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NINA Report

Perceptions of human waste mitigation in Kvalvika, Lofotodden National Park

A mixed method study of visitor impacts, behaviors, and waste mitigation preferences

Rose Keller and Sigrid Engen

NINA

Norwegian Institute for Nature Research

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Abstract

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The vital importance of national parks in Norway provisioning recreation values and friluftsliv experiences and underpinning local economic value creation is uncontested. In 2022, the number of jobs in Norway related to provisioning nature-based tourism services in communities near national parks and other natural attractions was 170 000, a 35% increase in jobs in this sector from 2000. But with increased tourism comes damages from heavy use, and we aim to understand how to reduce the negative consequences of high tourism and preserve the natural values of the national parks. We first mapped the extent of waste in Kvalvika (in Lofotodden National Park) following the Torsfjorden trail with 30 m wide transects in order to identify hotspots and conduct initial testing of water quality for potential hazards to human health. We also gathered qualitative data on visitor experience from short on-site interviews. We then conducted a broad-scale visitor survey guided by the Theory of Planned Behavior (TPB; Azjen 1991) and themes taken from our interviews and discussion with local managers to explore how visitors perceive waste and barriers to changing behavior. TPB suggests that human behaviors are the result of attitudes, norms (social rules of behavior), and perceptions of difficulty (of doing a particular behavior). We also explored through the survey what behaviors were most suited to visitor type with respect to visitor volume. The survey was designed to reveal human waste perception and preferences for management strategies and information modes. We had targeted questions about human waste pack out bags to assess knowledge and likelihood of use. The survey was launched online and in a survey box at the site. In total we collected 556 responses. We additionally cooperated with the Lofoten Friluftsrådet to establish trail counters in our study areas to corroborate our findings with actual visitor numbers. All data collection occurred during the peak tourist season: June – September. Our last stage of the project (summer 2023) will test the carrying out waste solution for human waste reduction that was most realistic for overnight visitors according to the responses. We will further evaluate the efficacy of the solution by measuring treatment and control areas for waste buildup. We will also test different communication strategies, both passive and active, to assess the efficacy in using communication tools to reduce negative impacts.

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Sammendrag

Keller, R.& Engen, S. 2022. Perceptions of human waste mitigation in Kvalvika, Lofotodden National Park: A mixed method study of visitor impacts, behaviors, and waste mitigation preferences. NINA Rapport 2238. Norsk institutt for naturforskning

Nasjonalparker i Norge sørger for rekreasjonsverdier og friluftslivsopplevelser, og underbygger lokal økonomisk verdiskaping. I 2022 var 170 000 arbeidsplasser knyttet til naturbaserte reiselivstjenester i lokalsamfunn nær nasjonalparker og andre naturattraksjoner, en 35 % økning i arbeidsplasser i denne sektoren fra 2000. Men med økt turisme kommer skader fra stor bruk, og vi har som mål å forstå hvordan vi kan redusere de negative konsekvensene av høy turisme og bevare naturverdiene i nasjonalparkene. Vi kartla først omfanget av avfall i Kvalvika (i Lofotodden nasjonalpark) langs Torsfjorden sti for å identifisere særlig utsatte områder. I tillegg gjennomførte vi innledende testing av vannkvalitet for å kartlegge mulige helsefarer. Vi gjennomførte deretter en bred skala besøksundersøkelse veiledet av Theory of Planned Behavior (TPB; Azjen 1991) og temaer hentet fra våre intervjuer og diskusjoner med lokale leder for å utforske hvordan besøkende oppfatter avfall og barrierer for endret atferd. TPB antyder at menneskelig atferd er et resultat av holdninger, normer (sosiale regler for atferd) og oppfatninger av vanskeligheter (av å gjøre en bestemt atferd). Vi undersøkte også gjennom undersøkelsen hvilken atferd som var best egnet for besøkstypen med hensyn til antall besøkende. Undersøkelsen ble designet for å rette seg mot oppfatninger av forsøpling og preferanser for styringsstrategier og informasjonstyper. Vi hadde målrettede spørsmål knyttet til avføring for å vurdere sannsynlighet for kommende bruk av poser for å fjerne spor av dobesøk fra området. Undersøkelsen ble lansert online og i en fysisk svarkasse på stedet. Totalt samlet vi inn 556 svar. Vi samarbeidet i tillegg med Lofoten Friluftsrådet for å etablere løypetellere i våre studieområder for å bekrefte funnene våre med faktiske besøkstall. All datainnsamling foregikk i høysesongen for turister: juni – september. I siste del av prosjektet (sommer 2023) vil vi teste løsningen som undersøkelsen viser er mest realistisk for de besøkende å gjennomføre. Videre vil vi evaluere effektiviteten til løsningen ved å undersøke både behandlingsområdet og et kontrollområde. Vi vil også teste ulike kommunikasjonsstrategier, både passive og aktive, for å vurdere effektiviteten av å bruke kommunikasjonsverktøy for å redusere negative påvirkninger av et høyt antall besøkende.

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Contents

1 Introduction.....8
1.1 Study Context 9
2. Methods……..…..9
2.1 Mapping process……9
2.2 Survey process…….....10
2.3 Interviews……10
2.4 Field observation and protocol……10
3. Results……..12
3.1 Water quality and mapping……..…12
3.2 Visitor Survey……12
3.3 Visitor Interviews……16
3.4 Field observations……17
4. Conclusion……19
5. References…….....21
6. Supplement A: Visitor Survey (Norwegian version, English version)……..……..22

Foreword

In 2021, NINA investigated the extent of littering in parts of Lofotodden National Park (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 more waste in the Kvalvika area. NINA's initial waste survey of the Kvalvika beach, Torsfjorden sti 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. Throughout the year, attention to waste in Norwegian national parks increased. In this report, we show the development of waste left behind in Kvalvika. We describe how visitors perceive their waste behaviors and what effects human waste has on nature and human health in Kvalvika. We show how human waste is experienced by the visitors, and what this can mean for nature-based tourism and local value creation. 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.

We would like to thank the national park board, advisory committee and local reference group in Lofotodden for good input and professional discussions during the project. Thanks to Hennie Engedal Lindøe and Eirik Sønstevold for their work in Lofotodden in 2021, getting this project up and running, and Anne Olga Syverhuset who has been active in outreach from the start. We would like to especially thank the Lofotodden national park manager, **Ole-Jakob Kvalshaug**, for his invaluable contribution in ideas and planning for the project, for his continued support in local outreach and coordination, and not in the least for his time helping us in the fieldwork. We would like to thank all those who have participated in surveys and interviews. And we send a big thank you to the Norwegian Environment Agency for their support.

19.12.2022, Rose Keller (project leader) and Sigrid Engen

1 Introduction

Waste is an issue faced in parks and protected areas around the world, but especially problematic is the growing problem of improper disposal of human feces, urine and toilet paper. In areas of high tourism, the absolute volume of waste may outpace the natural processes of decomposition and purification that fewer numbers of visitors allowed in the past. The literal biochemistry of soil can change due to nitrogen loading, pathogens and residual chemicals present in human waste (Shi et al. 2016), and pathogens which have serious health implications for humans and wildlife (Climburg et al. 2000), marine species (Gyawali et al. 2019) as well as the viability of keystone plant species (Li et al. 2022). Not in the least, human experience of nature and the quality of outdoor life is negatively impacted by seeing human waste (Smart et al. 2022)

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, tabacco 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 National Park manager and National Park 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 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, awareness of waste in Norwegian national parks increased, and so the project team collected additional internal NINA funding to support a mixed methods study of visitor behavior, impacts and mitigation preferences concerning human waste (i.e., toilet paper, human feces and other sanitary items) and litter in Kvalvika, and extended this research to Femundsmarka NP after request from the national park to also examine firepit and tree damage around Røvoltjønnan.

In this report, we describe the results from our mixed methods study on visitor impacts and behavior, along with preferences for waste mitigation strategies in Lofotodden NP and the Kvalvika area. We also describe human health and environmental effects of current levels of human waste and show how the visitor experience is compromised. This, in turn, could negatively affect nature-based tourism and local value creation. Finally, we make recommendations for an additional year of research where we aim to test a management strategy to reduce the levels of human waste in Kvalvika.

1.1 Study Context

Lofotodden National Park is located on the south-west side of Lofoten, often referred to as 'yttersida' by locals. The area attracts many visitors, which can pose a threat to the conservation values. The most visited area in the national park is Kvalvika beach, which can be reached by hiking from a parking spot in Torsfjorden, along a 2 km marked trail to the beach. From May to October 2022, this beach had around 30 000 visitors captured by automatic trail counters. In a baseline visitor survey conducted in 2019, 81% of visitors to Kvalvika were first-time visitors (Oslo Economics 2019). After erosion and marine litter, other types of waste (including toilet paper) was cited as the most problematic human impact. These results were largely confirmed by the survey carried out in this project (see table 3) where we found that 91% were first-time visitors, and 25% reported seeing toilet paper or human feces on their trip. Visitors are primarily on day trips (70%), while 30% spend a night or more at Kvalvika. On a summer evening with the midnight sun, there can be up to 37 tents along the 2 km long beach (field observation from

2022). Keller and Engen (NINA researchers) took interviews and established an online and on-site survey to give to visitors to Kvalvika in 2022. They collected 60 short interviews, and 556 complete survey responses. The surveys and interviews were in both Norwegian and English, but the primary source of information came from the English surveys.

2 Methods

The study is a mixed methods approach to understanding waste behavior among visitors to Kvalvika. We drew from the Theory of Planned Behavior (Azjen 1991) which is the most common behavior theory in recreation literature to predict individual's behavior based on their expressed attitudes, perceptions about waste, their own behaviors and the behaviors of others. We also used the communication theory model, (communication B model, COM-B) to frame how individuals' responses were connected under broad themes of motivation, perceived opportunity, and perceived capability in their own behaviors (Michie et al. 2011). Our interview guide and survey was 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. 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.

2.1 Mapping waste and water sampling

In summer 2022, we mapped the presence of human waste in June (baseline) and September (final). In June we examined the Torsfjorden trail and Kvalvika beach. After comparing our waste registrations with the waste mapping conducted by NINA in 2021 (Lindøe 2022; Sønstevold 2022), we identified five waste hotspots (green circles, figure 1) we returned to and mapped in September. Our team used the field mapping application, FieldMaps (Esri 2022). We registered all waste occurrences according to 10 categories. However, the main type of waste was used toilet paper and/or wet wipes with or without human feces (see figure 1).

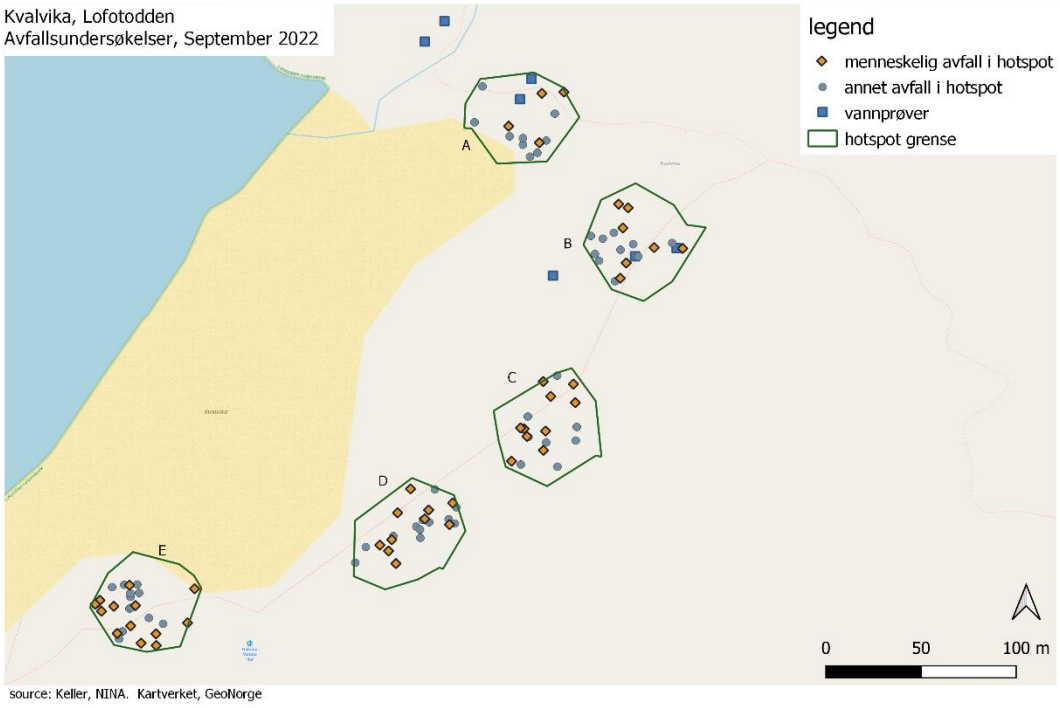

Figure 1. Overview of the mapping registration process for human waste and litter registration. Field registration form was brought into Field Maps (ESRI) mapping application as layers and photos were connected to each GPS point. Categories for registration were estimated for age (new, 1 year old, 2 – 4 years old, over 4 years old) and type. The waste category layer had 10 possible types: 1 – human waste & toilet paper, 2 – metal, 3 – clothing/articles, 4 – foodwaste, 5 – plastic, 6 – foil/packaging, 7 – fishing equipment, 8 – tobacco products, 9- single use grill, 10 - other

We took water samples for water quality and environmental DNA (eDNA) analysis in June, July and September in two streams and 6 areas (figure 1, 2) in Kvalvika. This was done because we observed human feces and toilet paper sites directly next to streams within the park that we also observed visitors utilizing for drinking water (figure 3). 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. In addition, we repeated the standard drinking water quality assessment we conducted in 2021 again at the same time of summer in 2022 from the same 6 areas. These samples were sent to the local water quality testing station (EcoLab) in Sortland.

Figure 2. Filtering water samples for environmental DNA analysis. (Photo: Rose Keller)

Figure 3. Human waste sites directly next to stream at Kvalvika, with tents in the background. (Photo: Rose Keller)

2.2 Visitor survey

The visitor survey was 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. We developed a short (2 pages) survey in both Norwegian and English (see Supplement A). 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 adopting the particular waste mitigation strategy of individuals packing out their feces using specially designed human waste bags (aka Waste Alleviation and Gelling (WAG) bags). The survey included assessments of visitors' knowledge of waste disposal, attitudes about environmental stewardship, perceptions of the natural values of parks and degree of concern about human waste in nature.

The survey was distributed using a survey response box (Norwegian: “svarkasse”) placed a 5-10 minute hike from the parking at Torsfjorden up the trail to Kvalvika (figure 4). Here visitors could fill out and leave behind a completed paper version of the survey or access the online version by scanning a QR code. Cards with QR codes were also sporadically distributed to people parked at Torsfjorden or left under windshield wipers of parked cars.

2.3 Interviews

We carried out short (15 min) interviews with visitors on their way back from Kvalvika beach on random week and weekend days during the period of July 7 – 27. The interviews were anonymous. The interview guide was adapted from the visitor survey, but with more general questions about the values of national parks, perceptions of the waste problem (if they saw it as a problem at all) in Kvalvika, and preferences about how to deal with human waste in nature. The interviews were transcribed from field notes each day. Later, interviews were compared and common themes categorized according the model of communication and behavior (COM-B). COM-B models individual’s behavior based on their motiviations, perceived opportunities and perceived capabilities to achieve a particular desired behavior change (Michie et al. 2011). This model highlights how individuals are motivated to engage in particular behaviors through communication.

2.4 Field observations and trail counters

During the period of July 7 – 27 and also during waste mapping in June and September, we made observations of visitor group size, estimated age, and language heard in order to corroborate survey findings. Field observation protocols also included counting tents on Kvalvika beach at 11am and 4pm. Trail counters were established in cooperation with Lofoten Friluftsrådet at the start of Torsfjorden trail and the trail to Kvalvika from Ryten. These were in operation from May to October 2022, and have been repeatedly deployed during the summer by Friluftsrådet since 2015.

Figure 4. Kvalvika visitor survey at the side of Torsfjorden trail. Visitors could take an English or Norwegian version and fill it out on site or take a QR code photo or card to take the survey online. We collected 286 online responses and 270 paper responses. (Photo: Ole-Jakob Kvalshaug)

3 Results

The overall result shows that many visitors to Kvalvika have observed waste, but whether they consider this problematic or not varies. Visitors tended to compare Kvalvika to other nature areas they have visited, and generally concluded that the state of Kvalvika was good compared with these places. Water quality was poor, and some visitors reported in the survey that they became ill after taking water from the streams along the beach. Preferences for waste mitigation were varied, but a majority from the visitor survey (63 %) reported being ready to adopt a carry out system for human waste in order to preserve the beauty of Kvalvika.

3.1 Water quality

Results in both 2021 and 2022 showed levels of *E.coli* present in the streams that render them unsafe for human consumption. Even though results in 2021 showed levels of *E.coli* present in Rørholmen at mid-risk levels, they were inconclusive about the source of bacteria. In 2022, the levels of E.coli were high, while levels of other indicators such as intestinal enterococcus were low, as to clearly suggest the source of fecal pollution from humans (Table 2). Both years water quality testing was carried out within the first week of August. The processing of the environmental DNA analysis is ongoing within NINA's GenLab and will confirm whether the source of *E.coli* is human or not.

Table 1. Results from water quality testing in Kvalvika area in summer 2022

Lokaliteter	**Rørholmen**	**Forsvatnet**	**Bergland (kontroll)**
E.coli (cfu/100ml)	>100	26	1
Intestinal enterococcus	10	1	80
Human health risk	Very high	High-mid	Low

For each stream site, we report here the highest amount of E.coli measured in the streams at Kvalvika and control stream (Bergland) in Lofotodden National Park in the summer of 2022. We also report the highest amount of intestinal enterococci. It is a group of bacteria that has a lower incidence than E. coli in human feces, but often in high concentrations in feces from livestock, especially ruminants. The bacteria are measured with colony forming units (cfu), which is the number of colonies detected per 100 milliliters of water. Norway's drinking water regulations state that E. coli must not be detected in public drinking water (<1 cfu/100ml).

3.2 Visitor Survey

We collected 556 completed surveys from the online and paper (response box at the site) surveys. Most visitors to Kvalvika were on a day trip (70%) in groups of two (48%) and did not see human feces on the trip (table 2). Among the overnight visitors (n =185), many (67%) reported seeing human waste.

Table 2. Basic visitor survey descriptive demographics

		n	**%**
Survey language	English	490	88.1
	Norwegian	66	11.8
		n	%
Residence	Norway	51	
	Germany	130	
	Sweden	57	
	France	39	
	United States	32	
	Czech Republic	26	
	Finland	20	
	Poland	16	

	Italy	14	
	Belgium	13	
	Netherlands	12	
	Switzerland	12	
	Austria	10	
	Spain	10	
	Other countries	47	
Gender	Female	253	49.8
	Male	256	50.0
	Other	5	0.8
Age	Born between 1950 and 1969	65	11.6
	Born between 1970 and 1989	177	31.8
	Born between 1990 and 2009	255	45.8
	Born after 2009	14	2.5

Nights in Kvalvika	**n**	**%**
Day hike	361	70.1
1 night	153	24.9
2 nights	14	2.5
3 nights or more	18	3.1
Group size		
	n	%
1	39	7.5
2	250	47.9
3	98	18.8
4	65	12.5
5 or more	28	5.4
10 or more	6	1.1
Notice human fecal waste, toilet paper		
No	308	57
Yes	134	25
Not sure	93	18
Negative impact if seen?		
Very negative	35	26
Negative	83	62
Neutral/no impact	16	12

Visitors seem to agree that human feces and toilet paper left in nature negatively affects people's nature experience and negatively impacts the environment, though to a lesser extent than one's nature experience (Table 3). Visitors' responses to the question of faecal decomposition in nature varied, and generally do not suggest that visitors are aware of the slower decomposition of feces in boggy, cooler, and sandy environments (Ells et al. 2011). Visitors were neutral in their agreement of whether it was problematic to leave feces behind in nature, that others expected them to carry out or bury waste but showed slightly more disagreement regarding other visitors behaving responsibly when dealing with toilet waste. Many visitors believed that human feces left in the national park can weaken the conservation values, and a few thought it could be harmful to human health (Table 3). Observational studies showed that people drank water from the

stream. Considering the high values of *E.coli* there in 2022, it is of potential concern that visitors do not consider health risks. In general, people slightly agreed that having toilets within the NP does not degrade the natural values of the park.

Table 3. Visitor responses to knowledge and attitudes about their own and others behavior in the national park

Survey responses (% of sample)	strongly disagree	disagree	slightly disagree	neutral	slightly agree	agree	strongly agree
Human feces decompose in nature quickly (499)	13	23	16	24	13	6	5
Human feces left in nature do not negatively impact the environment (481)	48	0	25	0	7	3	3
Human feces left in nature do not negatively impact people's nature experience (487)	60	21	7	5	4	3	1
Toilet paper decomposes in nature quickly (494)	37	27	11	12	6	3	2
Toilet paper left in nature does not negatively impact the environment (485)	48	25	12	10	3	1	1
Wet wipes decompose in nature quickly (483)	85	7	3	4	0.2	0.2	1
I would want toilets in this national park (488)	12	10	13	24	18	9	13
Having toilets in national parks does not degrade the natural values of parks (485)	6	12	13	28	22	7	13
I will feel guilty if I leave human feces behind (447)	7	11	10	24	25	7	16
Most people act responsibly when it comes to dealing with human feces (431)	7	13	21	29	23	4	3
Human feces left here has the potential to harm the natural values of this park (434)	7	5	8	25	5	22	28
Human feces left here has the potential to harm the health of other people visiting this park (428)	8	10	7	33	13	9	20

Visitors generally reported burying or hiding feces and toilet paper as appropriate behavior in nature, but that they observe others were not abiding to these rules of behavior. Some think that the solution is to go far away from paths and water and hide the feces under stones or vegetation, but at the same time a large proportion believe that human feces do not break down quickly, especially toilet paper and wet wipes, and that toilet paper left in nature has a negative impact on the environment (table 4). A possible solution that not many people think about, but are positive about, is to take their feces to the nearest bin with the help of a specially designed bag (see table 5).

Table 4. Visitor responses to perceptions of ease or difficulty of doing the following behaviors

Survey responses (% of sample)	very difficult	difficult	slightly difficult	neutral	slightly easy	easy	very easy
Pack out my own toilet paper and bury my feces (423)	3	8	11	24	18	11	23
Pack out my own feces and toilet paper in designed waste bag (430)	4	16	14	23	21	10	13
Carry waste-bagged feces and toilet paper with me until I find a trash bin (425)	7	18	14	20	16	12	12
Plan to go to a toilet before my trip into a park to avoid having to do so later (425)	5	8	5	17	22	7	35

Table 5. Prior knowledge and willingness to try waste alleviation and gelling bags as a mitigation strategy for human waste in Kvalvika

Did you know about personal waste bags?		**%**
WAG knowledge (n=446)	No	77
	Yes	23
Would you use one if free or accessible?		
WAG try (n=442)	No	6
	Maybe	31
	Yes	63

In the open-ended (qualitative) portion of the survey relating to the question: “anything else you would share about your experience today?”, trail erosion was the most common concern (figure 5). Hiding feces better was the second most common theme. Moreover, five separate visitors reported seeing toilet paper next to, or human feces in water sources and reported becoming ill from drinking the water.

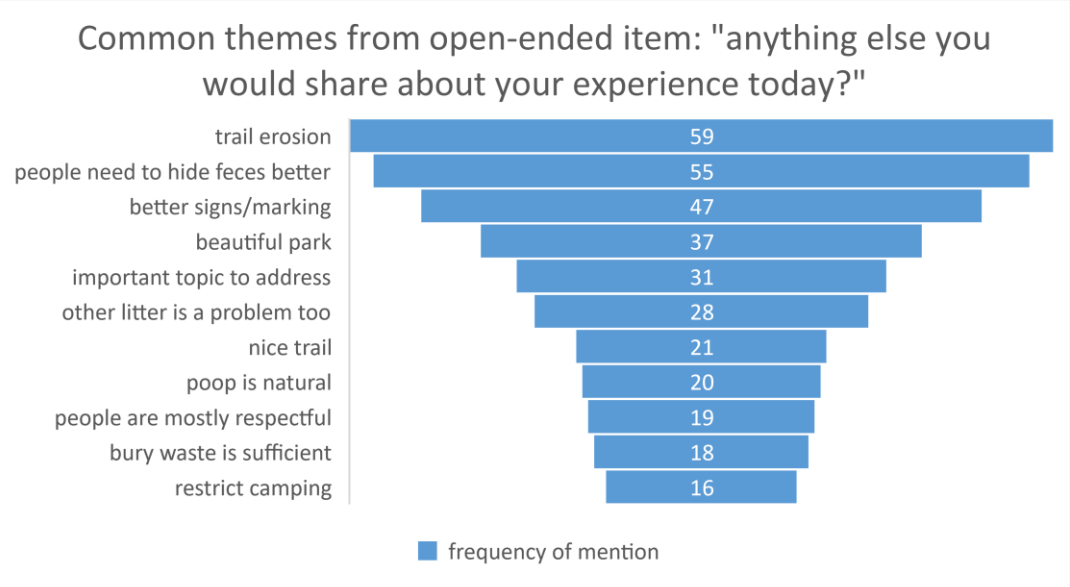

Figure 5. Common responses from the open-ended question in visitor survey of Kvalvika, July- September 2022

3.3 Visitor Interviews

We collected 62 short interviews (circa 15 minutes) from visitors returning from Kvalvika beach. The interviews covered the following topics with COM-B themes in (**brackets**):

- What is important about visiting the national park or nature in Norway (**Motivation**)
- Is litter, toilet paper or human feces a problem in Kvalvika (**Opportunity**)
- Is it okay to leave human waste (feces, toilet paper) behind in nature – what kinds of behaviors are appropriate (**Opportunity**)
- Possible solutions to the challenge of human waste in Lofotodden NP do they suggest, including opinions about toilets in Kvalvika (**Capability**)
- What are the emotions they express about nature, about human behavior or waste (**Motivation**)

Visitors to Kvalvika found it important to experience pristine nature and to protect scenic beauty. Scenic beauty was what the majority of visitors described as being most striking and memorable about their trip to Kvalvika. Experiencing the feeling of freedom in nature was also important, which was primarily related to opportunities for 'wild' free camping or hiking where one wanted. The importance of keeping national parks trash-free was also mentioned by the majority of interviewees (51 of 62).

Visitors often responded to the question: "have you seen any toilet waste toilet paper or human feces in Lofotodden NP?" by comparing Lofotodden NP (and sometimes Norway in general) with other nature areas in countries like Sweden, France, Serbia, Turkey and India – saying that these places had big problems compared to Lofotodden. In addition, many visitors responded that it is not a problem to leave feces if they are not visible, and that *"…people should be better about hiding them"* (Interview 53).

While visitors found that leaving trash is a problem at Kvalvika, **human waste generally is not considered a problem if it is not seen.** However, 26 of 62 interviewed visitors mentioned that whether or not toilet paper and feces is a problem depends on quantity and that it must be buried/hidden. Packing out toilet paper was reported by 22 of 62 interviewees to be normal behavior. **Human feces are considered natural, but possibly damaging for nature**. 38 out of 62 interviewed visitors reported seeing human waste or toilet paper – about half reported it having a negative impact and half neutral. This stands in stark contrast to the survey, where nearly all

who saw waste (n=134) reported it having a negative impact (only 12% reported neutral/no impact to experience) and this was a consideration they had about returning to visit Kvalvika in the future. Importantly, experiencing human waste implies an accepted norm of behavior the park may not wish to encourage. Eleven interviewees mentioned how seeing the evidence of other's behavior impacted their own – or others – idea of proper behavior:

*"Of course many of us hikers know that it is bad to leave trash behind, and toilet paper, but when there is already so much in one spot, it doesn't matter much what I do right? That's the sad, but I think it happens more often…" (*Interview 44*).*

*"Nature is supposed to be healthy, we need to protect a healthy nature. Thankful for places like Lofotodden, but if this can't be clean then there is no hope for the rest of the world and all places. I'm a teacher. And I spend time trying to educate kids about caring about nature. I show them how a bottle in nature, well, that's even worse than seeing plastic in the city. The bottle here stands out more and tells others – oh, this isn't worth protecting and caring about" (*Interview 54).

When asking visitors in interviews if human waste like feces and toilet paper is different than litter, common responses included that litter is "easy" to take out, or that animals leave feces in nature, so humans of course do too (26 of the 62 interviewed mentioned the need to at least take out toilet paper). Yet, if asked about what was important to protect about nature in the park, the majority of interviewees said to protect the park and nature against negative human impacts and to keep it clean/pristine. Humans were considered external to nature (negatively impacting nature with their presence) while simultaneously considered natural as their waste impacts are *part of nature* ("other animals do it, so we humans do too" *Interview 27*). This dissonance is reflected in other areas of tourism research (personal vs. tourism with large impacts) but waste research can benefit from exploring the tendency in human thinking to separate humans from nature when reflecting on environmental values (protection, preservation) and to lump them into nature when thinking about specific waste behaviors. The value-behavior gap is notorious in other areas of research concerning pro-environmental behaviors (see Niemiec et al. 2021 for review). Toilets in the park was a split issue: while most stated it would not degrade their experience if the toilets were hidden, nearly all reflected that toilets are high cost and if not maintained the problem may be worse. Visitors with strong attitudes of support or opposition to toilets were rare, which reflects the findings in the quantitative survey. When asked to consider packing out human waste in a specially designed human waste bag (WAG bag), most interviewees were skeptical, but some were agreeable when reflecting on the practice of pet waste bags, former experience in other nature areas or upon reflection about protecting the park (41%). **Nearly all interviewees wanted better information to educate others about leave no trace practice, and called for better trail marking.** Visitors reported strong motivations to protect special places like Kvalvika from too much human impact. Likewise, the sense of freedom of being in nature was connected to feelings of wellbeing, wholeness and relief.

"It is important to protect feelings of solitude and wild. Lofotodden is not pristine but it is still able to give these feelings most of the time" (Interview 33)

"…it feels good to be here. That is important to keep, keep the feeling of immense nature and small human feeling" (Interview 46)

Complied themes from visitor interviews using the COM-B model reveals opportunities for targeted communication about waste mitigation in Kvalvika that may work to establish new leave no trace norms. Visitors appear to be willing to adjust behaviors to be appropriate for the natural setting at risk, if health-based messaging is used – health of the park, and health of human visitors (figure 6).

Figure 6. Compiled interview themes according to the COM-B model of communication to affect behavior change, such as adopting a new norm in leave no trace behaviors. Themes compiled from 62 separate short interviews with visitors returning from their trip to Kvalvika.

3.4 Field observations and trail counters

Up to 50 tents were reported by visitors on a good weather day in July. The maximum number observed by researchers was 34 tents. Average daily passes on trail counters were 620 in June, 1012 in July, 890 in August. In total 60 000 passes were recorded on the trail counters to Kvalvika from Torsfjorden, which results in an estimated 30 000 visitors (from May to September 2022). Because the visitor survey is representative of visitors to Kvalvika according to prior studies (Sørensen 2020), we can estimate around 8 700 (conf. interval = 435) visitors camped on Kvalvika over the period May – September, due to 29% of respondents who reported staying one night or more on the beach.

Human waste was found throughout the mapped area, but it was most concentrated near streams and boulders at Kvalvika beach and within the first 300 m of Torsfjorden trail start (from parking area). Through GIS analysis using QGIS (v. 3.14) we found that overall average human waste deposit distance from water sources was 8.7 meters by taking the average distance of all human waste deposits within 30 m area of the stream's center line (local centroid). Litter (e.g. foil, plastic bottles, food-waste) was most concentrated at beach area in firepits and at camp sites. Trail erosion is a visible issue along the Torsfjorden trail, around the beach and especially at popular tent areas along the beach. This issue is known to the park management and active measures are underway to improve the condition. Trail erosion was in addition reported by interviewees to be a primary impact to their experience – some reported it having a positive impact

(because it is wide enough not to lose sight of), but of those who elaborated on the quality of the trail, most reported the need for better marking or signs to keep the trail from further erosion.

3.5 Conclusion

The knowledge that emerges from our Lofotodden NP study can be used in other areas that have high visitor numbers and similar challenges. Nature-based tourism is an important industry in Norway likely to increase in the future. This study can help make tourism more traceless and reduce the challenge associated with waste.

To ensure relevance and targeted solutions, it is important to anchor this research in the local context and to work closely with local stakeholders. This project is linked to a local reference group for Lofotodden NP and we met with this group to present initial findings and research designs for 2023. They pointed out that locals also see human waste as a challenge. At the meeting, we presented several strategies to reduce waste, and the group agreed that it should be tested that visitors carry their own waste in a specially designed bag to a bin at the entry gate. The cooperative that handles waste in the area (*Lofoten Avfallsselskap*) is part of this local reference group and is committed to accept the waste. This is in line with what the visitors see as possible solutions. In the survey, over 60% were positive about the solution of packing out their own waste in WAG bags, if these were accessible at the trail. Almost 80% were positive about taking toilet paper/wet wipes with them and hiding their feces. Feces are seen to a greater extent as waste that belongs in nature, while wet wipes and toilet paper are seen as manageable waste. At the same time, it is important that feces are also handled in a better way, since current behavior can result in the water not being drinkable and the nature experience being negatively affected. The untouched feeling is important to many visitors of Lofotodden NP and it is also how Norwegian national parks are largely marketed. If the expectations people have for the visit are not fulfilled, it can lead to dissatisfied guests and lower value creation in local tourism. Therefore, in the summer of 2023, we will test out special bags for waste in Kvalvika to see how well this works.

Suggested Management Focus

- Focus on a visitor strategy that includes visitor monitoring to reduce waste generating activities
- Understand through a program of visitor monitoring visitor's motivations, opportunities for change and barriers for change to affect desired leave no trace behaviors
- Anchor each visitor strategy to the local context; too large and the strategy misses important key differences of each park context
- Use the points above to develop a targeted and dynamic communication strategy and information campaign
- Continue to support visitor monitoring research in order to track how communication and interventions work to change visitor behaviors and improve the quality of natural and cultural values in Norway's national parks

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5 Supplement A: Survey instrument (English version)

Welcome! Lofotodden National Park and the Norwegian Institute for Nature Research have a three-year research project (2021-2024) where we study human waste in nature and how this possibly affects you and your experience of nature. We invite you to participate in this survey. It will take you 5-7 minutes. Toilet waste can probably be experienced as a slightly delicate topic for some, but your input is important so that the national park can make good decisions. We can assure you that your answers will be completely anonymous. Answer online using the QR code below. For more information, contact the project leader: Rose Keller, rose.keller@nina.no

VISITOR SURVEY about HUMAN WASTE IN LOFOTODDEN NATIONAL PARK

1. Are you a first-time visitor to this national park?
   ☐ No ☐ Yes
   IF NO, including this visit, how many times have you visited Lofotodden National Park?
_____

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

3. In what year were you born? _____

4. What is your gender? _____

5. Do you live in Norway? ☐ Yes ☐ No, (write in country) _____

6. How many nights will you stay, or did you stay (if this is your last day) in Kvalvika Beach?
   Number of nights_____ OR: ☐ Day hike only

7. Prior to or during this visit, did you seek out any information about waste disposal in this national park?
   ☐ No ☐ Yes (if Yes, go to 7b).

7b. What source(s) were the most helpful in planning waste disposal during your trip? (*select all that apply*)
☐ Tourist brochure ☐ Park sign at trailhead ☐ Park official ☐ Park website
☐ Park Visitor center in Reine ☐ Other visitors ☐ Social media ☐ Tourist information site

☐Other _____

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

	Strongly Disagree			Neither disagree nor agree			Strongly Agree
A. Human feces decompose in nature quickly	1	2	3	4	5	6	7
B. Human feces left in nature do not negatively impact the environment	1	2	3	4	5	6	7
C. Human feces left in nature do not negatively impact people's nature experience	1	2	3	4	5	6	7
D. Toilet paper decomposes in nature quickly	1	2	3	4	5	6	7

	Strongly Disagree			Neither disagree nor agree			Strongly Agree
E. Toilet paper left in nature does not negatively impact the environment	1	2	3	4	5	6	7
F. Wet wipes decompose in nature quickly	1	2	3	4	5	6	7
G. I would want toilets in this national park	1	2	3	4	5	6	7
H. Having toilets in national parks does not degrade the natural values of parks	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 (if Yes, Go to 9b)

9b. How did seeing human feces impact your nature experience in this park?
☐ Very negatively ☐ Negatively ☐ Neutral, no impact

10. In your opinion, who has the **main** responsibility for managing human waste in this park? (select one)
☐ tourism industry ☐ the park management ☐ visitors, like myself ☐ local government
☐ national government ☐ local (municipal) waste services
☐ other_____

Some people use a personal waste alleviation (WAG) bag for safely and hygienically packing out their feces during their trip in nature. This bag dries the feces and cuts odors. Used bags are thrown away in trash bins.

11. Have you ever heard of a human feces pack-out bag before (WAG bag)? ☐ No ☐ Yes

12. If personal waste alleviation and gelling bags(WAG bag) were available free of charge, would you be interested in trying one? ☐ No ☐ Maybe ☐ Yes

13. Please indicate how strongly you AGREE or DISAGREE with each of the following statements about behaviors in national parks in Norway.

	Strongly Disagree			Neither disagree nor agree			Strongly Agree
O. I would feel guilty if I leave human feces behind	1	2	3	4	5	6	7
P. I believe I should bury my own feces	1	2	3	4	5	6	7
Q. I believe I should pack out my own feces using an appropriate bag	1	2	3	4	5	6	7
R. Others expect me to bury my feces	1	2	3	4	5	6	7
S. Others expect me to pack out my feces in an appropriate bag	1	2	3	4	5	6	7
T. Most people behave responsibly when it comes to dealing with human feces	1	2	3	4	5	6	7
U. It bothers me when I see human feces in nature	1	2	3	4	5	6	7
V. Human feces left here has the potential to harm the natural values of this park	1	2	3	4	5	6	7
W. Human feces left here has the potential to harm the health of other people visiting this park	1	2	3	4	5	6	7

14. Please indicate how DIFFICULT the following behaviors would be to do every time you may visit national parks in Norway:

	Very Diffi-cult			Neither			Very Easy
Pack out my own toilet paper and bury my feces	1	2	3	4	5	6	7
Pack out my own feces and toilet paper in a designed waste bag	1	2	3	4	5	6	7
Carry designed waste-bagged feces and toilet paper with me until I find a trash bin	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?

_____

_____

_____

THANK YOU for answering the survey!

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2238

NINA Report

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.*

NINA was established in 1988. The headquarters are located in Trondheim, with branches in Tromsø, Lillehammer, Bergen and Oslo. In addition, NINA owns and runs the aquatic research station for wild fish at Ims in Rogaland and the arctic fox breeding center at Oppdal.

NINA's activities include research, environmental impact assessments, environmental monitoring, counselling and evaluation. NINA's scientists come from a wide range of disciplinary backgrounds that include biologists, geographers, geneticists, social scientists, sociologists and more. We have a broad-based expertise on the genetic, population, species, ecosystem and landscape level, in terrestrial, freshwater and coastal marine ecosystems.

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