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From Buzz to Bliss: A Pilot Study on Ecoacoustic and Perceptual Insights among Visitors in Femundsmarka and Rondane National Parks

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Abstract

Soundscapes are increasingly recognized as a vital, yet underexplored, dimension of visitor experiences in protected areas (PAs). This master's thesis examines how natural and human-made sounds influence visitor emotions, perceptions of crowding, and attitudes toward infrastructure in two contrasting Norwegian national parks: Rondane and Femundsmarka. Drawing on data from a visitor survey (n=70) and ecoacoustic recordings collected during the 2024 "Sounds Like Norway" pilot project, the study investigates emotional responses to soundscapes, visitor typologies based on wilderness purism, and acoustic variation across time and space. Results show that natural sounds, particularly biophonic elements like birdsong and water, are commonly associated with positive emotions such as joy and tranquility. However, some natural sounds, like buzzing insects, also trigger irritation. Visitors in Rondane reported higher appreciation for visitor infrastructure and slightly greater acceptance of crowding compared to visitors in Femundsmarka, where wilderness purists were more prevalent. Ecoacoustic analysis revealed distinct soundscape profiles across sites and times, with certain areas offering higher acoustic naturalness. These findings suggest that soundscape management can support both ecological integrity and visitor satisfaction by informing zoning strategies that balance accessibility with the protection of quiet, nature-focused experiences. The study contributes new insights to nature-based tourism research in a Nordic context and offers practical recommendations for integrating soundscape awareness into visitor management in Norwegian national parks.

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Preface

Hello there!

I will start by telling you congrats on being on your own academic journey, and super cool that you found my paper and may be citing it, or maybe not. Very exciting!

I can't imagine my life without sound or music, as it is something I appreciate and cherish every day. I love listening to birds sing whilst on a horseback ride in the forest, the roar of a waterfall while hiking up a mountain, or just my favorite songs playing as I cook dinner. People tend to say I am talkative, so sound follows me everywhere. With a bachelor's degree in Ecology and nature preservation, it was natural for me to choose a master's with an issue connecting this to the Nature-based tourism and Visitor Management I'm currently taking.

This whole process has been new and exciting. I'm currently writing this paragraph in my easter "break" at 5 in the morning, listening to Tsjaikovskij, because my circadian rhythm is completely off. The playlist I'm listening to is called "Epic Classical Music for Dictators to Conquer the World.." from a channel on YouTube named Quintessence Of Classic. Well, I felt kind of invincible while writing, so I'm guessing it works. Just another example of how much sound contributes to our emotions and perceptions. But I'll have to admit, I didn't listen to classical music for the most part. Just now, while watching the sun rise. My main supporters, audially, have been The Who, Led Zeppelin, Jefferson Airplane, Foreigner, The Beatles, Queen, and other musicians from the 60s, 70s, and 80s. These were with me both on my field trips and during the writing process. I have an excellent Spotify playlist if you are interested. It's great and lasts for 94h and 24m! Totally worth every second!

Firstly, I would like to thank my main supervisor, Øystein Aas, for feedback along the way, checking in on me when he hasn't heard from me in a while, and for being patient with me. I would also like to thank Dr. Rose Keller from NINA, my co-supervisor, for giving me this master's topic and the opportunity to join adventurous field trips, and Noelien Wilsnach for being a good discussion and field partner.

I would not have managed to write this thesis without "Charterfeber", which my peers and I, in the Nature-based Tourism and Visitor Management class, call our group chat. The Girls Choir "Pikekoret IVAR" at NMBU for all kinds of support throughout my student life. Samfunnet i Ås and UKA i Ås 2024, especially my sound committee pepz, for all the parties, knowledge, and CV-food I never would have acquired otherwise. My parents and general friends also deserve a thank you for listening to all my complaining and frustration, and for still being my friends and family afterwards. I would also like to thank the domesticated reindeers in Femundsmarka and the big, cold river near the cabin for a nice cooldown and good bonding time for us on the field trip. Lastly, I want to thank Ana Sirovic and Stephanie Mumma, a nurse, for tending to me in Rondane, when my femur acted up.

I will certainly not be thanking the awful weather during our hike to DNT Bjørnhollia, my darn thigh on the same trip that stopped working properly, the long sickness I got after UKA, or the hungry mosquitoes in Femundsmarka.

But all is good, and the master is being written, so with lots of relief and encouragement,

Frøydis N. N. Sveen *mic drop*

1.0 Introduction

When most people imagine protected areas (PAs), like a national park, they picture stunning visuals, dramatic landscapes, and encounters with rich wildlife. Yet, one of the most immersive elements of being in nature isn't what we see, it's what we hear. The subtle rustling of wind through leaves on trees, the call of a distant bird, or the rush of a mountain stream. Sounds like this can be just as central to a visitor's experience as the scenery itself. These elements make up an auditory environment, *soundscape*, and play a crucial role in shaping our experiences and interactions with natural spaces (Li & Liu, 2024; Wang et al., 2022). Natural sounds, like the ones mentioned before, not only enhance the aesthetic and recreational value of PAs, but also fulfill essential ecological functions, such as aiding species communication and regulating predator-prey dynamics (Pijanowski et al., 2011). Additionally, nature sounds enhance emotional well-being, foster feelings of tranquility, and strengthen one's sense of presence in the landscape (Miller et al., 2018). Conversely, noise pollution from infrastructure, tourism, or aviation can disrupt not only wildlife behavior, but also the quality of human recreation in natural settings (Buxton et al., 2019; Francis & Barber, 2013).

The modern soundscape is in flux and has undergone rapid change due to increasing human presence and technological influence (Buxton et al., 2019; Francis & Barber, 2013; Gage & Axel, 2014). The widespread use of mobile devices and headphones has altered how people interact with their acoustic surroundings, often distancing them from the natural sounds that define outdoor experiences (Krause, 2012). At the same time, tourism growth and rising levels of noise from transportation and infrastructure have transformed what were once serene, predictable sonic environments in many PAs. Visitors now enter national parks, not just with hiking boots and backpacks, but with earbuds in their ears, playlists in their pockets, and a new set of expectations about silence, solitude, and sensory stimulation. These shifting dynamics make it more important than ever to understand how soundscapes influence visitor perceptions of place, tranquility, and crowding. These insights are critical for managing access while protecting the integrity of natural environments. Recognizing the importance of soundscapes is increasingly vital for both ecological conservation and sustainable visitor management. While visual elements have

traditionally dominated landscape planning, the acoustic dimension remains underexplored (Franco et al., 2017; Kato, 2009; Pijanowski et al., 2011). Yet, by preserving and enhancing natural soundscapes, park managers can simultaneously support biodiversity and enrich visitor experiences (Miller et al., 2018; Moscoso et al., 2018).

This thesis seeks to contribute to filling that knowledge gap by investigating how visitors perceive and emotionally respond to natural versus human-made sounds in two Norwegian national parks; Rondane and Femundsmarka. These parks provide contrasting landscapes and visitor profiles, making them ideal case studies for examining acoustic experiences in different natural settings (Zouhar et al., 2024). Rondane National Park, with its rugged mountains and established visitor infrastructure, and Femundsmarka National Park, known for its wilderness qualities and relative remoteness, offer a valuable basis for comparison. The research forms part of the Sounds Like Norway (SLN) pilot project, which aims to explore how soundscapes affect both ecosystem integrity and the quality of recreational experiences. Pilot studies like this one serve a dual role; testing methods and refining survey tools, while also offering early insight into how acoustic environments shape human–nature relationships (Teijlingen, 2001). Drawing on field data collected through surveys and soundwalks in summer 2024, this thesis examines how soundscapes influence emotions, behavior, and perceptions. Ultimately, offering management recommendations that balance access and preservation in Norway's PAs.

1.1 Definitions of keywords

Protected Area (PA) is "a specifically delineated area designated and managed to achieve the conservation of nature and the maintenance of associated ecosystem services and cultural values through legal or other effective means" (Locke, 2018).

Soundscape refers to a landscape of sound or a sonic environment that focuses on the way a sound is understood and perceived by individuals and social groups. To be in a soundscape is a bodily experience in which one's body resonates with the environment. This is perceived as placing *one* inside the landscape, connecting humans with their environment. Soundscapes allow for a holistic conceptualization of the human-nature relationship represented by a place-specific sound (Kato, 2009).

Tranquility can be explained as experiencing peace, but the word is much vaster than that. Although tranquility is a fundamental aspect of human life, the experiential nature of tranquility remains elusive. Many religious, mystical, spiritual or philosophical traditions in the east and west have traditionally strived to reach tranquil experiences and produced texts serving as manuals to reach them (Christoffersen et al., 2022). Therefore, this word, or rather feeling, is difficult to define. I will be defining tranquility as a sense of presence and inner peace while conducting this thesis.

"Friluftsliv" is defined in St.meld nr. 18 (2015-2016) as "Opphold og fysisk aktivitet i friluft i fritiden med sikte på miljøforandring og naturopplevelse" which can be translated into "Outdoor recreation and physical activity during leisure time aimed at environmental engagement and nature experience" (Stortinget, 2016). "Friluftsliv" is a concept of the Norwegian outdoor recreation which symbolizes a "primitive and humble" existence in nature, with minimal resources or equipment, and where the main focus is to experience nature or to harvest natural resources like fish, game, or berries. This tradition forms an important part of Norwegian identity and self-image (Øian, 2014).

Ecoacoustic is an interdisciplinary field that studies the ecological and environmental significance of sounds produced by biological, geological, and anthropogenic sources in a given environment (Pijanowski et al., 2011; Schafer, 1994). By using acoustic indices such as the Acoustic Complexity Index (ACI) and the Normalized Difference Soundscape Index (NDSI), ecoacoustics offers tools to quantify soundscape composition and monitor biodiversity, ecosystem health, and human impact (Bradfer-Lawrence et al., 2019; Metcalf et al., 2022). Unlike traditional ecological monitoring methods, ecoacoustics captures temporal and spatial sound patterns, providing insights into ecological dynamics and visitor experiences in PAs. This approach is increasingly recognized as valuable for informing conservation strategies and sustainable visitor management, as it links ecological integrity with human perceptions of naturalness, tranquility, and place attachment (Buxton et al., 2019; Miller et al., 2018).

Zoning is a management strategy where different areas within a national park or PA are designated for different types of use or protection levels, based on their ecological sensitivity, visitor demand, or management objectives (Eagles et al., 2002).

1.2 Problem statement

Despite growing recognition of the importance of natural soundscapes, research and management of PAs still tend to focus primarily on visual and spatial elements (Franco et al., 2017; Kato, 2009; Pijanowski et al., 2011). This visual bias overlooks sound's immersive and temporal qualities, which play a key role in shaping human experiences of place. Unlike static visual elements, soundscapes unfold dynamically, engage the senses over time, and can evoke strong emotional and embodied responses (Franco et al., 2017).

This thesis argues that soundscapes are not simply background features, but essential components of the human–nature relationship. Natural sounds can foster tranquility, presence, and emotional restoration, while also strengthening place attachment and perceptions of wilderness (Buxton et al., 2021; Franco et al., 2017; Moscoso et al., 2018). As such, sound is both an ecological indicator and a cultural, emotional, and experiential touchpoint (Liu et al., 2017; Miller et al., 2018).

Drawing on Rosa's (2019) theory of resonance, the thesis proposes that acoustic experiences, especially in settings like national parks, can serve as powerful mediators of human–nature connectedness (Rosa, 2019). Resonance occurs when individuals are "touched" by their environment in ways that elicit reflection, responsiveness, and deeper relationships. In this view, soundscapes can prompt emotional engagement and even foster pro-environmental attitudes. Human perception and experience of the natural soundscape and natural tranquility encourage nature connections, and so on environmentally conscious behavior.

At the same time, these soundscapes are increasingly disrupted by anthropogenic noise from infrastructure, tourism activity, and personal technologies (Buxton et al., 2019; Francis & Barber, 2013). This intrusion risks not only ecological consequences but also diminished visitor experiences and weaker connections to nature. Furthermore, because soundscapes are inherently dynamic, varying across seasons,

times of day, and visitor behavior, they offer unique insights into how ecosystems function and how people engage with them. Understanding these dynamics is vital for visitor management strategies that aim to preserve both natural integrity and meaningful human experiences. However, despite the growing recognition of soundscapes as an important aspect of nature experiences, there has, until recently, been little research focusing on soundscapes in Nordic nature settings. This gap represents an important deficit in our understanding and highlights the need for further investigation in this context.

1.3 The thesis's objectives and research questions

This thesis aims to explore the experiential and managerial significance of soundscapes in Norwegian national parks, with a particular focus on their emotional, perceptual and behavioral impacts on visitors. By examining how different types of natural and anthropogenic sounds are perceived and emotionally interpreted by hikers, the goal is to highlight the value of sound as an underappreciated but vital part of nature-based tourism and recreation experiences. The following research questions guide this study.

RQ1: *How do visitors emotionally respond to different types of natural and anthropogenic sounds in Norwegian national parks?*

RQ2: *How do visitor characteristics, such as wilderness purism and visit frequency, influence perceptions of soundscapes, facilitation, and crowding?*

RQ3: *How does the composition and variation of soundscapes, measured through ecoacoustic indices, differ across sites and times in Rondane and Femundsmarka National Parks?*

RQ4: *How can insights from visitor experiences and soundscape monitoring together support sustainable visitor management in Norwegian national parks?*

2.0 Theoretical framework

This thesis draws on a selection of theories that help explain how people experience natural soundscapes, how these experiences relate to emotional and behavioral responses, and how this can inform sustainable visitor management. The following frameworks were selected for their relevance to the study's focus on perception, connection to nature, and differences among visitor types.

2.1 Theories on inner experience and human–nature connection

The *expectancy-valence theory* helps explain how visitors evaluate experiences based on their prior expectations and the emotional value (valence) of what they encounter (Kominis & Emmanuel, 2007; Vroom, 1964). If the actual experience aligns with or exceeds expectations, such as encountering tranquil natural sounds or fewer disturbances than anticipated, the emotional response tends to be positive. Conversely, if the soundscape is noisier or more crowded than expected, it may lead to disappointment or irritation. This theory is relevant in interpreting how visitors react to specific sound categories (e.g., biotic sounds vs. anthropogenic sounds), and how emotional responses might be shaped by what visitors hope to find in a PA versus what they actually encounter.

Originally developed to explain the cognitive benefits of exposure to nature, *Attention Restoration Theory (ART)* suggests that natural environments support recovery from mental fatigue by offering *soft fascination;* stimuli that are gently engaging but not demanding (Kaplan, 1989). While traditionally applied to visual environments, recent adaptations of ART have extended this concept to soundscapes (Payne, 2013). ART explains how natural sounds may help visitors feel restored by promoting a relaxed and attentive state. By contrast, sudden or mechanical noises may interrupt this process. This theory helps frame how visitors' attention and cognitive states may be influenced during soundwalks or listening stops, and how certain soundscapes may enhance or hinder psychological restoration.

At the heart of this study lies Hartmut Rosa's (2019) *theory of resonance*, which proposes that meaningful experiences arise when individuals are "touched" by their

environment in a way that fosters connection, responsiveness, and mutual transformation (Rosa, 2019). Resonance is about being in a responsive relationship with the world, as opposed to instrumental control or alienation. In this thesis, resonance helps explain how natural sounds can evoke emotional responses that foster deeper connections to nature, and potentially promote pro-environmental values or behaviors. This theoretical lens is especially useful in interpreting how attention to soundscapes, via soundwalks and listening stops may lead to stronger feelings of nature connectedness.

2.2 Theories on place, tourism, and soundscape management

The field of *soundscape ecology* provides the conceptual foundation for analyzing natural sound environments. Introduced by Pijanowski et al. (2011), this framework focuses on how sounds, both biotic (or biophonic) and abiotic, as well as anthropogenic, form acoustic patterns that reflect ecological health and human use (Pijanowski et al., 2011). Soundscapes are seen as dynamic, place-specific phenomena that influence human perception and ecological functioning. Soundscape ecology is central to the SLN-project and frames the methodological approach of this study, especially in how sound categories are analyzed and interpreted.

This study also builds on the *wilderness purism* construct, which categorizes visitors along a spectrum of preferences for naturalness versus development (Vistad & Vorkinn, 2010; Vistad & Vorkinn, 2012). Those high in purism typically prefer minimal infrastructure, solitude, and undisturbed nature. In contrast, visitors with low purism levels may accept or prefer managed landscapes with signs, cabins, and social interaction. In this thesis, purism is used to explore how different visitor groups perceive soundscapes, whether certain sounds are appreciated or disruptive, and how these preferences relate to crowding and facilitation.

Lastly, this thesis considers sound as part of broader “world-creating processes” within tourism (Hollinshead, 2009). Nature-based tourism does not simply offer passive exposure to landscapes, it actively constructs meanings, memories, and identities. Soundscapes are part of how these meanings are shaped through sensory immersion, cultural expectations, and emotional resonance. By viewing tourism as a

form of world-making, this perspective helps contextualize how soundscapes are more than physical phenomena; they are co-produced through visitor presence, management decisions, and sensory experience.

2.3 Soundscape research in tourism and PA settings

This chapter situates the thesis within the broader research landscape by reviewing key literature related to soundscapes, visitor experiences in PAs, and nature-based tourism. The aim is to identify existing knowledge, highlight relevant findings, and reveal gaps this thesis seeks to address.

Early work by Schafer (1994) and later by Pijanowski et al. (2011) introduced the concept of the soundscape as a critical dimension of environmental perception (Pijanowski et al., 2011; Schafer, 1994). In PAs, soundscapes are increasingly recognized for their dual ecological and experiential functions; they support species behavior and biodiversity, while also shaping how humans feel, connect, and respond to their surroundings (Buxton et al., 2021; Miller et al., 2018). Recent studies have demonstrated that natural sounds enhance visitor satisfaction, emotional well-being, and perceived restorativeness (Li & Liu, 2024; Payne, 2013). Conversely, anthropogenic noise, particularly from infrastructure and tourism, can disrupt these benefits (Buxton et al., 2019; Francis & Barber, 2013).

Within the field of nature-based tourism, soundscapes are gaining attention as a management-relevant resource. Research in US national parks shows that noise impacts can significantly affect visitor experience and perception of wilderness quality (Buxton et al., 2021; Miller et al., 2018). These findings have led to calls for soundscape-informed planning to balance access, enjoyment, and conservation (Franco et al., 2017). In Norway, studies are still emerging, but the application of soundwalks and listening surveys, as piloted in this thesis, is part of a growing interest in sensory-based visitor studies. The inclusion of wilderness purism (Vistad & Vorkinn, 2012) and theories of resonance (Rosa, 2019) reflects a shift toward understanding emotional and identity-based responses to nature.

Tranquility has long been valued in environmental psychology and philosophy, but its operationalization in empirical research is recent. According to Christoffersen et al. (2022b), tranquility is often described as a multi-sensory and affective state linked to

peace, awe, and spiritual reflection (Christoffersen et al., 2022). Studies show that natural soundscapes are especially effective at evoking these emotions, reinforcing the idea that sound is central to restorative experiences (Liu et al., 2017; Moscoso et al., 2018).

2.4 Gaps this thesis aims to fill

Soundscape research has expanded considerably in recent years, yet several important gaps remain, particularly at the intersection of acoustic environments, visitor experience, and nature-based tourism in a Nordic context. Much of the existing research has been conducted in North America, with a strong focus on US national parks, leaving a limited understanding of how these insights translate to the Scandinavian setting. Cultural values, outdoor traditions, such as “friluftsliv”, and expectations of wilderness in this region can differ from those in North America or Asia, suggesting the need for context-specific research (Øian, 2014). In addition, while there is increasing interest in the psychological and restorative effects of natural sounds, the emotional and experiential dimensions of soundscapes, such as how they evoke feelings of tranquility, joy, or irritation, remain underexplored, particularly in PAs (Liu et al., 2017; Payne, 2013; Rosa, 2019). Methodologically, there has been limited application of experiential approaches such as soundwalks and listening stops in remote or wilderness settings, despite being piloted in urban soundscape studies. This limits the ability to capture context-sensitive visitor experiences in natural environments. Finally, the influence of visitor typologies, including factors like wilderness purism or prior nature experience, is rarely examined in relation to soundscape perception. This represents a gap in understanding how different visitor groups experience and respond to acoustic environments, which is critical for developing targeted and effective management strategies in national parks.

3.0 Method

In this chapter, I present the methodological approach applied in this master's thesis. The data collection was carried out as part of a larger field study involving participant soundwalks, and the distribution of visitor surveys. My primary role in this process was to assist with the implementation of the visitor survey component. Throughout the writing and analysis phases, I utilized digital tools, including AI-based language models such as Microsoft Copilot and OpenAI's ChatGPT, to enhance the clarity of my English writing and to support coding tasks in RStudio, particularly for minor adjustments such as modifying visual elements (e.g., colors and labels).

Figure 1: The pilot test team on our way to Rovollen cabin in Femundsmarka National Park. Photo: Dr. Rose Keller, NINA

3.1 Case description

This master's thesis is written on the background of a pilot test conducted during the summer of 2024 for the NINA Project "Sounds like Norway" (SLN). SLN is a project aimed at increasing the understanding of which natural sounds are important for people when they are out in Norwegian nature, and to find out how much noise there is in two national parks known for providing a wilderness experience. The goal of the project is to map how important natural soundscapes are for outdoor recreation and biodiversity, and to develop indicators that can be used in national park planning. The project will test noise reduction strategies to improve nature experience without reducing the number of visitors to the natural areas, thus preserving local value creation from tourism. If you understand which sounds are most important for people's experience of and connection to nature, you can also more easily preserve these (Keller, 2023). The test areas are Femundsmarka National Park, from 27th of June to 4th of July 2024, and Rondane National Park, from the 21st to 27th of July 2024. The research group interviewed and gave out surveys to hikers on preselected sites, and established field sites for recordings of sounds. My research is based on the answers given in these surveys.

3.2 Area description

The first week of data collection was carried out in Femundsmarka National Park, which is considered the largest continuous wilderness area in southern Scandinavia when including the adjacent PAs on the Swedish side. The park is located in Røros Municipality in Trøndelag County and Engerdal Municipality in Innlandet County, situated east of Lake Femunden and west of the Swedish border. Femundsmarka was established as a national park in 1971, expanded in 2003, and currently covers an area of 573 km².

To reach Rovollen, the backcountry DNT cabin where we stayed during the pilot test, we traveled by boat from Røa and continued on foot to the cabin (Figure 1). Along this route, we placed sound recorders that were programmed to collect audio data for approximately one month. These recordings would later be used as sound snippets in the national survey forming the basis of the main project.

Figure 2: A map made by Dr. Rose Keller showing the placements of the recorders in Femundsmarka National Park.

Data collection was also conducted in Rondane National Park, a more accessible and visitor-oriented area with a wider range of activities and visitation patterns. Rondane is Norway's oldest national park, established in 1962 and expanded in 2003, now covering an area of 963 km². The park is located between the Gudbrandsdalen and Østerdalen valleys, stretching from Ringebu in the south to Dovre in the north. Rondane is also home to one of Europe's last remaining populations of wild reindeer.

For this part of the fieldwork, we traveled on foot from the Straumbu parking area to the DNT cabin at Bjørnhollia, where we stayed for three days. Accompanying us on this trip was sound specialist Tin Oberman, who led several of the organized soundwalks. As in Femundsmarka, we placed sound recorders along the route to the cabin. During our stay, we collected both soundwalk data and visitor survey responses.

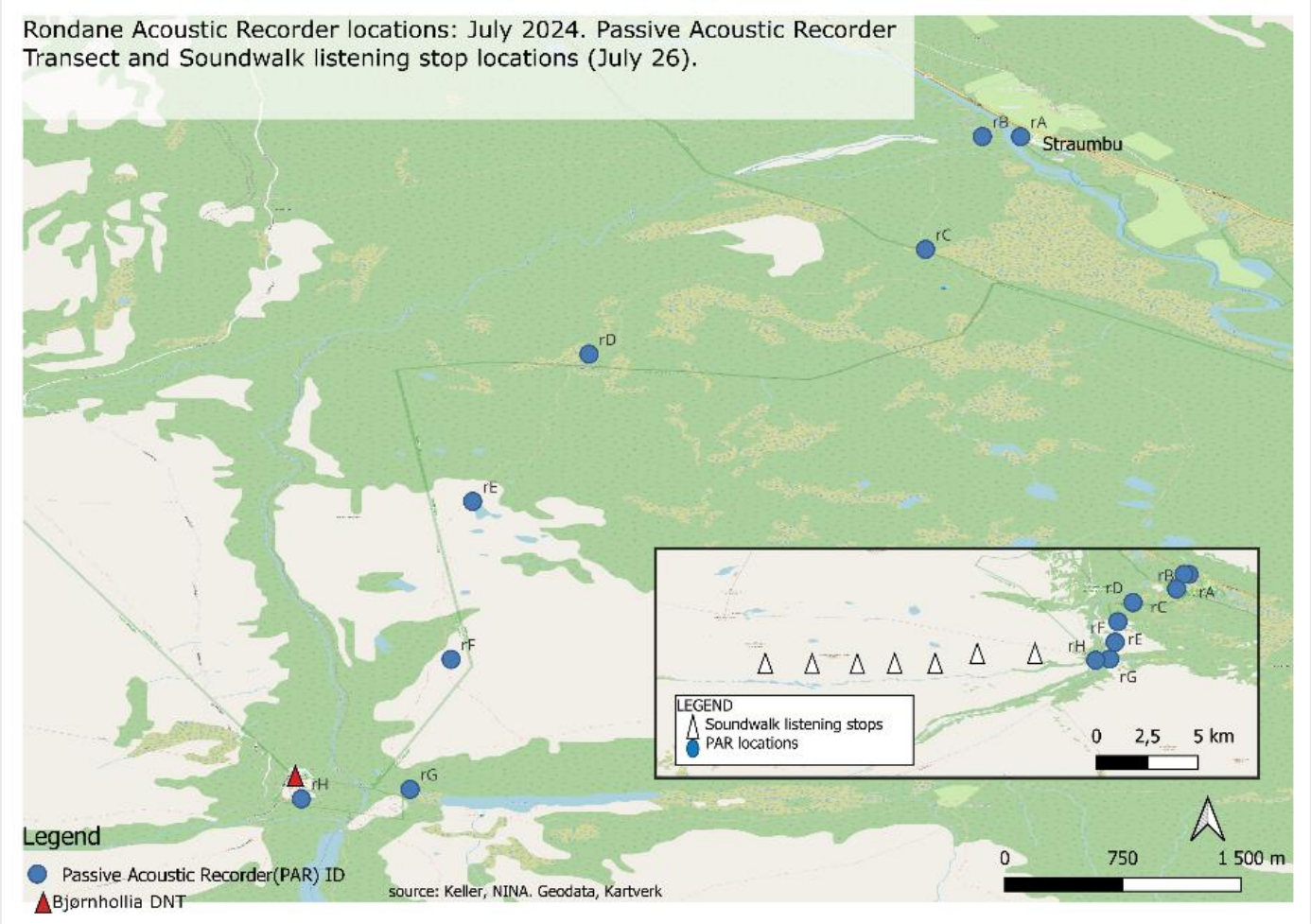

Figure 3: A map made by Dr. Rose Keller showing the placements of the recorders in Rondane National Park.

3.3 The pilot test

As mentioned earlier, this master's thesis is based on a pilot test conducted during the summer of 2024. A pilot test aims to find the best ways to conduct the main data collection of a research project (Teijlingen, 2001). The purpose of this exact pilot test is to test the survey workload and see which questions work for the SLN-project and which questions will need rewriting, reconstructing, or being taken out. We sadly made some changes to the number of questions while conducting the pilot test, making it difficult to fully get an overview of which questions worked and which did not.

There were eight different sites with recorders in Femundsmarka (A-H) and eight in Rondane (A-H), which were distributed along the way to the cabin in Femundsmarka, and along the way, plus a few extra places, in Rondane (Figure 2; Figure 3). The reason results and discussion only operate with three recording sites in Femundsmarka (A, B and E) was because the gain settings were too high for either the right or left microphone in sites C, D, G and H (gain at 16Hz). The same applies

Figure 4: PAR F tied up and camouflaged in a birch in Rondane. Photo: Rose Keller, NINA

to Rondane and site H. We elected to use the sites that displayed the most variation in soundscapes, which also corresponded to the start and end points of the measurement transect. We used Song Meter Mini 2 AA recorders to collect the audio data (Figure 4Figure 4).

3.4 Analyzing the metadata

All analyses were conducted using either Microsoft Excel or RStudio, while qualitative text data was coded in Microsoft Word. The metadata processed in Excel consisted of responses from 70 participants (n = 70).

3.4.1 Analysis of the respondents

From the metadata, information was extracted on the language used to complete the survey and visualized the distribution in a pie chart (Figure 5). There were also an identification of how many respondents were visiting from abroad versus different regions of Norway, and presented this in a bar chart created in Microsoft Excel (Figure 6).

3.4.2 Emotions and sound categories

Reported sounds were first organized into thematic categories. Similar sounds, as well as different spellings or descriptions referring to the same sound (e.g., "running water" and "water fizzling"), were grouped together. Mosquitoes were classified as insects, as they represented the only insect order specifically mentioned by respondents. All identified sounds were categorized according to the structure presented in Table 1. Responses that did not describe actual sounds (e.g., "sun" or "natural sounds") were interpreted and assigned to the most appropriate categories (e.g. “sun” -> abiotic sound, or “natural sounds” -> abiotic + biophonic sounds).

The frequencies of all identified sounds were calculated separately for each site. Based on these counts, the relative percentage of each sound group’s presence in the perceived soundscape was determined. These percentages formed the basis for the radar charts, which were created using Microsoft Excel.

Table 1: Modified categorization of visitor-reported sounds into thematic groups.

Abiotic sounds	Human sounds	Anthropogenic sounds	Biophonic sounds (non-human)	Other
Water	Voices	Boat	Moose	Absence of sound
Stream	Hikers' sounds	Chain saws	Birds	Music
Rain	Footsteps	Drones	Insects	Cellphone
Thunder	Panting from my friends	Fighter jet		
Rivers	Child screaming	Airplane		
Wind	Loud people	Highways		
Lightning	Happy people	Car		
		Drills		
		Motorcycle		
		Engine sounds		
		Traffic noise		
		Destruction of nature sounds		

3.4.3 Comparison between facilitation, crowding, and visits

The analysis of differences between perceptions of facilitation, crowding, and visitation behavior at the two different sites are based on questions 1 and 5 in the Survey (7.1 The survey). The variable Facilitation was calculated as the means of six infrastructure-related items (e.g. trails, signage, campsites), while Crowding was based on two items relating to social density (seeing many others vs. solitude). Visit frequency was categorized as binary, into four levels (1: 1 visit, 2: 2-3 visits, 3: 4-10 visits, 4: more than 10 visits) and the two locations were, as mentioned earlier, Rondane National Park and Femundsmarka National Park (Table 2).

Table 2: Overview of variables used to analyze the relationship between visitor appreciation of facilitation, acceptance of crowding, and number of visits, with location as a grouping variable.

Dependent variables	Independent variable	Grouping variable
Mean score for Appreciation of facilitation (Likert7) **Mean score for Acceptance of crowding (Likert7)**	Number of visits (1-4)	Location (Rondane and Femundsmarka)

The analysis began with a Shapiro-Wilk test to assess whether the assumption of normality was met for the dependent variables. The Facilitation variable met this assumption, while the Crowding variable did not. Consequently, a non-parametric Wilcoxon rank sum test was used to compare acceptance of crowding between the two locations. An independent samples t-test was conducted for the Facilitation variable, followed by an ANCOVA to account for Visit Frequency as a covariate.

To further explore the relationships between perceptions of facilitation, crowding, and visitation behavior, a Spearman correlation analysis was performed (Figure 10). The correlation matrix was generated using the "*GGally::ggpairs()"* function, which by default applies Pearson's correlation. As neither Crowding nor Visit Frequency met the assumption of normality, the correlation method was adjusted to Spearman's to more accurately reflect the data's distribution.

3.4.4 Wilderness Purism Scale

The Wilderness Purism Scale data were provided in a Stata file (.dta), by Dr. Rose Keller, which was imported into R using the "*haven*" package. While the initial calculations were based on a 7-item index, an 8-item index was applied in this analysis to account for the reversed solitude item (q5h_solitude_rev = 1 - q5h_novisitors), which indicates stronger purist attitudes. The Wilderness Purism Scale ranges from 0 to 6, where 0 represents strong purist attitudes and 6 represents non-purist attitudes.

3.4.5 Visualizing the NDSI and NMDS

The R script for visualizing the NDSI and NMDS figures was provided by Emilie Rojas, one of the fieldwork partners in Rondane. The diurnal variation in NDSI (Figure 12; Figure 13) was visualized in R using line plots with site-based color grouping. The "*ggplot2*" package was used to plot NDSI values across different recording hours, grouped by site. The x-axis represented the recording hour (as a categorical or numeric time variable), and the y-axis displayed the corresponding NDSI values. Site-specific variation over time was visualized by applying distinct colors for each site ID. Additional aesthetic adjustments, including axis labels, legend titles, and color palettes, were made to improve the interpretability of the plots.

The NMDS ordination plots (Figure 14; Figure 15) were produced using the vegan package in R, based on Bray-Curtis dissimilarity of the acoustic index data (Equation 1). The resulting ordination scores were visualized with "*ggplot2"*, where each point represented an individual recording and was color-coded by site. Although NMDS axes are dimensionless and reflect ranked dissimilarities, the axes were interpreted as gradients of soundscape composition, biophony and hydrophony, to aid in visual interpretation. Plot elements, including axis labels and color schemes, were adjusted to enhance clarity and readability.

Equation 1: The Bray-Curtis Dissimilarity is defined like this, where x_i and y_i are the values (e.g., acoustic index scores) for sample i in two different sites or recordings

$$Bray - Curtis\ Dissimilarity = \frac{\sum|x_i - y_i|}{\sum(x_i + y_i)}$$

4.0 Results

4.1 Overview of the respondents

Survey responses were collected in both Femundsmarka and Rondane National Parks. In Femundsmarka, 86.2% of respondents answered the survey in Norwegian, while 13.8% answered in English. In Rondane, 58.5% of respondents answered in Norwegian, and 41.5% answered in English (Figure 5).

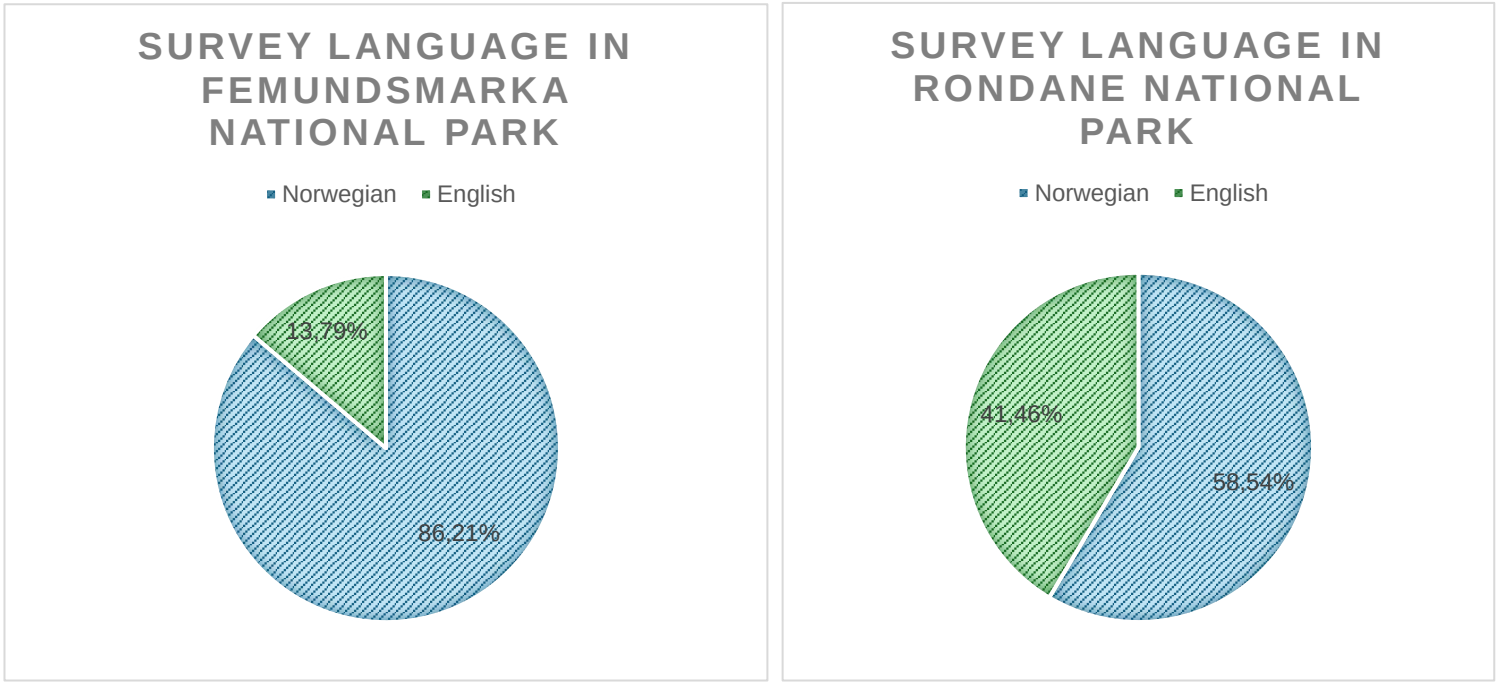

Figure 5: Distribution of survey responses by language (Norwegian and English) in Femundsmarka National Park (left) and Rondane National Park (right).

Figure 6 shows the reported place of residence for visitors in both national parks. In Femundsmarka, most respondents reported living in the Middle of Norway (n = 14), followed by East of Norway (n = 6), West of Norway (n = 4), and reported living outside of Norway (n = 3). No respondents in Femundsmarka reported to be living in the South or North of Norway.

In Rondane, the largest group of respondents came from outside of Norway (n = 15), followed by East of Norway (n = 12), West of Norway (n = 3), South of Norway (n = 2), and Middle of Norway (n = 2).

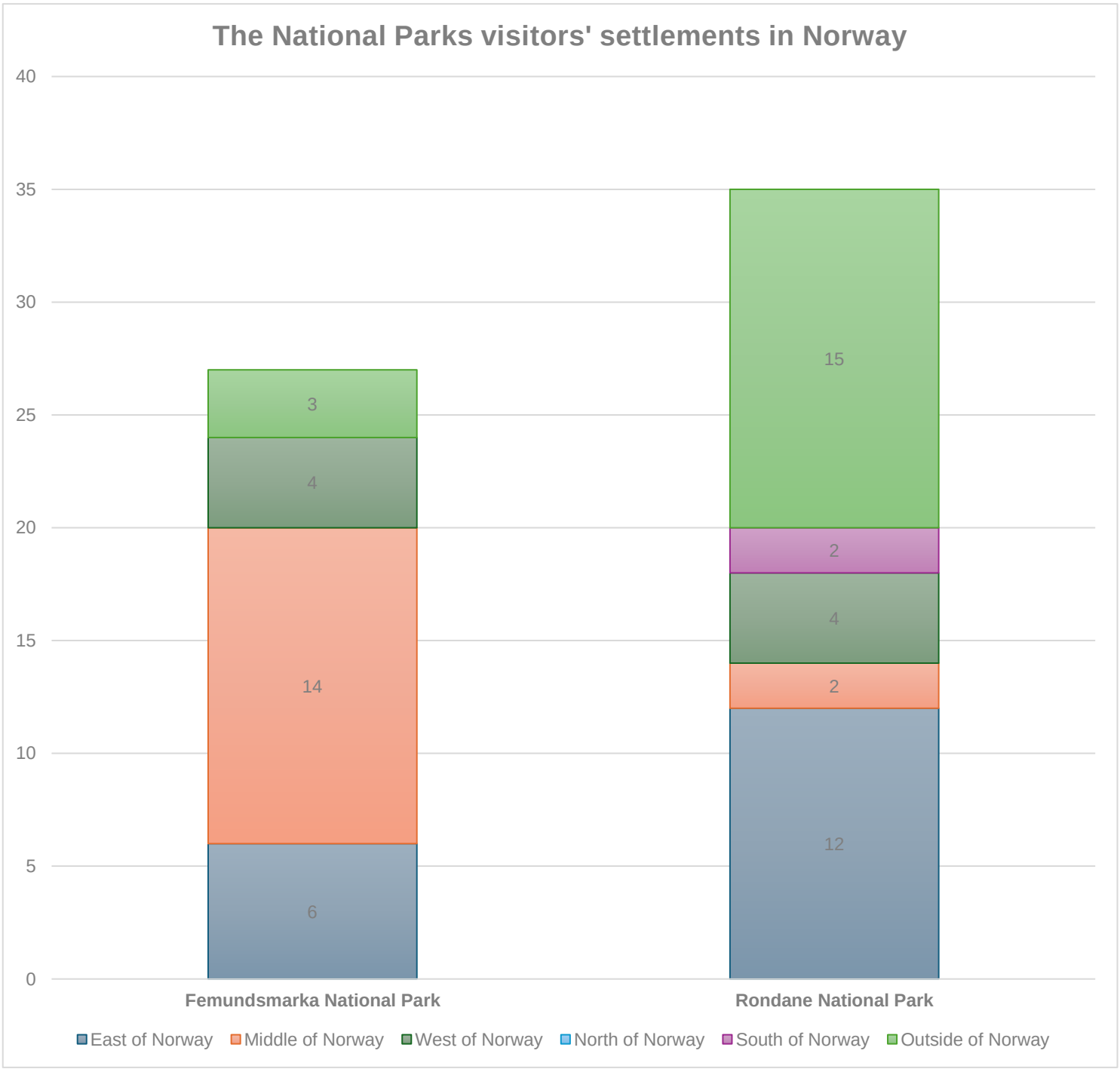

Figure 6: Bar chart visualizing the reported residential regions of national park visitors in Femundsmarka and Rondane, categorized by regions of Norway and outside Norway.

4.2 Linking emotions to sound categories

A comparison of emotional responses between Norwegian and non-Norwegian visitors showed that 44.44% of the non-Norwegian visitors expressed a diverse positive emotional vocabulary, marking sounds and linking them to emotions such as pride, love, and joy. In contrast, only 18.18% of Norwegian visitors reported similar emotional diversity.

In Femundsmarka, 33.33% of the non-Norwegian visitors (1 out of 3) showed diverse positive emotions, compared to 12.5% of Norwegian visitors (3 out of 24). In Rondane, 46.67% of non-Norwegian visitors (7 out of 15) showed diverse emotional responses, while 25% of Norwegian visitors (5 out of 20) did the same (Figure 7).

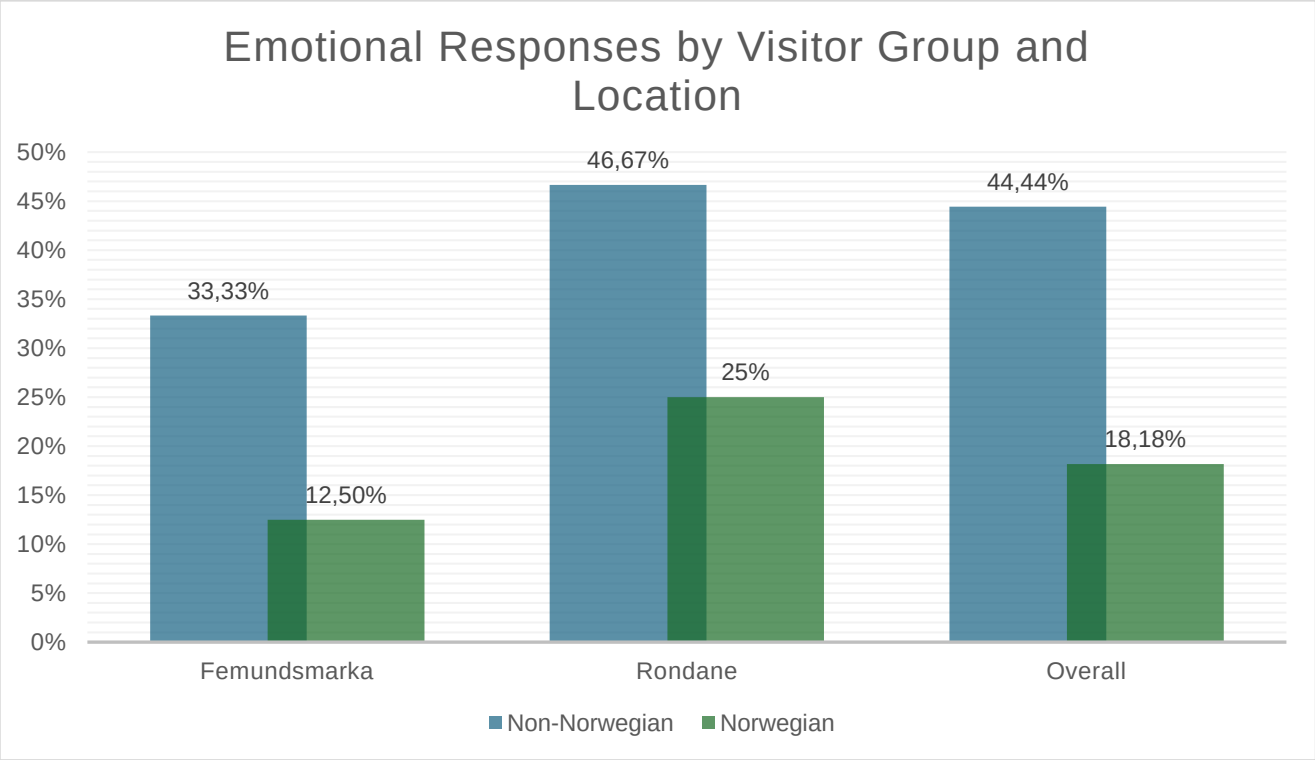

Figure 7: Comparison of diverse emotional responses by Norwegian and non-Norwegian visitors across Femundsmarka, Rondane, and overall.

Figure 8 shows the distribution of emotional responses associated with different sound categories in Femundsmarka National Park. Joy was the most frequently reported emotion, particularly in response to abiotic sounds, which received the highest percentage of joy-related responses. Biotic sounds (non-human) and abiotic sounds were associated with positive emotions such as joy, love, and pride, although biotic sounds (non-human) were associated at lower levels. Indifference, frustration,

and sadness were most commonly reported in connection with anthropogenic sounds and human sounds. Biotic sounds (non-human) elicited feelings of irritation. In Rondane, positive emotional responses were dominating, especially in relation to abiotic and biotic sounds, while negative responses were more commonly linked to anthropogenic disturbances.

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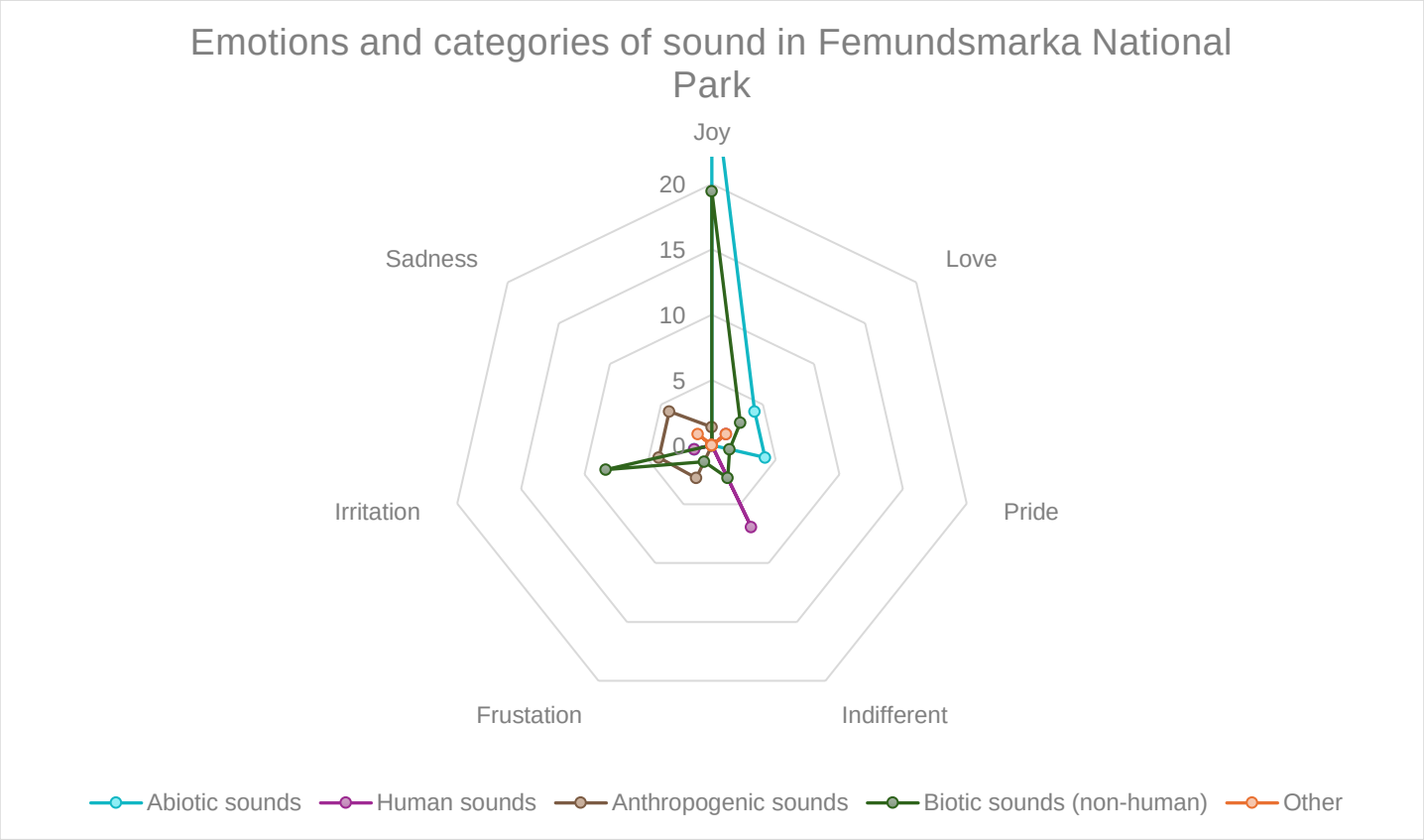


Figure 8: Emotional responses associated with different sound categories in Femundsmarka National Park visualized in a radar chart (in percentage).

Figure 9 presents the distribution of emotional responses linked to different sound categories in Rondane National Park. As in Femundsmarka, joy was the most commonly reported emotion, particularly in response to abiotic sounds and biotic sounds (non-human). Abiotic sounds also elicited positive emotions such as love and pride, though to a lesser extent than joy. Irritation, frustration, and shame were most commonly reported in connection with anthropogenic sounds and human sounds. Sadness and indifference were reported at lower levels across all sound categories.

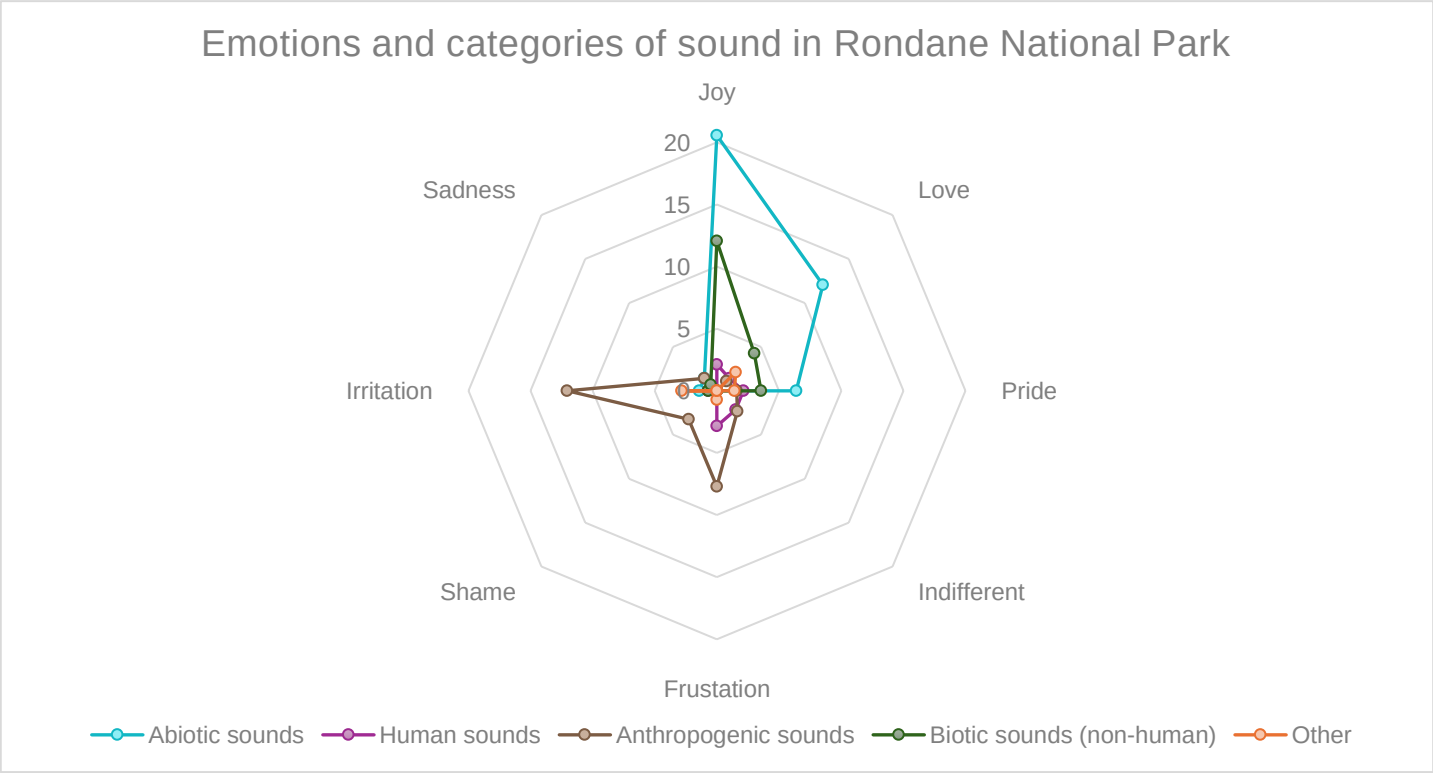


Figure 9: Emotional responses associated with different sound categories in Rondane National Park visualized in a radar chart (in percentage).

4.3 Survey comments

Qualitative analysis was also conducted on the open-ended comments provided at the end of the survey (Skjott Linneberg & Korsgaard, 2019). An initial round of open inductive coding was applied separately to the comments from Femundsmarka (**Feil! Fant ikke referansekilden.**) and Rondane (**Feil! Fant ikke referansekilden.**).

Table 3: Inductive coding results for open survey comments in Femundsmarka National Park.

Comment	Inductive Code(s)
Interesting study. Creates awareness.	Study interest, Reflection
It is nice to reflect on and share about this	Reflection, Personal engagement
It's quiet in the middle of the day. Maybe a little less birdsong at this time of day. Mostly the sound of mosquitoes.	Quiet moments, Mosquito noise, Lack of birds
Sherpas are currently making noise constructing the stairs, but it will be fine in the end.	Temporary noise, Construction impact
Very noisy with people in yellow vests making noise and working	Human disturbance, Visual and auditory disruption
It is a special situation with path construction nearby...	Preparedness for disruption, Changed soundscape, Awareness of external factors

Table 4: Inductive coding results for open survey comments in Rondane National Park.

Comment	Inductive Code(s)
Succes!<3	Positive feeling, Appreciation
A lot of bird chirping	Birdsong, Natural sound
The experience would vary... Absence of other people helps...	Crowding sensitivity, Appreciation of solitude, Enhanced nature experience
A lot of children	Human noise, Family presence
Without the bird chirping and the insects everything would be perfect	Annoyance with nature sounds, Ideal silence
There was very little diversity of sound...	Soundscape monotony, Lack of sonic richness

Similar codes were then consolidated into broader categories through a process of focused coding (**Feil! Fant ikke referansekilden.**).

Table 5: Focused coding categories for qualitative visitor comments.

Category	Sounds
Human Influence on Soundscape	*Construction noise, human disturbance, children, workers in yellow vests, crowding sensitivity*
Perception of Natural Sounds	*Birdsong, insects, sound diversity, quiet moments, lack of birds, mosquito noise*
Visitor Reflection and Values	*Study interest, reflection, personal engagement, appreciation, solitude*
Expectation and Reality	*Preparedness for disruption, changed soundscape, ideal silence, soundscape monotony*

The qualitative analysis of open-ended survey comments resulted in three main themes (Table 6). The first theme, Soundscape Quality and Visitor Satisfaction, included comments related to human influence and natural sounds. The second theme, Personal Values and Reflections, included comments about visitor reflection and the relationship between expectations and reality. The third theme, Context-Dependent Experiences, included comments covering all categories, describing how experiences varied based on time, place, and the presence of other people

Table 6: Overview of emerging themes from qualitative coding of open-ended visitor survey comments, including related categories and key insights.

Theme	Related Categories	Insight
Soundscape Quality and Visitor Satisfaction	Human influence, natural sounds	*Noise from people and construction interferes with the experience.* *Natural sounds are generally positive, but not always.*
Personal Values and Reflections	Visitor reflection, expectation/reality	*Many reflect deeply on their experience.* *Expectations can shape tolerance of disruptions.*
Context-Dependent Experiences	All categories	*Individual experience varies greatly based on time, place, and who else is present*

4.4 Differences and relationships between visitor use and perception

Visitor characteristics and preferences are likely to influence soundscape perceptions. Preferences for facilitation and “purism” might give interesting insights

4.4.1 Facilitation Appreciation and Visit Frequency

An independent sample t-test confirmed that difference in appreciation of facilitation between the two parks was statistically significant, $p = 9.493*10^{-6}$ (Table 7).

Table 7: Welch’s two-sample t-test comparing visitor appreciation of facilitation between Femundsmarka and Rondane National Parks.

Femundsmarka (M)	Rondane (M)	t-value	p-value
3,7	5,2	-4,99	p < 0.001

To account for differences in visit frequency, an ANCOVA was conducted with Facilitation as the dependent variable, Location as a fixed factor, and Visits as a covariate (Table 8). The results confirmed a significant effect of Location on facilitation appreciation, $p < 0.001$.

Table 8: Results from ANCOVA testing the effect of location and visit frequency on facilitation appreciation.

	Df	**Sum Sq**	**Mean Sq**	**F** value	**Pr(>F)**
Location	1	36.44	36.44	29.716	p<0.001
Visits_binary	1	5.42	5.42	4.423	p<0.05
Residuals	65	79.71	1.23		

Figure 10 displays a boxplot of visitor appreciation of facilitation in Femundsmarka and Rondane National Parks. The median facilitation score is higher in Rondane National Park compared to Femundsmarka National Park. The distribution in Rondane is narrower and shifted toward higher scores, while the distribution in Femundsmarka is wider and centered on lower scores.

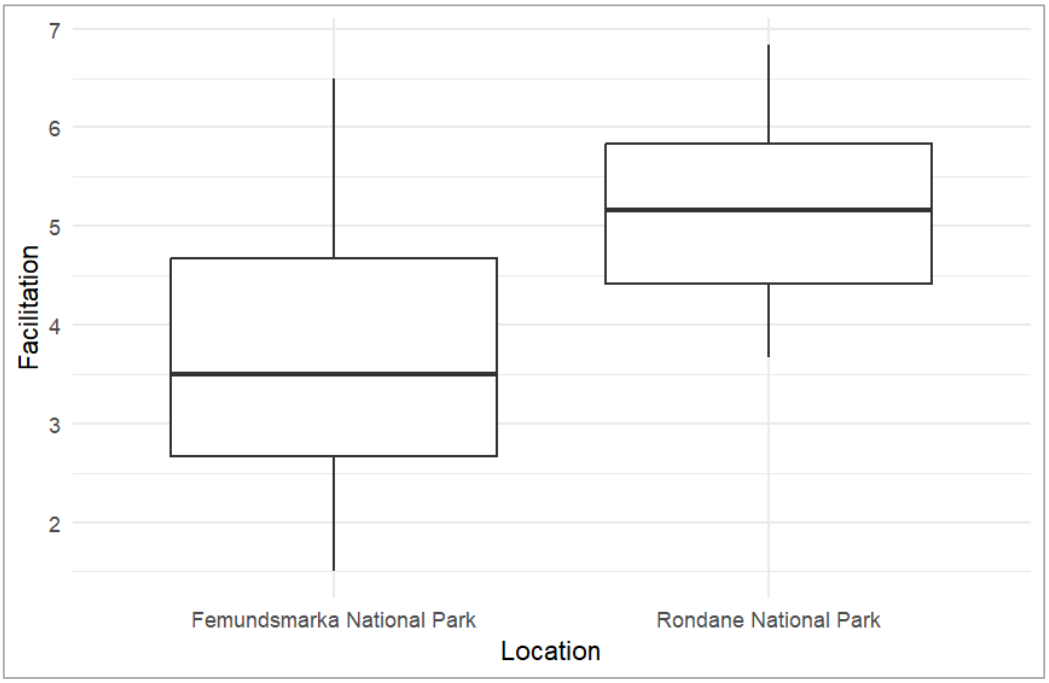


Figure 10: Boxplot illustrating differences in visitor appreciation of facilitation between Femundsmarka and Rondane National Parks.

4.4.2 Acceptance of Crowding

The available data were insufficient to assess whether there was a statistically significant difference in crowding acceptance between visitors in Rondane and Femundsmarka. A Shapiro-Wilk test indicated that the assumption of normality was met for the facilitation variable ($p = 0.092$), but not for acceptance of crowding ($p < 0.001$). Therefore, a non-parametric Wilcoxon rank sum test was used to compare acceptance of crowding between locations. The result was borderline statistically significant ($p = .056$), with M=4,38 in Femundsmarka and M=3,87 in Rondane (Table 7). This suggests a possible difference, where visitors in Rondane may have reported slightly higher acceptance of crowding. Given the borderline result, a larger sample size might confirm this pattern with greater certainty.

Table 9: Results from the Shapiro-Wilk test for normality and the Wilcoxon rank sum test comparing crowding acceptance between Rondane and Femundsmarka National Parks.

Type of test	M	W-score	p-value
Shapiro-Wilk test for Crowding	4.38 (F), 3.87 (R)	0.93	p<0.001
Wilcoxon rank sum test between Crowding and Location	4.38 (F), 3.87 (R)	715	NS

4.4.3 Correlation between the same variables

A Spearman correlation matrix with linear trendlines illustrates the relationship between facilitation appreciation, acceptance of crowding, and visit frequency (Figure 11). The results show a positive correlation of 0.266 between facilitation appreciation and crowding acceptance. A negative correlation of -0.313 was found between facilitation appreciation and visit frequency, and this relationship was statistically significant. No meaningful correlation was observed between crowding acceptance and visit frequency, with a correlation value of -0.063.

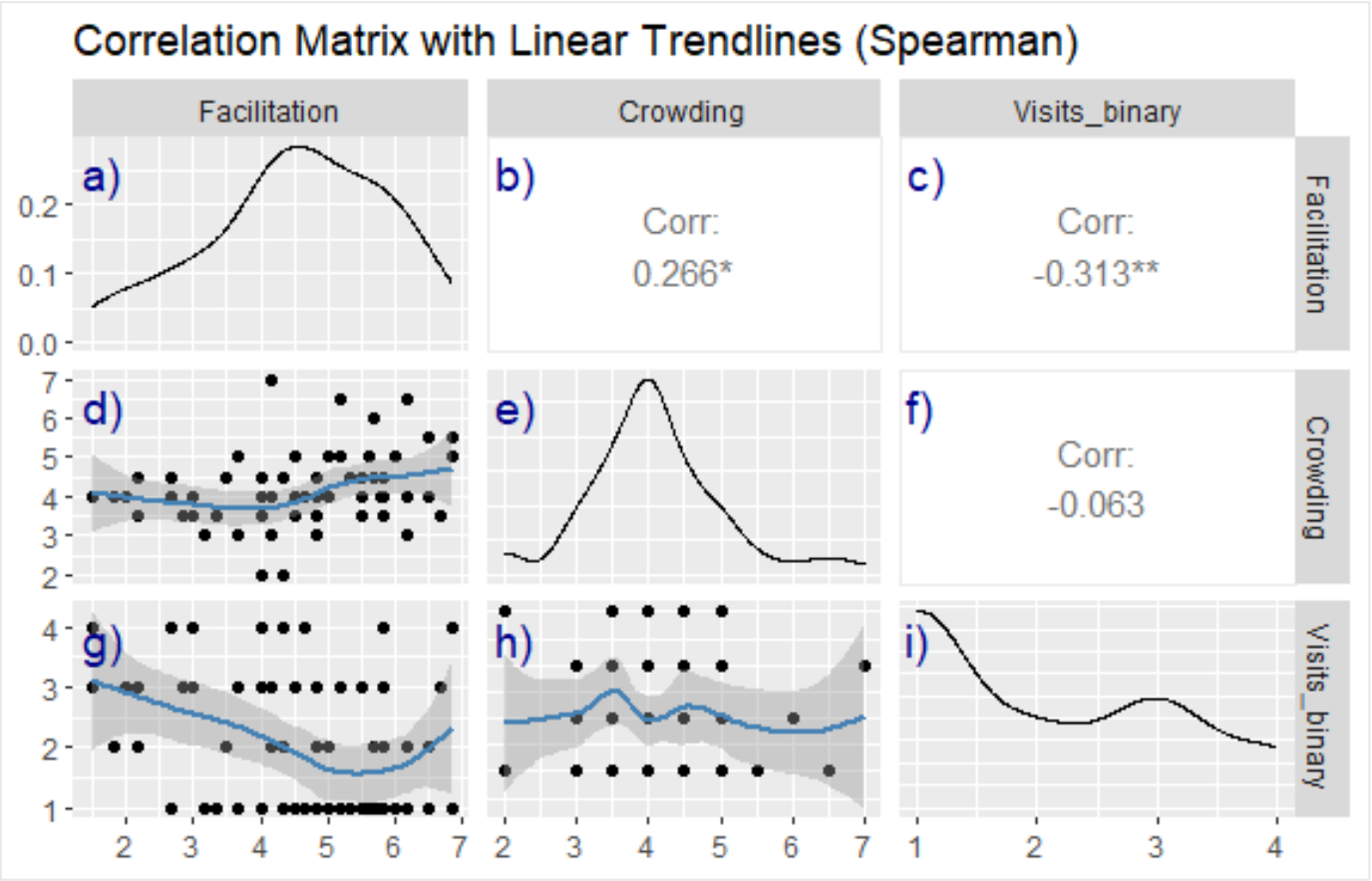


Figure 11: Spearman correlation matrix with linear trendlines showing relationships between facilitation appreciation, acceptance of crowding, and visit frequency.

4.4.4 Wilderness Purism Scale

Table 10 presents descriptive statistics for the Wilderness Purism Scale based on both the 7-item and 8-item index versions. The mean score for the 7-item version was 4.32, while the mean score for the 8-item version, which included the reversed solitude item, was 3.29. The inclusion of the reversed item resulted in a lower overall mean score.

Table 10: A table showing descriptive statistics for the 7-item and 8-item indices.

Number of items	Median	M
7-item index	4.43	4.32
8-item index	3.38	3.23

Table 11 show the correlation between the Wilderness Purism Index and the perception of marked trails, along with the mean scores of the index for both parks and each location separately. Across both parks combined, the correlation was 0.83 with a mean index score of 3.29. In Femundsmarka National Park, the correlation was 0.87, and the mean index score was 2.57, and in Rondane National Park, the correlation was 0.59, and the mean index score was 3.85.

Table 11: Correlation (r) between the Wilderness Purism Index and perceptions of marked trails, along with mean purism scores (M) for both national parks combined and for each park separately.

National Park	**M**	**r**
Both	3.29	0.83
Femundsmarka	2.57	0.87
Rondane	3.85	0,59

4.5 NDSI Variation Across Time and Sites

The Normalized Difference Soundscape Index (NDSI) is a widely used ecoacoustic metric that estimates the relative dominance of biophony versus anthrophony within a soundscape. The index is calculated as:

Equation 2: The basic formulation of NDSI.

$$NDSI = \frac{(\text{Biophony} - \text{Anthrophony})}{(\text{Biophony} + \text{Anthrophony})}$$

where biophony represents the average acoustic energy within the 2–8 kHz range (typically birds, insects, etc.), and anthrophony is derived from the 1–2 kHz range, which tends to capture lower-frequency human-generated sounds such as motors and technology (Equation 2). It's important to note that this banding differs from the full human hearing range (20 Hz–20 kHz) and primarily targets frequencies known to distinguish natural from anthropogenic acoustic activity.

Values approaching +1 indicate dominance of biophonic sounds, values approaching -1 indicate dominance of anthropogenic noise, and values near 0 reflect a roughly equal mix. In practice, however, the interpretation of these values in natural

environments like Norwegian national parks is complicated by other low-frequency, non-anthropogenic sounds such as wind and flowing water. For example, in the early morning and late evening hours in Femundsmarka, the NDSI drops into negative values not necessarily due to human noise but possibly due to hydrophonic or geophysical masking sounds, or even self-noise from the recording unit (Figure 12).

NDSI is typically most valuable for long-term monitoring to detect trends over seasons or years, particularly in areas undergoing changes in human use or infrastructure development. However, in this pilot, the results suggest that while the NDSI provides some insight into temporal variation in acoustic activity, it cannot on its own reliably differentiate between anthropogenic disturbance and natural low-frequency sounds without complementary methods such as spectrogram analysis and manual listening.

Figure 12 shows the diurnal variation in the NDSI across three recording sites (A, B, and E) in Femundsmarka National Park. All three sites followed a similar pattern, with NDSI values increasing from early morning, peaking around midday, and then decreasing toward the evening. Site A consistently showed the highest NDSI values, followed by Site E and Site B, which showed the lowest values throughout the day.

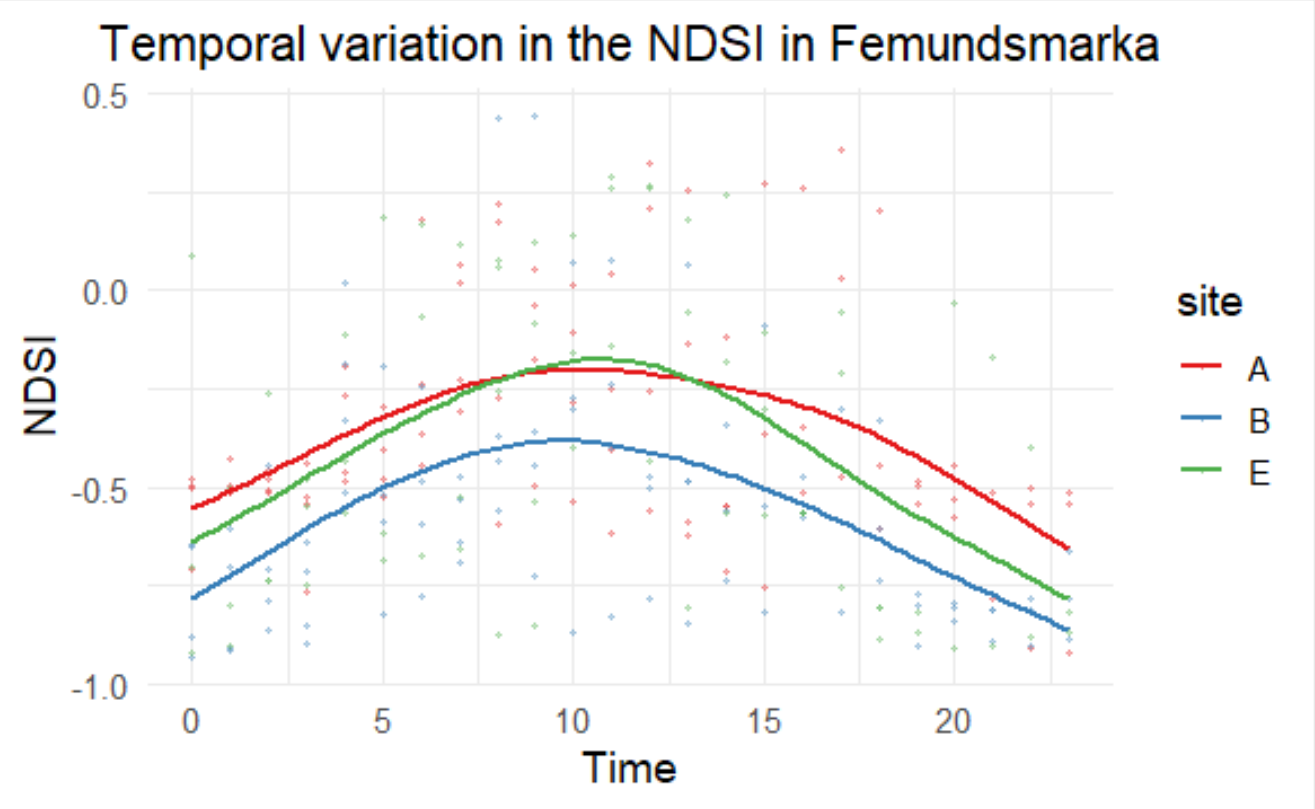


Figure 12: The diurnal variation in the Normalized Difference Soundscape Index (NDSI) across three sites (A, B, and E) in Femundsmarka National Park.

Figure 13 shows the diurnal variation in the NDSI across seven recording sites (A–G) in Rondane National Park. The overall pattern across sites shows relatively stable NDSI values throughout the day, with slight increases in the early morning hours and slight decreases toward the evening. Site B displayed the highest NDSI values throughout the day, while Site G showed the lowest values. The other sites (A, C, D, E, and F) showed intermediate and relatively stable NDSI values with minimal variation over time.

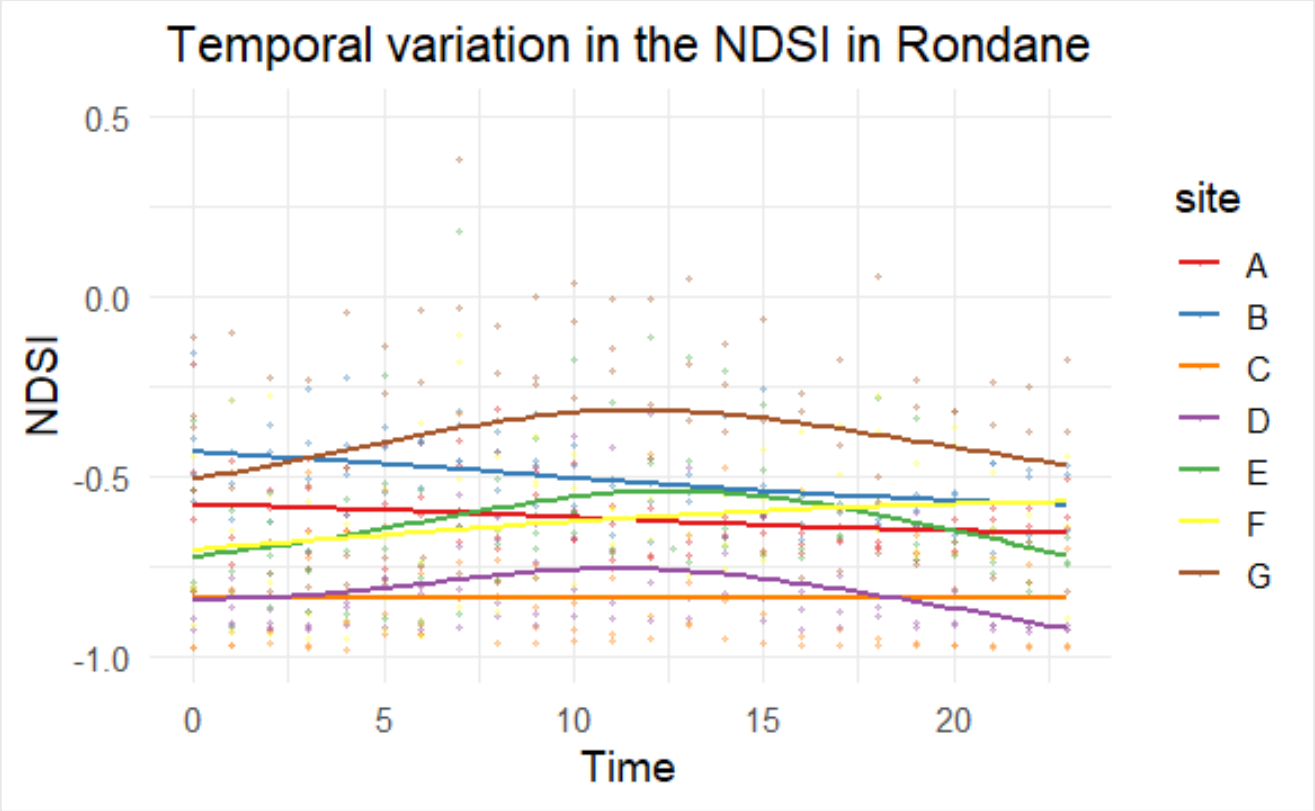


Figure 13: The diurnal variation in the Normalized Difference Soundscape Index (NDSI) across seven sites (A-G) in Rondane National Park

4.6 Soundscape Composition (NMDS)

Figure 14 shows the results of a non-metric multidimensional scaling (NMDS) ordination based on six standardized acoustic indices for three recording sites (A, B, and E) in Femundsmarka National Park. Each point represents a recording, with colors indicating site affiliation. The axes represent ranked dissimilarities in soundscape composition, not absolute values. The x-axis is assumed to reflect a gradient of biophony and geophony, while the y-axis is assumed to reflect hydrophony.

The ordination shows that Site A (red) displays partial overlap with both Sites E (blue) and B (green), but tends to cluster separately, suggesting some shared but also distinct soundscape characteristics between these two locations. Site A appeared to combine characteristics from both, offering a balanced soundscape with moderate biophony and geophony. Sites B and E form a more distinct cluster, indicating a soundscape composition that differs more clearly from each other. This separation might reflect differences in environmental features such as proximity to water, vegetation type, or visitor activity levels, although further field verification would be needed to confirm the specific drivers of these patterns. The clustering suggests that soundscape composition can vary notably even within the same national park, highlighting the importance of site-specific monitoring when assessing soundscape diversity.

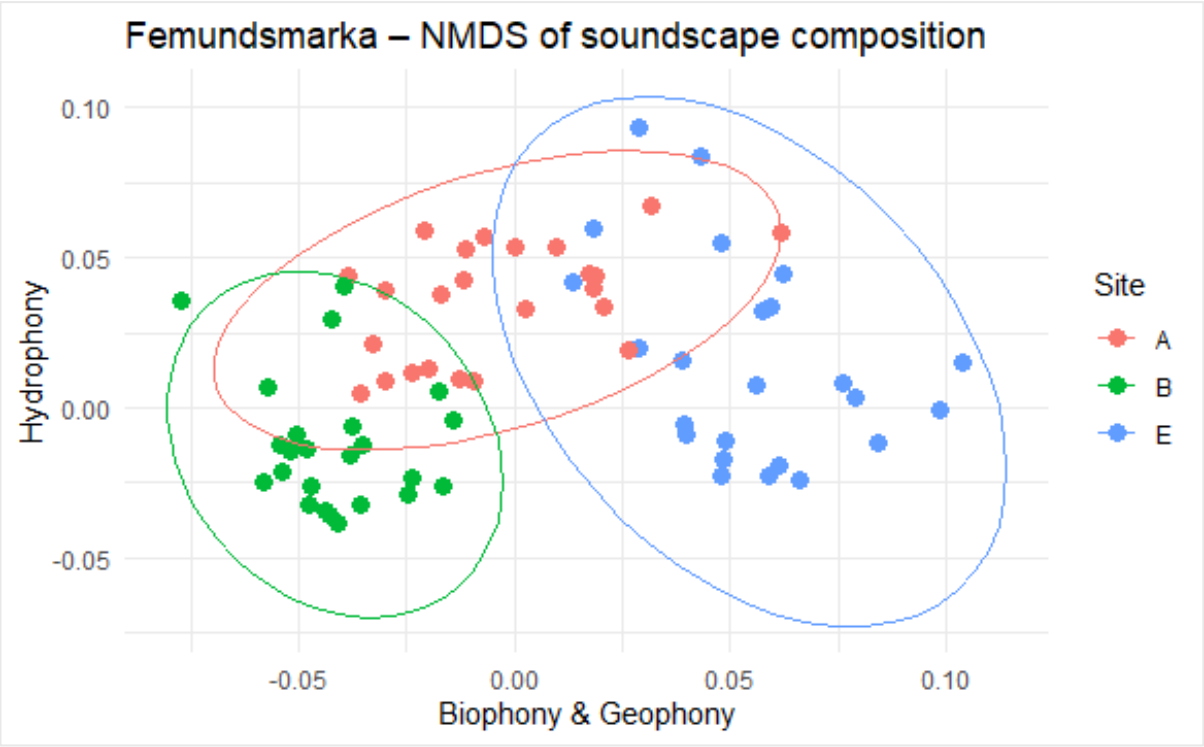


Figure 14: Display of the results of a non-metric multidimensional scaling (NMDS) ordination based on six standardized acoustic indices, across three sites (A, B, and E) in Femundsmarka National Park.

Figure 15 presents the results of a non-metric multidimensional scaling (NMDS) ordination based on six standardized acoustic indices for seven recording sites (A–G) in Rondane National Park. Each point represents a recording, with colors indicating site affiliation. The axes reflect ranked dissimilarities in soundscape composition, not absolute values. The x-axis is assumed to represent a gradient of biophony and geophony, while the y-axis is assumed to reflect hydrophony.

The ordination shows considerable variation in soundscape composition across the seven sites, with several distinct clusters and areas of overlap. Sites B (brown), A (orange), and G (pink) appear to form relatively tight and distinct clusters, suggesting consistent soundscape characteristics within these locations. In contrast, Sites E (blue), D (turquoise), and F (purple) show broader, more diffuse clustering, indicating greater variation within these site recordings. The separation and overlap of clusters may reflect differences in environmental settings, such as distance from trails, elevation, vegetation cover, or varying levels of human activity. This pattern highlights that even within a highly visited park like Rondane, soundscape diversity can vary considerably between sites, emphasizing the value of distributed acoustic monitoring for capturing this variability.

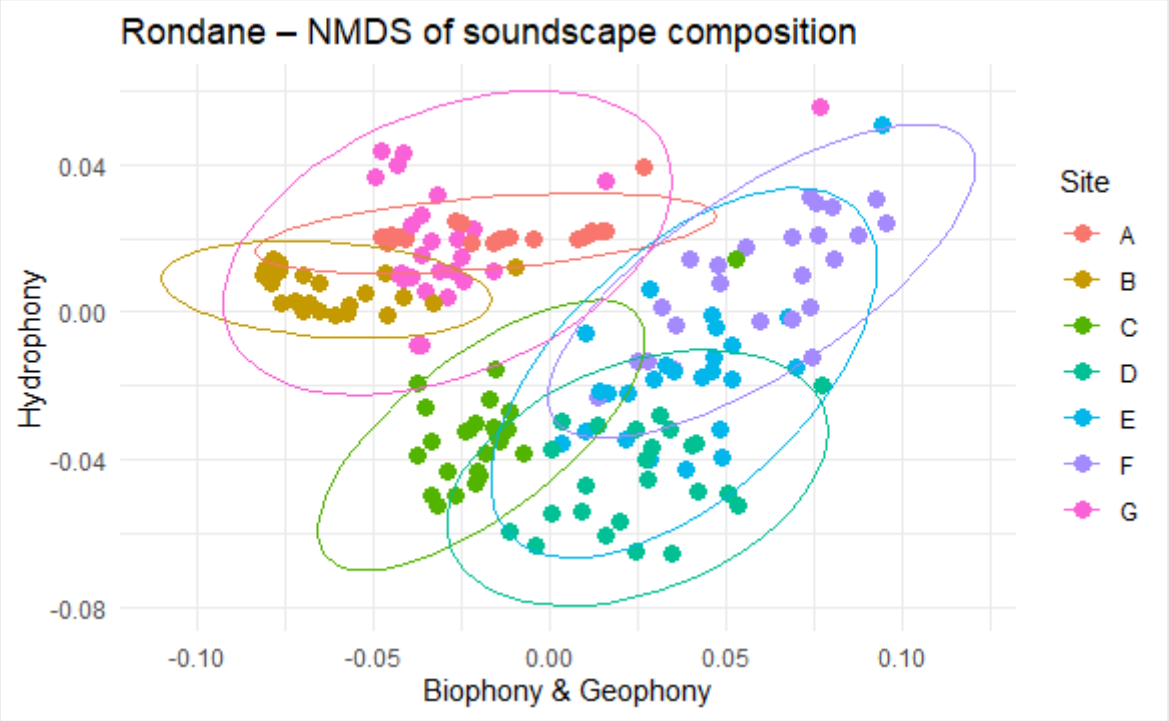


Figure 15: Display of the results of a non-metric multidimensional scaling (NMDS) ordination based on six standardized acoustic indices, across seven sites (A-G) in Rondane National Park.

5.0 Discussion

5.1 Findings

5.1.1 Emotions and sound

This study highlights how natural soundscapes are not merely auditory backdrops, but can be powerful emotional triggers that shape visitors' experiences of national parks. Across both Rondane and Femundsmarka, respondents commonly described feelings of joy, love, and pride when hearing natural sounds. These findings align with earlier research by Miller et al. (2018), which demonstrates the emotional and restorative value of natural soundscapes in PAs (Miller et al., 2018).

Interestingly, the data also revealed subtle cultural and linguistic patterns in emotional expression. Norwegian visitors tended to describe the positive sounds they heard with just the feeling of Joy, while international visitors more frequently marked a broader range of positive emotions (Love and Pride). This difference may reflect cultural norms in emotional expression or linguistic tendencies, as well as varying expectations of wilderness experiences. Something that comes to mind is “Janteloven”. This Norwegian cultural norm emphasize humility and discourage overt displays of individual success, leading to ascribing more negative traits to individuals expressing pride, suggesting a cultural inclination towards modesty in emotional expression (Bromgard et al., 2014).

While natural sounds were overwhelmingly associated with positive emotions, certain biophonic elements, particularly the buzzing of mosquitoes, elicited irritation and discomfort, underscoring that not all natural sounds are universally appreciated. Moreover, visitors in Rondane appeared to report slightly higher levels of irritation related to anthropogenic sounds, such as aircraft overflight sound or other visitors' chatter, compared to those in Femundsmarka. These findings suggest that the emotional resonance of soundscapes is both context- and visitor-dependent, reinforcing the importance of managing acoustic environments as part of the overall visitor experience in national parks.

5.1.2 Survey comments

The open-ended survey comments offer valuable qualitative insights that complement the more structured emotion and sound category results. Several respondents used the opportunity to reflect on their personal experiences, revealing a layered relationship between soundscapes, visitor satisfaction, and expectations. Comments often highlighted how both human-made and natural sounds shaped the quality of the visit, either enhancing or disrupting the experience. In both parks, visitors commented on how construction noise, other people's voices, or children's play affected their sense of tranquility. This supports earlier research suggesting that anthropogenic noise can disrupt visitors' desired experiences in nature (Buxton et al., 2019; Francis & Barber, 2013).

Some respondents in Femundsmarka showed a pragmatic attitude toward temporary disruptions, describing the Sherpa path construction as "*noisy, but necessary*", indicating that expectations and awareness of management actions can moderate negative reactions. This aligns with the expectancy-valence theory, where tolerance for disruption may increase if the outcome is perceived as beneficial (Kominis & Emmanuel, 2007). Visitors also expressed mixed feelings toward natural sounds. While birdsong was commonly described as positive, some visitors remarked that mosquitoes or even the dominance of a single sound, such as buzzing or chirping, could reduce their enjoyment. Comments like "*without the bird chirping and the insects everything would be perfect*" suggest that even natural sounds are subject to personal preferences and situational factors. This highlights that naturalness does not always equal satisfaction, supporting Payne's (2013) argument that soundscape quality is not solely about the absence of anthropogenic noise, but also about the balance and diversity of sounds (Payne, 2013).

Finally, the comments illustrated that visitor experiences are highly context-dependent, shaped by time of day, presence of other people, and individual expectations. For example, several visitors in Rondane noted that the absence of other people enhanced their experience, underlining the link between perceived crowding and acoustic satisfaction. The reflective tone of many comments, such as describing the survey itself as "*interesting*" or "*nice to reflect on*", also suggests that being prompted to listen and reflect may have heightened participants' awareness of

the acoustic environment. This points to the potential of soundwalks and listening stops not only as research tools but also as interpretive methods that can deepen visitor engagement with the natural soundscape (Rosa, 2019).

5.1.3 Facilitating, crowding, visits, and the wilderness purism scale

Building on the statistical findings, this study shows clear differences in how visitors perceive the balance between facilitation and crowding in two contrasting national park settings. Visitors in Rondane, a park known for its established trails and visitor infrastructure, expressed overall higher appreciation for facilitation compared to those visiting Femundsmarka. This aligns with Rondane's reputation as a more accessible and popular destination, where cabins, signage, and maintained trails are part of the expected visitor experience. In contrast, visitors to Femundsmarka, a park often marketed for its remoteness and wilderness qualities, showed lower appreciation for facilitation, suggesting that infrastructure in this context might be perceived as reducing the area's wilderness character.

The ANCOVA results showed that this difference in appreciation for facilitation remained significant even when controlling for how often visitors had been to the parks. Moreover, the Spearman correlation matrix revealed that visitors who appreciated facilitation were generally less frequent visitors, while those who visited more often tended to value lower levels of infrastructure. This suggests that new or less experienced visitors may rely more on physical infrastructure to feel safe and oriented, while repeat visitors or wilderness purists may view facilitation as unnecessary or even intrusive. This is consistent with earlier findings from Vistad and Vorkinn (2012), who noted that infrastructure can serve different functions for different visitor segments, with some seeking accessibility and others seeking solitude.

In terms of crowding, the Wilcoxon rank sum test results showed no statistically significant difference between the two parks, although there was a marginal trend of slightly higher crowding acceptance in Rondane. This suggests that both parks currently maintain visitor levels within generally acceptable thresholds for most users. However, the borderline result indicates that crowding should remain a management focus, particularly in Rondane, which attracts more international and first-time

visitors. These groups may have different thresholds for what they perceive as “too crowded” compared to domestic or experienced users. The positive correlation between facilitation appreciation and crowding acceptance further suggests that visitors who value infrastructure may also be more tolerant of not being in solitude. This group may seek a more social or shared recreational experience, where encounters with other visitors are not necessarily negative. Conversely, visitors who prefer less facilitation may also be more sensitive to crowding, valuing solitude and quiet as part of their desired experience.

The Wilderness Purism Scale analysis provided further insight into the diversity of visitor preferences across the two parks. The overall mean purism score indicates that most visitors held moderate purist attitudes. This suggests that while many visitors appreciate naturalness and solitude, they also accept a certain degree of infrastructure. This balanced distribution is consistent with earlier research in Norwegian national parks, where the majority of visitors have typically been categorized as low to medium purists (Vistad & Vorkinn, 2012).

The strong positive correlation between acceptance of marked trails and the overall purism score, for the combined results for both parks, reinforces the idea that attitudes toward trails are a key indicator of broader visitor preferences for facilitation. Visitors who were more accepting of marked trails also tended to be less purist across other dimensions, including acceptance of cabins and other infrastructure.

When comparing the two parks separately, the data showed some notable differences. Visitors in Rondane exhibited a higher mean purism score, indicating less purist attitudes overall. This is consistent with Rondane’s more developed trail network and visitor facilities, which is likely to attract a wider range of users, including those who value accessibility and comfort. In contrast, Femundsmarka visitors showed a lower mean purism score, reflecting stronger purist preferences, such as valuing solitude and minimal infrastructure. This supports the park’s branding as a more remote and wilderness-like experience.

Furthermore, these patterns align with the observed relationships between facilitation appreciation, crowding tolerance, and visit frequency. Visitors with lower purism scores (less purist), more common in Rondane, tended to be more accepting of both facilitation and crowding, suggesting they may prefer or tolerate more social and

accessible recreational settings. Conversely, stronger purists, more common in Femundsmarka, appeared to favor experiences characterized by fewer people and less infrastructure. While nationality was not analyzed as a variable in the purism scale, previous research suggests that Norwegian visitors tend to be less purist than international visitors (Vistad & Vorkinn, 2010; Vistad & Vorkinn, 2012). Given that Rondane attracted a higher proportion of international visitors, future monitoring of purism scores could help detect shifts in visitor expectations as international tourism grows.

Overall, wilderness purism results provide a valuable framework for zoning and visitor segmentation. By recognizing that visitors have different preferences for facilitation and solitude, managers can better design experiences that minimize user conflicts and protect the unique qualities of each park. These findings also suggest that purism levels may influence how visitors experience soundscapes, where more purist visitors may be more sensitive to anthropogenic noise, while less purist visitors may be more tolerant of human-made sounds as part of the overall park experience. Integrating purism profiles with soundscape management could therefore help tailor communication and zoning strategies that support both ecological integrity and diverse visitor expectations (Vistad & Vorkinn, 2012; Zouhar et al., 2024).

5.1.4 Soundscape variation across time and sites (NDSI analysis)

In Femundsmarka, NDSI values, showed a clear diurnal pattern, with higher values around midday and lower values in the morning and evening. This suggests that biophonic sounds, were more dominant during the middle of the day. This was somewhat unexpected, as birdsong typically peaks in the early morning during what is known as the "dawn chorus" (Staicer et al., 1996). The midday increase observed in this study may therefore reflect a combination of lingering biophonic activity and increased human presence, aligning with typical patterns of recreational activity. This highlights how biophony and anthropophony can overlap during peak visitor hours, shaping the overall soundscape that visitors experience. Site-specific differences were also evident. Site E exhibited the highest NDSI values, indicating a soundscape dominated by natural sounds, while Site B had consistently lower NDSI values, likely due to masking sounds from flowing water or other environmental noise. Site A

presented intermediate values, representing a balance between biophonic and abiotic sound sources.

In Rondane, the NDSI values were more stable throughout the day, showing only modest diurnal variation. However, spatial variation was still present. Site G showed the highest NDSI values, particularly around midday, suggesting a stronger presence of biophonic sounds. Other sites, such as Sites B and F, maintained consistently low NDSI values, indicating a greater influence of anthropogenic or masking noise like wind or water. These findings reflect the more developed and open landscape in Rondane, where environmental and human-made sounds may blend more uniformly throughout the day.

From a visitor management perspective, these findings are relevant for both experience design and acoustic conservation. In Femundsmarka, the strong variation in NDSI across sites and time of day suggests that managers could promote specific locations, such as Site E, for visitors seeking natural quiet or wildlife listening experiences. The midday peak in biophony also points to optimal timing for soundscape-focused activities or interpretation programs. Conversely, Site B's lower acoustic naturalness may make it more suitable for activities that generate more visitor noise, minimizing potential disturbance in more sensitive areas. While soundscape variation was less pronounced across time in Rondane, the site-level differences still provide opportunities for zoning and experience management. For example, quieter sites like Site G could be prioritized for visitors seeking tranquility, while noisier sites like Sites B and F could accommodate higher visitor use without severely impacting the acoustic environment. NDSI findings reinforce the value of site-specific soundscape monitoring as a tool for identifying and managing acoustic hotspots and quiet zones. By aligning visitor activities with the acoustic character of different areas, managers can help protect the sensory qualities that contribute to visitor satisfaction and ecosystem integrity.

5.1.5 Soundscape composition and site differences (NMDS analysis)

The Non-Metric Multidimensional Scaling (NMDS) analysis provided a more nuanced view of how the soundscape composition varied between sites within each park, beyond the simple biophony-anthropophony ratio shown by the NDSI. The NMDS ordination plots demonstrated that different areas within the parks offered distinct acoustic environments, shaped by both natural features and visitor use.

In Femundsmarka, the NMDS results showed three distinct soundscape profiles. Site B clustered separately from Sites A and E, strongly associated with hydrophony, the result of nearby flowing water dominating the soundscape. This supports earlier ecoacoustic findings that geophysical sounds, like rivers or streams, can mask biophonic signals, potentially reducing visitors' perception of soundscape richness (Pijanowski et al., 2011). In contrast, Site E clustered toward biophonic elements, representing a more diverse and natural acoustic environment. Site A appeared to combine characteristics from both, offering a balanced soundscape with moderate biophony and geophony.

In Rondane, the soundscape mapping revealed interesting contrasts that may reflect both natural features and patterns of visitor use. Sites A and B stood out as areas where water sounds, or perhaps wind exposure, seemed to dominate, potentially shaping how visitors experience these locations as more acoustically "busy" or masking. This could help explain why such areas might feel less suited for quiet or contemplative activities, aligning with management considerations for accommodating higher visitor use. In contrast, Sites E, F, and G appeared to offer richer biophonic diversity, suggesting they may provide more opportunities for wildlife listening or restorative experiences. Sites C and D fell somewhere in between, showing a mix of acoustic qualities that may shift depending on the weather, time of day, or visitor presence. These transitional zones highlight how soundscapes are dynamic and context-dependent, reinforcing the importance of flexible, site-specific management rather than one-size-fits-all solutions.

These patterns have direct management implications. Sites that exhibited higher acoustic diversity and naturalness, such as Site E in Femundsmarka and Sites E, F, and G in Rondane, could be prioritized as soundscape conservation zones. These

areas may be especially valuable for visitors seeking quiet, restorative, or wildlife-focused experiences. In contrast, sites characterized by hydrophony or persistent masking noise, such as Site B in Femundsmarka and Sites A and B in Rondane, could be managed as higher-use zones, where increased visitor activity would have less risk of degrading the perceived soundscape quality. Moreover, these findings reinforce the importance of site-specific management, rather than applying uniform strategies across entire parks. By recognizing and managing for the unique acoustic qualities of different zones, park authorities can better balance visitor distribution, experience diversity, and soundscape protection.

When comparing the perceptual findings from the visitor survey with the ecoacoustic patterns revealed in the NMDS analysis, some meaningful connections emerge. In Femundsmarka, visitors generally reported fewer disturbances from human-made sounds and stronger purist preferences, aligning with the NMDS results showing more acoustically diverse and natural soundscapes at sites like E. Conversely, in Rondane, visitors expressed slightly higher sensitivity to anthropogenic sounds and placed greater value on facilitation, which corresponds with the NMDS clustering of sites dominated by hydrophony or masking noise, such as Sites A and B. These sites were probably located closer to infrastructure or water sources that produced continuous background noise. This suggests that visitor perceptions are shaped not only by personal expectations and purism levels but also by the physical and acoustic characteristics of the sites themselves. The alignment between visitor-reported experiences and the acoustic profiles supports the validity of combining perceptual and ecoacoustic data to inform management decisions (Pijanowski et al., 2011). It also highlights the need to recognize that different parks, and even zones within parks, offer distinct sensory environments that attract different visitor types and support different kinds of experiences (Zouhar et al., 2024). Integrating these insights can help managers design zoning strategies that are both visitor-centered and ecologically grounded.

The NMDS analysis also highlights the value of ecoacoustic monitoring as a management tool. By using acoustic indices to map soundscape composition, managers can make evidence-based decisions about zoning, assess visitor flow, and infrastructure development that take into account both ecological and experiential values and perceptions.

5.2 Implications

This thesis demonstrates that soundscapes play an active role in shaping visitor experiences and perceptions in PAs, extending far beyond their function as background environmental elements. By combining visitor surveys, and ecoacoustic monitoring, the study offers new insights that can inform both academic understanding and practical visitor management in Norwegian national parks.

5.2.1 Scientific implications

This study contributes to the growing body of research on soundscapes by applying established theories, such as resonance (Rosa, 2019), attention restoration (Kaplan, 1989), and wilderness purism (Vistad & Vorkinn, 2012), to the Norwegian nature-based tourism context. While much of the existing soundscape research has focused on US national parks, this thesis provides region-specific insights that reflect the cultural values of “friluftsliv” and wilderness experiences common in Norway. The findings confirm that natural sounds are important emotional triggers, enhancing feelings of joy, tranquility, and presence. At the same time, the results reveal that not all natural sounds are equally appreciated, and that tolerance for anthropogenic noise varies across visitor groups. The observed differences between Norwegian and non-Norwegian visitors' emotional expression suggest that cultural norms, may influence how visitors articulate their emotional connection to nature. Femundsmarka visitors showed stronger purist tendencies than Rondane visitors, and Norwegian visitors expressed fewer emotional terms than international visitors. These findings highlight the complexity of soundscape experiences and the need to account for cultural, emotional, and situational factors in soundscape research.

The NDSI is a promising tool for long-term monitoring of soundscapes in protected areas, its use in wilderness-like Norwegian settings must be carefully interpreted. The pilot project highlights the importance of combining NDSI with qualitative validation methods, such as spectrogram inspection and listening to sound clips, to distinguish between human-made and natural low-frequency noise. This supports the need for developing context-sensitive ecoacoustic indicators for Norwegian national parks, and underscores the value of this pilot study in refining appropriate methods for future large-scale soundscape monitoring.

5.2.2 Practical and management implications

For national park managers and tourism planners, the findings provide actionable recommendations on how to integrate soundscape considerations into visitor management strategies.

Sites with high acoustic naturalness, such as Site E in Femundsmarka or Site G in Rondane, could be prioritized as quiet or contemplative zones for visitors seeking solitude or wildlife experiences. In contrast, areas already dominated by masking sounds (e.g., Sites B and F in Rondane) could be designated as higher-use areas where visitor activities are less likely to degrade the perceived soundscape.

Visitor segmentation analysis showed that less purist visitors tend to appreciate infrastructure and are more accepting of crowding. This insight can support zoning and infrastructure planning that balances the needs of different visitor groups. Managers could therefore prioritize infrastructure improvements in high-use areas like Rondane, which attract less purist and more social-oriented visitors, while maintaining low-facilitation zones in more wilderness-oriented parks like Femundsmarka. Zoning strategies that provide both accessible and remote experiences could help balance these diverging expectations, minimizing user conflict and ensuring that both parks continue to offer meaningful experiences for a wide range of visitors (Eagles et al., 2002; Zouhar et al., 2024).

The reflective comments from visitors suggest that soundwalks and listening stops not only collect valuable data but also enhance visitor awareness and connection to the natural environment. These methods could be developed into educational or interpretive tools to foster pro-environmental attitudes and deepen visitor experiences (Rosa, 2019).

The application of ecoacoustic indices (NDSI, NMDS) demonstrates a scalable method for monitoring soundscape quality across time and space (Bradfer-Lawrence et al., 2019). These tools can support evidence-based decision-making in PA management, helping managers identify acoustic hotspots, quiet zones, and areas where visitor activities may need to be regulated.

5.2.3 Broader societal relevance

In an increasingly noisy and technologically mediated world, managing natural soundscapes can provide visitors with restorative experiences that support mental health and well-being (Buxton et al., 2021; Payne, 2013). By recognizing sound as a vital part of nature-based tourism, this thesis contributes to more holistic management practices that address both ecological and human values. Protecting the acoustic integrity of Norwegian national parks not only supports biodiversity, but also enhances visitor satisfaction and strengthens human–nature relationships, contributing to long-term sustainability goals.

5.3 Limitations and future research

While this thesis provides new insights into how visitors experience and interpret soundscapes in Norwegian national parks, several limitations should be acknowledged. These limitations reflect both the scope of the project and the practical constraints of conducting a pilot study within a limited timeframe.

One of the main limitations lies in the restricted scope of the pilot study. Data collection was conducted over a short period during the summer of 2024 in just two locations, Rondane and Femundsmarka. This seasonal and geographic focus limits the generalizability of the findings. Visitor perceptions of soundscapes likely vary across different times of the year, during quieter or busier periods, and in other types of PAs with different visitor profiles or environmental conditions. Since the pilot was designed primarily to test survey tools and methods, the sample size was also relatively small, particularly when responses were split by location, nationality, or visitor typologies. As such, the findings should be interpreted as preliminary rather than definitive.

The survey itself also presented some challenges. While the majority of participants appeared engaged, some sections of the survey were cognitively demanding and potentially repetitive. In particular, the sound listening and dual rating tasks, where participants were asked to rate a long list of sound categories in terms of both acceptance and irritation, may have caused fatigue. This could have affected the quality or consistency of responses in the later parts of the survey. Some questions

may also have been redundant or overlapping, particularly those dealing with expectations of soundscapes and emotional responses. These observations suggest that the survey could benefit from further streamlining to reduce participant burden in future studies.

In terms of data analysis, another important limitation relates to the ecoacoustic component of the study. While I was able to perform basic analyses using indices such as the Normalized Difference Soundscape Index (NDSI) and visualize general patterns through NMDS ordinations, I did not have sufficient time to conduct a more advanced examination of the ecoacoustic data using specialized R-packages like "*seewave*" and "*soundecology*". These tools offer more detailed acoustic analyses, including frequency-based indices and sound profile characterizations, which could have provided a richer understanding of the soundscape composition. Similarly, although the audio recordings were available, I did not have time to extract or visualize sound snippets using Audacity or include spectrograms or waveform figures in this thesis. Such visualizations could have provided tangible examples of the sound environments captured in the parks, helping to bridge the gap between technical data and visitor experiences.

Future research should address these limitations by scaling up the survey to a larger and more diverse sample, covering different seasons, locations, and visitor groups. Longer-term ecoacoustic monitoring would be valuable for capturing temporal variability and identifying trends across time. Future studies should also refine the survey, reducing redundancy and simplifying the rating tasks to improve participant engagement. Additionally, doing the analysis of acoustic data using advanced tools and visualizations would strengthen the scientific and communication value of the findings. Extracting and presenting spectrograms or audio snippets could make the acoustic data more accessible to both managers and the general public, supporting efforts to raise awareness about the importance of soundscapes in nature-based tourism and conservation.

By addressing these gaps, future research can build on this pilot study to provide more comprehensive knowledge and practical tools for managing soundscapes as an integrated part of sustainable visitor experiences in Norwegian national parks.

6.0 Reference list

Bradfer-Lawrence, T., Gardner, N., Bunnefeld, L., Bunnefeld, N., Willis, S. G., & Dent, D. H. (2019). Guidelines for the use of acoustic indices in environmental research. *Methods in Ecology and Evolution*, *10*(10), 1796-1807. https://doi.org/https://doi.org/10.1111/2041-210X.13254

Bromgard, G., Trafimow, D., & Linn, C. (2014). Janteloven and the expression of pride in Norway and the United States. *J Soc Psychol*, *154*(5), 375-378. https://doi.org/10.1080/00224545.2014.914884

Buxton, R. T., McKenna, M. F., Mennitt, D., Brown, E., Fristrup, K., Crooks, K. R., Angeloni, L. M., & Wittemyer, G. (2019). Anthropogenic noise in US national parks – sources and spatial extent. *Frontiers in Ecology and the Environment*, *17*(10), 559-564. https://doi.org/https://doi.org/10.1002/fee.2112

Buxton, R. T., Pearson, A. L., Allou, C., Fristrup, K., & Wittemyer, G. (2021). A synthesis of health benefits of natural sounds and their distribution in national parks. *Proc Natl Acad Sci U S A*, *118*(14). https://doi.org/10.1073/pnas.2013097118

Christoffersen, V. R., Škodlar, B., & Henriksen, M. G. (2022). Exploring tranquility: Eastern and Western perspectives [Conceptual Analysis]. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.931827

Eagles, P., McCool, S., Haynes, C., & Phillips, A. (2002). Sustainable Tourism in Protected Areas Guidelines for Planning and Management. https://doi.org/10.1079/9780851995892.0000

Francis, C. D., & Barber, J. R. (2013). A framework for understanding noise impacts on wildlife: an urgent conservation priority. *Frontiers in Ecology and the Environment*, *11*(6), 305-313. https://doi.org/https://doi.org/10.1890/120183

Franco, L. S., Shanahan, D. F., & Fuller, R. A. (2017). A Review of the Benefits of Nature Experiences: More Than Meets the Eye. *International Journal of Environmental Research and Public Health*, *14*(8), 864. https://www.mdpi.com/1660-4601/14/8/864

Gage, S. H., & Axel, A. C. (2014). Visualization of temporal change in soundscape power of a Michigan lake habitat over a 4-year period. *Ecological Informatics*, *21*, 100-109. https://doi.org/https://doi.org/10.1016/j.ecoinf.2013.11.004

Hollinshead, K. (2009). The "Worldmaking" Prodigy of Tourism: The Reach and Power of Tourism in the Dynamics of Change and Transformation. *Tourism Analysis*, *14*, 139-152. https://doi.org/https://doi.org/10.3727/108354209788970162

Kaplan, R. K., Stephen. (1989). *The Experience of Nature: A Psychological Perspective*. Cambridge University Press. https://books.google.no/books?hl=no&lr=&id=7l80AAAAIAAJ&oi=fnd&pg=PR7&dq=Kaplan+%26+Kaplan,+1989&ots=TrL-QKsa4g&sig=4u2bl26DKxz4vZD9T-XhKP4jsUM&redir_esc=y#v=onepage&q=Kaplan%20%26%20Kaplan%2C%201989&f=false

Kato, K. (2009). Soundcape, cultural landcape and connectivity. *Sites: A Journal of Social Anthropology and Cultural Studies*, *6*(2), 80-91. https://doi.org/https://doi.org/10.11157/sites-vol6iss2id123

Keller, R. (2023). *Sounds like Norway: the aural experiences of outdoor life and biodiversity*. Norwegian Institute for Nature Research (NINA). https://prosjektbanken.forskningsradet.no/en/project/FORISS/334724

Kominis, G., & Emmanuel, C. R. (2007). The expectancy–valence theory revisited: Developing an extended model of managerial motivation. *Management Accounting Research*, *18*(1), 49-75. https://doi.org/https://doi.org/10.1016/j.mar.2006.10.002

Krause, B. (2012). *The Great Animal Orchestra: Finding the Origins of Music in the World's Wild Places*. Little, Brown and Company. https://books.google.no/books?id=cds1AQAAQBAJ&printsec=frontcover&hl=no&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

Li, W., & Liu, Y. (2024). The influence of visual and auditory environments in parks on visitors' landscape preference, emotional state, and perceived restorativeness. *Humanities and Social Sciences Communications*, *11*(1), 1491. https://doi.org/10.1057/s41599-024-04064-4

Liu, A., Wang, X. L., Liu, F., Yao, C., & Deng, Z. (2017). Soundscape and its influence on tourist satisfaction. *The Service Industries Journal*, *38*(3-4), 164–181. https://doi.org/https://doi.org/10.1080/02642069.2017.1382479

Locke, H. (2018). The International Movement to Protect Half the World: Origins, Scientific Foundations, and Policy Implications. In *Reference Module in Earth Systems and Environmental Sciences*. Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-12-409548-9.10868-1

Metcalf, O. A., Carlos; Ashington, Bob; Baker, Ed; Bradfer-Lawrence, Tom; Browning,, Ella; Carruthers-Jones, J. D., Jennifer; Dick, Jan; Eldridge, Alice; Elliott, David; Heath,, Becky; Howden-Leach, P. J., Alison; Lees, Alexander; Meyer, Christoph; Arana,, & Usue Ruiz; Smyth, S. (2022). *Good practice guidelines for long-term ecoacoustic monitoring in the UK*. T. U. A. Network. https://e-space.mmu.ac.uk/id/eprint/631466

Miller, Z., Taff, B. D., & Newman, P. (2018). Visitor Experiences of Wilderness Soundscapes in Denali National Park and Preserve. *International Journal of Wilderness*, *24*(2), 32-43. https://ijw.org/2018-visitor-experiences-of-wilderness-soundscapes/

Moscoso, P. M., Peck, M. P., & Eldridge, A. E. (2018). Emotional associations with soundscape reflect human-environment relationships. *Journal of Ecoacoustics*, *2*(1), 1-1. https://jea.jams.pub/article/2/1/32

Payne, S. R. (2013). The production of a Perceived Restorativeness Soundscape Scale. *Applied Acoustics*, *74*(2), 255-263. https://doi.org/https://doi.org/10.1016/j.apacoust.2011.11.005

Pijanowski, B. C., Villanueva-Rivera, L. J., Dumyahn, S. L., Farina, A., Krause, B. L., Napoletano, B. M., Gage, S. H., & Pieretti, N. (2011). Soundscape Ecology: The Science of Sound in the Landscape. *BioScience*, *61*(3), 203-216. https://doi.org/10.1525/bio.2011.61.3.6

Rosa, H. (2019). *Resonance: A Sociology of Our Relationship to the World*. John Wiley & Sons. https://books.google.no/books?hl=no&lr=&id=nMOlDwAAQBAJ&oi=fnd&pg=PT8&dq=Hartmut+Rosa%E2%80%99s+(2019)+theory+of+resonance&ots=jKsyU3otti&sig=K8GEaBZHcVkQ16-_2LK_ZQR13VE&redir_esc=y#v=onepage&q=Hartmut%20Rosa%E2%80%99s%20(2019)%20theory%20of%20resonance&f=false

Schafer, R. M. (1994). *The Soundscape Our Sonic Environment and the Tuning of the World*.

Skjott Linneberg, M., & Korsgaard, S. (2019). Coding qualitative data: a synthesis guiding the novice. *Qualitative Research Journal*, *19*(3), 259-270. https://doi.org/10.1108/QRJ-12-2018-0012

Staicer, C. A., Spector, D. A., & Horn, A. G. (1996). 24. The Dawn Chorus and Other Diel Patterns in Acoustic Signaling. In E. K. Donald & H. M. Edward (Eds.), *Ecology and*

Evolution of Acoustic Communication in Birds (pp. 426-453). Cornell University Press. https://doi.org/doi:10.7591/9781501736957-033

Stortinget. (2016). *Friluftsliv - Natur som kilde til helse og livskvalitet*. regjeringen.no Retrieved from https://www.regjeringen.no/no/dokumenter/meld.-st.-18-20152016/id2479100/?ch=3

Teijlingen, E. v. H., Vanora. (2001). The Importance of Pilot Studies. *Social Research Update*, *35*(1360-7898), 1-4. http://sru.soc.surrey.ac.uk/SRU35.pdf

Vistad, O. I., & Vorkinn, M. (2010). Wilderness purism revisited: The value of a simplified standardised scale for monitoring purposes. In M. Goossen, B. Elands, & R. v. Marwijk (Eds.), *Recreation, tourism and nature in a changing world* (pp. 69). Alterra, Wageningen University and Research centre. https://mmv.boku.ac.at/downloads/mmv5-proceedings.pdf

Vistad, O. I., & Vorkinn, M. (2012). The Wilderness Purism Construct — Experiences from Norway with a simplified version of the purism scale. *Forest Policy and Economics*, *19*, 39-47. https://doi.org/https://doi.org/10.1016/j.forpol.2011.12.009

Vroom, V. H. (1964). *Work and motivation* (1st ed.). Jossey-Bass Publishers.

Wang, P., Zhang, C., Xie, H., Yang, W., & He, Y. (2022). Perception of National Park Soundscape and Its Effects on Visual Aesthetics. *International Journal of Environmental Research and Public Health*, *19*(9), 5721. https://www.mdpi.com/1660-4601/19/9/5721

Zouhar, Y., Gundersen, V., Vistad, O. I., Selvaag, S. K., Köhler, B., & Wold, L. C. (2024). Hvem bruker nasjonalparkene i norske fjell? Karaktertrekk ved bruken og klassifisering av områdene.

Øian, H. (2014). *4 Friluftsliv – norsk kulturarv og nasjonal identitet* (1073). N. i. f. n. (NINA).

7.0 Attachments

7.1 The survey

(Femundsmarka-English version)

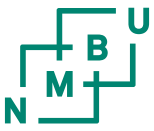
C:\Users\froyd\OneDrive\Skrivebord\NMBU\MREIS\2.Året\MASTEROPPGAVEN\Feltarbeid\Skjema Femunsmarka ENGELSK _2706.pdf

7.2 The survey metadata

https://d.docs.live.net/3c7715b0163b2f05/Skrivebord/masteroppgaven/Min_masterdata.xlsx

7.3 Temperatures of the recorders

https://d.docs.live.net/3c7715b0163b2f05/Skrivebord/masteroppgaven/temperatures_pilot_SLN.xlsx



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