




Original Article

The state of mountain research in Canada

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Abstract: Nearly a quarter of Canada's landmass is covered by mountainous terrain, making mountains an important aspect of the physical and human geography of the country. Mountain areas in Canada have motivated a great deal of research activity, yet the state of mountain research in the country has never been systematically characterized, precluding a detailed understanding of what is being studied, when, where, how, and by whom. In response, we conducted a systematic scoping review to rigorously identify, collate, and critically examine existing peer-reviewed articles related to mountains in Canada. 2,888 articles were included in our review, which reveals strong biases towards work in the natural sciences and in the mountain west, with little work to date in the social and health sciences or in other mountainous regions of the country. Our results demonstrate that Canada is among the most productive contributors to mountain research globally, but that topical and geographical biases in existing research effort leave important gaps that must be addressed to successfully navigate challenges and opportunities facing mountain areas in Canada. We provide a roadmap to guide future mountain-focused research activities in the country.

Keywords: Canada; Mountains; Systematic scoping review; Research

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1 Introduction

The importance of mountains, which cover approximately one quarter of the earth's land surface, is well established (Ariza et al. 2013; Körner and Ohsawa 2005; Messerli and Ives 1997; United Nations 1992). For example, mountains are the source of almost all of the planet's major river systems, and are an essential source of freshwater for at least 1.8 billion people globally (Immerzeel et al. 2020). Mountains are also globally important centres of biodiversity and endemism and are associated with 27 of 36 "biodiversity hotspots" (Körner and Spehn 2019; Myers et al. 2000). In addition, mountains are home to nearly 14% of the global population; a much larger proportion of the planet's population lives adjacent to, and rely upon, mountain areas (Romeo et al. 2020).

Mountains are also highly sensitivity to climate change and other anthropogenic stressors, with the rapid recession of mountain glaciers and snowpacks, habitat destruction, and increased pressure from human uses now threatening the characteristics of many mountain systems. Serious consequences of these pressures have already been documented across mountain geographies globally, including impacts on the timing, availability, and quality of water from mountain areas; changes in the frequency and severity of natural disasters; and modifications to the structure and function of mountain ecosystems (Adler

et al. 2022; Hock et al. 2019). As in other countries, mountains in Canada are both highly important and increasingly threatened (McDowell 2020; Sandford 2010).

In Canada, mountains cover 2.26 million km² (24% of Canada’s landmass) – an area large enough to contain the entirety of Nepal 15 times – making them an important aspect of the physical and human geography of the country (McDowell and Guo, 2021). Given large differences in their latitude, longitude, and altitude, Canada’s mountain environments can be classified into ten distinct major mountain regions (Fig. 1). Each of these regions has unique physical and ecological features, socio-cultural histories and characteristics, and associated biocultural relationships interdependencies. Across Canada, mountains continue to shape communities and ecosystems in important and diverse ways, while also exhibiting changes that threaten the role of high places in supporting well-being, inspiring cultural activities, and harbouring iconic landscapes and species.

Mountains have motivated a great deal of scholarly activity in Canada, yet the state of mountain research in the country has never been systematically characterized. This has precluded a detailed understanding of what is being studied, when, where, how, and by whom, which in turn has constrained our ability to make evidence-based decisions about needs and priorities for mountain research going forward. In response, this study was initiated by the Canadian

Mountain Assessment - a 3.5-year initiative to advance understanding of mountain systems in Canada - to rigorously identify, collate, and critically examine existing peer-reviewed articles related to mountains in Canada.

2 Methods

2.1 Research approach

This study used a systematic scoping review methodology to assess the state of mountain research in Canada. Such reviews provide a robust means of collating available literature on a given topic, critically examining key characteristics of existing studies (e.g. when, what, where, how, by whom), and identifying and analyzing key knowledge gaps (Munn et al. 2018). Our ‘scoping’ approach is broader than traditional systematic reviews, which focus on answering specific research question *vis-à-vis* a narrowly defined body of literature. However, it is guided by similarly rigorous review protocols, making it distinct from less structured approaches to literature synthesis. Here, methodological systematization, transparency, and reproducibility (Gough et al. 2017; Gough et al. 2019), as well as the utilization of widely accepted reporting guidelines (i.e. PRISMA) increase understanding of review procedures and results (Page et al. 2021). Given their capacity to provide credible information about topics of interest to researchers, decision

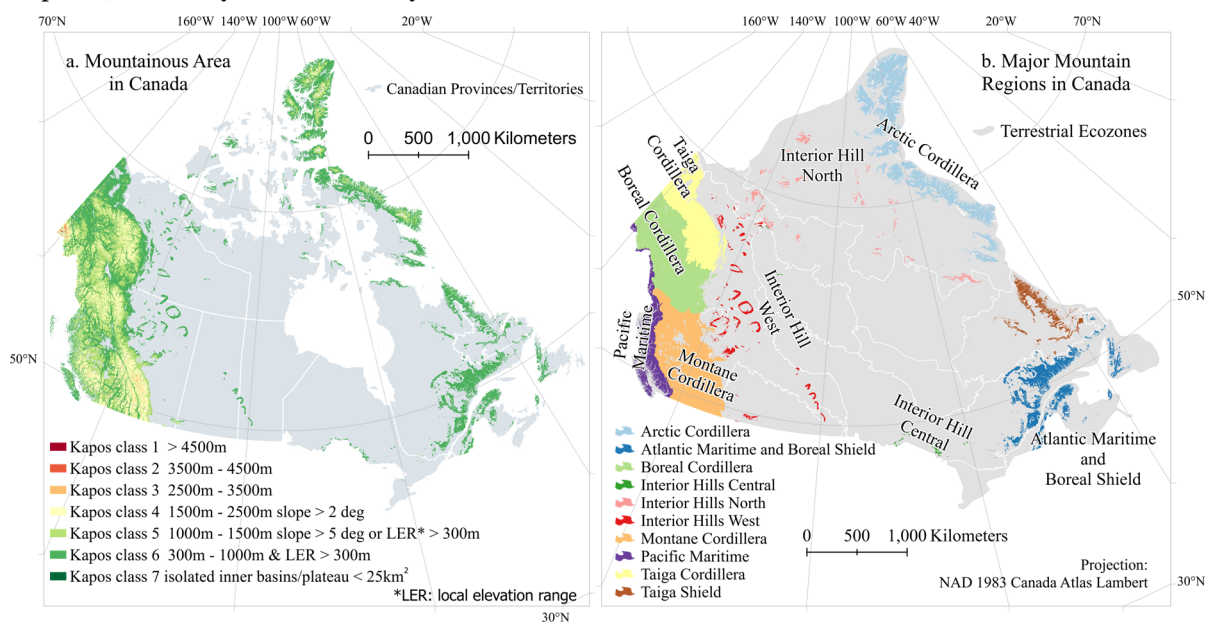


Fig. 1 Mountainous and major mountain regions in Canada. Mountainous area based on definition given by Kapos et al. (2000). Mountain regions based on McDowell and Guo (2021).

makers, and the broader public (Ford and Berrang-Ford, 2016), the use of systematic literature synthesis methodologies has increased dramatically in recent years, including in studies focused on mountain systems (e.g. Aggarwal et al. 2021; Martín-López et al. 2019; McDowell et al. 2019; McDowell et al. 2014; McDowell et al. 2021; Mukherji et al. 2019; Palomo, 2017; Rasul et al. 2019; Shukla et al. 2017; Vij et al. 2021). Our research approach builds upon and contributes to such review efforts.

2.2 Research procedures

Our systematic scoping review aimed to identify all peer-reviewed literature related to mountains in Canada. To be included documents had to be published between 1 January 1900 and 31 December 2021, to be written in either English or French, and to be substantially focused on mountains in Canada. We defined mountain systems as all areas meeting the commonly used criteria provided by Kapos et al. (2000) (i.e. K1) – see McDowell and Guo (2021) for application to Canada – and the associated biological, physical, and social characteristics, process, and relationship therein. Studies could be either explicitly focused on mountains or incidentally focused on mountains – research about an aspect of a mountain systems but not explicitly described as mountain research – so long as the study was focused primarily on physical, biological, or social themes pertinent to mountains (i.e. substantial focus criteria). Likewise, there were no restrictions related discipline, field, or topical focus; all studies related to mountains in Canada were eligible for inclusion.

A search string based on terms related to mountains and to Canada was used to identify

potentially relevant peer - reviewed articles catalogued in Web of Science, Scopus, and Medline (OVID) (database searches completed on 5 January 2022). The general syntax is provided below; database specific modifications were made, as appropriate.

(Mount* OR montagn* OR mont) AND (Canad* OR Alberta* OR British Columbia* OR Manitoba* OR New Brunswick* OR Newfoundland* OR Labrador* OR Northwest Territor* OR Nova Scotia* OR Halifax* OR Nunavut* OR Ontario* OR Prince Edward Island* OR Quebec* OR Nunavik* OR Saskatchewan* OR Yukon*)

The search of our target databases produced 20,335 non-duplicate returns. Document titles, abstracts, and full texts were then screened according to our inclusion criteria; unsuitable documents were removed at each stage (Fig. 2). Most documents removed during the screening process did not have a substantial focus on mountains in Canada (e.g. only passing mention of mountains), were focused on other mountainous regions of the world, or were not peer-reviewed documents. The Covidence systematic review platform was used to organize and document

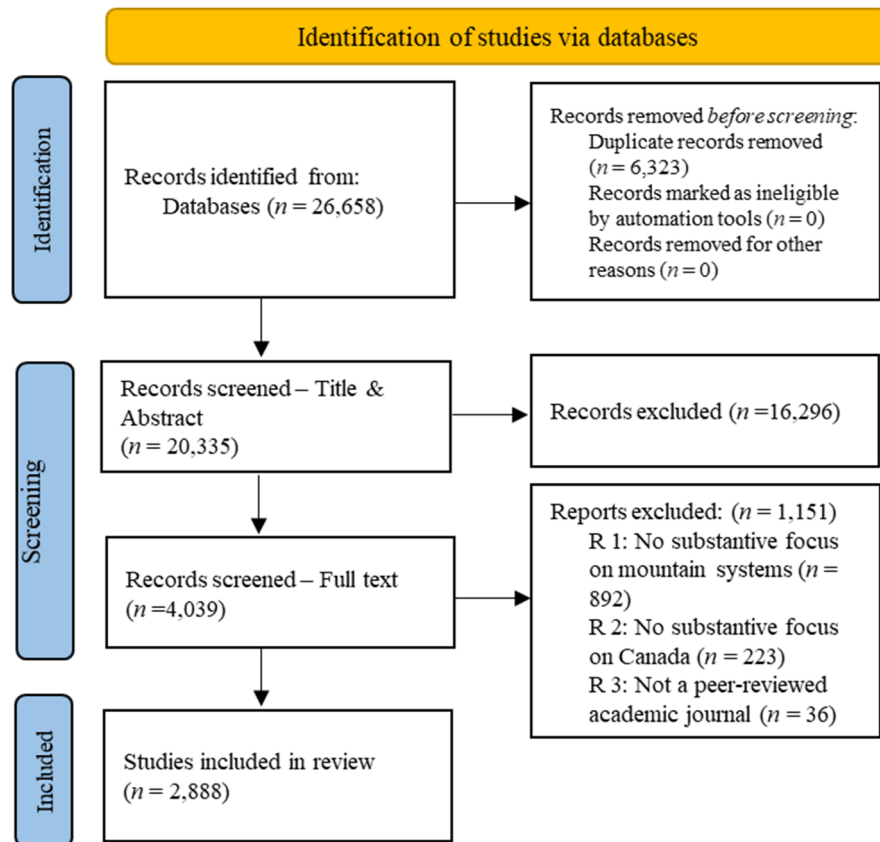


Fig. 2 Document identification, screening, and inclusion progression. Adapted from PRISMA 2020 Flow Diagram (Page et al. 2021).

the process of identifying relevant articles. In total, 2,888 documents were included in the study.

Data extraction for the included documents was guided by a questionnaire, which was accompanied by a codebook defining all key terms and the meaning of possible response options to reduce subjectivity in coding activities. Each document was coded for primary focal topic as well as secondary focal topic and four possible topic modifiers. For example, a paper might be focused primarily on water, with secondary focus on Livelihoods and well-being. An environmental change focus modifier would indicate that these topics were examined in the context of changing environmental conditions. In addition, documents were coded for study region, research approach, and whether the study was explicitly or incidentally focused on mountains (Table 1). Study regions were based on those given by McDowell and Gou 2021 (Fig. 1), while research approaches were based on thematic areas defined by the Canadian Government’s three research funding agencies: Natural Sciences and Engineering Research Council (NSERC), and Social Sciences and Humanities Research Council (SSHRC), Canadian Institutes of Health Research (CIHR). Studies that were explicitly focused on mountain were presented as mountain research by authors, whereas studies that were incidentally focused on mountains were conducted in mountain areas but not described as mountain research per se (e.g. a geological study conducted in a mountain area but not framed as a ‘mountain geology’ paper). Summary statistics were calculated for all documents following coding activities. These results underpin our review of the state of mountain research in Canada. All steps of the review process were carefully recorded and can be viewed along with the codebook and included documents in the Supplementary Materials.

Like all systematic review efforts, our specific protocol for identifying relevant studies has limitations that lead to the probable omission of some relevant articles, as discussed below.

3 Results

Most research about mountains in Canada has been published since the late 1960’s. Since this initial uptick in research activity, publications have continued to trend upwards, a trend particularly

Table 1 Coding themes used to characterize publications

Theme	Response options
Research focus	Each article was coded according to their ‘primary’ and ‘secondary’ research focus. The same categories were used for each group and included: <ul style="list-style-type: none"> • Geology • Weather and climate • Ice and snow • Water • Ecosystems, biodiversity, and wildlife • Parks and protected areas • Livelihoods and well-being • Tourism & recreation • Art and literature • Resource development, industry, and infrastructure • Governance, institutions, and laws/policy • Risks, hazards, and vulnerability • Adaptation, resilience, transformation
Modifiers to research focus	<ul style="list-style-type: none"> • Paleo/historical focus • Environmental change focus • Indigenous Peoples focus • Highland/lowland connections focus
Study region	<ul style="list-style-type: none"> • Montane Cordillera • Pacific Maritime • Arctic Cordillera • Boreal Cordillera • Taiga Cordillera • Taiga Shield • Atlantic Maritime and Boreal Shield • Interior Hills North • Interior Hills West • Interior Hills Central • National scale/all regions N/A
Research approach	<ul style="list-style-type: none"> • Natural sciences • Social sciences • Health science
Mountain focus	<ul style="list-style-type: none"> • Explicit focus on mountains • Incidental focus on mountains

apparent over the last two decades which saw an average increase in publications of 6.5% per year. Reflecting this consistent increase in publishing, the bulk of peer-review articles about mountains in Canada were published after 2000 (68%, $n = 1970$) (Fig. 3a).

More than two-thirds of the documents reviewed represent studies explicitly focused on mountains (77%, $n = 2225$), suggesting that a large proportion of published materials stem from scholars actively

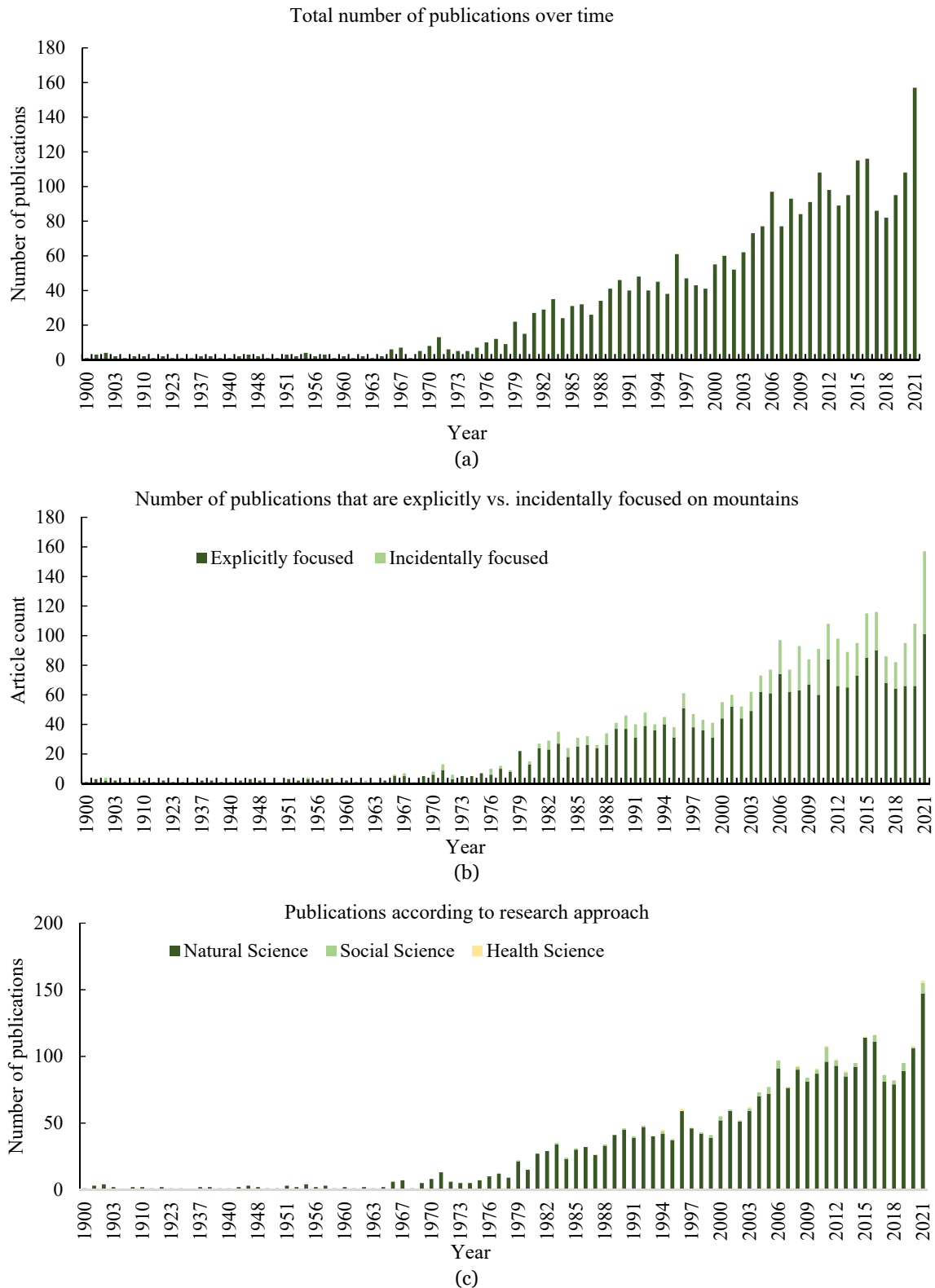


Fig. 3 Characteristics of publications about mountains in Canada between 1900 – 2021. (a) Counts for total publications per year; (b) counts for publications explicitly vs. incidentally focused on mountains per year; (c) counts for publications by research approach per year.

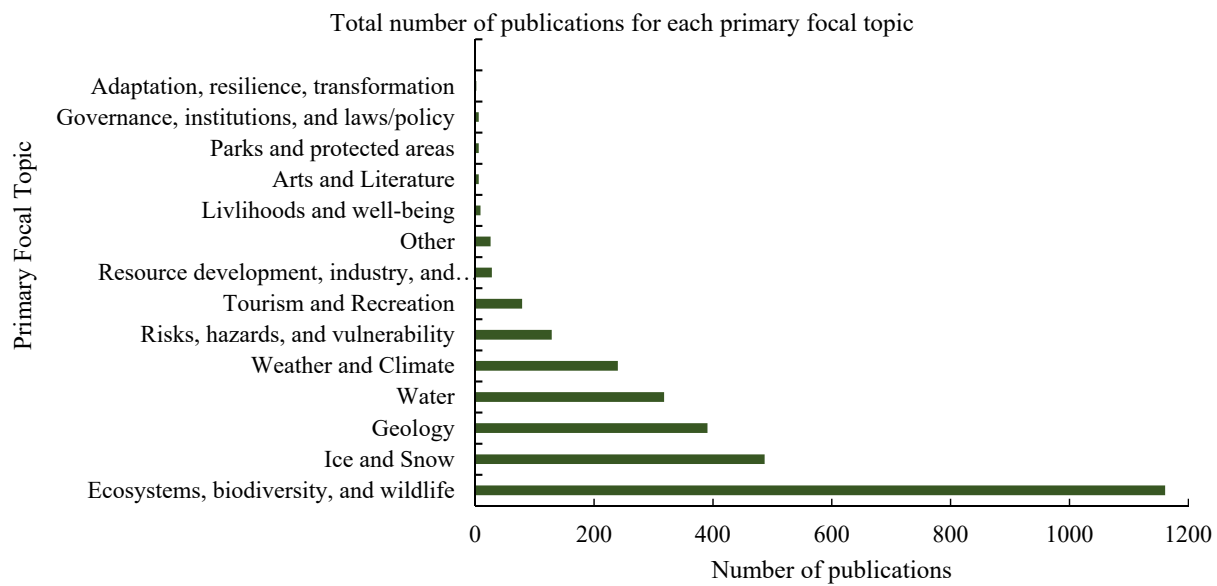


Fig. 4 Primary focal topics for publications about mountains in Canada.

engaged in research about mountain systems in Canada. Conversely, we see that 23% of studies ($n = 663$) mention mountains but are not framed as mountain research *per se*, suggesting that a sizable amount of mountain-related research is being conducted without any formal recognition of its relevance to advancing understanding of mountain systems (note: additional potentially relevant articles that do not include the word ‘mountain’ (i.e. “Mount* OR montagn* OR mont”) were not captured in our review). The proportion of explicitly focused to incidentally focused publications in a given year is generally stable over time, with raw counts for both increasing over time (Fig. 3b).

The mountain literature is dominated by work in the natural sciences (96%, $n = 2779$), with very little social science (3%, $n = 94$) and health science (0.5%, $n = 15$) work published to date. Relatedly, the vast majority of growth in publishing about mountains has been associated with natural scientific studies (e.g. glaciology). Research examining mountains systems through the lens of the social science (e.g. human geography) and health science approaches (e.g. epidemiology) are more prevalent in the last three decades, but only very modestly so (Fig. 3c).

The primary focal topics for publications about mountains in Canada reflect the predominance of research in the natural sciences, with the greatest number of studies focusing on mountain Ecosystems, biodiversity, and wildlife (40%, $n = 1161$); Ice and snow (17%, $n = 487$), Geology (14%, $n = 391$); Water

(11%, $n = 318$); and Weather and climate (8%, $n = 240$), respectively (Fig. 4). Research associated more with social and health sciences approaches such as Tourism and recreation (3%, $n = 79$) and Livelihoods and well-being (<1%, $n = 9$) is far less common, with several major topic areas receiving little engagement in the existing peer-reviewed literature, including Governance, institutions, and laws/policy (<1%, $n = 6$) and Adaptation, resilience, and transformation (<1%, $n = 2$).

As indicated in Fig. 3c, research focused primarily on the physical and biological aspects of mountains in Canada began earlier than most work on social and health dimensions of mountain systems. However, the distribution of work according to specific topics has varied over time. For example, while geological studies appear early in the publication record, they peak around 1990, with per year publication activity generally declining thereafter. Similar, but less dramatic patterns are observed for research focused on ice and snow and water, respectively, both of which peak around 2015 followed by modest reductions in research output. The earliest social scientific work appears in the early 1900s; most of these publications are associated with tourism activities in the Canadian Rockies. However, like other social scientific and health research topics, most publications appear from the 2000s onward. Given the very limited number of publications for topics such as mountain Art and literature; Governance, institutions, and laws/policy; and Livelihoods and

well-being (e.g. 1 or 2 every few years), we do not observe directional trends in publishing activity. Publications focused on topics at the intersection of physical and social systems are somewhat more common, with upward trends in publishing focused on Resource development, industry, and infrastructure as well as Risks, hazards, and vulnerability observed since the 1980s.

To further reveal the nature of mountain research in Canada, each document was coded for secondary focal topic and four possible 'modifiers' (see Table 1). For example, an article might have a primary focus on Ice and snow, a secondary focus on Water, and an Environmental change focus modifier (e.g. Chernos et al. 2020; Marshall 2014). Sixty percent of articles included in the study had an obvious secondary topic focus. The most common secondary focus topics were Weather and climate (13%, $n=372$); Geology (10%, $n=75$); Resource development, industry, and infrastructure (8%, $n = 239$); Water (7%, $n = 215$); and Ecosystems, biodiversity, and wildlife (6%, $n=185$). Modifiers were relevant for 43% of the studies reviewed. The most common modifiers were Environmental change focus (20%, $n = 582$), Paleo/historical focus (17%, $n = 505$), Highland/lowland connections focus (5%, $n = 141$), and Indigenous Peoples focus (1%, $n = 24$). Engagement with these themes in mountain research in Canada has been increasing since the mid-1990s, except for Paleo/historical research, which has been in decline since the early-2000s. Fig. 5 breaks down the diverse relationships between primary focal topics and their respective secondary topics and modifiers.

A full 89% of mountain research in Canada has been conducted in the mountain west (i.e. Montane Cordillera, Pacific Maritime, Boreal Cordillera). Conversely, only 5% of existing research has been conducted in the eastern mountain regions, including the extensive mountain regions of the eastern Arctic and sub-Arctic (i.e. Atlantic Maritime and Boreal Shield, Taiga Shield, Arctic Cordillera). Even less research (3%) has been conducted in the dispersed interior mountain regions of the country (i.e. Interior Hills West, Interior Hills North, Interior Hills East). Research focused on multiple regions is somewhat common (18%), but national scale studies (1%) and studies with no specific regional focus (<1%) are rare (Fig. 6).

Fig. 7 provides an overview of the 21 most productive mountain scholars based on publications

meeting our inclusion criteria (any authorship order counts towards publishing productivity). All of these researchers have careers beginning no earlier than the early 1970s, a pattern that is consistent with the uptick of mountain-related publishing in Canada as well as the intensification of publishing expectations in academia more broadly. Of the 21 most productive mountain researchers, 95% are male; 0% are visible minorities or Indigenous individuals. These researchers are predominantly (86%) associated with Canadian Universities, most of which are based in western Canada (81%), and have departmental affiliations dominated by Geography and Earth Sciences. The remaining 14% of these researchers are associated with federal (75%) and provincial (25%) government agencies. No researcher from outside of Canada are included in the most active scholars category, a finding that differs from other geographies such as the Hindu Kush Himalaya, where many scholars are based outside of the region (Gurgiser et al. 2022).

4 Discussion

The extent and diversity of mountains in Canada, as well as the increasingly well recognized pressure affecting mountains systems (Adler et al. 2022; Hock et al. 2019), has inspired a significant amount of research about Canada's high places. Indeed, no less than 2,888 studies examining mountains in Canada have been published in the peer-reviewed literature to date. This work represents several decades of substantial research effort and makes Canada one of the top 10 publishers of mountain research globally (Gurgiser et al. 2022). However, research activities involving scholars from outside of Canada remain limited, nearly a quarter of existing studies were only incidentally focused on mountains systems, and an additional but unquantified amount of mountain-relevant literature remains peripheral to core debates in mountain research due to its omission of the word 'mountain' (i.e. Mount* OR montagn* OR mont).

For specific topics, existing research about mountains in Canada is well established and provides a robust understanding of fundamental and applied research issues. Research in the natural sciences is by far the most well developed, with topics related to mountain ecology, the cryosphere, and hydrology receiving a significant amount of scholarly attention

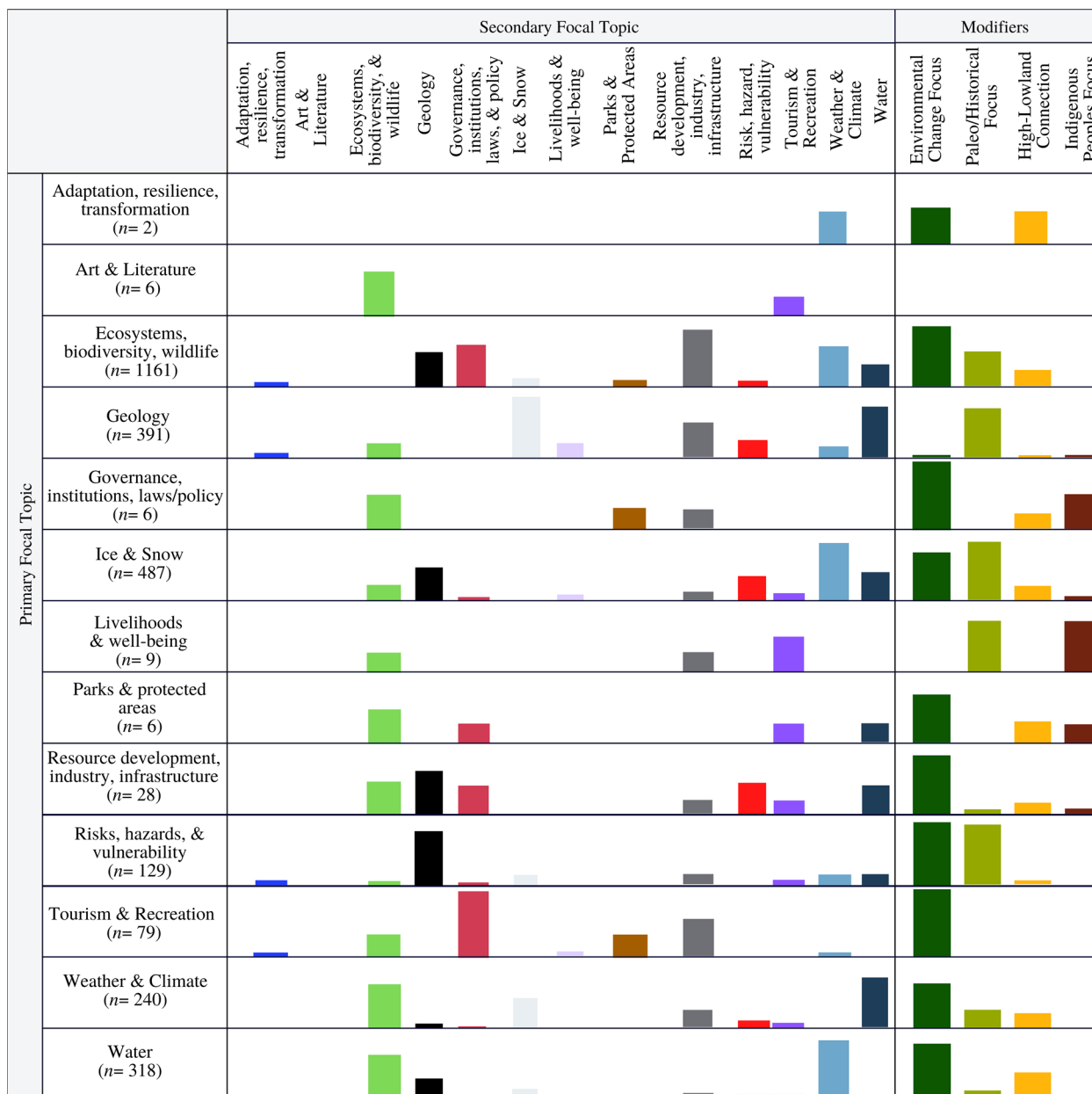


Fig. 5 Relationships between primary focal topics and their associated secondary topics and modifiers.

in the existing literature, a finding that is consistent with the well-established importance of mountains as repositories of biodiversity and frozen reserves of freshwater (Adler et al. 2022; Hock et al. 2019). While this research is incredibly important, the predominant emphasis on understanding and documenting physical and biological dimensions of mountain systems highlights an important bias in the literature and connotes significant gaps in understanding for topics outside of the purview of the natural sciences.

Research in the social and health sciences is extremely limited in the exiting literature, severely limiting scholarly understanding of the human dimensions of life in mountains. For example, limited research related to Risks, hazards, and vulnerability as well as a paucity of research related to Adaptation, resilience, and transformation portends consequential deficits in the ability of mountain communities (and those downstream) to understand, plan for, and successfully navigate the challenges and opportunities of socio-ecological change in Canada’s mountain areas

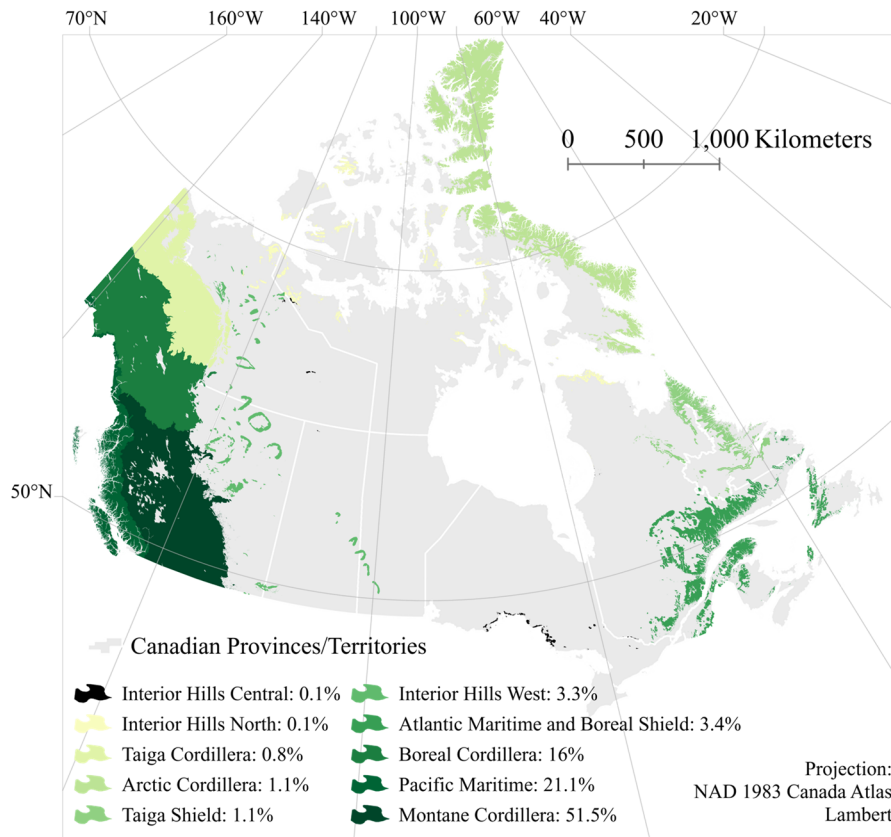


Fig. 6 Mountain research activity by major mountain region. Regions based on McDowell and Guo (2021).

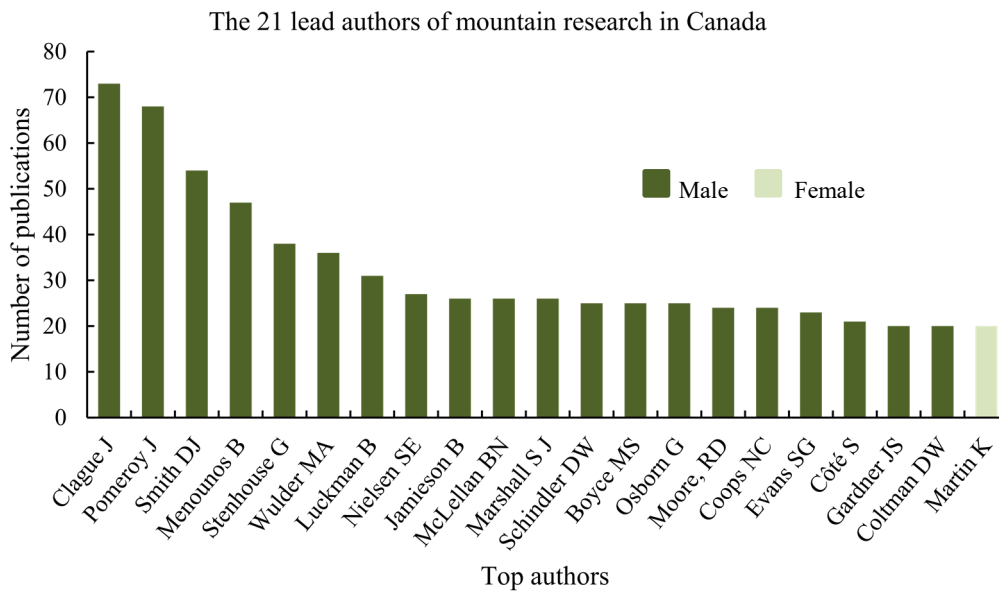


Fig. 7 Top 21 authors of mountain research in Canada between 1900 - 2021.

(e.g. climate change, demographic change, economic change). A dearth of research related to Governance, institutions, and laws/policy; Livelihoods and well-being; and the health dimensions of environmental and social change exacerbates this blind spot. Likewise, the relatively limited amount of research

related to Resource development, industry, and infrastructure as well as Parks and protected areas constrains land management decisions that aims to balance economic development and conservation objectives in mountain environments. Furthermore, recreation studies and humanities research (reported

in peer-reviewed articles) is very limited, with implications for our understanding of the socio-cultural aspects of life in Canada's mountains.

In terms of topics addressed under our modifier category, research focused on Paleo/historical conditions and Environmental change are reasonably well represented (17% and 20% respectively), although such work is dominated by natural science studies. However, studies evaluation connections between mountain and lowland systems as well as studies focused on or including Indigenous Peoples are extremely limited. This is inconsistent with growing awareness of interdependencies between mountains and surrounding lowlands – particularly in the context of water (Egan and Price 2017; Immerzeel et al. 2020; Viviroli et al. 2020) –as well as the extent and diversity of Indigenous Peoples in Canada, many of whom have territories associated with mountain areas and nuanced knowledges of mountainous places (Kassi et al. 2020; McDowell and Guo 2021; RCGS 2018).

We suspect that research on topics not well represented in this study is taking place in mountain areas, but that subsequent articles are being published by scholars who do not consider mountains to be relevant to their analyses (and therefore do mention the term 'mountain' in their articles). To enhance the inclusion of a broader range subject areas in mountain research and associated debates, we believe that there is a pressing need to raise the profile of mountains in Canada as germane targets of scholarly attention. Here, success in raising the profile of the Canadian Arctic within and beyond Canadian research communities is illustrative.

Mountain research in Canada is also highly concentrated geographically, with three of ten major mountain regions receiving almost 90% of research attention to date. This strong geographical bias towards work in the western mountain regions means that scholarly understanding of eastern and northern mountain regions, which account for 48% of Canada's mountains terrain (McDowell and Guo 2021) is very limited. This is highly consequential, as the considerable biophysical and socio-cultural diversity of mountain regions in Canada, limits the transferability of insights from western regions to these geographies. Likewise the paucity of national scale studies, which in other countries tend to be focused on macro-scale policies or environmental and socio-economic inventories pertinent to mountains

(e.g. Muccione et al. 2016; Vij et al. 2018), denotes the largely local and regional scale focus of mountain research in Canada, as well as the prioritization of place-based research efforts.

Finally, research efforts associated with mountains in Canada have been spearheaded by a group of highly qualified, motivated, and impactful scholars with long research careers. However, these scholars are primarily white males, with little representation of women, visible minorities, or Indigenous Peoples amongst those most active in publishing about mountain research to date (assessing other dimensions of difference was beyond the scope of review protocol). Certainly, research about mountains in Canada would be enriched by the inclusion of a greater diversity of perspectives and experiences. Encouragingly, we suspect that this is already taking place and that publishing by early and midcareer scholars will diversify our understanding of mountain systems in Canada.

Mountain research in Canada has made significant contributions to knowledge in several topical and geographical areas and represents an extensive body of information that is a valuable for mountain scholars and practitioners in and beyond Canada. This review, for the first time, reveals the scope and characteristics of this body of research, including the fact that over three-quarters of studies are explicitly focused on mountains, a finding that suggests that there is a substantial community of scholars interested in mountains in Canada. However, the review also identified the existence of several substantial gaps in publishing related to mountains, which can be understood as signposts for future research activities focused on mountains in Canada (Table 2). Importantly, these are high level research needs; disciplinary and field specific recommendations are beyond the scope of our review efforts.

This initial review of the state of mountain research in Canada is subject to several limitations. Like all systematic review efforts, our protocol for identifying relevant studies could have led the omission of relevant peer-reviewed articles. For example, germane publications that did not include the word 'mountain' (i.e. Mount* OR montagn* OR mont) were not captured in our review, leading to the probable underrepresentation research from the Arctic and other regions not commonly thought of as mountainous (e.g. Interior hill regions). Similarly,

Table 2 Priorities for mountain research in Canada

Topical priorities	
<ul style="list-style-type: none"> • Enhanced engagement with social and health science topics in mountain research, particularly: <ul style="list-style-type: none"> ○ Livelihoods and well-being ○ Risks, hazards, and vulnerability ○ Adaptation, resilience, transformation ○ Governance, institutions, and laws/policy ○ Tourism and recreation • Enhanced engagement with lands management topics, including: <ul style="list-style-type: none"> ○ Resource development, industry, and infrastructure ○ Parks and protected areas ○ Highland/lowland connections 	
Geographical priorities	
<ul style="list-style-type: none"> • Enhanced research activity in the eastern, northern, and interior mountain regions of Canada, specifically in the: <ul style="list-style-type: none"> ○ Arctic Cordillera ○ Atlantic Maritime and Boreal Shield ○ Taiga Shield ○ Taiga Cordillera ○ Western, Eastern, and Northern Interior Hill regions 	
Inclusion priorities	
<ul style="list-style-type: none"> • Enhanced inclusion of unrepresented groups in research activities, including (but not limited to): <ul style="list-style-type: none"> ○ Visible minorities ○ Women ○ Indigenous Peoples and knowledge systems (see Reid et al. 2021; Wong et al. 2020) 	

McDowell et al. (2019) have shown that a significant amount of literature related to mountain systems is not framed as mountain research *per se*, further exacerbating challenges related to collating all relevant literature (e.g. minerology studies). Indeed, a targeted review by Hanly et al. (In preparation)⁽¹⁾ focused on mountain-specific glacio-hydrological literature in Canada indicates that additional relevant articles can be identified when using detailed, topic-specific search syntax. Notwithstanding, our counts for included articles are consistent with a recent global scale bibliometric analysis of mountain research by Gurgiser et al. (2022), which includes Canada; we therefore believe this review captures the majority or peer-reviewed articles explicitly focused on mountains in Canada, as well as a sizable proportion of studies that are incidentally relevant to mountains.

In addition, we did not assess the quality or specific details (methods, results) of included articles. Accordingly, we have not been able to provide nuanced insights about potential variability in the robustness of mountain research activities, or the state of knowledge for specific fields or topics. However, work by Hanly et al. (In preparation) is examining these nuances; we encourage others to reanalyze articles included in our review to advance understanding of such details. Our study is also limited by its exclusive focus on the peer-reviewed journal articles. We recognize that some relevant

research, especially that in the humanities, appears primarily in books. We therefore expect that this review underreports the scope of humanities research related to mountains in Canada. More broadly, academic research is only one body of knowledge relevant to understanding mountains systems; our analysis did not include Indigenous or local knowledges of mountain systems. Accordingly, our study should not be construed as an exhaustive review of existing knowledge related to mountains in Canada. The reader is referred to the forthcoming Canadian Mountain Assessment for a more fulsome articulation of the breadth, depth, and diversity of knowledges related to mountains in Canada.

5 Conclusions

This study provided the first formal assessment of the state of mountain research in Canada. It offered fundamental insights into when research has been conducted, what is being studied, where, how, and by whom. For example, it revealed a substantial amount mountain research activity since the 1970s, particularly amongst natural scientists, with substantial publication activity related to Ecosystems, biodiversity, and wildlife; Ice and snow; Geology; Water; and Weather and climate. The majority of this work has been carried out in the major mountain regions of the mountain west. Other subject areas,

(1) Hanly et al. (In preparation) is a systematic scoping review of peer-reviewed glacio-hydrological literature in Canada between 1900-2021. Data analysis is complete, but has not yet been peer-reviewed.

particularly those within the purview of the social and health sciences are considerably less well represented in the existing literature (e.g. human dimensions of climate change). Likewise, research activities in other major mountain regions are very limited. Studies with an environmental change or paleo/historical focus are fairly common, while engagement with highland/lowland connections and Indigenous Peoples is limited. Furthermore, of the most prolific mountain researchers, nearly all are male, and none are visible minorities. This cohort of scholars are largely associated with Canadian universities in western Canada.

The results of this study demonstrate considerable Canadian leadership in mountain research; they also reveal conspicuous gaps in the existing literature and signal attendant research priorities for mountain research in Canada (see [Table 2](#)). Our hope is that this review will raise the profile of mountain research in Canada and motivate concerted efforts to address currently understudied topics and geographies, while contemporaneously fostering meaningful engagement with those whose voices are currently underrepresented in mountain research in Canada. Doing so will significantly improve our collective ability to navigate the challenges and opportunities facing mountain systems in Canada.

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