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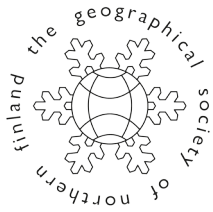

Discussions and interventions

Notes from the field: An interdisciplinary perspective on the experiences, challenges and solutions for conducting fieldwork in glacial and periglacial environments

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Social media summary: As the cryosphere changes, so must our fieldwork - embracing different knowledge systems for more impactful research.

Abstract

Interdisciplinary research approaches are critical to understanding the profound shifts in glacial and periglacial environments due to climate change. However, conducting fieldwork in these geographies often involves navigating the complexities of situated narratives, traditionally dominated by masculinist and geoscience-centered approaches. In this commentary, using feminist glaciology as a lens for understanding the socio-environmental dynamics within the cryosphere, we reflect on the significance of interdisciplinary and cross-boundary research. Drawing from three different yet interconnected fieldwork experiences—nature-based tourism research in Patagonia, geophysical surveys in High Mountain Asia, and engaging with the green transition and indigenous perspectives in the European Arctic—we explore the challenges and solutions of doing research in these extreme environments while reflecting on

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positionality, knowledge production, and the need for diverse perspectives in the climate crisis.

Keywords: feminist glaciology, cryosphere landscapes, early career researchers, scientific practices

Introduction

Glacial and periglacial environments are critical components of global climatic-socio-ecological systems and highly sensitive to anthropogenic climate change (Bamber et al. 2019; Biskaborn et al. 2019; Box et al. 2019; ICCI 2019; Immerzeel et al. 2019; IPCC 2019). They are composed of complex entanglements between geophysical, ecological, social, cultural, economic and geopolitical dimensions which act across multiple scales, intertwining local, regional, and international interests (Fountain et al. 2012; Gagné et al. 2014; Graham et al. 2023). While scientific knowledge production in these regions carries significant weight, these interconnections also create a dynamic and often contested landscape of knowledge and authority, where the underlying assumptions of scientific research methods too often remain unacknowledged and unexamined. Such assumptions become particularly evident in the positionalities and perspectives researchers bring to the field, relating also to how local communities or indigenous knowledge holders perceive our scholarly endeavours.

As early career researchers (ECRs) coming from the social and natural sciences, we are uniquely positioned to shape future research cultures and practices whilst also being vulnerable to their existing academic pressures (Guímaro et al. 2024). Consequently, we recognise the importance in critically examining how we produce knowledge about and within these contexts. Motivated by our experience attending the Norwegian Scientific Academy for Polar Research summer school held in Svalbard in June 2023, which brought different scholarly, epistemological, ontological, and cultural backgrounds together, we argue for the need to go beyond disciplinary and geographic boundaries and consider the implications of our own positionalities for research practices and experiences.

Drawing from the feminist glaciology framework developed by Carey et al. (2016), in this Discussions and Interventions paper, we reflect on the challenges, solutions, and experiences for conducting research in and around these frozen environments. We present three distinct, yet interconnected fieldwork experiences, namely a) nature-based tourism in Patagonia, Chile; b) geophysical mountain glacier research in High Mountain Asia; and c) sustainable transitions in northern regions of Norway, Sweden and Finland. Situating these fieldwork experiences within a feminist perspective, we highlight that while gender considerations form part of our reflection, we understand gender, similarly to Carey et al. (2016: 771), "not as male/female binary, but as a range of personal and social responsibilities" and as a lens through which to examine "power, justice, inequality and knowledge production". Based on our backgrounds in both the social and physical sciences, we analyse how our positionalities have shaped our research methods and experiences and consider the broader implications for interdisciplinary and equitable research practices. Our critical examination of epistemological practices contributes to calls for fostering feminist approaches regarding fieldwork. This is important for both the research community and to the local communities that are intended to benefit

from academic knowledge (Dance et al. 2024; Moosa & Tuana 2014; Robel et al. 2024). Our analysis highlights the often-unaccounted complexities of knowledge production in fragile and remote environments, where the scholar is not only dependent on geophysical factors, but also on collaborations on varying degrees.

A feminist approach and the self in fieldwork

Scientific research in glacial and periglacial environments has long been shaped by traditional masculinist narratives, tied to legacies of exploration, endurance and risk, reinforcing perceptions of these landscapes as remote, isolated and dangerous (Carey et al. 2016). These narratives influenced not only whose knowledge of these environments was deemed legitimate, but also what kinds of knowledge were ultimately valued. Likewise, privileging a supposedly 'objective' (physical) inquiry has often marginalised the social, political, cultural, and economic contexts of these regions (Brugnach et al. 2024; Carey et al. 2016).

In recent decades, there has been a growing shift toward more holistic studies of the cryosphere, in which local knowledge, histories, identities, beliefs, and non-human elements are recognised as crucial for addressing long-term socio-environmental challenges (e.g. Dodds & Smith 2022; Gagné & Drew 2024; Gagné et al. 2014; Gagné 2024). Beyond the physical hydrologic, geomorphic, and ecological functions, glacial and periglacial environments also serve as social and cultural spaces, influencing human mobility, contested rights, and practices such as religion, education, or tourism (Allison 2015; Bravo 2009; Mark & Fernández 2017; Welling et al. 2015; Young et al. 2020). Understanding these entanglements, however, requires interdisciplinary approaches and a critical engagement with the processes and assumptions of knowledge production. Feminist inquiries provide a framework for unravelling these complexities. Rooted in the recognition that scientific practices are shaped by the researcher's situated position and influence, feminist approaches underscore the importance to reflect on how knowledge is produced, whose perspectives are included or marginalised, and how social, cultural, and material factors, such as technology, discourses, institutions and environmental contexts, interact in shaping research outcomes (Haraway 1988, 2016; Jasanoff 2004).

This line of questioning allows us to decentralise knowledge production about glacial and periglacial environments revealing diverse 'ice ontologies' that include local and indigenous knowledge systems and highlighting that knowledge production is rarely neutral (Brugnach et al. 2024; Gagné & Drew 2024). In these contexts, various issues emerge. For example, Dance et al. (2024) found that women researchers often experience gendered dynamics in polar fieldwork where, regardless of their disciplinary or cultural background, they face negative experiences related to power imbalance, gender-stereotypical task assignments, and lack of accountability. Because glacial and periglacial environments encompass more than their geophysical characteristics, it is essential to remain critically attentive to how knowledge is produced and to potential gaps or biases introduced by prevailing scientific practices.

Accordingly, in designing and conducting this commentary, we drew on feminist critique (Carey et al. 2016; Butler 1990; Gagné & Drew 2024; Haraway 1988, 2016; McDowell & Sharp 1999; Rose 1997) and social science approaches (Harding 1991; Jasanoff 2004) to analyse the positionalities and lived experiences of researchers within fieldwork in the cryosphere. In detail, we draw on the fieldwork experiences

of three of our co-authors who are in their early career stages. These reflections on scientific practices consider their positionalities, including gender, career stage, and being an outsider. We present experiences of conducting both quantitative (geophysical surveys) and qualitative methods (semi-structured interviews, surveys, and participant observations) during fieldwork.

Carey et al. (2016) prompt us to question scientific practices from four perspectives: who is producing knowledge and how gender affects the process; how scientific credibility is gendered; how power dynamics have shaped glaciological science; and what alternative ways exist for investigating and depicting glaciers. We focus particularly on the first perspective, the scientist, by asking our three contributors to reflect upon their own fieldwork contexts, personal backgrounds and the challenges, surprises, or solutions they encountered, and subsequently consider how these reflections shaped their understanding. The stories we present are kept sufficiently general to protect the identities of both contributors and their collaborators in the field. While the collected vignettes are women ECRs' fieldwork experiences, it was not our intention to focus solely on women's fieldwork. Storying these experiences allowed us to develop a more situated understanding of glacial and periglacial environments, highlighting their social, political, cultural, and epistemological dimensions alongside their geophysical features. These reflections also encouraged us to account for the messiness of scientific practices, which are inevitably embedded in perspectives, biases, and vulnerabilities, for example, related to gender or local/indigenous status, while honouring the knowledge and expertise of the people whose livelihoods are intertwined with these environments (Haraway 2016).

Nature-based tourism in Patagonia, Chile

While born and raised in southern Chile outside of Patagonia, I have been involved in different fieldwork activities in Chilean Patagonia since 2005. During my fieldwork, I built on my familiarity with local traditions, food, flora, fauna, landscape, and local news, yet I would often come across new experiences. I conducted my fieldwork in rural Patagonian villages – tourism destinations – tucked between fjords and glaciers. With long distances between the villages and dirt roads, weather conditions define what and when certain activities are feasible to carry out. Working in the remote peripheries, I decided to use public transport (ferries and buses) whilst conducting my fieldwork, to truly understand what is meant by the ideas of 'remoteness' and 'periphery' (see Figure 1, 'Glacier tourism, O'Higgins lake, southern ice fields, Aysén region, northern Patagonia, Chile').

This contribution builds upon two solo qualitative research projects on nature-based tourism (including semi-structured interviews and observations) in spring-summer seasons. During fieldwork, it turned out that geological and oceanographic research was much more familiar to some of the local residents than I had anticipated. Some of them had participated in scientific expeditions or had seen researchers installing monitoring equipment in lakes and glaciers (Bachmann-Vargas 2021). When presented with the idea that interviews are a way to collect data, some interviewees questioned whether it was 'real science', surprised that talking to people was enough as a research practice (field notes). This experience made me realise the different positionalities we encounter while doing fieldwork. Thus, a longer explanation was needed to situate my

Figure 1. Glacier tourism, O'Higgins lake, southern ice fields, Aysén region, northern Patagonia, Chile. Photo taken by Contributor 1.

research about nature-based tourism within what was already understood as scientific research in glacial and periglacial environments (Bachmann-Vargas 2021).

During the fieldwork, I met several challenges. As a female researcher conducting solo fieldwork, I sometimes had to assess whether certain places or activities were safe enough for me. For instance, considering potential risks of being harassed, and assessing the changing weather conditions, before hiring a tour or going on a solo hike. Furthermore, tour operators during the summer season were always busy, so I quickly learned that one hour for an interview was too long of an interruption in their work. Instead, I developed a short survey allowing me to approach most of the tour operators in a short time (Bachmann-Vargas et al. 2022). In addition, fieldwork in glacial and periglacial environments is costly. From accommodation, food, and proper clothing and equipment to the fact that you do not go on ice alone and must hire a guide. These day trips are also weather dependent and require previous knowledge about weather conditions and right preparations. One must be flexible in adapting to unexpected situations, such as the internet, electricity or water being down, or a ferry being delayed by five days due to a storm (Bachmann-Vargas 2021).

I was careful to reflect on my own awareness of local knowledge and traditions. I sought to understand the local context first, while being cognisant of possible paternalistic comments. In the context of switching between English and Spanish, it was important to recognise negative or positive connotations of certain words. I was also honest about my research and refrained from raising expectations regarding the outcomes, through explaining the meaning of my research and what I will do with it.

Geophysical fieldwork on mountain glaciers in High Mountain Asia

I am a British female researcher based in the UK and Germany. This was my first time conducting fieldwork in High Mountain Asia although I had previously visited our local collaborators and it was my first experience leading a fieldwork project. The research used geophysical techniques to look at ice storage in periglacial environments. I worked as part of a field team consisting of myself and two other European female ECRs, a rotating team of 12 local researchers (all male) and an external supervisor (male). The mountainous site was located at 3500–4000 m altitude; within a restricted permit zone meaning there was limited public access to the site (see Figure 2, 'The site was at an elevation of ~4000m, accessed by an off-road vehicle and by foot'). We were in the field for approximately a month.

We experienced challenges due to language, cultural and gender differences that meant that initially it took some time to establish a good working relationship as a team. This was in part due to women less commonly participating in fieldwork in this region, and our positionality as outsiders. Initially, we experienced differences in expectations around how we (as women) would participate in the field. For example, my female colleagues and I were keen to take a more active role but had to sometimes demonstrate our physical strength and experience by actively carrying and operating equipment. We encountered further practical hygiene-related challenges that our all-male local partners had not considered. Working with two other women made it easier to address issues that arose, especially those with a gendered aspect. Finding the balance between listening

Figure 2. The site was at an elevation of ~4000m, accessed by an off-road vehicle and by foot. Photo taken by Contributor 2.

to the expertise of our local collaborators whilst making sure our voices were heard and respected was sometimes challenging and required careful communication and awareness of the cultural differences. However, as we overcame initial differences in expectations, our relationship as a team improved and the field campaign was ultimately successful.

As we built our relationship with the local field team, we learnt more about their own research and discussed ideas, methods and questions, which led to further collaboration. However, differences in institutional cultures and funding systems meant that our goals and valued outputs sometimes differed, requiring compromise. Generally, my European colleagues and I placed more significance on the broader research questions, context and recording of secondary observations to assist with interpretation. However, our local colleagues were already very familiar with the site and the environmental-socio-political context. Reflecting on these experiences highlighted the importance of considering how positionality influences approaches to problem-solving, valued information, logistics, and safety. As a physical scientist I had not fully considered my own positionality before going to the field. I feel that this is something still not widely discussed in the physical sciences and I had not been encouraged or required to do so by my institution(s). In the future, during the planning stage I would explicitly address my own and my team's positionality and consider how this might impact the fieldwork

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Research with the Sámi People in Northern Norway, Sweden and Finland

I am a Greek female researcher, conducting an individual research project funded by a university in Belgium. For the past 7 years, I was involved in several projects related to indigenous Sámi communities and have experiences from living and working in the Arctic. Currently, I am engaged in research involving Sámi communities in the European Arctic. My fieldwork, based on semi-structured interviews and observations, is situated in the Sápmi regions where Sámi communities and mining activities coexist, Kiruna in Sweden and Inari in Finland (see Figure 3, 'Fieldwork in the rural areas of Northern Scandinavia.'). The two regions are relatively well-connected by roads, however, scarce and indirect public transport makes it difficult to reach fieldwork locations. Travelling often requires time-consuming and expensive detours via larger towns and depends on weather and road conditions. In some rural or forested parts of Sápmi, mobile signal and internet access can be weak or absent, complicating coordination, navigation, and emergency preparedness during field visits.

The main issue I come across as a female researcher derives from the perception that my work is considered 'challenging' and even 'dangerous' because I am a woman working in the Arctic. For example, due to sparse infrastructure, I often rely on costly rental cars or on community members for transportation—posing ethical and practical challenges, particularly regarding reciprocity and independence in research. I drive long distances alone, stay in isolated areas, or depend on strangers for transport or lodging. Mining areas, construction zones, and transport hubs can be male-dominated and carry a masculine culture, making them uncomfortable or unsafe for women. Furthermore, I have encountered scepticism because I am a non-indigenous individual working on indigenous matters, questioning my motives, my positionality and my perception on this research. Sometimes, I am navigating multiple layers of difference—ethnic, linguistic, and gendered—which can shape how I am perceived and how safe or welcome I feel. Local power structures and my positionality (non-indigenous, foreign, female) have

sometimes affected trust, access, and even my safety, depending on the dynamics on each site.

Figure 3. Fieldwork in the rural areas of Northern Scandinavia. Photo taken by Contributor 3.

During fieldwork, I came to recognise I operate from a position of privilege—having access to the means, funding, and institutional support that afford me the security to conduct research in these contexts. This shapes how I move through the field and how I interpret and represent others' experiences. It is crucial to acknowledge that these are not my stories to tell. Rather, my role is to ensure that the voices of research participants are conveyed with integrity, care, and accuracy—as they choose to share them. My task is to draw meaning from these narratives while striving to minimise the imposition of my own positionality and instead remain critically reflective of how it shapes my understanding. Practicing this reflexivity is essential to uphold the ethical responsibilities of conducting research in indigenous territories, especially as an outsider.

Discussion

Reflecting upon our fieldwork practices and positionalities as women, outsiders, and scientists, we highlight how these profoundly influence our understanding of glacial and periglacial environments. Our experiences resonate with feminist critique (Haraway 1988; Butler 1990; McDowell & Sharp 1999; Rose 1997), which views knowledge production as inherently situated, partial, and influenced by relationships of power. This approach stands in contrast to dominant perspectives in cryosphere studies, where physical is often separated from the social, disregarding the rich entanglements of human and non-human worlds (Carey et al. 2016). In a context where climate change, policy decisions, and community livelihoods are profoundly intertwined, it is especially important to challenge this separation. Our experiences highlight the importance of understanding that scientific practices in glacial and periglacial environments are not conducted in a vacuum, and that they are affected by the researcher, the locals, the environment, and other surrounding factors.

Although our case studies in Patagonia, High Mountain Asia, and Sápmi differ considerably, we believe they collectively demonstrate the significance of reflexive and intersectional approaches. Our positionalities influenced not only the questions we asked and the relationships we formed in the field, but also the interpretations we drew and the way we presented them. The common thread is the way knowledge is co-produced in context. Glacial and periglacial environments are often remote, and, therefore, far from decision-making bodies, whether these are scientific or governmental decisions. The people who live in and alongside these environments are the ones most directly affected by policy making, which can often be based on data collected by us, the scholars in the cryosphere. If we are to produce knowledge grounded in a particular place, we must rethink who is involved in its production and how. Our reflections resonate with Haraway's (2016) call for "staying with the trouble"—engaging responsibly with complex, messy, and unsettled situations in a way that neither disregards their social dimensions nor falls back into pure scientific objectivity. Capturing the messiness of our living world(-s) necessitates methodological innovation and greater awareness of power relations in knowledge production. The fieldwork experiences of our contributors align with previous studies that view glaciated spaces not just as physical formations but as sites of intersectional vulnerability, resistance, and transformation (Allison 2015; Bravo 2009; Gagné & Drew 2024). Thus, to understand these polyrhythmic landscapes we need to embrace messy fieldworks by stepping beyond the disciplinary boundaries and paying attention to unfolding histories of glacial and periglacial environments (Tsing 2013).

The unruly nature of these environments means that the navigation of difficult field conditions requires methods that enable collaboration with community members as well as reflection of our own positionalities and vulnerabilities. As our contributors experienced, women researchers still face additional barriers when conducting fieldwork in glacial and periglacial environments — from doubts about their ability to handle physical and logistical hardships, to the cultural scepticism stemming from their non-male, non-dominant positionalities. Additionally, in some cases where methods are qualitative or collaborative, straying away from 'objective' measurements can be viewed as less 'scientific' or rigorous (Harding 1991), illustrating the persistent effects of masculinist narratives in framing what constitutes credible knowledge. Coupled with intersectional vulnerabilities related to gender, ethnicity, outsider status, and whether working in a group or alone, this established hegemony of positivist science can undermine both the credibility of the researcher and their ability to work safely in the field. The example from Patagonia, where the validity of qualitative methods was questioned, calls for us to reconsider how our methods align with dominant scientific practices, while retaining their ability to account for the lived experience of glacial spaces. In High Mountain Asia, working alongside all-male team members both provided support for the fieldwork and presented physical and interpersonal obstacles, yet this challenge also opened space for collaboration and for reconsidering how knowledge is constructed under differing cultural conditions. Meanwhile in Sápmi, engagement with Sámi communities enables us to rethink the notion of objectivity in science and appreciate the significance of honouring indigenous perspectives and their own epistemologies (Haraway 2016).

Furthermore, cooperation and flexibility in working with local communities, whether as study participants or as colleagues in data collection, are paramount. Glacial and periglacial environments are time- and budget-consuming, and dealing with the effects of climate and infrastructure further adds uncertainty to our work. Difficult accessibility requires networking both between international and local researchers, and local communities as investigating complex, remote spaces cannot be done in isolation. Importantly, while funding structures are designed by governing bodies or funding agencies, their priorities may not align with the actual needs for understanding regional socio-ecological complexities or the goals of individual projects and stakeholders. This, alongside questioning methods, further emphasises the power relations in knowledge production — who decides what is researched and how. As ECRs without secured financial support, we must frequently conform to funding structures that may dictate and constrain our research designs. Uncertainties stemming from unfavourable weather, bureaucratic or political obstacles, or logistical issues related to transport require us to be flexible and adaptable in our scientific practices.

Concluding thoughts and ways forward

Looking forward, we as early career researchers need to reflect critically on our roles in knowledge production and policy guidance. The experiences we shared in this reflection piece highlight that the main challenges we face while conducting fieldwork are not just physical, navigating difficult terrains and icy conditions, but also social and political, related to the way knowledge is produced, valued, and perceived. This is especially significant as glaciated environments, once viewed as remote, become central for understanding our changing world.

Feminist perspectives provide a powerful critique of historical masculinist and colonialist narratives of exploration that have led to gendered biases in the recognition of expertise and whose or which knowledge is valued (Harding 1991; McDowell & Sharp 1999; Rose 1997). For us, feminist approaches mean dismantling persistent power asymmetries reproduced by scientific practices and opening a passageway to flourishing diverse epistemologies and ontologies, which are key for understanding the physical and the social dimensions of frozen environments in a warming world. We must remain attentive to different knowledge systems and make space for both scientific data and the lived experiences of local and indigenous communities. This holistic and reflexive approach is essential if we want to make meaningful contributions to both science and society.

To shape future directions, we call for cross-boundary, participatory, reflexive, and intersectional methods in glaciology and related fields. This means developing collaborative approaches with indigenous and local stakeholders and employing methods that enable their voices and knowledge to guide the framing of research questions, data collection, and policy-relevant outcomes (Carey & Moulton 2023; Haraway 2016; Harding 1991). Moreover, extending comparative studies across different glaciated environments and their respective social formations can help illuminate both the universal and particular mechanisms through which climate change impacts human and non-human worlds.

Our experiences demonstrate how knowledge production is influenced by the epistemologies we employ and the institutional structures we work within. Advancing our understanding of socio-environmental complexities therefore requires a critical examination of the way knowledge is produced, alongside a conscious effort to challenge traditional perspectives. We encourage the exploration of intersectional perspectives, including feminist glaciology and indigenous feminisms, which integrate multiple knowledge systems and are attentive to power relations. These perspectives enable more reflexive, equitable, and socially informed approaches to research. As ECRs, we see ongoing dialogue and collaboration across disciplines as crucial for creating space for a greater diversity of voices in both knowledge production and policy responses.

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