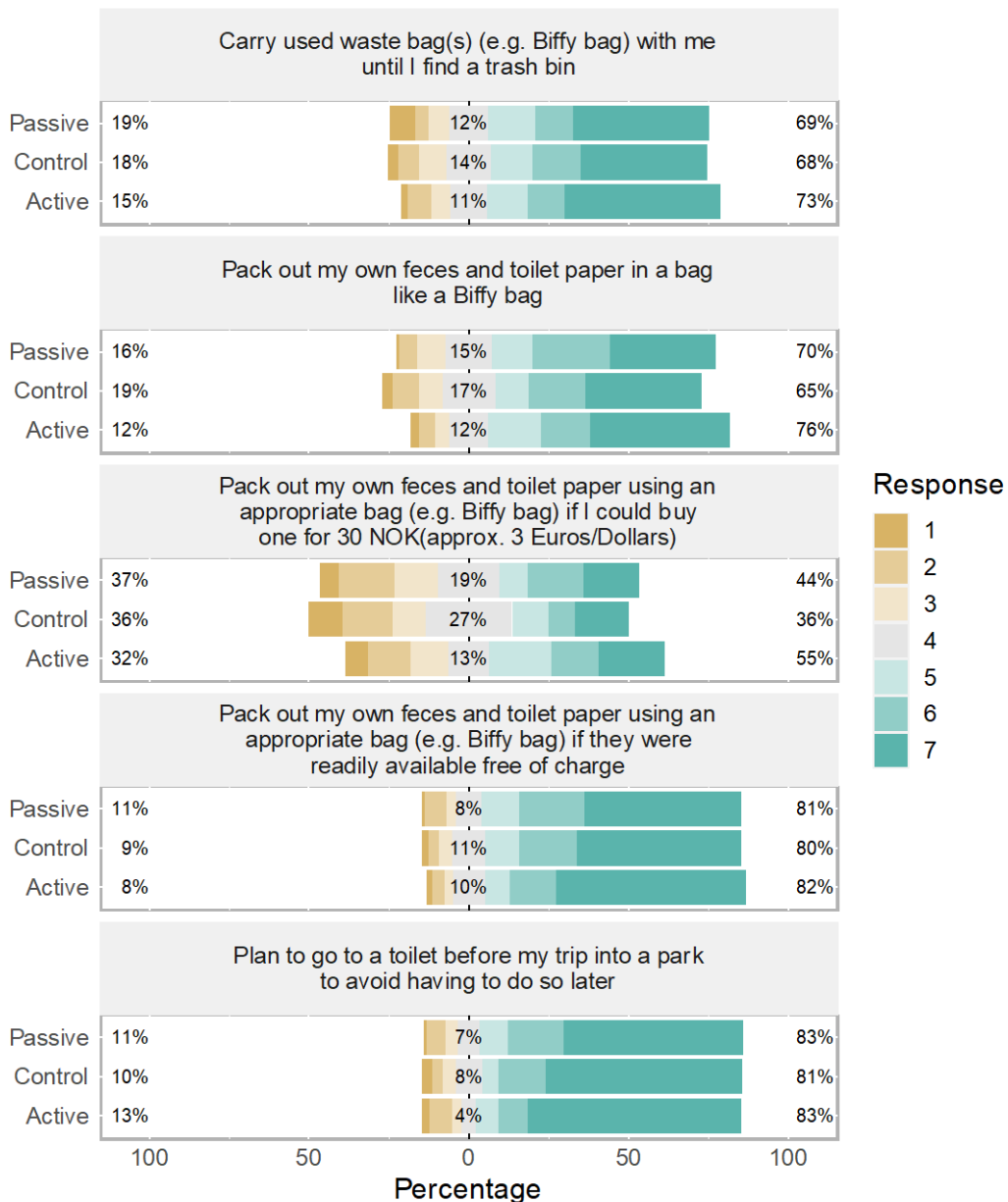


Figure 3. Visitor survey responses to the question: How easy or difficult would it be for you in a future trip to a national park to do any of the following statements about going to the toilet in nature?

Key takeaways for the future behavior (intentions) to use a Biffy bag or plan ahead before entering the park: A 7-pt Likert scale of difficulty: 1 = very difficult, 7 = very easy.

- Majority agreed easy to pack out own feces and toilet paper in a bag

- While most agreed easy to pack out feces and toilet paper using a bag if they were readily available free of charge, responses are much more spread when bags cost 30 NOK. The control respondents, who were making a judgement of their future behavior based on seeing/hearing no information about Biffy bags in Lofoten were the most spread: 36% agreed and 36% disagreed with easy when bags cost 30 NOK. Slightly higher proportion of active respondents agreed with easy when cost 30 NOK (55%), compared to passive treatment (44%) or control respondents (36%). This shows there is an effect on increasing willingness to try a Biffy bag if visitors are exposed to education about human feces issue in Lofotodden.

## 6.2 Communication surveys (n = 110)

### 6.2.1 Q5 communication Likert statement responses

Table 1. Percentage of responses to each item in Q5 of the communication survey. N detailed total sample percentages are calculated out of, considering there are varying NA responses for each statement (see NA count column).

Item	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	n	NA count
Enhanced my appreciation for the area	6	6	6	19	16	23	25	109	1
Made me act more carefully in the area	0	4	7	29	29	14	18	28	82
Increased my knowledge about leave no trace behaviour	11	6	5	15	19	22	23	109	1
Made my visit to the national park more meaningful	10	14	8	24	20	16	8	109	1
Changed the way I will behave after I leave Lofotodden	19	13	9	22	16	11	10	109	1
Encouraged me to tell others about this topic	4	8	8	9	29	19	23	110	0
Made me care more about the nature in this area	6	6	5	24	21	15	25	109	1
Made me care more about protecting other places like this	6	0	7	15	23	18	31	108	2
Reduced my sense of freedom during this trip	64	21	4	4	5	3	1	110	0
Gave me an increased appreciated for the possible need for restrictions in this national park	5	7	3	21	23	23	18	109	1

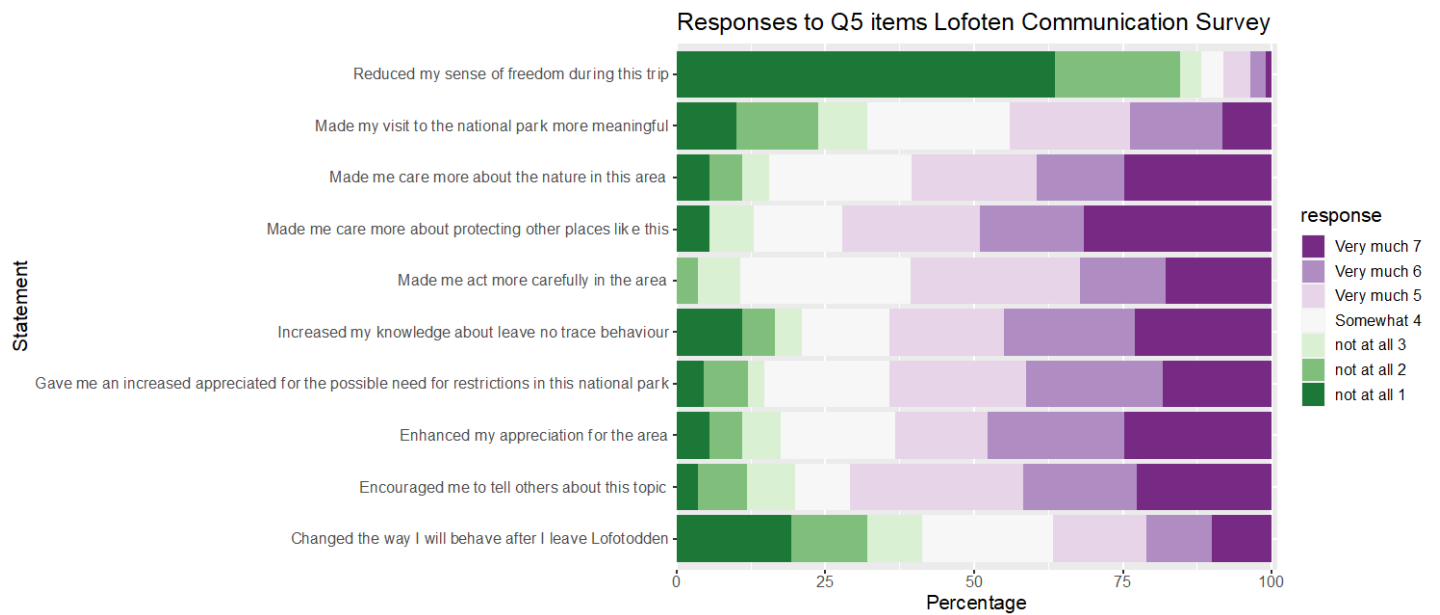


Figure 4. Likert responses to Q5 statements in communication survey. Note percentages are calculated out of different sample sizes for each statement (due to NA responses).

- 80% of respondents selected 1 or 2 (Not at all) in response to the statement ‘Reduced my sense of freedom during this trip’
- 49% of respondents selected either 7 or 6 (Very much) in response to ‘Made me care more about protected places like this’
- 46.5% of respondents selected either 7 or 6 (Very much) in response to ‘Gave me an increased appreciation for the possible need for restrictions in this national park’

### 6.2.2 Q6 communication Likert statement responses

Table 3. Percentage of responses to each Likert statement in Q5 of communication survey and the number of NA responses per statement (hence total sample size varies for each statement).

Q5 Item	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	n	NA	re- sponses
<b>Focused on emotions</b>	27	13	17	20	13	6	4	109	1	
<b>Focused on factual information</b>	1	3	2	16	15	31	32	110	0	
<b>Acknowledged multiple perspectives</b>	10	10	10	32	19	11	8	105	5	
<b>Emphasized the connection between visitors and place</b>	2	3	8	15	25	28	20	109	1	
<b>Had a clear message for visitors</b>	0	1	4	3	13	23	57	110	0	
<b>Emphasized the benefits of following leave no trace behaviour</b>	3	2	5	8	15	31	37	106	4	
<b>Talked about the challenges of following leave no trace behaviour</b>	6	15	15	17	17	17	15	109	1	
<b>Emphasized what others may think is acceptable behaviour</b>	5	5	8	25	18	21	18	109	1	

<b>Emphasized how easy it is to follow leave no trace behaviour</b>	2	3	5	10	17	28	35	110	0
<b>Gave clear examples of how to leave no trace behind in the national park</b>	1	1	3	6	11	28	50	109	1
<b>Made me reflect on the content and it's deeper meanings</b>	6	5	5	23	23	20	18	79	18

- Note that the n sample for each statement varies because some people missed out/choose not to answer certain items.
- Item “Made me reflect on the content and it’s deeper meanings’ was only available in the paper version, meaning there was a high number of NA responses to this statement (18 NA responses).

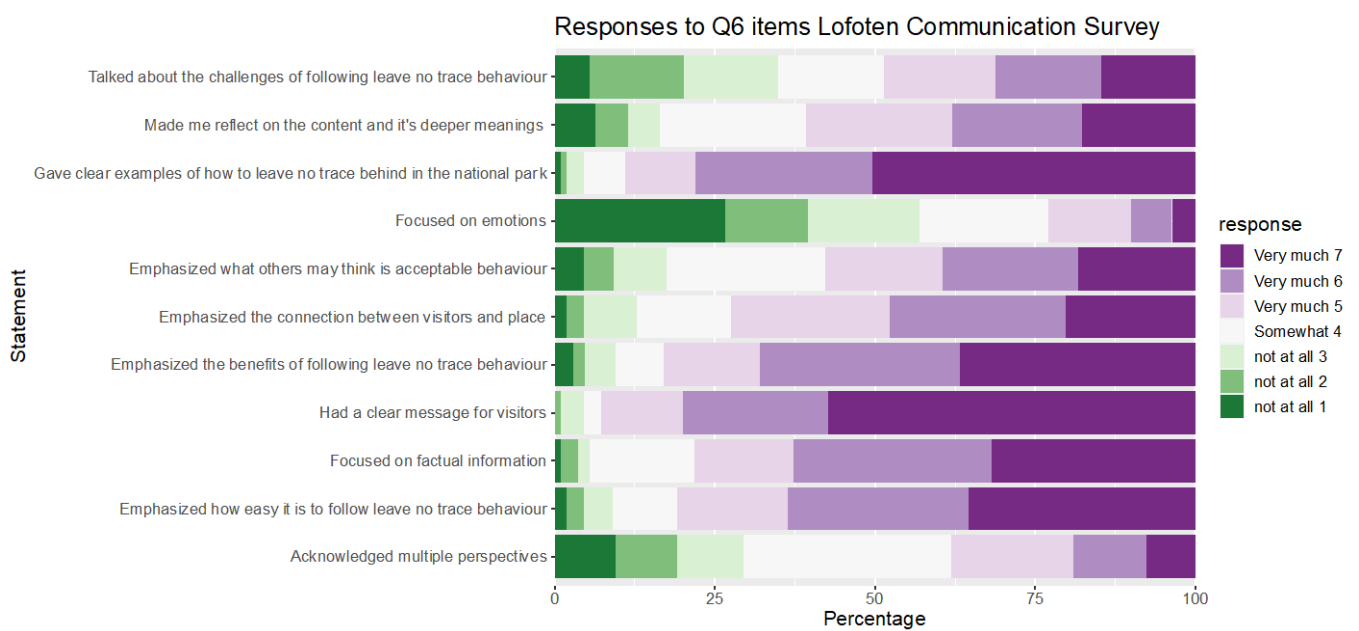


Figure 5. Likert plot of responses to Q6 statements in communication survey. Note percentages for each statement are calculated out of different sample sizes due to NA responses (see Table 3).

- Over half of the respondents that answered the statement agreed that the communication ‘had a clear message for visitors’ and ‘Gave clear examples of how to leave no trace behind in the national park’.

## 7 Supplement B. Descriptive statistics of visitor surveys

### 7.1 2.1 Communication surveys

#### 7.1.1 Demographic descriptive statistics:

**Gender:** 64 respondents identified as Female (58%) and 46 identified as Male (42%)

**Age:**

- Respondents age between 18 – 70.
- Min age = 18 and max = 70
- Mean age = 39.55
- Median age = 37.5
- When grouped in age bins, most respondents age between 25-34 (46%).

Table 1. Percentage and frequency of communication survey respondents by age group

Age group	Frequency	Percentage (2dp)
18-24	18	16.36
25-34	51	46.36
35-44	23	20.91
45-54	10	9.09
55-64	6	5.45
>65	2	1.82

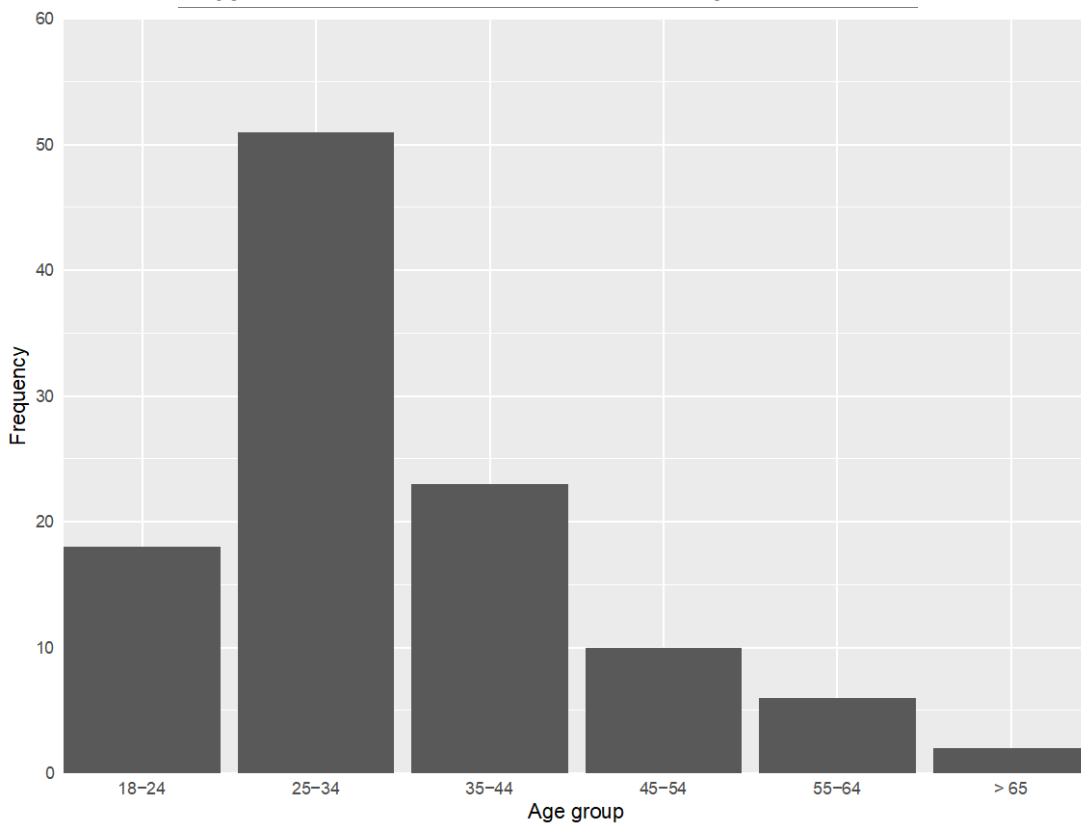


Figure 1. Frequency of respondents per age group for communication survey.

**Residence:**

- Of the communication survey respondents, 16/110 resided in Norway.
- Most respondents did not live in Norway (85%). The majority (22/110) stated that they resided in Sweden.

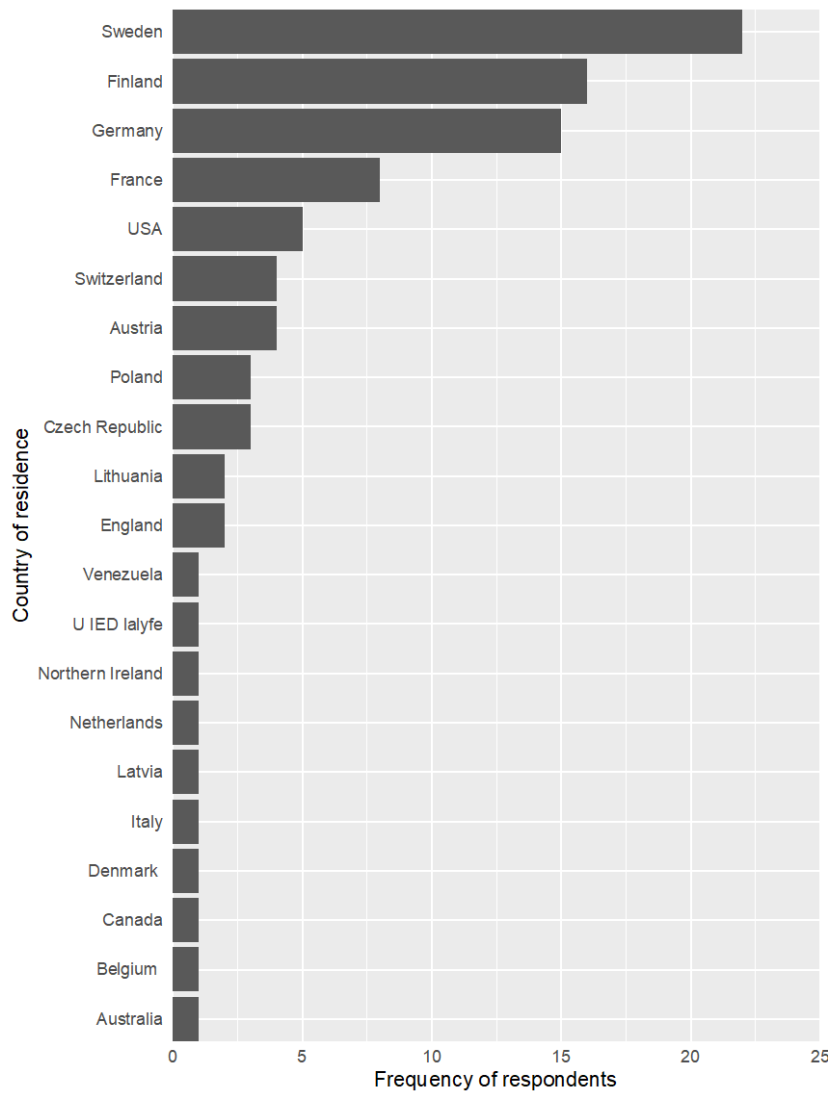


Figure 2. Frequency of ‘other’ countries of residence stated in communication survey.

**Info type received:**

- Most (78%) respondents received the communication sign in person (from member of re-search team)

**Group responses**

- 22% of the communication survey respondents responded as a group

## 7.2 Control survey

The average group size for control surveys was 3 people and 55% of respondents stayed for at least 1 night.

### 7.2.1 Control – Demographic descriptive statistics

Of the 99 control survey responses (following cleaning), 18 were collected online (via QR code) and 81 were collected in person (paper surveys).

**Gender:**



- Of the 99 control responses, 50 identified as female, 48 as male and 1 as non-binary

**Age**

- Control respondents ages between 18 – 67
- Mean age of control respondents = 39
- Median age = 38
- Most respondents age between 25-34

Age group	Frequency	Percentage (2dp)
18-24	17	17.71
25-34	39	40.62
35-44	18	18.75
45-54	10	10.54
55-64	9	9.38
>65	3	3.12

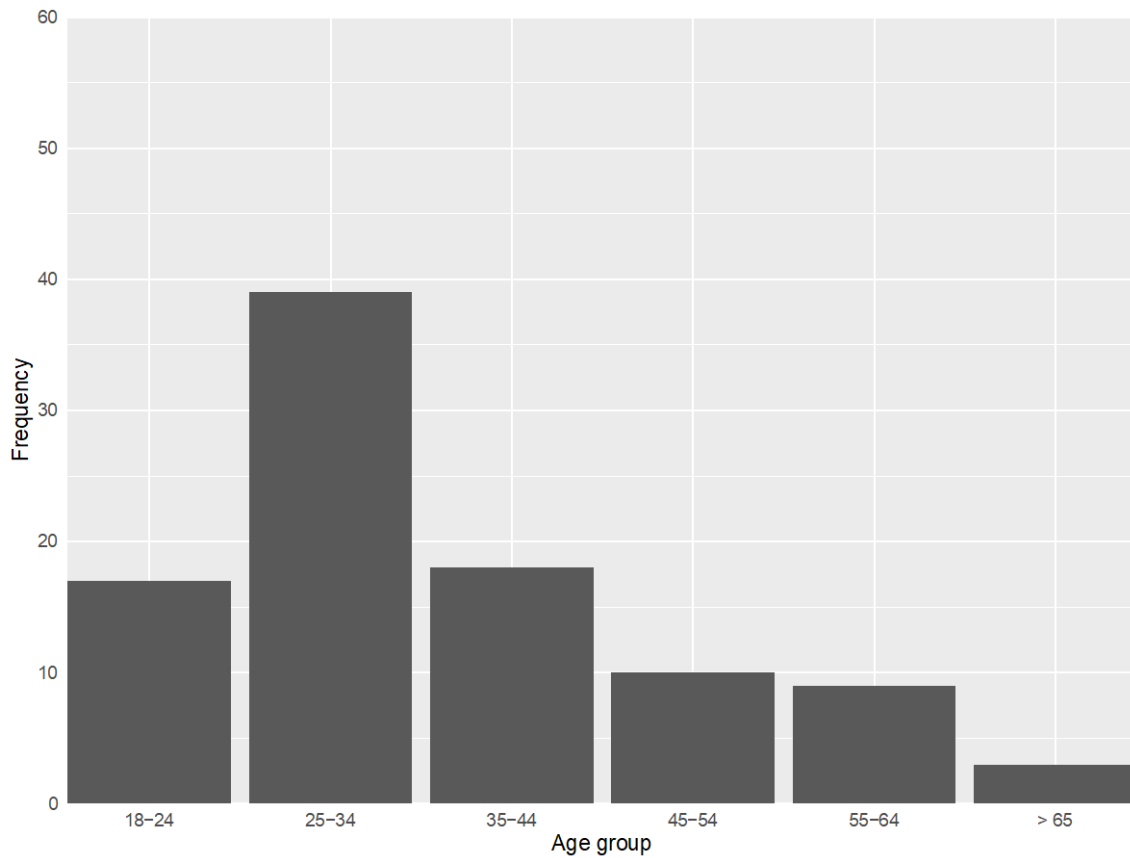


Figure 5. Age groups represented in control survey responses.

**First visit to the national park:**

- For most control respondents, it was their first visit to the national park (88/99).

**Residence:**

- The majority of respondents to the control survey resided outside of Norway (79/99).
- Other countries of residence stated in the control survey included the below (20 different countries):

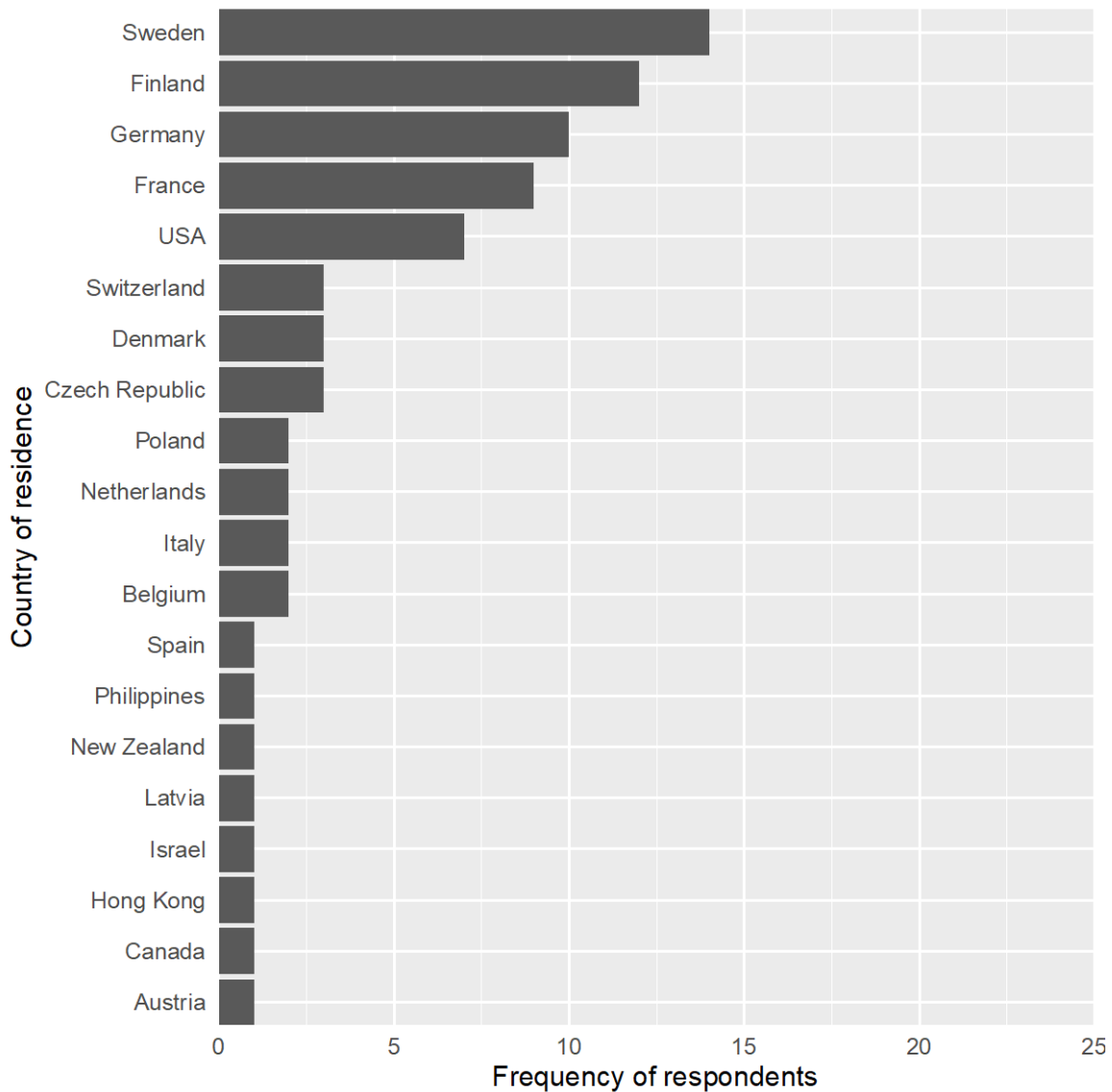


Figure 6. Other countries of residence stated in control survey responses.

#### Information received

- Most (85%) control respondents did not receive any information about how to dispose of human waste whilst in the national park.
- Of those that did receive information (15%), most stated 'other' which included:
  - The blue Biffy bin by the carpark
  - Friend
  - Online/news unspecified

#### Notice feces and Biffy bag knowledge:

- Most control respondents had not noticed any feces (60/69), 11 selected not sure/Maybe and 25/96 control respondents had noticed feces during their trip in the national park
- Most control respondents (58%) had not heard of Biffy bags
- The majority of control respondents (93%) had never used a Biffy bag before
  - 7/99 control respondents had used a Biffy bag before

#### Responses to whether would try a Biffy for free in future:

- 71% of control respondents stated that they would try a Biffy bag if they were readily available, free of charge. 24% stated ‘Maybe’ and 5% stated ‘no’.

### 7.3 Treatment surveys

#### 7.3.1 Treatment– Demographic descriptive statistics

Of the 263 control survey responses (following cleaning):

**Gender:**

- 119 identified as female, 143 as male and 1 as non-binary

**Age**

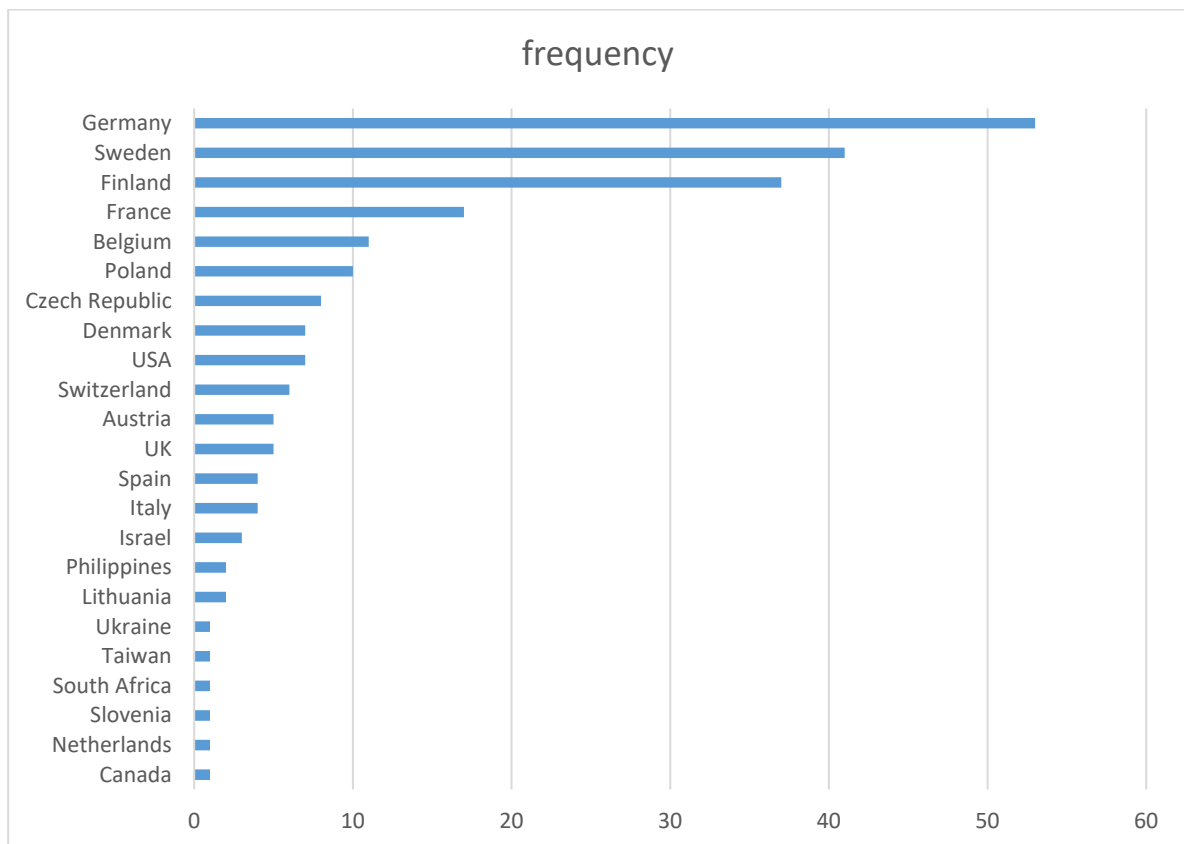
- Treatment respondents ages between 18 – 71
- Mean age of treatment respondents = 39
- Median age = 37
- Most respondents were aged between 25-34 (48%)

**First visit to the national park:**

- For most treatment respondents, it was their first visit to the national park (219/263).

**Residence:**

- The majority of respondents to the control survey resided outside of Norway (35/263).
- Other countries of residence stated in the control survey included the below (23 different countries):



### Information received

- Most (60%) treatment respondents received information about how to dispose of human waste whilst in the national park.
- Of those that did receive information, most stated 'park sign at Torsfjorden' (32%)
- 14% stated they were intercepted by a 'national park employee' (one of the research team during active treatment 2 phase).
- 7% stated 'social media'
- 4% stated 'Other visitors on the trail'
- 3% stated other which included:
  - The blue Biffy bin by the carpark
  - Friend
  - Online/news unspecified

Following data cleaning, there were 263 **treatment survey** responses (103 passive and 160 active).

Of the 263 treatment responses:

- 124 (47%) had seen the Biffy bags at the start of the trail
- 23 (34% of *overnight* treatment respondents) had reported in the survey that they tried the Biffy bag
  - 23 tried /124 saw bags = 18,5% of those who said saw also tried the bag
- Visitors we did not reach for survey, but who took bags: 40% (363 n surveys / 598 n bags = 40% had taken bags but no surveys, and 60% had taken surveys and possibly bags).

Of the 23 who tried the bag:

- 4 had used a Biffy bag before, 8 had not used a Biffy bag before and the remaining 11 did not respond/NA
- 9 had heard of Biffy bags before, 10 had not, and 4 did not answer/NA

## 8 Supplement C. Visitor Survey during Treatment period (English Version)



Communication

### **VISITOR SURVEY about HUMAN WASTE IN LOFOTODDEN NATIONAL PARK: 7 minutes to complete**

***We are conducting a survey to better understand people's experiences with human waste in the national park and their opinions about some waste management options the park is considering.***

1. Is this your first time to the national park?

No  Yes

2. How many people are in your group today for this trip? \_\_\_\_\_

3. Age: \_\_\_\_\_

4. Gender: \_\_\_\_\_

5. Do you live in Norway?  Yes  No, (write in country) \_\_\_\_\_

6. How many nights did you stay in Kvalvika Beach?

Number of nights \_\_\_\_\_ OR:  Day hike only

7. During this visit, did you get any information about how to dispose of human waste in this park?

No  Yes, if Yes go to 7b.

7b. How did you get information about human waste disposal in the national park? (*select all that apply*)

- Park sign at Indresanden (trail to Ryten)  Park sign at Torsfjorden (trail to Kvalvika)  
 A Park employee talked to me on the trail  National park visitor center  Other visitors  
 Social media  Other \_\_\_\_\_

### **8. Please indicate how strongly you AGREE or DISAGREE with each of the following statements.**

	Strongly Disagree		Neither disagree nor agree			Strongly Agree	
	1	2	3	4	5	6	7
<b>A.</b> Human feces decompose in nature quickly	1	2	3	4	5	6	7
<b>B.</b> Toilet paper decomposes in nature quickly	1	2	3	4	5	6	7
<b>C.</b> Burying waste is sufficient to protect nature	1	2	3	4	5	6	7
<b>D.</b> Wet wipes decompose in nature quickly	1	2	3	4	5	6	7
<b>E.</b> Human feces left in nature do not negatively impact the environment	1	2	3	4	5	6	7
<b>F.</b> Human feces left in nature do not negatively impact people's nature experience	1	2	3	4	5	6	7

9. Have you noticed any human feces during your trip in Lofotodden National park?

No  Not sure  Yes

Some people use a specially designed personal waste alleviation bag (portable toilet) for safely and hygienically packing out their feces during their trip in nature. This bag is hygienic, dries the feces and is odorless. Used bags are thrown away in trash bins. A common type of bag used in nature is a Biffy bag.

**10. Have you ever heard of a specially designed human feces bag before (like a Biffy bag)?**  No  Yes

11. Did you see the free Biffy bags here at the start of the trail?  No  Yes If Yes, go to 11b.

11b. Did you personally try to use the Biffy bag(s) during your trip to Kvalvika?  No  Yes: **If No: go to 11c**



11c. What is the main reason you have not tried Biffy bags during this trip?

- I don't have Biffy bags
- I don't like using Biffy bags
- I dealt with "going to the toilet" during my trip through other means/haven't had the need to use a bag

12. Would you use Biffy bags or a similar bag on future trips?  No  Not sure  Yes

13. Did you see Biffy bags left behind by other visitors during your trip?  No  Not sure  Yes

**14. Please indicate how strongly you AGREE or DISAGREE with each of the following statements about human waste in the national park.**

	Strongly Disagree		Neither disagree nor agree			Strongly Agree	
O. I believe I should bury my feces	1	2	3	4	5	6	7
P. I believe I should pack out my own feces using an appropriate bag	1	2	3	4	5	6	7
Q. Others expect me to pack out my own feces using an appropriate bag	1	2	3	4	5	6	7
R. I believe most people will leave their feces in the park	1	2	3	4	5	6	7
S. It is inappropriate if the park encourages visitors to pack out their own feces using an appropriate bag	1	2	3	4	5	6	7
G. I would prefer seeing toilets in this national park instead of packing out my own feces	1	2	3	4	5	6	7

**15. Please indicate how DIFFICULT the following behaviors were for YOU during this trip:**

	Very Difficult		Neither			Very Easy	
Read and understand the sign at the trailhead about human feces disposal	1	2	3	4	5	6	7
Follow the instructions for use of a Biffy bag for human feces disposal	1	2	3	4	5	6	7
Pack out my own feces and toilet paper in a Biffy bag	1	2	3	4	5	6	7
Carry Biffy bag(s) with me until I found a trash bin	1	2	3	4	5	6	7

**16. Please indicate how DIFFICULT the following behaviors would be for you during a future trip to the national park:**

	Very Difficult		Neither			Very Easy	
Pack out my own feces and toilet paper in a bag like a Biffy bag	1	2	3	4	5	6	7
Carry used waste bag(s) (e.g. Biffy bag) with me until I find a trash bin							
Pack out my own feces & toilet paper using an appropriate bag (e.g. Biffy bag) if they were readily available free of charge	1	2	3	4	5	6	7
Pack out my own feces & toilet paper using an appropriate bag (e.g. Biffy bag) if I could buy them for 30 NOK (approx, 3 Euros/dollars)	1	2	3	4	5	6	7
Plan to go to a toilet before my trip into a park to avoid having to do so later	1	2	3	4	5	6	7

17. Is there anything else you would like to share with us about your experience (negative or positive)?

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**THANK YOU for answering the survey!**

## Visitor Survey during Control period (English Version)



Control

**VISITOR SURVEY about HUMAN WASTE IN LOFOTODDEN NATIONAL PARK: 7 minutes to complete**  
**We are conducting a survey to better understand people's experiences with human waste in the national park and their opinions about some waste management options the park is considering.**

1. Is this your first time to the national park?

No  Yes

2. How many people are in your group today for this trip? \_\_\_\_\_

3. Age: \_\_\_\_\_

4. Gender: \_\_\_\_\_

5. Do you live in Norway?  Yes  No, (write in country) \_\_\_\_\_

6. How many nights did you stay in Kvalvika Beach?

Number of nights \_\_\_\_\_ OR:  Day hike only

7. During this visit, did you get any information about how to dispose of human waste in this park?

No  Yes, if Yes go to 7b.

7b. How did you get information about human waste disposal in the national park? (select all that apply)

Visitor center in Reine  Other visitors  Social media  Other \_\_\_\_\_

**8. Please indicate how strongly you AGREE or DISAGREE with each of the following statements.**

	Strongly Disagree		Neither disagree nor agree			Strongly Agree	
	1	2	3	4	5	6	7
<b>A.</b> Human feces decompose in nature quickly	1	2	3	4	5	6	7
<b>B.</b> Toilet paper decomposes in nature quickly	1	2	3	4	5	6	7
<b>C.</b> Burying waste is sufficient to protect nature	1	2	3	4	5	6	7
<b>D.</b> Wet wipes decompose in nature quickly	1	2	3	4	5	6	7
<b>E.</b> Human feces left in nature do not negatively impact the environment	1	2	3	4	5	6	7
<b>F.</b> Human feces left in nature do not negatively impact people's nature experience	1	2	3	4	5	6	7

9. Have you noticed any human feces during your trip in Lofotodden National park?

No  Not sure  Yes

Some people use a specially designed personal waste alleviation bag (portable toilet) for safely packing out their feces during their trip in nature. This bag is hygienic, dries the feces and is odorless. Used bags are thrown away in trash bins. A common bag used for nature trips is called a Biffy bag.

**10. Have you ever heard of a specially designed human feces bag before (like a Biffy bag)?**  No  Yes

11. Have you personally used a human feces bag (e.g., specially designed or regular plastic bag) on hikes before this trip?  No  Yes

12. If these human feces bags (like Biffy bags) were provided here at the trail free of charge would you be willing to try one?  No  Maybe  Yes

(NEXT PAGE)



Control

**13. Please indicate how strongly you AGREE or DISAGREE with each of the following statements about human waste in the national park.**

	Strongly Disagree		Neither disagree nor agree			Strongly Agree	
G. I believe I should bury my feces	1	2	3	4	5	6	7
G. I believe I should pack out my own feces using an appropriate bag	1	2	3	4	5	6	7
H. Others expect me to pack out my own feces using an appropriate bag	1	2	3	4	5	6	7
I. I believe most people will leave their feces in the park	1	2	3	4	5	6	7
J. It would be inappropriate if the park encourages visitors to pack out their own feces using an appropriate bag	1	2	3	4	5	6	7
K. I would prefer seeing toilets in this national park instead of packing out my own feces	1	2	3	4	5	6	7

**14. Please indicate how DIFFICULT the following behaviors would be for you during a future trip to the national park:**

	Very Difficult		Neither			Very Easy	
Pack out my own feces and toilet paper in a bag like a Biffy bag	1	2	3	4	5	6	7
Carry used waste bag(s) (e.g. Biffy bag) with me until I find a trash bin							
Pack out my own feces & toilet paper using an appropriate bag (e.g. Biffy bag) if they were readily available free of charge	1	2	3	4	5	6	7
Pack out my own feces & toilet paper using an appropriate bag (e.g. Biffy bag) if I could buy them for 30 NOK (app, 3 Euros/dollars)	1	2	3	4	5	6	7
Plan to go to a toilet before my trip into a park to avoid having to do so later	1	2	3	4	5	6	7

15. Is there anything else you would like to share with us about your experience in this park?

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**THANK YOU for answering the survey!**



# Communication Visitor Survey: experience of message (English Version)



## Lofotodden National Park

**1** Date: \_\_\_\_\_ **2** Gender: Female  Male  **3** Age: \_\_\_\_\_

**4** Residence:  Norway  Outside Norway (Country): \_\_\_\_\_

**5** To what degree did the information given to you affect you?

	Not at all			Somewhat			Very much		
1. Made me reflect on the content and its deeper meanings	1	2	3	4	5	6	7		
2. Enhanced my appreciation for the area	1	2	3	4	5	6	7		
3. Increased my knowledge about leave no trace	1	2	3	4	5	6	7		
4. Made my visit to the national park more meaningful	1	2	3	4	5	6	7		
5. Changed the way I will behave after I leave Lofoten	1	2	3	4	5	6	7		
6. Encouraged me to tell others about this topic	1	2	3	4	5	6	7		
7. Made me care more about the nature in this area	1	2	3	4	5	6	7		
8. Made me care more about protecting places like this	1	2	3	4	5	6	7		
9. Reduced my sense of freedom during this trip	1	2	3	4	5	6	7		
10. Gave me an increased appreciation for restrictions in this national park	1	2	3	4	5	6	7		

**6** What do you think about the information you received?

	Not at all			Somewhat			Very much		
1. Focused on emotions	1	2	3	4	5	6	7		
2. Focused on factual information	1	2	3	4	5	6	7		
3. Acknowledged multiple perspectives	1	2	3	4	5	6	7		
4. Emphasized the connection between the visitor and the place	1	2	3	4	5	6	7		
5. Had a clear message for the visitor	1	2	3	4	5	6	7		
6. Emphasized the benefits of following leave no trace behaviors	1	2	3	4	5	6	7		
7. Talked about the challenges of following leave no trace behaviors	1	2	3	4	5	6	7		
8. Emphasized what others may think is acceptable behaviors	1	2	3	4	5	6	7		
9. Emphasized how easy it is to follow leave no trace principles	1	2	3	4	5	6	7		
10. Gave clear examples of how to leave no trace behind in the national park	1	2	3	4	5	6	7		

**7** Do you have other things you would like to share about the information you received?

*Write below and on back of survey card if needed:*





*The Norwegian Institute for Nature Research, NINA, is as an independent foundation focusing on environmental research, emphasizing the interaction between human society, natural resources and biodiversity.*

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